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Integrating science and soul in education

The lived experience of a science educator bringing Holistic and Integral perspectives to the transformation of science teaching

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This thesis contains no material which has been accepted for award of any other degree or diploma in any university. To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made.

Abstract

Integrating science and soul in education: The lived experience of a science educator bringing Holistic and Integral perspectives to the transformation of science teaching

This is an auto-ethnographic study into the lived experience of a science teacher as she attempts to transform her science teaching practice and the practice of other science teachers over a period of 15 years. In exploring what it means to be a holistic educator she is faced with disorienting dilemmas which cause her to question underpinning assumptions, values and curriculum frameworks which inform traditional science teaching practice and culture. In trying to reconcile science and soul in the pedagogical space of a physics classroom her journey requires a deep investigation of self in various cultures – science culture, educational culture, modernist and postmodernist cultures.

Part 1 of the study introduces the key referents of Integral Theory, Holistic Education and Spirituality which she used to inform her changing education practice. Part 2 reflects on her journey from a traditional constructivist classroom, into ones which explore meaning, questioning, significance, discourse, ethics and enabling frameworks.

Part 3 concludes with an attempt to integrate science and soul into a vision for science educators. This includes a model which suggests that science has various development stages or cultures and that science teaching can be strategically aligned to facilitate the growth of human consciousness.

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Foreword

Welcome to my narrative study where I look at ***what it means to integrate science and soul in education.***

Just the question ***what does it mean?*** opens up to rich possibilities… what techniques do you use, how do you think about it, what does it look like, what are the implications, dilemmas, what happens to the teachers and students in the process of doing it, what can it lead to?

There is no right answer, yet the question suggests that a key way to answer it is perhaps through real experience.

So that is what I have done - I have explored (and am still exploring) this question through my lived experience as a teacher, curriculum planner, leader of professional learning, and co-establisher of the Holistic Education Network of Tasmania.

This then is the story of my own transformative journey (my lived experience) as I try to resolve my big 'disorienting dilemma': *what does it mean to integrate soul in my teaching of science?*

This written study aims to capture the process of my journey – the dilemmas which challenged and perturbed me to new levels of perception and my continuing development of tentative 'living educational theories'. In addition, the writing itself was a journey. So, as I write and reflect on my experiences using Integral Theory as an interpretive lens, I am challenged again to revise my understandings; seeing new potentials and assisting in my own integration

This is an auto-ethnographical study. I am the subject. Yet I hope it has more value than mere navel gazing. That my dilemmas, processes and emergent theories might speak to others. That in layering this study with rich meaning and authentic experience I am able to create a praxis and reflectivity in others.

My journey is an effort to synthesize – to find emergent wholes. So, I conclude this study with a possible way of thinking about Integral Science and Integral Science Education which can be generalizable in the meaning that Whitehead (1998) gives it – able to be shared and promoting dialogue with others. I am hoping to initiate a conversation with science educators and teachers. What vision of science and science education would we like to have which can support the sustainable future of the world and assist in the evolution of consciousness?

The journey wasn't necessarily a straight one

At the core of me I am a scientist; someone who likes to question and inquire, to explore the nature of reality and come up with possible answers. I spent four years working as a scientist and another three working in economic research before I started teaching. Yet at the core of me is also this spiritual self - someone who has been very keen to discover the meaning of life and someone who was disillusioned with science as a means of determining that.

Now in 1990 I find myself in my first year of teaching in a Year 11/12 class where I have to teach physics. Can I compartmentalize these two aspects of myself, these two very different cultures? Or is there a way I can find wholeness and integration? I have 10 years to find out.

Yes, put very simply, this is my disorienting dilemma. I can name it now with the benefit of hindsight. But back in 1990 when I started teaching it was pretty messy. So what conditions can fertilize this journey of mine?

Condition 1: Put me in a Year 11/12 Tasmanian college which is brand new and make me part of the visioning process of what education should be like. Put me in a supportive environment where collaborative action research between teachers is a way of life. Let me learn from some of the most forward thinking, experimental, pedagogically thoughtful teachers in the state as we create an Australian 'lighthouse' school.

Condition 2: Allow the state education system to revision itself and change curriculum metaphors and let me be a player in designing and implementing facets of this. Introduce ideas of constructivism and 'girls in physics' to science teachers in the state, taking us on a journey of rethinking the way we teach science.

Condition 3: Introduce me to ideas of Holistic Education and Ken Wilber. Open me up to well articulated theories and pedagogies based on a spiritual paradigm and let me experiment with these in my classes. Let me tentatively start to bring soul into science and to discover what it might be like trying to be a holistic teacher.

Condition 4: Now in 1996 put me in a new school which is coming from a traditional schooling paradigm with disempowering operating structures where there is little educational dialogue. Let my need for dialogue and my own continued learning push me into joining the newly formed Curtin doctorate group in Tasmania and introduce me to academic approaches to postmodernism and the social sciences.

Condition 5: Now let me engage in an intense action inquiry process of my own lived experience as a physics and journalism teacher for four years. Let me deconstruct myself and my underpinning values and then try to pick up the pieces, integrating old with new, trying on new roles. Let this school act as another 'disorienting dilemma' which pushes me to look for power relations and underpinning structures, cultures and curriculum metaphors which shape the way the system operates.

Condition 6: Now in 1999 invite me to work with the university physics department in coordinating a year long action research project with physics lecturers to improve physics teaching. Let me be exposed to the issues of adult transformation which opens the door to my later interest in transformative learning.

Condition 7: Now, let me get diagnosed with Chronic Fatigue, requiring me to take a three year break from teaching - finding a new quiet space to be, a deeper, more mindful experience of spirituality and a greater sensitivity and attunement. In this space I discover the artist who might also be at the core of me … who has been patiently waiting to be expressed through clay.

Condition 8: Now let me tentatively start teaching again with this new sensitivity but with little resilience. Give me a class of very needy, at risk students who challenge my notions of what it means to be a holistic teacher and who force me to look deep into myself, as I try to look deep into them.

Condition 9: Now in 2004, bring on a major review of Tasmanian curriculum and invite me to be a critical friend to that process. Stir me up. Remind me of my passion for education. Stimulate in me the need to revisit my doctoral studies, to get them out of the closet and dust them off. Stimulate me to read the latest on Integral theory, to get excited, to join international discussions on

how this might be articulated into educational practice. Let me see the potential for this to assist in the curriculum visioning process.

Perhaps at the core of me I am really an activist and a change agent, just wanting to change the world, whether through my writing or actions. It is ironic that in trying to change the world that I change myself, and maybe, just maybe, in the process the world changes as well.

So these are the conditions for growth, but what emerges? What deep insights about students, education, learning, science and spirituality can emerge from these conditions? Want to find out?

In this writing inquiry about my lived experience I will try to bring to the process various lenses or inquiry modes which I introduce below. But perhaps more importantly is the state of being that I bring. Why come on such a personal journey with me if we can't together be playful, light of heart, yet deep of soul? So I promise a different style of writing. One that might at times be surprising, poignant, imaginative, adventurous as well as thoughtful, authentic, constructive, deconstructive and compassionate.

In inquiring into the integration of science and soul I am really searching for wholeness - and I wish to bring to this inquiry process all the elements of wholeness. Naturally I will not succeed! After all this is just a piece of paper and these are just words… no matter how much they might come from the heart or soul of me. But perhaps in the space between the author and the reader these words might take on their own life and their own wholeness… I invite you then to come with me on my journey and open yourself to what possibilities may emerge.

My epistemology

My study is loosely situated in the auto-ethnography genre where I examine self and culture through narrative. I am examining the evolution of my teaching of Year 11/12 physics from 1990–1999 within the mainstream education system in Tasmania. And in doing so I am asking questions such as who is this person who is teaching and what informs her practice, her values and her thinking about herself? What culture is she in? How does she construct her notions of learning and what it means to be an effective teacher?

During the time period of 1990-99 I was engaged in action research and action inquiry processes (situated in the lived experience research genre) with the purpose of evolving my teaching practice. This process was informed by constructivist, holistic and integral theories of teaching. My specific questions during that time were:

What does it mean to be a human being?
What is the purpose of education?
How can I help my students to learn, do, be, become?
What might education based on holistic and integral ideals look like?
What does it mean to be a holistic teacher?
What is spirituality?
How can I make my teaching more meaningful, significant, empowering?
How can I integrate soul in my teaching of science?
What is the nature of science?
What is the purpose of science education?

This written study now examines that experience, eliciting key themes, and applying integral lenses to explain the experiences. It then becomes a study not

just of evolving practice but also of my process of transformation and efforts to transform others.

Central to my inquiry is my need to synthesize – to look for emergent wholes. I am looking for a grand narrative which can marry together science and soul in education as well as explain my own journey. I find Integral Theory is a key tool in assisting me in this integrative process. So while on the one hand I am 'unpacking' and seeking meaning in my experience, on the other hand I am 'packing together'– using mapping tools of integral theory as well as key processes such as *transcend* and *include*.

This synthesizing process is one of competing needs - seeing enough of the parts and the environment to see the shape of the whole, and going deep enough into a part to give it texture and pattern. I am wary of all that I missed out in seeing the detail as I am involved in this systemic process.

During my process of action inquiry I went deep into aspects of my own experience and questions but I have not included them here for the sake of being able to paint the bigger picture. And in doing that there is the danger of being too shallow. So while an ethnographer might explore one key experience deeply, I am more in the category of a structural analyst – looking for patterns - and in doing this I am bringing in my experiences with other science educators and the Tasmanian education system.

Writing as Inquiry

In the writing process I am both discoverer of meaning for myself and also constructor of meaning for the reader. I try to be playful and holistic in the artful construction of the study, not just for the benefit of the reader, but also in stimulating my own understanding. I try to enter different writing

places, some storytelling, some impressionistic, some very reflective and peaceful, some with more of an academic voice, some speculative and tentative. I often use dialogue as a way of enabling contradictions to play with each other, thus enabling emergence of greater insight, rather than being trapped in dualities. And I like using metaphor – I believe it has the capacity to speak to something deeper in ourselves and lingers on long after the words have disappeared.

This style of writing is consistent with auto-ethnographical (Ellis & Bochner, 2000) and 'writing as inquiry' methodology (Richardson 2000) where there is a movement away from an academic voice disseminating endpoint understandings, to writing which enables co-existence of multiple perspectives and emergent meanings (crystallization). I am wary though of competing needs to be coherent, to provide sufficient contexts, to document my journey, to be complete and whole, to support my own process of reflection as well as giving appropriate experiences for the reader's own journey. I am not sure that I succeed in balancing all this.

In my own inquiry process I rely on a holistic approach. That is, I am trying to integrate *eye of the mind* (interpretation, analysis and modeling) with *eye of the senses* (empirical data) and *eye of the spirit* (meditative practice) (Wilber 1980). I am using the seven modes of inquiry of Henderson and Kesson (2004) to help me create in myself different spaces in which to explore my key themes.

I tease out my epistemology further at the beginning of Part 2 when I start my reflective inquiry which examines my journey of evolving physics teaching. I use epistemological pauses throughout Part 2 as a way of stepping back from my writing and bringing a more critical eye to the processes I am using as I make sense of my past experiences.

Part 1 introduces my key referents – Holistic Education, Integral Theory, Spirituality and Transformative Learning. While these chapters function as establishing the lenses for my inquiry I have also used them as an opportunity to introduce my classes and experiences so that my canvassing of the fields are seen in the context of my own dilemmas. I have not gone as deeply into the meaning behind things as I would like, but rather have tried to give an overview. I hope that enough of the essences come through. Chapter 1 gives a holographic taste of this journey I have been on, setting the stage for my exploration.

I wrote Part 1 in 2005 in a very different space to the one I am in now – it was much more 'a writing in the dark' (van Maanen 2003), as I explored self in an iterative and deeply reflective way. I have since gone back and removed much of that reflection and emergence in order to 'keep it tight'. I am a little sad about this as the process itself revealed some of what I mean about inquiry with *eye of the spirit*. However, this process lives within me and I hope I can bring the insights I gained from my writing journey of 2005 to Part 2 of the study which I have been engaged upon in 2006 – which explores my physics journey.

Validity

I am blurring the genres in my research and it may be hard at different times for you, the reader, to know where I am situated and what standards should be applied in judging the academic rigor of the work.

In Appendix 1, I explicate my research process, discussing the various research methodologies which have influenced my approach, some of which are quite invisible in this final product. As I have grown along my journey, I have drawn on different methods which have suited the stage I was at and so have been on

a journey through different ways of thinking about research which is delineated by Taylor (2006). (Research methods have included: lived experience/action research, fictional writing (exploring issues through fictional characters), writing as inquiry, structuring/modeling, auto-ethnography and then back to lived experience as a way of structuring the writing). This has created quite a few tensions in trying to balance the competing needs of different genres. I discuss these tensions in Appendix 1.

A key tension is between my need to synthesize and create grand narratives and between my need to explore the plurality of meanings of an experience. So one process may seem to situate me in the modernist camp, while the other in the postmodernist camp. I wonder if I can solve this by claiming to be in the Integral one (which aims to integrate all inquiry modes and all levels of the Spiral.)

What standards might you then apply to Integral research? Coverage? While I might claim to have immersed myself in the action inquiry/lived experience mode, others were more a short dip… and some shorter than others because the water was too cold. Perhaps then rigor lies in an awareness of what mode one might be in? Or the ability to dance and weave between many?

I am not sure that I have achieved that level of critical epistemological awareness, but it is a learning journey. Yes, it certainly is easier to select one mode and stick with it.

I list below the key genres that I draw from with their claims to validity:

Auto-ethnographical studies are usually judged in terms of authenticity (aims to develop the reader's understanding and appreciation of their own views), verisimilitude (how well it conveys a sense of the real?), crystallization

(enabling plurality of meaning), and coherence (clear sense of story and direction – chronological or propositional).

Action research/lived experience studies are usually judged on how systematic was the research, the level of critical inquiry and reflection brought by the researcher, evidence for any claims and a transparency about the values one is bringing in making those claims, and contextualizing within current educational theories and frameworks. (Whitehead, 1998)

The writing itself could be judged in terms of aesthetics, artistry and literary qualities – Is it compelling? Does it transport the reader to another place? Do the metaphors work powerfully? Is the language poetic? Is the composition artful and intriguing? Is the story moved forward? Does it have dramatic control and characterization? Does it create perturbations and ambiguities to enable space for the reader to come to their own understandings?

But perhaps central to my own need as a change agent, is this - does this study create **praxis?** Does it excite the urge to do, to change understandings or practice? Can it help inform transformation of the system? Yes, I am changed in the process of doing this study, but is it enough?

The contexts

Physics in context with other subjects and ways of teaching

I frame my experience of teaching Year 12 Physics with the teaching of my other classes – Journalism and Maths - in order to contrast the different teaching styles, the underpinning curriculum metaphors and the different needs of the students.

Physics sits within a content based culture of delivery to self-actualized learners, while journalism is an enterprising, experiential, project based course which fosters student transformation and self-reflection. My 'students-at-risk' Maths class features students who are dealing with deep personal issues and are marginalized by our current education system. These students help me to dig deeper in myself in asking *what is the purpose of education?* and *what does it mean to be a holistic teacher?* (See a tabulated summary of the differences of the three subjects in Appendix 5.)

Holistic teaching of physics in context of Constructivism

Constructivism has been a key referent in the last 10 years in Tasmania (and the world) for science teachers in thinking about how to teach science. So I contextualize my journey in Part 2 by starting with constructivist pedagogies and then showing how holistic pedagogies and principles can infuse and transform these.

Physics teaching in context of the Tasmanian Education system

I am also working within context of the Tasmanian Education system whose changing frameworks also provide a context for my research. So although a key theme for me is looking at ways to reconceptualise science education, I am also very interested in how my experiences can inform curriculum visioning for Year 11/12 colleges in Tasmania. So as part of my playful writing I introduce a fictional group of Year 11/12 *curriculum planners* who discuss the implications of my exploration on the development of new curriculum frameworks. Their discussions are in **Arial** font. Below, I describe the context of the Tasmanian Education system so that you are familiar with both the contexts of my journey and my fictional curriculum planners.

The Tasmanian Education system context

Tasmania is a small state in Australia, in both physical size and population (only 470,000 people). It has 214 government schools with 63,000 students, 66 non-government schools with 21,000 students, and 5,700 teachers in total. (National Report on Schooling in Australia, 2002).

The different education sectors are: **primary schools** which go from pre-Kinder to Year 6, **high schools** from Year 7 to Year 10 and **colleges** from Year 11 to Year 12 (including a few mature age students). From college, students can articulate to university or technical/vocational colleges or training.

There has been a major review of K-10 education over the last five years, resulting in a new curriculum framework - the ***Essential Learnings*** (ELs). A key aspect of the new curriculum is the movement away from discrete subjects into a more integrative inquiry based curriculum – *the thinking curriculum*. This has been in various stages of implementation, depending on the school, for the last few years and will not be fully rolled out for another few. It will have major ramifications for college curricula.

There are eight government Year 11/12 colleges in the state. They each have between 600 and 1400 students and can offer a large range of subjects because of their size. They prepare students for university entrance, provide vocational training and pathways, as well as provide more general subjects. From 2004 to 2006, Year 11/12 education has been under a major review process – *what are our values, worldviews, future trends, student needs, impact of the ELs and what conceptualization of a curriculum framework can cater for the emerging educational vision?*

Because of Tasmania's small size the process of educational re-visioning has aimed to be consultative, inclusive and empowering. Tasmanian education has

had a history of face to face moderation between teachers, with teachers participating in subject writing parties and part of whole curriculum conceptualizing. It is easy for an ordinary teacher to have quite an impact on the whole and many teachers have an expectation of being able to be part of any new developments. This is possibly unique as many other education systems have top down decision making often by people who have been out of a classroom for years.

Significance

How can one person's teaching of Year 12 Physics inform thinking about science education?

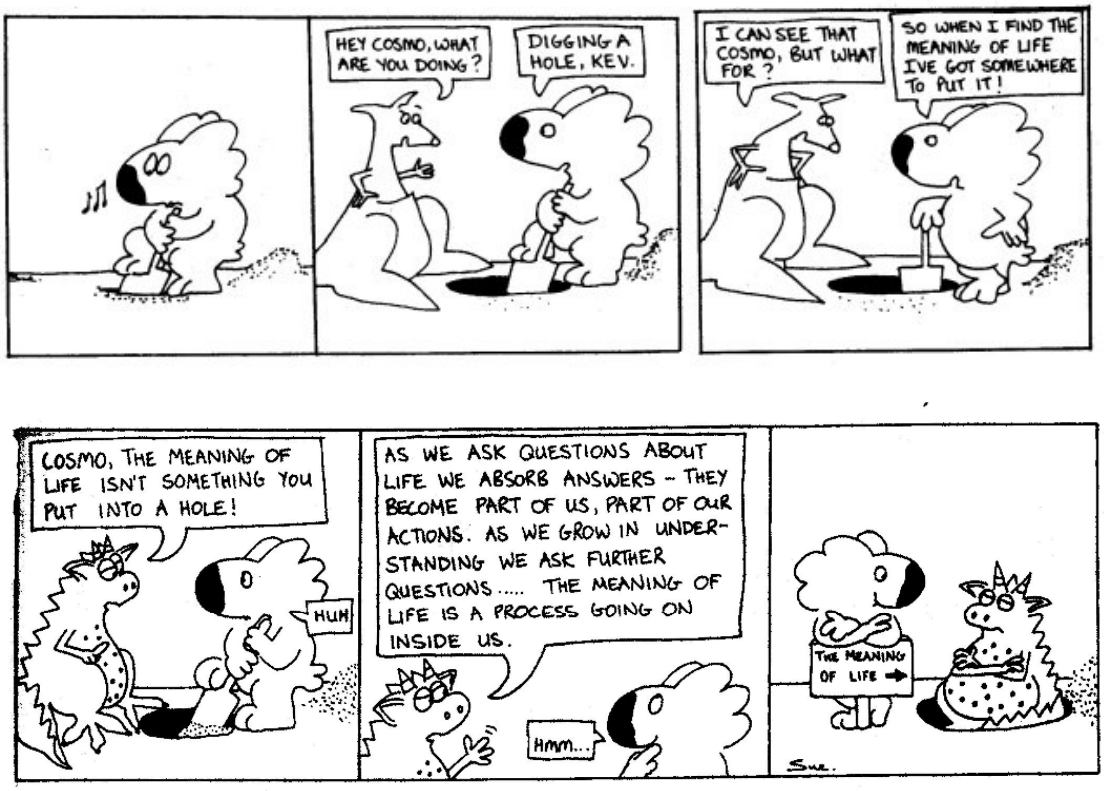
Physics has considerable significance in the design and consideration of science programs from primary to university. High school science programs (Years 7-10) are often designed with the aim of providing students with pre-requisite knowledge for pre-tertiary Year 11 and 12 courses like Physics and Chemistry, even though the majority of students do not choose these subjects in Years 11/12. By examining the issues to do with teaching such a class I question the assumptions that such curriculum designers are making about what is important in science education. What are our underpinning metaphors and are these what we really want to have? What are the purposes of science education?

By showing what these Year 12 students might be able to achieve in physics I am challenging universities to consider programs which speak to the development age of the students and help to foster students' continued transformation.

In examining the issues that university lecturers and teachers face in changing practice, I am able to apply a cultural theory (spiral dynamics) which explains some of the issues and possible solutions in the transformative processes.

My culminating effort of creating an integrative model for soul and science has major implications for science educators who are interested in exploring the implications of Integral and Holistic perspectives in their teaching of science and teaching of science educators.

Cosmo *and his Search for the Meaning of Life*



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Part 1

Setting the scene

Chapter 1
Moving towards being an Holistic teacher

Introduction

This chapter is a holographic introduction to the whole thesis – a taste of the questions, dilemmas and layers of concern. It is an introduction to my disorienting dilemma – *how can I integrate my spiritual self with my scientific self in the space of a physics classroom*? It also introduces Holistic Education; its educational concerns, its relevance, its community processes and why I use it as a key referent. It provides a sense of what motivates me on my journey as researcher and now writer. I introduce a fictional group of curriculum planners in **Arial font** who like to ask lots of questions and continue to do so throughout the thesis**.**

June 14, 2004 – Orienting myself for a day in the classroom

I am lying in bed, thoughts swirling around my brain somewhat anxiously. It is Monday morning 6am, the first day of second term. I have an hour before I have to get up and start the process of becoming a teacher. After two weeks of holidays I am feeling very reluctant to get back to school. Yet education is my passion. I have spent the last two weeks big picture thinking for the current review of Year 11/12 College curriculum for our state, Tasmania; particularly looking at the underpinning worldviews that we bring to any thinking on it.

I have been exploring a holistic worldview for over a decade now; its implications for classrooms, disciplines, professional development, whole schools. More and more teachers are looking to something like 'holistic' as an answer to the many problems that we have with our education system and particularly a large cohort of students which it appears to be failing.

We have already had four years of changes in the K-10 domain – *The Essential Learnings* (ELs). But we college teachers of Years 11/12 have been largely insulated from this process. There is a lot of fear about the impact of the ELs on us and our institutions. What impact will the new focus of *Integrated Learning* and *Teaching for Understanding* have on our status quo?

But I need to wrench my thoughts away from these considerations and orientate myself (let's be honest… I mean psyche myself up) for my classroom and the everyday school issues I will be facing.

My Maths class….

sigh

Why do I feel the energy drain out of me as I think of it? This is what is called a 'low level' maths class which aims to build numeracy – maths for life - in students who have a range of difficulties with maths (e.g. Some don't get place value, don't know when to divide or multiply, don't really see the meaning of numbers… is 20% off a good discount or not?) Some students would be considered around Grade 2 level- others up to Grade 8 in maths ability. But they are 16, 17, 18 and yep one 40 year old. We have five classes at about this level in a college of 1000 students.

However, it is not their level of maths that is the problem with my maths class - though I spend many anguished moments trying to understand how they each conceptualise and learn - it is the fact that most of them are on the most wanted list by either the police or the school. Bullying, stealing, being rude and obstructive to teachers, poor attendance…. Some of these students don't know what it means to be out of trouble…. it is a way of life. When I go into class frazzled I find myself buying into The Game… *Us* versus *The World*. The class is like resistant mud which I am trying too hard to move through or corral.

Take Brandon who has a history of bullying, who uses tantrums, emotional manipulation, accusations to get what he wants. Sometimes I allow myself to get sucked into his habit pattern of interacting with the world. But almost from the first lesson something clicked between he and I… a connection, a recognition… I see him… and he knows he has been seen. What I see is not the bully but something deeper, beyond words… almost a sense of waiting. I know his mother is a bully and treats him like nothing, his father left them, I know he wants to be loved and liked and is consumed by fear. But this is a mental knowing or seeing… I am talking about something more fundamental.

Do I love him? There is a sense of a connection, an empathy and compassion, a warmth in my heart even though exasperation is in my head. There is a sense that we two are on a journey together and perhaps I can help him see himself and he will help me to see myself. He challenges me, makes me think about what I value and how I see the world and in what

ways I am in the world. What ways of being can I be that may resonate with him, speak to him? And the answer is not that far away… being mindful. He demands me to be mindful in the moment and allow authentic focused being.

I always manage to do the wrong thing when I am distracted and I am trying to juggle too many balls in the air, have too many other students make demands on me. Each of these students requires such mindfulness. They are such complex beings - so used to hurt and fear that it is so easy in my rush to miss the key body language, the hidden plea. But time is always the problem… how can I extend time?

I can. I'll do it now. I start my deep breathing and put a cocoon of golden light around myself. I see the classroom and the students in it and fill it with golden light. I begin to see the energy patterns around each student… out of control whirring, the dark wisps and suddenly I find myself next to Jason. He talks back to teachers and has been suspended 13 times during high school. His mouth goes on and on, disconnected from his heart and mind. I see it like a wall around him keeping everyone out, trying to hide his fear. Jason, who is so difficult and incites so many of the others that when absent the class runs a hundred times more smoothly and I sigh a guilty sigh of relief. Jason, how can I help you connect your heart to your voice… what sort of project could you do which might allow you to become whole? What sort of relationships could you have?

I breathe. I see. I will remember. Time will slow when I am with you and I will not react but be with you.

Time to get up and have a shower. But my thoughts can't go away. I love the shower. That is often when ideas and connections come to me. But today I am remembering. Remembering the passion I have for teaching physics and the wonderful sense of community we have in my classes - scientists together, energetically and curiously exploring the world… using all our being and all our faculties to come to know. How we think about our thinking, play with ideas and play with the idea of science itself. The joy of being perturbed and finding something new. Our enchantment with the cosmos.

It is another planet to my maths class. My physics class embodies what I think of as holistic practice… what learning is all about. My maths class is a cause of perturbation for me, a thorn in my side of complacency. A reminder of how far we have to go in providing meaningful education for all students… not just the elite bright ones with happy homes. Should I be even trying to teach something called 'maths' to such students? What does it

mean to provide holistic education within a class, within a school within a whole education system? Would such education be helpful? What does it look like? Is it a curriculum, a way of being, a perspective?

* * *

What is Holistic Education exactly?

Herhem. Thank you for coming here today. As you know our topic is Holistic Education and how it might inform our current curriculum review process for the reframing of year 11 and 12 curriculum. We are using the word 'holistic' more and more to describe the sort of education we want… *holistic* curriculum … *holistic* learning, education for the *whole* person. What do we really mean by this?

So what might Holistic Education have to say about what we value in education, about the role of disciplines, and our curriculum and assessment frameworks? What sort of learning experiences do we want to give our students and what sort of teachers do we want to be? I would like to share with you some of my journey in exploring these questions as well as describing the holistic principles and pedagogies. Perhaps by teasing out some of the dilemmas I have faced, we can see the implicit assumptions in our current system and ask *where do we want to go*? Any questions?

Yes, you at the back… "What is Holistic Education exactly?" a good question… it is a good idea to get some hard and fast definitions on the table first rather than just talking about it nebulously. Would it help if I draw you up a table? Yes? Good….

Oh damn, my chalk broke….. I am just going to have to do this another way….

Maybe you should all come and sit in a circle…

The animals of the forest were gathering together for a picnic under the big tree. As usual Rabbit was bossing everyone around; where to put food and where to sit, and as usual everyone was doing their own thing anyway, but in a very good hearted way.

Now Pooh was just settling down to contemplating the lovely array of treats when there were some very loud crashing and splitting and falling sounds coming from the big tree. Then a few seconds of silence followed by a big whump, which landed right in the middle of the picnic cloth. All the animals crowded in to look.

"Well," said Rabbit, "that looks like a very big book"
"*The Almost Comprehensive and Complete Guide to Holistic Education*," read owl slowly, enunciating each letter.
"Why would it be *almost* comprehensive?" squeaked Piglet. "It looks pretty comprehensively huge to me."
"Obviously there are pages missing" said Rabbit
"Obviously," said Owl, "it is trying to indicate that while it is aiming to be comprehensive there might actually be gaps in its knowledge, so should these gaps be found by the reader it would not negate everything else the book says."
"Or perhaps," said Pooh thoughtfully, "it can only be complete when there is someone actually reading it?"

"Well what is Holistic Education anyway?" asked Kanga curiously, "With Roo growing up there are so many questions I would like to ask."
Owl flicked over the pages. "Holistic, obviously," said owl , "is a word that means something like whole or complete or inclusive. For example, like whole person…. holistic medicine takes into account all aspects of a person… spiritual, mental, physical, emotional."
"Isn't that Wholistic with a W?" asked Pooh. "Does the W make a difference?"
"Holistic could come from holographic" squeaked Piglet.
He shrank smaller and smaller under all the eyes that turned his way. Tigger bounced next to him.
"Ummm," Piglet squeaked apologetically, because being a small animal next to big bouncing animals like Tigger was very hard on the nerves. "If you break a hologram in bits then you can see the whole picture in each bit. But if you break a photo into bits you have only that bit. So Tigger, your thumb contains the universe!"
"**My** thumb contains the universe?" said Tigger, trying to hold it reverently while bouncing with excitement. "Everyone come look at **my** thumb, the universe!"
"Hummmph," said owl, "that is just non-rational religious nonsense!"
"Yes" said Eyeore "it disadvantages all us non-thumb animals who don't have universes in their hooves."

“Holons” announced Pooh. “Holistic …. holons… there could be a relationship? You know, holons, emergent systems with new properties containing smaller systems”
“Oh you mean Systems Theory!” said Owl knowledgably. “Feedback loops, dynamics…an excellent engineering and planning tool!”
“Holons …like the Russian dolls?” asked Kanga. “One within another?”

“The web of life?” asked Piglet, “like how we are all interconnected in ever increasing systems of complexity - cell, organs, whole body, ecosystem, biosphere?”
“Like social systems,” said Rabbit “Please don’t talk to me about interconnectivity and relationships,” Rabbit’s left eye began to twitch as his head vibrated from side to side. “Have you ever tried to keep track of the relationships between 300 rabbits? Imagine trying to understand the rest of the universe! Impossible!”
“Ummm, well,” said Pooh, “holons help us understand life and the universe – the physical world as well as our interior worlds… the great chain of being… from body, mind, soul to spirit…. each higher holon containing the other… showing our ultimate interconnectivity and interpenetration through spirit. We are connected through much more than the physical reality of the web of life.”

There was a bit of silence as the animals tried to digest this complexity of words which were straining to reveal how the complexity of life was actually quite simple to understand, if only you could get your head around it… but then again, maybe it was something that was impossible to understand through the *eye of the mind* - you might only be able to understand it through the *eye of the spirit.* There was a bit of shuffling of feet, and looking out the corner of eyes (which weren’t quite used to seeing in other ways) as no-one wanted to admit they didn’t have a clue what Pooh meant, but at the same time they didn’t want to hurt Pooh’s feelings (except Owl, whom one wonders if he knows whether feelings exist.)

There was a bit more silence, real silence this time - less worry and more contemplation - and in that space between the silence some interpenetration happened …
gently…smilingly… connectingly…

“Umm, what is the difference between soul and spirit, Pooh?” asked Kanga after a pause.
“Soul is about the individual – their spirituality, their being in the world. Spirit refers to a universal spirit which is called different things in different religions – non-dual reality, God, nirvana….”
“Why do we keep coming back to religion?” hmmmphed Owl, “irrational nonsense!”

"Well," said Pooh, "the spiritual dimension is a key aspect of holistic – it allows you to unlock a whole other side to existence and learning. Educational research has done a lot in trying to understand how people develop and learn throughout their lives but if researchers only consider the physical, mental, emotional and social aspects and leave out the spiritual ones then they can only come up with incomplete models."
"Where does learning actually occur anyway," asked Piglet, "is it just in the mind or the heart or the soul or all of them?"

Christopher Robin had been very quiet up till then but he leant forward earnestly, "I would really like to know more about how learning occurs. Is there another way than sitting at my desk all day doing what the teacher tells me to do and really not learning as much as I do being in the forest with you…"
"Though," he added thoughtfully, "I don't mind learning about Ancient Greece, sometimes."
"*Palladium Cesium Mania*", pronounced Owl ponderously, "Ancient Greece is absolutely critical to the curriculum, I don't know where I would be without it."
Kanga hid a smile and then turned to Pooh.
"So Holistic Education would want to understand how people learn and how they develop in all their being?" asked Kanga. "Does it have a guide for mothers? When to expect what?" she covered her mouth with her hand and said "I think Roo is going through a phase just now and I want to ensure I don't damage his spiritual growth."
"Hogwash!" exploded owl "Fairy stories! Next he will be dancing around pretending he is a fairy! Ill-informed mothers. New-age nonsense."
"But, Owl," said Kanga, "a lot of this stuff is actually very good and well researched. Take the multiple intelligences. It used to be on the fringe, but now everyone is embracing it. There is even a naturalist intelligence and a new one called existentialist which is recognizing a spiritual element. Notice how well Tigger is doing at school once his teachers realized he was a kinesthetic learner."

"All this blabbing on," said Eyeore," and as usual you have missed the point."
Everyone turned around and looked at Eyeore, who was trying not to appear too smug and as usual failing.
"It is obvious. You have to ask 'what is the purpose of education?' What does holistic have to say about that then, huh?"
"Well," said Owl, importantly as he turned the pages "surely it is obvious what education is for…"
"Like how to be a good rabbit and fit in with the rest of the rabbits." interrupted Rabbit

“Like how to be a very good bouncer,” said Tigger who would like someone to help him master the double somersault and twist bounce, (and also someone to massage him with tiger balm oil while he was in the process of mastering it.) “And to be able to balance.”
“Or to help even very small and frightened animals to find that inner very big animal which exists inside them?” squeaked Piglet who sometimes dreamt that he was a rather large leopard.
“Or how to appreciate life to its fullest” said Pooh who had befriended a jar of honey and was tasting whether it actually was honey with great pleasure, an exercise where body-heart-mind-soul were integrated in the moment, “though do you need education to tell you that?”
“Maybe education could help you contribute to the world in a positive and creative way,” mused Christopher Robin who would like to design a non-ozone depleting car.

“Obviously the purpose of education is to know things,” said Owl, finally getting a word in.
“But why,” asked Kanga? “What sort of knowledge and for what? Should I let Roo discover things for himself or should I teach him? Should I be teaching him disciplines or thematically? Attitudes, skills or knowledge?”
“Perhaps you could help him learn how to think, be and relate for himself?” said Pooh.
“And anyway,” said Kanga, wouldn’t it be better if he has wisdom rather than knowledge?”
“What is wisdom?” asked Christopher Robin “We talk about it a lot but how could you teach it, where does it come from?”
“Hmmm,” said Pooh, “maybe it comes from experience, moments of insight, effort to understand, perpetual unwrapping to get to the bottom of things – not taking things for granted and questioning your perspective, intuition, connecting to a greater consciousness. A journey of inquiry, self-transformation and integration. A process of waking up to reality. I see something new today and it effects the way I am in the world, so I am wiser today than I was yesterday.”
“I’m not,” said Eyeore.
“We know,” said everyone at once and then they all laughed.
“Education for wisdom would be a lifetime endeavor,” said Kanga looking at Eyeore admonishingly. “Or maybe three or four lifetimes in your case.”
“Perhaps,” said Pooh, “we are thinking of education as something we adults do *to* younger children, when maybe education is the whole process of interaction between teacher/student/community/life and is happening simultaneously in the adult and the child and all the space in between.”

“What concerns me, said Kanga, is that there are so many conflicting views. Which one is right? What happens if I choose one way and it damages Roo for the rest of his life?”

“Perhaps everyone has their own purpose or path with education…. so there can’t be just one size fits all for everyone, one right answer.” said Pooh, “Perhaps you are not the one who should be doing all the choosing, perhaps Roo should be part of that?”
“But that would be chaos!” said Owl. “Schools wouldn’t be able to run like they do,” exclaimed Owl, “How can you expect a young child to make reasonable choices?” hyperventilated Owl.
“Perhaps there is an education system which allows you to have a bet each way – enables all the conflicting views about how people learn, and the purposes of education to exist together,” said Christopher Robin.
“Wouldn’t that be worse, a mishmash of different ideas, no coherence?” asked Kanga..
“So is it important then for there to be a coherent system? Where we have a coherent understanding of the world in all its reality, of what it means to be a person, how people develop mentally, emotionally, socially, spiritually, how people learn across all their intelligences?” asked Christopher Robin.
“So is Holistic Education offering a coherent system? Is it comprehensive and will it answer all my questions?” asked Kanga “what does the book say, Owl?”
Owl flicked through the book until he came to about halfway. “The rest is empty pages, he said in amazement.
“Perhaps we are meant to fill them in,” said Pooh who by now had come to the end of the honey pot and was looking inquiringly inside it to see if anything was left in its dark depths.

“Perhaps,” Pooh muffled as he stuck his head and shoulders into the pot, coming triumphantly out with a last lick of honey, “you have to go deep for the answers.”

“Eugh!”said Eyeore in disgust, “But you get too sticky!”

* * *

1990 – Back to the beginning: Teaching Physics

It has been a big year. I have made a tough decision – to move out of the business development sector of government into teaching. I have been offered a position at a new experimental college for Year 11/12 students which is going to emphasize applied and

enterprise learning. My skills in enterprise, business research and development meant they were very keen to get me…..with the proviso that I also teach Year 11 pre-tertiary Physics.

Honestly I never expected to have to do this. Yes, I have a physics degree but I am so disillusioned about physics teaching, especially at high school level where for the sake of simplicity so many partial 'truths' and even lies are taught. I had such big hopes when I studied physics at uni. You might consider me an idealist. But I was swept away by the literature that was about the new quantum physics, and particularly the connection between the organization of subatomic particles and eastern mysticism. I wanted to understand the essence and meaning of the universe and felt that there was a point where physical reality collided with a spiritual one… what could it possibly tell us?

The actual reality of university physics was very different to my hopes and although I went on to do science in industry afterwards (using my physics knowledge) I had felt in many ways I had left physics behind as a meaningful way of revealing what 'reality' really was. I had to look elsewhere – into esoteric knowledge and into spiritual practice – to seek such answers. So physics for me became a pragmatic exercise to solve problems, rather than enable insights. And now I was teaching it. With all this history of disappointment.

I have told you this is a brand new school. Very small – only 250 students – only Year 11 for the first year. I am the only physics teacher. So commenced a period of scouting around the other colleges and teachers for whatever resources they could give me… teaching notes, way of teaching, problem worksheets, tests, experiment instructions. You don't have to look at the type face of these papers to realize these resources are at least 20 years old and been copied year after year with no change. I am overwhelmed with memories of my university physics… dry… ancient… meaningless.

Where do I go from here? How do I use this? I meet the physics teachers at my first moderation meeting… all men…all older than me…. all so seemingly confident and knowledgeable, confusing me with what they effortlessly seem to know… while I really don't get the whole course… what is it about? Is there a theme? Why is this bit relevant? How do these things connect? Why is that so? I know something is wrong with the experiments they use… it isn't real science... the sort I have been used to in industrial research where you go through a process of thinking and investigating. But someone bought all my equipment already… it is all based around these set activities.

I have got into a rhythm in my class based around advice from the other physics teachers… have a discussion or demonstration on the particular topic, write *The Notes* on the board for the students to copy down… do *The Problem Worksheet*… do *The Experiment*… give *The Assignment*… then later give *The Test*.

Robert is ruining my rhythm by asking questions. They are good questions and make me think, but often might not directly correspond to what I need to get done today. I am on a tight schedule with my whole year mapped out. I notice the other students are getting quite cross with him as they like the rhythm and anything off the rhythm means they can't be learning. Right? Then why do I feel that Robert is the only one actually learning?

I feel like I am cut in two in my teaching of physics. There is my spiritual side and understanding which I feel is not being expressed at all in this class. In contrast I am teaching Enterprise which is student centred, messy, project based, applied learning, just-in-time teaching, experiential learning. I love it, although it is chaos. I feel like my physics class is on a different planet (or perhaps in a time warp) – ordered, structured, all thinking the same – and I am the director. Apart from Robert they just want to hear the party line.

I was doing magnetism today and ended up fielding a question about why the earth's magnetic field worked. This wasn't part of my notes so I had no straight answer. So, I presented two theories of it and asked the students what they thought. Some of them got really cross with me. "You tell us," they said. "What is the point of learning two theories if only one is right?" they said. "But perhaps neither of them is right," I said. "Well, why even bother us unless you know the answer," they said.

Hmmm. Was this a product of their education so far, or a product of my own teaching? Had I been training them to expect a science that was cut and dried and only to be interested in learning something if it was to be assessed?

I want to shake them from their complacency that science is fixed and the truth and the only way of seeing the world. Can I do this? I feel like I might be imposing my beliefs and my own disillusionment with science on the students.

I have an idea. I am going to give them a research project where they have to investigate a new and controversial innovation, something which is yet to be pinned down, something which can reveal the messiness of science, the international arguments and the process of how leading-edge science becomes mainstream. Perhaps something like superconductors,

cold fusion, string theory. I know it isn't in the course - the course doesn't have anything more recent than the early 1900's – but maybe having a healthy attitude about science should be a concern of the curriculum.

The students loved doing this. It generated a lot of discussion and thought about what science was. I have selected the best essays on each topic and made them into a booklet which we have made available beyond the classroom – the students are really proud, showing it to their friends and parents. How can I bring this sense of us participating in breaking science into my normal teaching?

I am beginning to see links in the course. Force is a main theme coming up again and again. How can I use this?

The course is so much a Newtonian point of view. We don't do a quantum view, but shouldn't I allude to it? I would like to show the students how a Newtonian point of view has impacted on our thinking beyond science… into the social sciences… into the very assumptions behind most of our lives. What might life and society be like if it was informed by a quantum world view? But can I do this? I feel it is imposing my view on others. It isn't physics. I feel I have to stay within the physics box.

Ok. I did it. But because I wasn't very confident I just presented it on the board… like told them, rather than really allowed them to participate in it. I reckon it fell pretty flat. They couldn't see the relevance to passing the exam.

I mentioned this to some physics teachers. They got on their high horse. "That is the problem, people taking physics ideas out of context… it just isn't done!"

I am reading about systems theory now and chaos. I love the idea of emergent properties and holons. How the parts do not add up to the whole – the whole is much much more. It has given me a whole new question. Can you teach physics as a whole, rather than just parts, like it is now? What does it mean to look at something and try to understand it from a systems point of view? Is there a way of knowing beyond intellectual understanding? Is this perhaps where spirit can intersect with science? I still strongly feel I want to bring them together.

It is the last term and my Enterprise class has been through amazing growth and personal transformation. I have watched my students gain in confidence, responsibility, flexibility, problem solving ability and interpersonal skills in the course of the year. Doing authentic

projects which they are passionate about provide so many opportunities for learning. Every obstacle becomes a personal testing ground, the completion of the task a rite of passage and a time for reflection and story telling. Our originally disparate group becomes a community.

This is learning which seems to integrate heart-mind-body in the very action of doing. Could this be what learning from a 'whole' perspective means… the 'whole self' is called upon … a 'whole curriculum'…. emergent surprising properties coming out of a complex task?

Can I prise open the box which so tightly contains physics … is there a way that some of this messy enterprise learning can happen in physics? But I do not feel confident in doing projects…. I have a syllabus to cover, I can't let the students down – they have to be able to do the exam at the end of the year! Can I teach physics in such a way that engages the whole person, if I stick to a content-driven format? Are there some elements and principles in the way I teach enterprise that I can bring to physics? What other techniques or thinking can help me?

What does the discipline of physics have to offer in ways of seeing the world, in the processes it uses? What in the actual doing of physics could aid in personal development? What can physics offer me? What might enchant me?

* * *

Well, I think we need a little break after all that. Who would like to stretch? Get a coffee?

I'm going to put some thinking music on… Mozart… so feel free to let your thoughts roam - sit quietly or find one or two people to chat with - allow questions to come up… how does this connect to your experiences and your thoughts about education? What sort of things would you like to know more about?

We'll come back together in another 15 minutes and share any thoughts and questions…

“Sue, my group has been discussing how we are beginning to get a sense that you can’t just understand Holistic through words alone… it is a much greater experience, a mind-body-heart knowing that you are talking about.”
“Yes,” adds another group member, “that sense of care and heart that comes through it all… the sense of personal journey by the teacher…both a sense of being and becoming.”
“Yet, we also get the sense that there is a model or framework… but you are not giving it to us straight away…”
“Yes, we are thinking that perhaps you are preparing our ‘eyes’ so we can really ‘see’ it.”
“We have been talking about our different assumptions about what a human being is and what we think education is for… it is really hard to articulate something which is so complex… the classroom is such a complex web of relationships and purposes… we are concerned that as soon as we try to provide a model or map of the territory that it reduces it to its bits.”
“Or generalizes it too much...”
“Exactly, but on the other hand we are thinking that having some straight answers or models or theories might help us organize our thinking and enable us to ‘see’ order out of chaos…”
“…as long as we use the models as temporary stepping stones to deeper understanding.”
“So, what do we want to know? We have a list…”
“What exactly is a holistic world view and how does it compare to current ones in schools?”
“Does Holistic Education have a model for curriculum design?”
“Does it have recommended pedagogy?
“Where does it come from… how does it relate to conventional educational research?”
“Who is doing it around the world and how does it cater to different cultures?”
“Are there teachers being trained in it?”
“What evidence is there that it is giving a better education for students?”
“Yeah, and maybe most importantly, how can it input into our current review and re-visioning of the year 11/12 curriculum?”

Hmmm, really good questions. Bastard questions, but good ones. Just as well I have got internet connected here today and we can do a virtual tour of the world.

Here's a website that will get you started… www.hent.org … yes I admit to being co-founder of the site with my husband… who does most of the work.

Would each group like to take one question and see what you get and we can come back in say 30 minutes and share what we have? I'll just put on some more up beat music which will get us into action mode…

"As long as it's not the William Tell overture… I am sure that would give me a heart attack….."

* * *

1992 – A process for inventing new curriculum?

My College is now two years old but it hasn't stopped re-visioning itself each year and trying new things. I am involved with a project looking at developing a Vocational Education program in the school. We are one of the first schools in Australia to do this and have major funding for pilot studies which has given us the luxury of professional development, thinking and planning time, and using outside experts.

We are wary of falling into the trap of teaching just for skills; we believe that vocational education can provide a motivation for students who are disenfranchised with current Year 11/12 general education, yet at the same time we can ensure it is more than just vocational specific... if we are clever that is. We have already experimented with enterprise style learning – experiential and project based learning - and wish to incorporate these elements within any program which is more associated with achieving 'tick box' competencies. Yes, there are lots of issues and possible models and we want to ensure that we have a really good understanding first before we leap in.

I have found the workshops for we teachers extremely valuable. It is not just sit around and talk. We are required to experience stuff, go through processes our kids might be expected to go through, put on plays or skits to express our understanding, or create real things, have reading and reflection time as well as be part of the workshop design process. It is encouraging us to be present with all our intelligences and to bring all our learning styles to the table. Everyone is participating 150% and what is emerging is insightful, empowering and very innovative.

In the last workshop our group had put on a little play and, even though I was pretty sure what the issues were when we were planning it, I was amazed at how my understanding seemed to click in at a fundamental level during our presentation. It was one of those 'Aha!' moments. I had to live it and be it, not just mentally know it.

We are now in the final stages of planning the Vocational Education curriculum and it is clear what a depth of understanding those who have participated in the workshop program have. We have a shared vision, and a common wavelength which makes decision making very smooth. That doesn't mean we don't argue, but it is creative and constructive and there is a sense of shared commitment in coming up with resolutions. The whole process has been very energizing and I feel very connected to the other teachers.

"Sue, can I interrupt? It seems that the point you are making is that we cannot review and design curriculum just from a series of discussions… that it needs a more embodied exploration… particularly if we are trying to design holistic curriculum - which values the multi-dimensionality of being ….we have to get inside all the dimensions… but how? How can I design good curriculum for the spirit if I myself haven't really experienced it or understood it? It is all very well to get inside vocational education in this way… it is pragmatic… but…holistic?"

* * *

1992 – Discovering Holistic Education

I am really excited. My husband and I have just come across a very interesting movement in Education, called Holistic Education. A brief summary:

Holistic Education

Holistic Education is based on the assumption that the universe is an integrated whole in which everything is connected. This assumption of wholeness and unity challenges the mechanistic assumption that underpins most contemporary thinking and practice. The holistic paradigm counters the reductionistic approaches of the last 200 or 300 years that have led to a world view characterized by separation and fragmentation.

Holistic Education is concerned with the growth of every person's intellectual, emotional, social, physical, artistic, creative and spiritual potentials. It actively engages students in the teaching/learning process and encourages personal and collective discernment and responsibility.

Holistic Education is a quest for understanding and meaning. Its aim is to nurture healthy, whole, curious persons who can learn whatever they need to know in any new context. By introducing students to a holistic view of the planet, life on Earth, and the emerging world community, holistic strategies enable students to perceive and understand the various contexts that shape and give meaning to life.

Holistic Education recognizes the innate potential of every student for intelligent, creative, systemic thinking. This includes "students-at-risk" most of whom have severe difficulties learning in a mechanistic, reductionistic paradigm which emphasizes linear, sequential processes.

Holistic Education recognizes that that all knowledge is created within a cultural context and that the 'facts' are seldom more than shared points of view. It encourages the transfer of learning across academic disciplines. A holistic curriculum encourages learners to critically approach the cultural, moral and political contexts of their lives.

Holistic Education values spiritual knowledge (in a non-sectarian sense). Spirituality is a state of connectedness to all life, honoring diversity in unity. It is an experience of being, belonging and caring. It is sensitivity and compassion, joy and hope. It is the harmony between the inner life and the outer life. It is a sense of wonder and reverence for the mysteries of the universe and a feeling of purposefulness of life. It is the moving towards the highest aspirations of the human spirit.

Fig 1.1

Why this excites me is that it is bringing together pedagogies which we have been exploring at my College (such as multiple intelligences, authentic negotiated tasks) with a spiritually based world view. Does this mean that I can somehow legitimately bring my sense of spirit into my teaching? How? What do I mean by spirit anyway? How can I separate my beliefs in order to form a more essential spirituality? What would it look like in my classes? Do I teach it separately?

Am I covering all those other aspects which are valued by a Holistic Education perspective through what and how I teach? What might it mean to do it well?

I want to know more…. What is happening in the world? Is there a book?

OK I admit it. I have bought into this idea. It has so much potential…I am obviously attracted to something which unifies. Am I being discerning enough?

I find there is so much literature out there in this area now we are looking; some which gives the big picture and others which focus on a particular aspect… it is really hard to get it all in my head… do I really understand it? Some of it is really challenging my preconceptions… how can I reconcile such different viewpoints? Is there a common holistic paradigm or are there just a whole lot of individuals doing their own thing? I keep thinking that if Tasmania went the Holistic Education route it would mean total re-visioning of the whole way we see schooling. Would schools even exist?

Holistic Education

Principles

- Connectedness
- Wholeness
- Being

Pedagogies

- Whole-Brain Learning
- Multiple Intelligences
- Cooperative Learning
- Contextual Learning & Process rather than Content
- Integrative Curriculum & Interdisciplinary Knowledge
- Life-Long Learning
- Knowledge of whole systems - Global Literacy
- Multi-Dimensional ways of knowing - Intuitive Knowledge

Informed by:

- New science
- Perennial philosophies, spiritual renewal
- Feminist Perspectives
- Indigenous wisdom
- Critical Theory
- Alternative education
- Ecological and sustainability principles

Fig 1.2

I am really going to have put this stuff into practice in my class, just one step at a time and see what happens - it is too overwhelming to do all at once… I don't have an end picture in

view at all. Maybe I can use an action research model, do it scientifically, get student feedback and see what emerges.

What conferences are there? Who can I link up with? Is anyone interested in being part of a group which tries to make sense of this paradigm?

Connecting, transforming and unifying

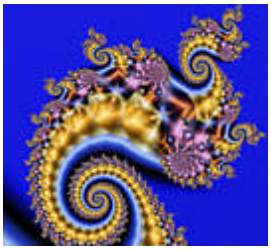


Fig 1.3

If you were to ask me to give a metaphor to describe the next 10 years I would use fractal imagery. That no matter what level of the system… relating with students, investigating a particular classroom, working with physics teachers, engaging in scholarly dialogue, running professional development or workshops for teachers, inputting into state curriculum design, making links across the world or the co-creational process with my husband Roger …. when you are engaged in holistic inquiry it appears that there are some key characteristics.

One of these is the personal connection. No matter which of the above levels you are operating at, people engaged together on this journey are going deep and making themselves vulnerable. They are willing to expose their vulnerability and through doing this provide a space for authentic heart-felt relationships with others on the journey, whether students or colleagues. Connections made between people during this process are very deep and survive across countries and time. They can be life changing.

Holistic educators are also characterized by a sense that they are trying to walk the talk… they have an integrity and passion and they are fully expressing who they are… some literally shine with their souls vibrantly present. Everyone is at a different stage of the journey and at times may be undergoing major personal transformations – there are times of angst and perturbation as well as effortless flow and laughter. There is a sense of respect – honoring people – for where they are, for their own management of their process.

Egos can be involved too, but generally people engaged in inquiry within a holistic paradigm become very caring; there is a sensitivity to others as a result of increasing sensitivity to and understanding of self.

How do people in the field of holistic inquiry get together? Well, over the years there have been local discussion groups, retreats and workshops, international conferences and internet discussion lists and email. Each of these milieus have developed their own way of operating which attempts to model a holistic approach.

Can you have authentic, heart-felt email you ask? Yes! Just in the same way that discussions can be argumentative and critical and get no-where, there is a whole new protocol for conversation which is reflective, centered, honoring, wondering, connective and emergent. So there is the quick impersonal language of email *or* email as a process of heart-felt reflection to a critical friend, where the heart is as visible as if you were physically present.

Australian and International conferences or retreats that we participated in over the years have been based around experiential learning and dialogues, with activities like song and rhythm to help connect ourselves with our spiritual self and each other. Spirit was deliberately woken to be present prior to any of the more intellectual discussions, thus enabling greater insight and creativity.

Over the last 10 years I often felt that what was being played out in my local situation was mirroring what was happening on a global scale. There appeared to be a global field of consciousness which could be tapped into; many of us around the world were working on the same wavelength, independently coming up with similar processes and explanatory models… a number of books might suddenly appear, independently developed, but containing similar things. What was really freaky was that often after our local group had a very deep, emergent conversation I would later read almost the exact thing in a book just hot off the press. You might explain this by saying we were all starting from a similar set of principles so could only end up thinking the same… but the similarity across cultures and disciplines was amazing.

Given we were all coming out of a post-modern world which was trying to show there was no grand narrative… only individual experience… this congruence was really bucking the trend. Were we idealists? Or were we on the threshold of something which could truly unify?

There were a number of key conferences; the 1997 *Spirituality in Education* conference (Colorado, USA) brought together for the first time a range of luminary educational thinkers (like Parker Palmer, Ron Miller, bel hookes, David Orr) with spiritual leaders and researchers (like the Dalai Llama, leading Rabbis and Houston Smith). The 800 participants

came from a milieu of spiritual perspectives and different levels of education; the majority from the USA.

This conference wasn't just about connecting with others and sharing. Such a collection of varied experiences and perspectives engaging in dialogue around things that mattered, making an effort to come to know the other, resulted in what I can only describe as the birth of a new level of collective consciousness – or in terms of systems thinking… an emergent property coming out of a complexly interacting system… developing the next holon layer. Not only have people taken this consciousness back with them as an integral part of a transformed self, but also, in the way of Rupert Sheldrake's morphogenic fields, this consciousness is available to all. A big claim I know. However, we all knew that this conference was a very significant point in the development of the field; something which can't be discerned from the book of conference papers.

The 2003 Spirit of Learning conference (NSW, Australia) is having a similar effect for Australia… it was a major birth of 'soul in education' consciousness in this country and has generated much energy within mainstream education and academia as well as enabling enduring links between individuals and organizations.

So the growth of Holistic as a global consciousness has come about from:

1. personal journey and endeavor – transformation of individual consciousness
2. connecting with the global flow of knowledge
3. connecting deeply at a personal level with others engaged in the field
4. collective consciousness transformation

So what does it mean to move towards being a holistic teacher? It is more than embracing a paradigm or trying out some pedagogies; it is about embracing a process of transformation. And perhaps in transforming self, one can transform what it is one is teaching. Yes, my main game between 1990 and 1999 was being a science teacher – teaching physics. In transforming myself can I also transform science and science education?

Yes, I will get to that later, but back to the real world… back to the maths class I have been preparing myself for…

June 14, 2004 - After my maths class

Time for a reality check. My maths students. The lesson wasn't bad as lessons go. That visualization I did before I got out of bed this morning really helped me in not reacting to Jason's antics – I could respond in a way that not only defused them but steered his energy into more positive expressions. Perhaps we have turned a corner. I think we are moving towards a relationship now.

But the other boy, Brandon, said to me that he knows I am trying to be nice to him and he is going to provoke me until I get mad with him, because he says that is how it works in his life - no matter what - people always get mad at him. He spent the whole lesson trying to push as many of my buttons as he could and he is a master at it. He has made it a competition. And yes I did get mad, trying hard to bottle it up. Trying to deal with his behaviour sensibly and firmly, but in the end losing it more than I would like. This is a problem. Help! I am not a psychologist but perhaps I need to be.

Working with people who obviously have major issues in their lives is a very challenging experience for me. It would be easy to ignore their problems and just be a maths teacher, remorselessly plowing my way through the course, defusing the behaviour issue through behaviour management strategies (which was the approach I used in my first years of teaching maths). But at this moment in time I can't take that approach because of who I have now become. Brandon can't learn maths or anything while he is constrained by these behaviours, issues, and ways of being.

So while teaching physics was about teaching science well and inspiring already self-actualized students, this maths class is about assisting my students *to* a state of self-actualization. But how?

Looking towards Integral Theory for answers

A key aspect of my reading in Holistic Education from 1992 to 2000 was the work of Ken Wilber who has been on a long journey exploring consciousness and what it might mean to integrate spirit within our material world. His work was crucial in helping me find a way to integrate holistic principles and spirit into my teaching of physics. But then, because of my

illness over the past 4 years, I have really put that sort of reading on the backburner… just trying to get well and build up enough resilience to get back into a classroom.

But now in 2004 I have just spent two weeks of the holidays working with my husband creating a whiz bang PowerPoint presentation for teachers. It looks at how we construct worldviews, the history of worldviews and ways of integrating conflicting worldviews – using spiral dynamics and Integral theory.

In revisiting Integral Theory after a four year break, I now could view it from the point of view of someone needing different answers. Not how to integrate science and spirituality – but how to understand people, their development and their issues. And Wilber's models in Integral Psychology (2000b) opened me up to a whole new ball game. It had in it the seeds of a richly articulated educational theory (way beyond the standard Behaviourist approach of Tasmanian Education training) which could support the practice of Holistic Education.

And, fortuitously, there was an international discussion group being set up to particularly look at ways of articulating Wilber's latest extended integral theory into educational contexts. My husband and I joined and over the next year became part of the theory group discussions. We both believe that integral theory has much potential in informing curriculum thinking and have been involved in further dissemination of ideas of integral theory around the state.

But the biggest impact on me was that it helped me to revive my doctorate studies which were based on an *action inquiry* approach which I had undertaken in 1996 - 99. My topic was, *What did it mean to move towards being a holistic teacher?; the lived experience of a science teacher.* I had felt I had really moved on since then, but now this emerging Integral Theory in the context of education, gave me a new interpretative lens in which to examine what it meant to be a holistic teacher, and what science was. The curriculum review of Year 11/12 teaching in the state gave me the impetus – here was an opportunity for renewal, for re-visioning and I could be part of the discussion. My experiences in teaching science, journalism and maths were still very relevant and my approaches were still leading edge.

So in 2005 I begin to write. And the writing itself is inquiry… van Manen's (2003) writing in the dark – I have no idea where it is going. As I write about integral theory, holistic education and spirituality I am forced to go deep, to question and challenge my assumptions and understandings. I go deep into my own spiritual experience. There is some healing and some integration. I cry and laugh and see things with new eyes and from new perspectives –

the process itself is a transformative one for me. But it is all still very raw. I have had too much experience and I try to cover too much. Where do all my different experiences with my different style of classes or student groups come in?

A long break and now in 2006 I have decided to focus more or less on one thread… looking at how to integrate science and spirituality within a context of a holistic/integral educational paradigm. Where does this lead? Can we envision an Integral Science? So now this final work is an integration of the two processes – the broad one of 2005 and the focused one of 2006.

In 2005 I was writing with an audience in mind of curriculum planners engaged in a review of Year 11/12 curriculum and I wrote them into the story giving them a voice. So even though they are not the main audience now, I still give them a voice throughout this work to tease out the implications for both teachers and curriculum. But now there is another audience – one of science educators *of* science teachers – people who might be engaged in visioning structures of science education. I have not given this audience a voice in my work – because, dear reader, you are that audience and you have your own voice.

So where do I go now?

My question is: *What does it mean to integrate science and soul in education?*

To begin to answer it I now introduce the key ideas of integral theory which provide both a solution to the question as well as a lens in looking at it.

I then briefly examine the field of Holistic Education, using integral theory as a way of structuring it. I then explore the field of secular spirituality using my curriculum planners to draw out the implications for educationalists, again using integral theory as a way of structuring it.

And now having got some key ideas out on the table I then begin my own journey as a physics teacher of Year 11/12 , starting at the beginning – my first year 1990 – with all my doubts and conflicts. It is a rich noodle soup – each noodle representing a particular theme that I have extracted with the benefit of hindsight.

I introduce three different selves which have created within me an inner conflict– my science self, my spiritual self and my pedagogical self. The physics classroom becomes the space

where these different selves interact. My efforts to integrate these selves and resolve the conflicts draw forth my own evolution and transformation as well as enabling me to develop a rich practice and living educational theories, and to reconceptualise science. I move through different ways of perceiving and being until in 1998/9 the constraints of the current system cause me to challenge deeply the underpinning metaphors and assumptions of our system… something that I couldn't solve then, but now with the benefits of Integral Analysis can begin to see the greater complexities.

In Part 3 I offer some beginning steps that might help us perceive an integral science … hopefully these ideas provoke further discussion, ideas and possibilities… because this is a process which we are just starting on and needs to be part of a global dialogue.

Involution/evolution

Interlude: Sue takes a walk up a mountain and reflects on the nature of journeys and transformation

Here I am now at the top of Mt Wellington, 1270m. I am surrounded by crystal clear blue skies and the rocky terrain of the mountain… there are views of Hobart and the south west peaks in the distance. I breathe in the air – fresh and tangy. I am ready to start my walk, full of anticipation. I stride out along the main track. I am not really noticing much, I am still in my head, different thoughts demanding my attention. Here is the turn-off. The track is rarely used; it is very rocky, and easy to lose. There are yellow markers every 50 m or so.

I have to concentrate and it is hard to find my walking rhythm as each rock requires careful negotiation. I have my head down, and occasionally I look up and take a bearing on the yellow markers to help me work out where the path is. I am in a state of disequilibrium, sometimes stretching my tendons too far.

I begin to be immersed in these red rocks which I am stepping on and over, beginning to feel that connection with the ground and the enormous mountain underneath my feet. I remind myself to look up and enjoy the view. As I step over one rock I notice some flowering heather. It is like it never existed before…. Now that I've seen this first bush I look up and see a carpet before me. I start appreciating the different hues and foliage, admiring the delicate flowers.

But now I have strayed off the path. I didn't realize this, I was so absorbed in being totally present on this mountain. I have lost sight of the yellow markers. I need to get my bearings, so I climb up a large pillar of red dolomite. It is in the sun and I sit down. My view takes in Hobart with the East coast in the distance, and then down towards the south west.

I get out my pen and paper hoping maybe I can write something insightful, but no thoughts come to me. I allow my eyes to rest on the view, this arc of about 120 degrees. I am so high up I can see the horizon.

I am on an island, surrounded by water. Yes, it hits me, this is my place, this is where I live. Tasmania.

But there is something else. Look at the way the horizon is curving. I can see the shape of the earth way below me! It is a sphere. I can feel it below me. I seem to be moving higher and

higher in view. Yes, I am on a planet, a ball floating in space, sustaining life despite the total vacuum surrounding it. I am looking directly towards the South Pole, the axis of the earth, from my grand height on top of the world. I am sitting still, yet spinning around in space along with other planets, stars and galaxies. I am a member of the universe. This is where I live.

I am still myself, or am I? Have I changed with this new awareness and new way of seeing? Will I remember this?

Where do I go from here? Do I forge my own path, take the one with markers, or go back on that main track? Can I take my new perspective with me as I negotiate all those possibilities?

Touch the sky

Chapter 2

Integral Theory

Questions:

- *What is integral theory?*
- *Why is it useful?*
- *What implications does it have for educators?*
- *What might it be like to teach it in a classroom?*
- *How can it help me integrate science and soul?*

Introduction

My 'disorienting dilemma' is related to the demarcation of spirituality and science. I would like to integrate spirituality in my science teaching. But what does this mean? Being a more spiritual person as I teach? Introducing spiritual ideas to my students alongside physics ideas? Building their capacity as spiritual beings? Helping them to connect to their inner selves and the world more deeply? Helping them explore the world using spiritual inquiry as well scientific inquiry?

In 1992 my dilemma meant wondering how I could help my physics students challenge the status of the prevailing science paradigm - see the implications of Newtonian thinking in our world today and ask what other views and ways of thinking there might be. But I felt uncomfortable with this as I thought I was pushing my own views too much. While there was a lot of literature about spirituality, it certainly wasn't considered in the same conversation as science.

In 1993 I thought spirituality in science might be the **WOW** factor – **W**onder **O**f the **W**orld, enchanting my students with the cosmos. But is this all it can be?

In 1994 I thought perhaps spirituality in science could be seen in quantum foam, fractals and the new sciences… that the world itself revealed its spiritual origins and therefore the examination of it helped us understand the nature of spirituality.

In 1995 I thought perhaps integrating science and spirituality was in the quality of experience my students had as they went about being scientists using their whole selves. That the process of doing science included other ways of being than purely the empirical and rational modes of

inquiry – imagination, visualization, experiential. I wondered if there was a role for spiritual practice in science classes as a way of building capacity to see the world with other eyes and new perspectives.

In 1996 I thought perhaps spirituality in science was in my students' evolution as human beings and I wondered what my role might be in that as a science teacher. What role do I have in helping to develop all aspects of my students from cognitive mind to spiritual consciousness to whole beings?

In 1997 I read Wilber's *Eye of the Spirit* which introduced his 4 quadrant model where he demarcates our ways of exploring reality. It tries to show where the different approaches lie and how we need to give each approach equal consideration. It seemed to me a powerful model which could help me justify the role of spirituality. But it firmly separated the physical reality and the spiritual reality, saying that the new sciences did not reveal the *inner* spiritual reality, but were just an *exterior* expression of reality. So I had to make a few adjustments in my thinking about the new sciences. But did I really understand such a model? It opened me up to more than just the spiritual and physical divide – I was introduced to the role in all this of the social sciences.

So now I think that it might be useful to introduce Wilber's model to my classes as a way of helping them situate physics within a bigger framework and look critically at its claim to know the world and its validity. I do this in an instructor fashion because this is quite new to me. I realize that for many of my students the model is interesting but not necessarily significant. I don't really get them to do anything with it. Perhaps a model is really only useful if it solves a problem.

So in 1998 I decide to introduce it again but now with an activity for my students to do. It is the beginning of the topic on quantum theory and I want to situate the major paradigm shift in thinking that occurred as a result of the theory of quantization. What are the ways we see Newtonian thinking in our lives and in society? How has a Newtonian to quantum view shifted our ways of thinking about the world? What claims can physics have in understanding the world? Have ideas from physics colonized all other thinking?

I am back into my 1992 head of thinking about spirituality and science as a demarcation of paradigms. I am about to enter my 1998 classroom and I invite you to come with me. What happens in this classroom is a key in my journey of utilizing the evolving Integral Theory as a means for reconciling science and soul, and legitimizing various notions of science and spirituality in education.

The episode in the classroom serves to introduce the issues which clamor for some sort of solution which I find in Integral theory. I also use it to introduce you to my physics class. It is an important moment for me because this is a tentative time for me. I have just discovered a mental model that might prove fruitful and I am coming to grips with it. My students play out for me the questions and issues I have and they push me into further questions and understanding. Without this interaction I am not sure I would have progressed with it… it might be one of those interesting things you read but never really use because you haven't got inside it enough.

So this is just a little taste of getting inside it and then I follow that up with looking at the 2005 version of Integral Theory.

So why is integral theory important for me? It offers both the structure and the method in helping me find a way of reconciling spirituality and science in my teaching. It became a powerful way for my thinking about curriculum, the purpose of education and the role of teachers. So while my tension between physics and spirituality worked for 10 years to force me to transform my teaching practice and conceptions of science, integral theory has been the tool for understanding that process in a way that might be generalisable for others. So these models that I introduce here are the key referents I use throughout my thesis and the basis for my grand conception of integral science.

The meaning of life is…
Introducing Integral Theory to a Year 12 Physics class

Sept 1998

It is third term. Just 6 teaching weeks to go. I am introducing the topic on quantum theory. The students are very attentive because this is something we have been looking forward to for a

while… yes I have kept them in suspense about the wave/particle duality and they want a solution. I get into introducer mode:

"Before we start exploring quantum theory in detail, I would like us to explore the significance of what we are going to find. Quantum Theory has thrown up some pretty amazing claims about the universe….e.g.

- At a fundamental level of reality – electrons, photons, protons - everything is connected
- As we try to examine things more closely, the more uncertain other aspects of them become (Heisenberg's Uncertainty principle or quantum fuzziness)
- Particles can just pop out of nothing and return to nothing (quantum foam and zero point energy.)
- Both light and particles seem to have a dual nature – acting either as a wave or a particle.

"You have probably all heard by now the famous quote by Bohr *"if you are not shocked by quantum mechanics then you don't understand it."* Should we be shocked? Are you? Are these just interesting facts that only apply to photons and electrons… do they have any meaning for your everyday world that you are living in?

"Some thinkers from business, education and computing are asking whether we can apply these ideas as metaphors to the way we do things. Some claim that quantum thinking would enable us to solve problems that we haven't been able to tackle successfully before because we have been locked into a more linear discrete way of thinking that comes from Newtonian 'billiard-ball' physics. Many physicists say that applying principles of quantum theory to the macro world is a complete misuse of the ideas. Where do you stand on this? Any ideas?

"So what we are doing today is a little exercise which will get you thinking about whether what we find out about quantum only applies to quantum or whether it can answer the big questions about life, the universe and everything… and whether like some people claim, it even leads us to God! Ready?

"Your task… I would like you to explore this question: **What is the essence and purpose of the universe and where would you need to look to find your answer?** There are 6 groups for you to choose from each representing how different disciplines or ways of thinking might tackle this

question… Physics, Biology, Philosophy, Sociology, Holistic and Spiritual. I have designated a leader for each group. You will be presenting your findings to the class in 15 minutes."

I know it was a lot of talk… there was some discussion throughout it, so it wasn't all me. And I have probably made it more fluent than it actually was. So what happens next? The students get into their groups and from the start appear really engaged… leaning close to each other in huddles, talking excitedly. I was called over to clarify or assist sometimes but soon they were ready and eager to present their findings to the class. Some were looking quite pleased with themselves and others a bit more tentative.

Physics group: Sean: "We thought perhaps you could look at the very small –quantum - and the very big - Big Bang and galaxies. We don't think that physics would be able to comment on whether the universe had a purpose but we think we would be able to say what its essence was."
"Yeah," said Erica, "Possibly made up of fundamental particles. We are not sure whether the principles of quantum theory are an *essence* or give some clue as to the *nature* of the universe."
"And gravity and the other fundamental forces comes in there somewhere" said John.

No surprises here, I think.

Biology group: Angie: "We decided to look at the history of life... how we have evolved from single cells to more complex life forms. So we were thinking perhaps that evolution might be the purpose of the universe. Perhaps life is the essence."

My eyes open wide. The notion of evolution was really insightful… it hadn't occurred to me at all. I thought they would come up with notions of life, but to see the *whole pattern* of life was another level of awareness. It was quite different to the physics group which was looking at *things* rather than *principles.* I was quite astonished. And it is causing me to think about the 4 quadrant model that I am about to introduce.

"But we are not sure how that explains rocks." said Leon.
"I wonder if you see evolution as a principle when you look at the Big Bang and creation of galaxies and solar systems" said Angie turning to the physics group.

"How would you explain stars dying then?" asked Sean (from Physics) "perhaps growth **and** decay are better principles."

Philosophy group: Scott: "Well we actually didn't get to answering the question. In fact we don't believe that the question is valid and we spent the whole time arguing on whether you can actually even ask that!"
We all laugh. The philosophy group huddled closer and another argument broke out. The rest of the class looked at each other, rolled their eyes and shook their heads. They knew Scott and his deep interest in philosophy.

"Do you want to explain that," I ask.
"Well," said Scott, "asking us to find the essence and purpose of the universe presupposes the existence of a universe. Even if there was one it does not logically follow that it has to have an essence or a purpose."
"But if it did?"
"Hmmm. Well. The essence could be thought, but then again there are flaws in the derivation of that argument."

I think that the whole response to the question was possibly typical of a philosophical perspective. But I couldn't have predicted it when I set this task…again, in hindsight it seemed almost obvious.

Spiritual: Tiffany: "Well we decided that spirituality is personal. It is something inside yourself. You have to go inside. It is how you experience it that counts. So the essence and purpose might be different for different people."

Wow… again another interesting perspective. Tiffany was a Catholic who was going through a bit of crisis of faith… re-examining her values and coming to her own notions of what is spirit and what is reality rather than the party line. This seemed to summarize the journey she had been on this year.

Jenny: "We talked about God and the difference between God as this person you worship – something outside of you - and the notion of god/spirit you feel inside you. Perhaps there is an underlying spirit which is the essence of the universe which is everything or in everything."

"Perhaps, it is just a figment of your imaginations?" said Sean (from the physics group) "How do you know it really is there?"
"Because I feel it!" said Tiffany. "You cannot deny what I am feeling just because you can't measure it!"

I could see this was going to be a big argument so I stop them and say "we will have a chance to discuss the different viewpoints later… but let's get them out onto the table first."

Sociology group: Ryan: "We were looking at society and we realized there were different types of groups in society… big communities, workplaces, schools, friends. We decided to look at what we thought was an important unit of society – the family. So we went inside the family and looked at what held them together. We took away the walls of the house… we looked at how families interact and we tried to look past the actual actions into what was really holding things together, what was motivating people. We decided it was… love."

There was a big gasp of surprise from the class… this was totally unexpected by everyone. Another amazing insight. I am thinking how truly amazing my students are and I am not sure that I would have been able to strip away to the bare essence as much as they did – perhaps I had too much baggage.

"So we think the essence of the universe is love…" Ryan turned to the physics group "… and perhaps that is the reason why gravity happens… attraction… a love for other matter."

I could see Sean's feathers rustling as he took exception to this claim. "Later," I mouthed at him. However the Spiritual group were all nodding and smiling at the sociology camp as if they were vindicated.

Holistic: Matthew: "Well, it took us a little while to really think out what a holistic view would be and in the end we decided that the view it would take is whatever is most useful to whatever you are doing or thinking."

Again I am really surprised…I narrow my eyes as I wonder if this is a cop out and then I think… perhaps this really insightful… a magician-like dance to cope with complexity and multi-dimensional reality. Did they really mean that?

“OK, guys” I said, “it is now open slather… you can ask any group to explain their ideas more or question them… but we will do it in an orderly fashion.”

At this point we had a very engaging and intense discussion between groups. Ok, lets be honest … the philosophy group argued with everyone… saying they were applying the wrong sort of thinking to things. The Physics group and the Spiritual group had an argument which got more and more emotional and the players further and further apart. We had the Spiritual and Sociology groups siding against Philosophy and Physics, with Biology and Holistic groups watching on with delight.

It was not the collaborative dialogical practice that I had come to expect from my class. It was heated and intense. People were emotional, buying into the stance they had chosen to take, which was unusual for them. I watched as this happened and felt they were replaying for me some of my conflicts. No wonder this had been such an issue for me in my teaching the last 8 years. It was emotive and problematic.

“Let’s take a deep breath,” I said.

“Let’s think about what is happening here,” I said.

“They are just not listening to us,” said Tiffany. “It is like they are on a different wavelength. Why can’t they accept that my point of view is as valid as theirs?”

“Will you feel better,” I said, “if you know that in the last hour you have been reliving the same arguments that science and religion have had in the last 300 years?”

“What!” they said.

“What are your choices in resolving your argument?” I ask.

“Agree to disagree,’ said Tiffany “…science can go and look at the physical universe but agrees not to make judgments on my internal one.”

“So is that how it is now? Different disciplines which look at the world in different ways stay isolated in their little corners and never interact? Is that how you see all your different subjects? Are they separate or do you try to integrate them?”

We then had a very interesting discussion with most students saying how they compartmentalize their various subjects; for example, Physics and English, Chemistry and Sociology. “Nothing you do in one relates to the other, except perhaps Physics and Chemistry. But that is the way it is.” says Erica.

“Is there any way we can connect our different knowledge and different ways of seeing and experiencing the world?” I ask. There is silence and bemusement “Like what,” says Sean.

I draw up on the board some models of how we construct knowledge – isolated bits, or building blocks, jigsaws, a tree of knowledge, an interconnected web, a tapestry, the elephant (which they are all familiar with), the notion of the river where you can never have the same experience again. I have captured the elements of these in Fig 2.1 on the following page.

“Is there one truth that we are all looking at but seeing in a different way? Is even thinking there is one truth, a particular way of thinking? Which of these metaphors do you think describes how you make sense of all the different types of knowledge and ways of knowing that you have?”

The students discuss these and it is interesting how different they are, some positioning themselves in two or more metaphors. Several like the river metaphor of reality while others prefer the building blocks or jigsaw models. I then say that there is another model which tries to reconcile the different way we see things which might help us to look at their different group positions in a new way. I introduce Wilber’s 4 quadrant model.

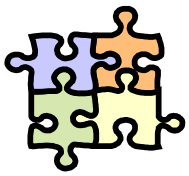
Wilber suggests that we experience the world in three distinct ways…

1. **from a first person perspective**… how we are feeling and thinking inside… it is our experience … this is when we use **‘I’** to describe the experience.

Knowledge Metaphors

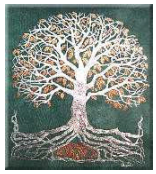
How do you think of the relationships between knowledge which you have gained from different disciplines or different aspects of your life? How do you integrate them?

Knowledge gained from different disciplines is quite separate and you can't integrate them.

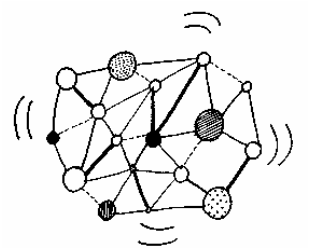


Knowledge from different disciplines fit together like a jigsaw puzzle.

You can build knowledge from different disciplines, but some disciplines are more foundational than others. Is there unlimited potential for building knowledge or is it restricted by its foundations?

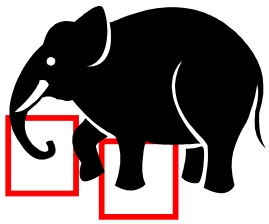


There is a tree of knowledge… metaphysics explains maths explains physics explains chemistry explains biology explains love. Is there knowledge to be found outside the branches of the tree?

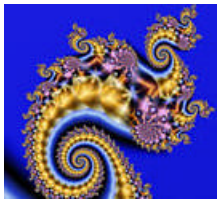


When you allow different disciplines to interrelate they create emergent understandings and new types of questions. Do our questions create the universe to be discovered?

Knowledge is nested within greater knowledge perspectives; each new level includes and transcends earlier ones.



There is one truth to be found. Each discipline sees one aspect of this truth, which could give a distorted view. We need to bring in all perspectives to see the whole. What perspectives might be missing?



Whatever level of reality you look at you see reflections of the whole.

Knowledge is like a river… it moves and changes. If you dip your toe into the river tomorrow, you will experience a different river to today. There is no truth which stands still to be found.

Fig 2.1

What alternative metaphors do you have?

2. **from a second person perspective** … this is the **'WE'** … how we share an experience, a culture, the language we use… how we come to know each other… the feelings between us… the connection we feel between each other. The **WE** is affected by the different cultural perspectives and the worldviews we have.

3. **from a 3rd person perspective**… this is when we look on the outside of something…. We see the chair, can measure its height. I see you – what you are wearing, how you are sitting, but I cannot know what it is you are experiencing. This is the world of **'IT'** or **'ITS'** … the physical world.

Wilber's 4 Quadrant Model

Individual

I How I experience, feel, think and believe.	**IT** How it appears, how it behaves, what can be measured…
WE How we share an experience and come to know each other. Our shared inner intentions and cultural behaviours that shape our relationships.	**ITS** How things connect and relate to other parts. The processes that determine how systems function.

Inner (subjective) — **Outer (objective)**

Collective

Fig 2.2

On his model he divides things into four – on the left hand side are the interiors, the subjective reality – the **I** and **WE** quadrants. On the right hand side are the exteriors, the objective reality which we all can see – the **IT** and **ITS**. Along the top are the individual quadrants - **I** and **IT**. Along the bottom the collective ones - **WE** and **ITS**.

The **ITS** relate to systems such as… ecosystems, social systems, galaxies and *how* they work - the relationships and processes between the parts – what we see happening. The **WE** are like the inner intentions and meanings of those systems – *why* they are doing what they are doing. Wilber suggests that there is perhaps one reality and that the **IT** and **ITS** enable us to see the outside aspects and the **I** and **WE** the interiors. When I feel love, you can measure the change in my body using an **IT** approach, but it is only using the I and **WE** approach you can really understand how that feels. We need all perspectives to see the whole.

"So where might each group go on this map?" I asked.

Sean "Well obviously quantum would be an exterior and probably an **IT** whereas the galaxy would be an **ITS**"

Tiffany: "The spiritual perspective is definitely coming from the **I** - it is seeing a completely different part of the elephant to physics."

Ryan: "Our perspective is looking at a social system, which is collective, but what is it? A **WE** or an **ITS**?"
"Love has to be an interior experience, doesn't it?" says Tiffany. "So it is a **WE**?"
"But social systems could be **ITS**?", says Ryan.

Yes, interesting. This is making me think it is not so easy to demarcate things – it depends how you are looking at them. When we are making shared meaning it is a **WE** but when we are dealing with the networks and structures of society then it is an **ITS**.

Scott: "Well Philosophy covers all the aspects. We are interested in the internal motivations of the individual when we consider ethics. We look at the existence of God… I think we are everywhere on this chart."

Tiffany: "But how do you look at the existence of god? Are you doing it through those logical arguments you so love, Scott, or are you having a direct experience of god? I think you are only looking at the world from a 3rd person perspective!"

Scott: “I disagree! I am using my mind which is internal to me. I can use it to examine exteriors and interiors.”

Ryan leapt in passionately, “In philosophy you are using your mind to talk about and analyse love… that is not the same as an experience of the heart, of love itself!”

“But, Ryan,” said Scott reasonably, “you are using your mind to make sense of that love experience. Mind is really your only reality.”

“Unnngh!” said Ryan shaking his head in frustration, “I can’t talk to you!”

Yet Scott is so logical. I am almost sucked into his argument. I think I can solve it, but I will come back to it.

“So at this stage we have a bit of an impasse” I said… “let’s just put philosophy outside the chart for the minute…. A pending question. What about Biology?”

Angie: “Well I think it is both **IT** and **ITS**… **IT** for evolution of cells and **ITS** for evolution of ecosystems.”

Matthew: “I think holistic would support every point of view, but perhaps there is a suitability to them depending on what questions you are asking. Like how long my toast takes to cook is really not an **I** or **WE** question is it?”

Good point.

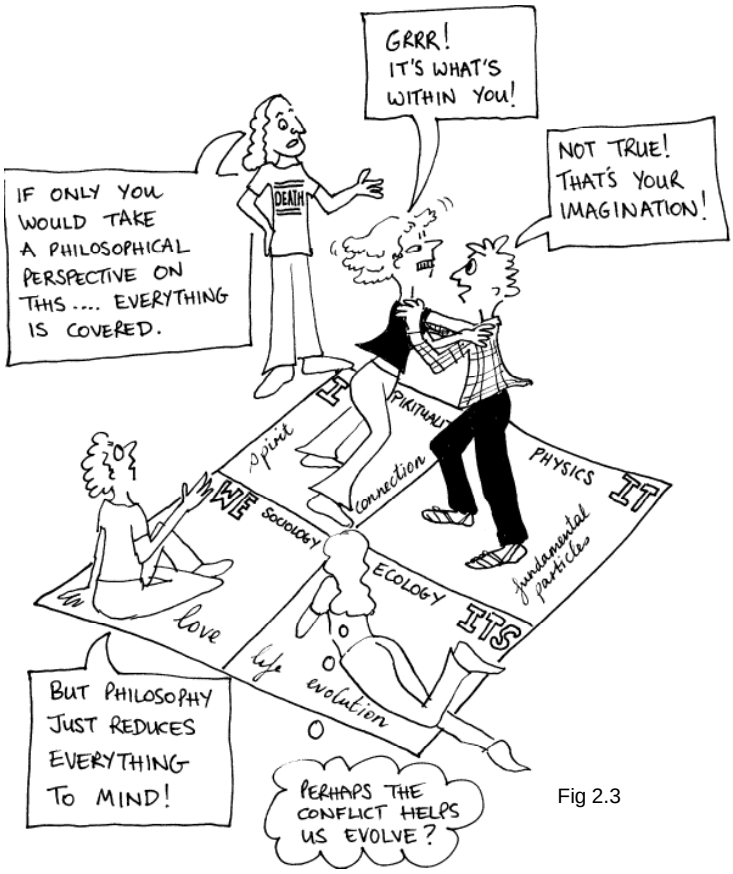


Fig 2.3

And now for my next trick I decide to introduce Wilber's model of Holons – the notion of evolution from *body –mind –soul – spirit*. Each subsequent holon includes and transcends the earlier ones with each having its own eye or way of seeing reality. So a rock or an atom might just be at the body stage whereas a human would have all aspects.

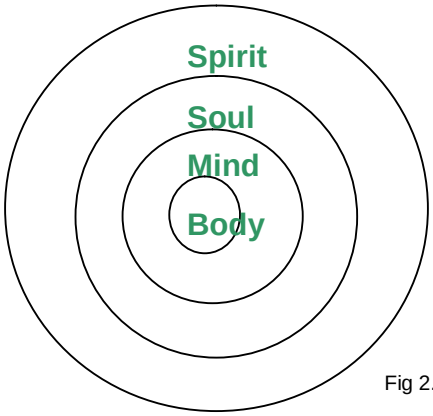


Fig 2.4

I draw this up on the board and think that this might solve Scott's contention that mind is the way to experience everything. Tiffany is nodding her head. She likes the idea that spirituality includes everything. Others are looking a little puzzled. What does it really mean to them? But Scott comes up to the board and redraws it. He puts mind on the outside and says that it is mind which includes everything. Spirit can be in there somewhere but it isn't the overarching part. Tiffany disagrees. Ryan, says puzzled "Where is heart on this model? Where does love come in?"

At that point I am floored, but look at the time, we have gone over recess time! I finish up the lesson, I haven't even got to where I wanted to go, drawing in all the conclusions about the relevance to quantum theory and what we can claim to know. It is problematic. The model is problematic and it certainly is not one which all of us agree on and understand. Can it still be the basis for discussion? I need some thinking time. There is a lot here for me to process, and I need to go back and look at the literature. Was I just looking at it at a surface level, without really understanding the implications because it could simply solve my own spirituality and science demarcation issue? What about the other bits, I hadn't really paid attention to those aspects much? And had the model really solved my problem anyway? Wasn't there a lot more to spirituality than just a way of coming to know the world? I am confused!

Just as well Wilber kept writing books that pulled together more and more aspects of consciousness, epistemology, psychological development, cultural evolution. I need to get deeply into each of these aspects to really understand these nice tools to map reality. And are they any more fruitful than the metaphor of the elephant or the one of the river? And what assumptions is Integral Theory making about the nature of TRUTH? Was there one? But were we just seeing it through different lenses? Could there really be a grand narrative in this postmodern world?

Later, Tiffany wrote this in her 'I wonder' journal:

The Essence of the Universe

The essence of the universe
Is what is inside you.

It's not the smallest particle,
Nor the gluons which hold things together.
It's not the neurons which live in your brain.
No.
No, it's much more complex than that.

The essence is you,
Your soul,
Your emotions, your beliefs,
Your hopes, your dreams,
The disappointments you encounter,
The mistakes you make
And whether you learn from the mistakes.

The essence of life and the universe
Is the soul.
Without the soul there would be no life.
Stars would still burn and decay,
But life would not exist, at least as we know it.
Without the soul,
We would be meaningless, directionless, senseless,
Just floating along,
Fatalistic,
With no thought for today,
Tomorrow,
Or yesterday.

Maybe I am just a very spiritual person,
Religious, soulful
And that's what I feel.
But you can't have life without a soul
And that is the essence of the universe.

Some curriculum planners engage in some thinking and debriefing in listening to the above story:

"Thanks Sue, for that story. It certainly seemed like the students were doing some really insightful thinking. It is almost too good to be true. Did it happen?"

"Actually yes, though I have paraphrased their arguments to make it more readable…I tried to capture the emotions of the students as well as their thoughts and language…. Perhaps overtime I have value-added the story, though it was a pretty amazing lesson… and a real tribute to that group of students. The following year I tried it with a new class, but the students weren't mature enough in their thinking about thinking to come up with good principles for each discipline… they floundered a bit. This first session was invaluable for me in seeing the ideas being played out… helping me to tease out my understanding of the quadrant model… it certainly left me with lots of questions about it!"

"I have to say, Sue, that I found it really interesting how the different disciplines aligned themselves with one or two of Wilber's quadrants. We could certainly tease this out further. Do they really sit where the students suggested? Does it matter who might be doing the discipline? Would Deep Ecology be just in **ITS** or in **I** and **WE**?"

"Sue, I have been wondering about where philosophy does sit in all of it. What is the difference between heart, soul and mind and where they fit on the quadrants? Does the holon model of body-heart-mind-soul actually sit in the quadrants? And was Matthew correct in his role for holistic according the literature?"

"Yes, and where is the soul in all this… is it only in the **I** and **We** quadrants? Could soul be used to connect the quadrants?"

"And what about love? I was interested in Ryan's question of where love sat."

"Could love be something that existed at every holon level? Perhaps at **body level**, it is about sensual love, at **mind level** it could be cultivation of appreciation and affinity, at **soul level** it is an expression of the heart, and at spirit level…. Well, perhaps that is the

loving source of everything…. The creative energy which draws us up in evolutionary progress, the energy which infuses our daily living and which we can bring into ourselves at any time to experience our true wholeness."

"That is a very beautiful idea - isn't that the principle of evolution and involution. We evolve to something, while at the same time we draw in what is already there."

"Now that is too confusing for me. But I am wondering now whether love might also be on all the quadrants."

"How would that go? I am thinking about English Literature and how we are looking at aspects of love at the moment, romantic and mythic love, for example. Where would they go on the quadrants? Could we draw a table?"

Integral Map of Love

Upper Left: **"I"** **Interior-Individual** I feel loved I love Unconditional Love	**Upper Right**: **"IT"** **Exterior-Individual** Love as a chemical reaction Love as sex Love as 'animal magnetism'
Lower Left: **"WE"** **Interior-Collective** Romantic Love Mythology of Love Erotic Art	**Lower Right**: **"ITS"** **Exterior-Collective** Love for species survival Parental Love Love for social harmony

All approaches are valued

Fig 2.5

"You know this might even be useful to discuss in my English class – perhaps it could help my students see different aspects… we discuss inter-objectivity and inter-subjectivity but often it doesn't click – perhaps a chart like this does help put things into perspective."

“Hmmm. As long as it is not making us too smug and thinking we have solved everything!”

“Sue, I am very interested in the notion of evolution – although it was a key principle of biology, isn’t it a key principle for all quadrants… the notion of evolution. Is it in fact a key essence to the whole of life?”

“Sue, I was interested in seeing the tensions coming out of the different disciplines. It reminded me of all this trans-disciplinary stuff we have to consider now. I am wondering if the difficulty they are having at bringing together science, sociology and spirituality perspectives at university level is because everyone is very entrenched in their perspectives of the world and don’t value the others… or can’t even see them. What sort of teaching could help students become expert and rigorous in each perspective and open and flexible in their use of them? Would being able to situate yourself on a chart help in doing so?

“Yes, I would like to see the different disciplines sitting down together and realizing where they sat in relation to each other and beginning to value the other perspectives… perhaps then science might realize that it also needs to include **I** and **WE** when it examines major issues.”

“Or can it just stick to the empirical studies, but then work with other disciplines to ensure all aspects of an issue are covered? A demarcation leading to a multi-disciplinary approach?”

“I also like the idea of trans-disciplinary where new ways of inquiring might result from cross fertilization of perspectives and methods from one discipline to another. Perhaps here there is opportunity for both. Part of the issue is having a mental model like this which can help you see the issues and possibilities of integration.”

“Could this be a new way of thinking about curriculum?”

“Again, these are really good questions. I had better fill you in on where Wilber is now on his model… and then we can begin to explore some of these.”

A brief summary of Integral Theory

Ken Wilber has been developing an Integral way of knowing the world for over 20 years with over 20 books, lots of articles and several websites. (Some of these include: Wilber 1980, 1983, 1995, 1998, 2000a, 2000b). Currently there are projects all over the world in various disciplines taking his ideas and applying them to various contexts. So there are a plethora of interpretations. The theory is multi-dimensional, complex and deep.

I have been working with a group in the US attached to the Integral Institute trying to apply the ideas to an educational context. The more we engage with the material and try to apply to education the more possibilities arise with ever deeper questions. So here I am going to try to sketch a summary of the main features and later tease out some of the dilemmas and the implications for someone attempting to move to more a holistic and soulful education practice.

A key concern of Integral theory is to bring together disparate ways of knowing and being in the world…. to enable a way forward in a world where postmodernism has done away with grand narratives and modernism has separated inner and outer realities (e.g. The Spiritual/Physical divide.) Integral Theory would say that there *are* grand narratives; the way to find them is through a method of generalization… look at the common patterns… realize that every perspective has a truth. Jettison (for now) the dogma and look for the essence. Realize that this truth is partial; but still an important part of the whole. This is a process of *transcending* the differences and *including* all perspectives into new understandings.

An example of this process might be an examination of various religions. What is the common essence? This would be the **perennial philosophy**… the notion that there is a nested or holonic relationship between body/matter, mind, soul and spirit. As one evolves there is a movement to a more expanded awareness of reality which involves transpersonal ways of knowing and being in the world.

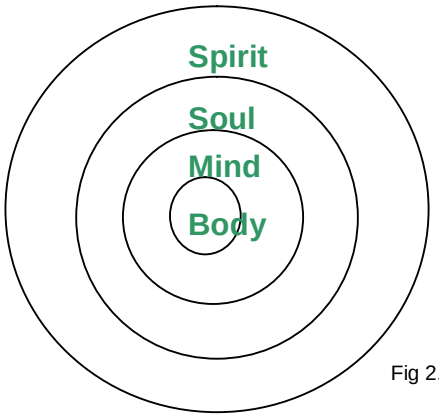


Fig 2.6

Based on this, Wilber has suggested that we need three different *eyes* to see the world – the *eye of the spirit* (e.g. Mysticism), the *eye of the mind* (e.g. rationalism) and the *eye of the body* (e.g.

empiricism). Integral Theory is very much a rational model; it helps us identify the map of the territory but is not a substitute for the actual experience of it. For example, to understand spiritual ways of knowing, one needs to use the *eye of the spirit* through contemplation. To learn how to hammer a nail, one has to do it, rather than just know the theory.

Wilber also looked at different ways we have of **knowing and being** in the world and believe that these can be mapped on a 4 quadrant model.

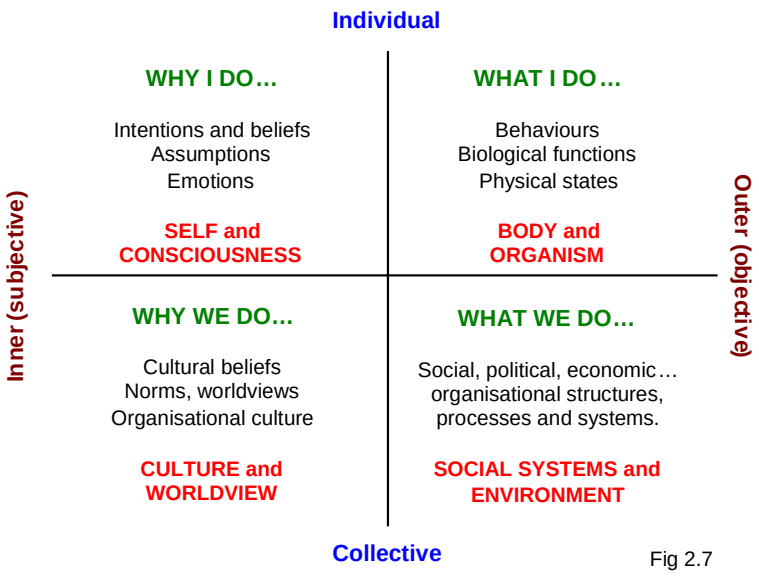


Fig 2.7

So different types of research epistemologies could be mapped as follows:

4 Quadrant Integral Theory

Upper Left: **"I"** **Interior-Individual** phenomenology, psychotherapy, meditation, emotional intelligence, personal transformation	**Upper Right**: **"IT"** **Exterior-Individual** empiricism, scientific analysis, quality control, behavioural analysis
Lower Left: **"WE"** **Interior-Collective** hermeneutics, multiculturalism, postmodernism, worldviews, corporate culture, collective values	**Lower Right**: **"ITS"** **Exterior-Collective** systems theory, social systems, communications networks, systems analysis

All approaches are valued

Fig 2.8

Wilber (2004) suggests that each quadrant can be further understood by considering *inner* and *outer* perspectives making up *8 indigenous perspectives.* The *inner* perspective looks at the reality of the quadrant from a 1st person perspective while the *outer* takes a 3rd person perspective on it. Thus research methodologies can be seen as those which explore the interiors of each quadrant and those which look at the structures of those realities.

The Eight Indigenous Perspectives

Individual

Inner (subjective)	**I** **Inner: phenomenology:** explores direct experience *(1st person of 1st person)* **Outer: structuralism:** explores patterns of direct experience *(3rd person of 1st person)*	**IT** **Inner: autopoiesis:** explores self-regulating behaviour *(1st person of 3rd person)* **Outer: empiricism:** explores measurable behaviours *(3rd person of 3rd person)*
	WE **Inner: hermeneutics:** explores mutual understanding *(1st person of 1st person)* **Outer: cultural anthropology:** explores patterns of mutual understanding *(3rd person of 1st person)*	**ITS** **Inner: social autopoiesis:** explores self-regulating dynamics in systems *(1st person of 3rd person)* **Outer: functionalism:** explores functional fit of parts within whole *(3rd person of 3rd person)*

Outer (objective)

Fig 2.9

Collective

For example, researchers studying the behaviour of children in order to come up with theories of learning and development (e.g. Skinner and other Behaviorists) would be in the **IT** quadrant, using a 3rd person perspective of 3rd person realities (outer). They would be gaining empirical data and then using rational interpretations to come up with patterns and theories.

Researchers interested in exploring, say, the intentions of the children in making moral decisions (e.g. Kohlberg) in order to see if there was a pattern of moral development, would be in the **I** quadrant (outer) – using 3rd person perspectives on 1st person realities.

Researchers interested in how students' language and culture influenced their learning (Vygotsky) and whether there were any patterns of cultural development (e.g. Gebser 1985, Beck and Cowan 1996), would be in the **WE** quadrant using 3rd person perspectives on 1st person realities.

Researchers interested in the relationships of the student with their environments (home, community, class, friends, peers, school, eco-system) and how that affected their learning or development (e.g. Vygotsky and Dewey 1966) would be in the **ITS** quadrant… 3rd person perspective on 3rd person realities (outer).

A researcher or teacher trying to come to an understanding of the **'I world'** of the student would be using a hermeneutic process with the student to ensure that they had gained a shared meaning of the student's interior experiences. (1st person perspective on 1st person perspective).

If, as a teacher, I was interested in my own intentions and experiences in interactions with students then I would be coming from the 1st person perspective in the **I** quadrant (inner). I could be using experiential, reflective or contemplative tools. If I wanted to understand my own development stages and the way my worldviews and culture influenced my intentions then I would be moving to a 3rd person perspective of my inner individual and collective realities.

Confused? So now could you place in the quadrants all the different research and thinking on education? What would you see? Are some of the Indigenous Perspectives more represented than others? What might it mean to include the whole picture? You might also notice that we seem to be much stronger in using the eyes of the body and mind, than we are in using the *eye of the spirit.* Where would we go for information?

So as a result of research so far we have a reasonably good understanding of human development using 3rd person perspectives of **I**, **WE** and **IT** realities up to the mental development stages. Wilber suggests that we can consider that each human being has many distinct **development lines** which are represented in each quadrant,

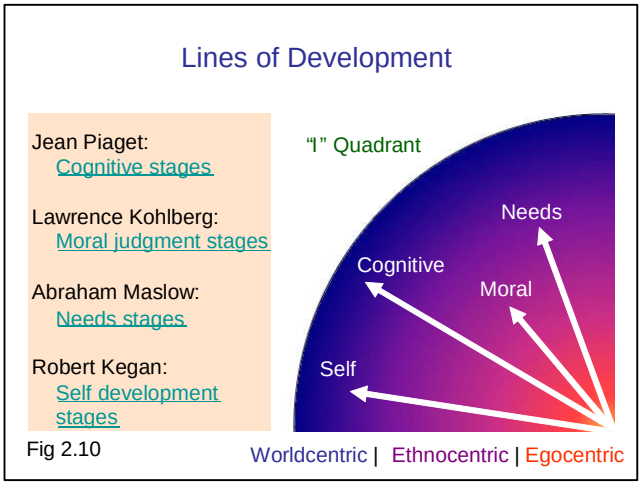


Fig 2.10

some of which are ego, consciousness, cognition, emotional, moral, cultural, social, psycho-sexual, artistic, kinesthetic, spiritual, contemplative.

In his book *Integral Psychology,* Wilber (2000b) considers development models from over 80 different researchers or cultures. Each researcher has identified distinguishable stages in each development line (from 3 to 12 stages depending on the line) which Wilber has tried to cross correlate on his own spectrum of consciousness schema. Here is a brief example:

Average age of emergence	**Wilber** (spectrum of consciousness)	**Jane Lovinger** (ego stages)	**Erik Erikson** (Psycho-social stages)	**Kohlberg** (moral judgment)	**H. Gardner** (universal waves of development
0 – 18 months	Matter Sensation Perception	Pre-social autistic	Trust vs mistrust		
1 – 3 years	Exocept Impulse/emotion Image Symbol	Symbiotic Impulsive	Autonomy vs shame and doubt	Magic wish	**Pre-conventional** Event structuring Analog mapping
3 – 6 years	Endocept Concept	Self protective	Initiative vs guilt anxiety	Punishment/ obedience	Digital mapping Notational systems Symbolic flowering
7 – 10 years	**Rule/role**	conformist	Industry vs inferiority	Naïve hedonism Approval of others	**Conventional** Rules / regulations Skills mastery
11 – 21 years	**Formal logic** (Early) (late)	Conscientious conformist Conscientious Individualistic	Identity vs role confusion Intimacy vs isolation	Law and order Prior rights /social contract	**Post-conventional** Self critical / relativism
21 years minimum	Vision logic (early) (late)	Autonomous Integrated	Generativity vs stagnation Integrity vs despair	Universal ethic of care	Integration of self and culture
	Transpersonal Stages (4 further levels)				**Post – post - conventional**

Fig 2.11

There seems to be a generic pattern. Humans (and cultures) move from *pre-conventional* to *conventional* to *post-conventional.* So moral development moves from selfish actions in the world, to following the rules, to a deep sense of a universal ethic of care. Cognition moves from pre-operational, operational to vision-logic.

Wilber was very interested in seeing where the spiritual dimensions go on these development maps. Are they outside, or a separate development line or in fact part of an evolutionary chain as suggested by the perennial philosophy? Wilber examined different religions and the thinking of mystics and discovered a coherent story… the post-conventional stage is more than just a mental knowing of the world… it involves further stages of development involving transpersonal states of awareness and being in the world. This is often referred to as *post-post-conventional*. So Wilber suggests that the later stages of **all** lines have that transpersonal potential… though the researchers probably didn't have the eyes to see it. Thus he sees human development as a grand evolution in line with the perennial philosophies… which is in all quadrants… all lines.

Levels (or Stages) of Development

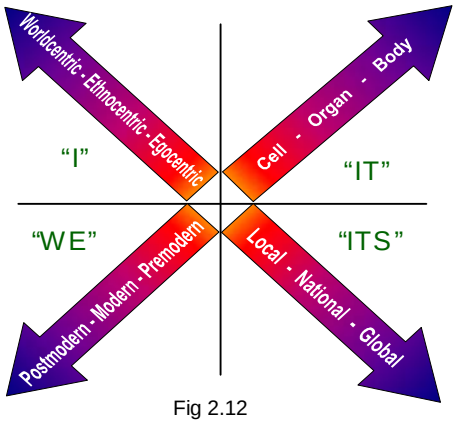


Fig 2.12

Wilber suggests that **integral development** is one which enables individuals to develop in a balanced way. To progress up a stage is called *transformation* and to broaden one's experience in a stage is called *flourishing, translation or information*. Both are needed for healthy development.

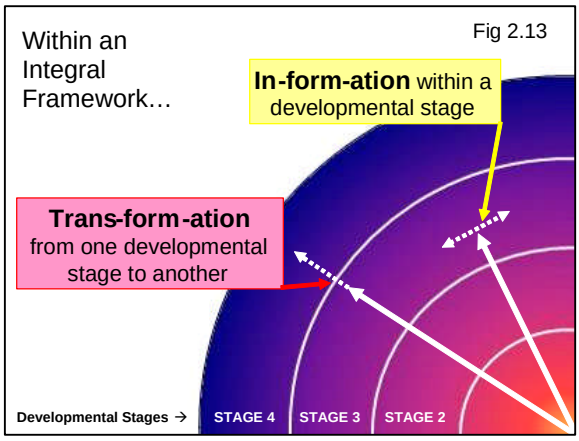


Fig 2.13

In reality, development of the lines is not even, but if some are pushed to grow while others lie undeveloped then pathologies can develop. In particular, healthy development in the transpersonal stages is best supported by use of the imagination and contemplative practice early on. It requires well developed *vision-logic* as an anchor. He refers to the whole development of the person as developing in *waves*.

To broaden this multi-dimensional picture of a human being Wilber says we must also consider **types** and **states**. *Types* can be related to gender types (male, female), learning styles, the enneagram etc. *States* refer to the state of consciousness – *awake* (conscious awareness, gross

body), *dreaming* (subconscious awareness, subtle body) and *deep sleep* (super-consciousness, causal body).

People can have what are called **peak experiences**, which are experiences of upper transpersonal stages or other states. These are temporary experiences and are not sustained because the developmental work in self has not been done.

Wilber describes 5 ways that **spirituality** can be considered in context with the territory he has mapped out:

1. spirituality involves the highest stages of the developmental streams
2. spirituality is the sum total of the highest levels of the development lines
3. spirituality is itself a separate development line
4. spirituality is an attitude (such as openness or love) which you can have at whatever stage you are at
5. spirituality involves peak experiences

Spiral Dynamics (Beck and Cowan 1996) is also a key aspect of Integral Theory, sitting in the **WE** quadrant. It is a model which suggests that societies or cultures move through stages called *vmemes* (**v**alue **memes**, worldviews or shared ways of living and being in the world.) The spiral shape represents the sense of evolving upward, yet the higher levels include the earlier ones in a holonic way. Individuals within a group, organization or culture *tune into* particular memes (I use 'memes' as a shorthand way of saying 'vmeme' throughout this thesis). They can operate at different meme levels depending on what they are doing… going to church, working, playing sport or being with family. Individuals and organizations can have meme profiles which show how much they might be accessing different memes.

Spiral Dynamics has been a key model used in understanding and enacting organizational or global change… and was specifically used in South Africa in shifting from the system of Apartheid.

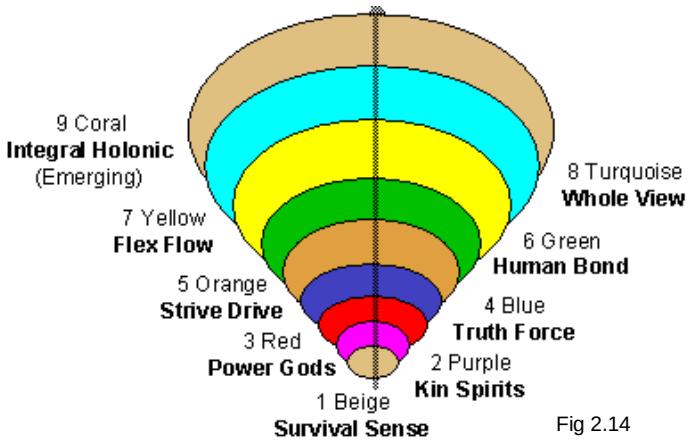


Fig 2.14

So it is not enough to understand the learner as an individual but one also needs to understand their cultural situatedness, the memes they tune into and the dynamics of their relationships with others and the larger environment.

Meme	People Value	People Do	Meaning of Life
Beige	Instinct, Survival, Food, Warmth	What is natural according to instincts	Do what you must to stay alive
Purple	Kinship, Magic, Safe living	What is traditional or what their group does	Keep the spirits happy and the tribe/group safe
Red	Egocentric, Impulsive, Status, Power	What is good for them and gives them control	Be what you are and do what you want
Blue	Stability, Order, Ultimate Peace	What is right according to the rules and Laws	Life has purpose with predetermined outcomes
Orange	Scientific, Strategic, Material	What gets results or puts one ahead	Play the game to win
Green	Sensitive, Humane, Affectionate relations	What is caring to meet the needs of others	Seek inner peace and care for others
Yellow	Integrative, Whole Person, Synthesis	What is good for all systems	Live fully and as responsibly as you can
Turquoise	Holistic, Being, Wisdom	What is wise according to deeper insight	Wholeness of mind and spirit

Fig 2.15

The first 6 meme levels (Beige to Green) are called first tier, and the next ones belong to second tier. 'Second tier thinking' refers to being able to see and operate at any level of the spiral, realizing that each meme has advantages and disadvantages according to the context at hand. Someone who is only operating at first tier level may not be able to see the bigger picture, and be caught in a particular meme without seeing how to adopt a different way of thinking or being. They may also be in conflict with people who are operating at other meme levels.

What are the implications of Integral Theory for educators?

Spiral Dynamics

How do schools operate? At what meme level might administration, teaching or curriculum be tuned to? How might different learning and teaching preferences be mapped on the memes?

Meme	Needs	Learning/Teaching Styles
Beige	Find what you need	Instinctual learning, automatic responses
Purple	Petition the gods with ritual	Reassurance, repetition, honour group customs
Red	Align with those in power to get your needs	Reinforcement, power relations, individual learning, rewards
Blue	Follow the rules, don't exceed roles	Authoritarian, order and discipline, right answers
Orange	Excel, set goals, measure success	Build autonomy, risk taking, competition, enterprise
Green	Appreciate diversity, seek consensus	Collaborative learning, respect for other's views, equity
Yellow	Integrate diversity with discernment, wholeness	Interdisciplinary learning, freedom to be and discover
Turquoise	Peaceful expression of a multidimensional self	Holistic/Integral learning, inner wisdom

Fig 2.16

Within one educational system or one school we might see multiple memes operating, some appropriately for the context and some in conflict. For example, an education system might value empowerment of its students but this could mean different things in different memes. Perhaps taking an integral view enriches the experience for learning, whereas just focussing on one meme may limit possibilities.

Blue meme	Empower students by providing literacies, information, and skills for living and working in today's world. Being able to follow conventions.
Orange meme	Empower students by giving them opportunities to act for themselves - projects, enterprise, having a voice, negotiation of learning. Being autonomous.
Green meme	Empower students by helping them to see a different cultural perspectives that shape their thinking - appreciating and caring for other. Appreciating difference and diversity.
Yellow meme	Empower students by giving them the tools to integrate and synthesise - understanding different worldviews, ways of knowing and ways of thinking. Diversity within unity.
Turquoise meme	Empower students to be fully emancipated beings who act with ethical freedom according to their inner ideals.

Fig 2.17

Can spiral dynamics help educators understand the complexities of curriculum, school management systems and classroom teaching better? Can it help us understand the issues of trying to bring about change?

I will be using this model throughout this 'writing as inquiry' process to help me explicate the various cultures in science, management and curriculum frameworks. It has helped me understand better the issues of trying to transform educational systems and I will be referring to it throughout this study.

Transformative Learning

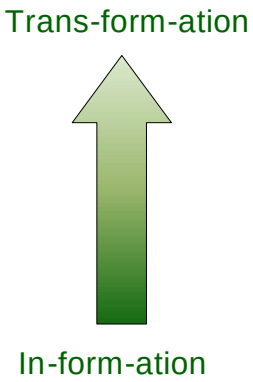
Transformative Learning has now become more popularized in education, but it comes with various meanings. For example, research by Mezirow (2000) and 0'Sullivan (1999) come from the field of *adult learning* (ways of challenging perspectives, habits of mind and underpinning worldviews) whereas Kegan (1982) is looking at transformation of the ego using a development stage model from birth to death. This is more consistent with Wilber's notion that transformation should refer to moving from a lower to a higher stage in the various development lines.

Mezirow sees Transformative learning as something which builds capacity for mindfulness, self-reflectivity, discourse, autonomy, democracy and agency. It is often stimulated by disorienting dilemmas which cause self examination of feelings and underpinning assumptions. It leads to exploration for new courses of action and new roles. There is a trying on of new roles and new habits of mind and seeking new skills to cater for these new experiences. Then there is a time of building confidence through interactions as one moves towards integrating the new self or ways of thinking.

The development of Emotional Intelligence is seen as important in supporting this process as well as being in protective environments where there is a social democracy between teachers and learners.

Transformation is seen is a leading out from an established habit of mind. *Information* is within an established habit of mind.

Yorks and Marsick (2000) suggest that we consider the following criteria in the process of moving from information to transformation:



FORM	PROCESS
Adopting **new** cognitive structures	Reflection on process, content and premises
Adopting **new** points of view	Reflection on process and content
Analysis **within** existing frames of reference	Reflection on content
Elaboration **within** existing frames of reference	Gather content Incidental reflection

Fig 2.18

For Kegan (1982), the key to transformation of ego from stage to another is the ability to adopt *new cognitive frameworks* that enable us to manipulate aspects of self that previously were an embedded part of our ego.

Kegan's development model has 6 stages -incorporative, impulsive, imperial, interpersonal, formal-institutional and post-formal –inter-individual. These stages oscillate between a desire for interdependence and a desire to be independent. He suggests that as we grow and transform up the stages our locus of view widens. When we are in a stage, the characteristics of a stage own us. When we move to the next one, what we were *subject to*, now becomes *our object*, something we can now manipulate. A young child, for example, might be *subject to* their feelings – they *are* their feelings. Then in the next stage they find that feelings are something they *have* and they can control… feelings are now an *object*.

At College we see many teenagers *(interpersonal stage)* defining themselves through the relationships they are having, particularly with peers. For them their whole world becomes this interconnected reality of close friends… and it is hard for them to see beyond that. Breaking up a friendship with someone is a breaking up of self, because of the deep entanglement in another's being … it can be one of the most painful experiences that these young people go through. Moving out of this stage you see students become less owned by their friendships, more their own person. They *have* friends, rather than self is created through friendships.

Patricia Gordon (personal communication, July 6 2005 and forthcoming paper), part of the Integral Institute team working on applying Integral Theory to education, has synthesized development models of Kegan (1982), Cook-Greuter (2002) and Wilber (2000b) to come up with the following perspectival development stages, suggesting that development of this line is crucial in the development of spirituality and consciousness as well as ego and cognition. Being

able to take ever more spacious perspectives enables us to witness ourselves which helps us transcend and then include.

Perspectival Stages	
Pre-conventional ***1st person perspective*** Egocentric, magic, preoperational	**Fluid Mind** Immersed in perceptions and impulses **Unsocialized mind – Impulsive mind** Treats perceptions and impulses as objects to manipulate and reflect on, making it possible to create categories embedded in its own point of view
Conventional ***2nd person perspective*** Socio-centric, mythic, concrete operations	**Socialized mind** Treats categories as objects to manipulate and reflect upon, making it possible to internalize society's rules and values
3rd person perspective World-centric, rational, formal operations	**Self Authoring mind** Treats society's rules as objects to reflect upon, making it possible to create its own ideology and identity
Post –Conventional ***4th person perspective*** World-centric, pluralistic, postmodern, formal operations	**Pluralistic mind** Treats its own ideology and identity as an object to reflect upon, making it possible to respect diversity
4th person perspective expanded World-centric, holistic, general systems thinker, formal operations	**Systemic mind** Treats pluralities and contradictions, both inner and outer as objects to reflect upon, making it possible to organize pluralities
5th person perspective World-centric, holarchial, integral, vision-logic	**Integral mind** Reflects upon systems as objects, making it possible to correlate and organize them into meta-frameworks
Mystical Levels - transpersonal **6*th person perspective*** Theocentric, nature mysticism to deity mysticism to formless mysticism, including and transcending all of the above, Saint to sage, illumined mind, to intuitive mind, to unitary mind to over-mind.	**Psychic Mind, Subtle Mind, Causal no-mind, Witness, Non-dual** Able to see all experience, including the rational, as phenomena of being, valuing all states of being. Less interested in the seeking as in the being, focussed in the now. Realize that understanding is an illusion. Comprehend things in a visionary and holistic way in addition to apprehending them through the rational mind.

Fig 2.19

A key aspect of Holistic Education is to encourage and support transformation of the teacher – "*to transform the world, be a transformed being living in the world*." (Palmer 1997). So what helps transformation in these perspectival levels? Gordon suggests that there are three principles an integral teacher could consider in her own development as well as assisting her students in theirs:

1. **Nonexclusion:** lighting up and actualizing all relevant, current world spaces, or perspectives.

2. **Enfoldment:** evolving into greater world spaces, or perspectives, expanding the range of light, the spaciousness in which it shines.

3. **Flexflow:** flexflowing this light, shifting the patterns of what is lit up according to what is appropriate in the situation.

Although we might think of evolution as linear – an upwards process, she also suggests that perhaps a better metaphor is one of *stretching* and *recovering*…

> One of the most effective ways integral practitioners deal with–and find--contractions and dimness is through deliberately **stretching** their current cognitive, emotional, physical, spiritual, and ethical capacities that are limited **and subsequently recovering deeply**. In stretching they bump up against and exceed their limits and in recovering they give time for healing, consolidation, and growth.

So transformation involves not only moving into a new development stage but an embracing and re-integrating of earlier ones. We revisit these and re-contextualize from a new conceptual framework. We find earlier stages which might need further flourishing, so this recovery and consolidation time is an important part of the evolutionary process.

I have found Gordon's model a very powerful one in thinking about transformation of myself, my students and my colleagues. I will be using this model alongside spiral dynamics to help me understand dynamics of personal and system transformation throughout this study. It becomes an underpinning framework in helping me think about science education and whether this too might have stages.

A key aspect of Holistic Education is transformation of both teacher and student which I discuss further in the next chapter.

Curriculum planners comment:

"Sue, the first thing that comes to mind is how much in our education system we have ignored what it means to be human, based on the multiple dimensions that Wilber has suggested. We seem to be only concerned with the gross body and conscious mind, ignoring the subtle and causal. We are only concerned with stages up to the mental… ignoring the transpersonal. And while we have tried to bring multiple intelligences to our teaching there are still key development lines that don't seem part of the education equation…I haven't even heard of psycho-sexual and what does a spiritual development line look like? Not to mention we have completely disregarded the *eye of the spirit*."

"Sue, I am really concerned that we don't really have an agreed vision in education about what we are doing it for… there is a sense we are preparing the student for a job or for life… but it seems Integral Theory is suggesting a much grander enterprise… evolution of both individual and collective human consciousness. Can our students progress to the upper stages with the current education system? Have we provided them with the preparation they need, or, in fact have we created problems by the uneven development of lines? Where else do they get development of their whole possibility of lines? Should this be our role? Are we nurturers of the evolving consciousness of humankind?"

"And perhaps students need to be better informed of the processes they are going through. Would it help for them to know the evolution stages of human consciousness?"

"Yes, and this reminds me about the current focus in the curriculum on creating sustainable futures. We seem to be concerned with creating thinking people who can come up with creative systemic solutions to these global problems. Is that sort of thinking on the wrong track? I am interested in this notion of developing a universal ethic of care… how does this develop? If people's actions came from a more aware and caring consciousness then perhaps our current technical solutions would be

superseded… as we would no longer be doing the things that create the problems in the first place."

"I don't know about that… surely thinking is important… it helps you be more aware and conscious of what you are doing and the consequences… perhaps thinking is a necessary preparation for a universal ethic of care?"

"Hmmm. Could you develop a sense of care for the environment and for each other in all stages that speaks to each stage? I wouldn't want us to say, that's not our job to develop that because that is a later stage."

"Hmmm, Can children in the pre-conventional stage even understand another's feelings?"

"OK, probably not, but they can still plant seeds and watch them grow… take care of a pet… our job is perhaps to look at each development line and ask what experiences could assist students in developing these qualities at the stage they are at."

"Well, I am not too sure I even agree with all the different stages. When you look at students it is not so cut and dried… it is like they are blurring across different stages and lines are intertwined. Is there really a demarcation between the stages?"

"Oh, I don't know. I think you can really tell when students are going through transformation. Their whole perspective and sense of self changes. It is like a birthing process."

"Yes, that's true… but what is interesting is that that doesn't even seem to be our main concern. We are more interested in whether they have understood the subject than whether they have just transformed into stage 4 of ethics…or stage 5 of ego-consciousness. In fact doesn't all that teenage angst get in the way of getting good marks!"

"How ironic… you are right… yet this theory would be suggesting that it is those very things that do annoy us that are possibly the most significant thing for them… part of

the process of their transformation! Something that we should be supporting and celebrating!"

"And perhaps we should be accrediting? Though I do not want any more marking load!

"But you have a point there. What is important? Are we too much in the mindset that curriculum is knowledge to learn, rather than development of the human being?"

"But they do need to get jobs or go to university. How do you balance all that together?"

"And we haven't even mentioned the fact that our own expertise and our own development is also limited. What do I know about transforming students? Let's face it, I am a science teacher. There is no way I could feel comfortable developing a student's spiritual line. In fact I have problems with their emotional one! Who is going to teach me? Do I need to start contemplation myself? The fact that this line is underdeveloped in myself, does this mean **I** am pathological!"

"God forbid! Yes who is going to teach the teachers?"

Interlude: what might transformation look like in a class?

Location: An island of disconsolate emotional angst, adrift in a turbulent sea, holding on for better days

(the forum signature of a year 12 student)

Physics Class 1996

See Justin. He has been sitting over there for nearly 30 minutes just staring into space while his group has continued with their task. I am very surprised and am wondering what is going on. Is he off task, thinking about the weekend? Is he ill?

I go over and ask him if he is OK. He tells me that he needs time to adjust…. He feels he is in a state of shock. Something we have just done has made him question everything he knows about the world. Not a small incident you would think! He has just realized that when he thought of radioactive decay he saw it as one substance decaying into nothing – now he knows it transmutes into something else... a new substance… mother into daughter.

He tells me that he is trying to fit this into what he knows already; he is beginning to wonder if everything else he knows is correct or not. He describes it as a house of cards falling down…pretty scary. "What can I be certain of?" he asks with anguish.
"Can I do anything to help?" I ask.
"I think I just need time?" he says.
I let him sit undisturbed.

What sort of challenge is Justin going through here? A new way of perceiving something? A challenge to his knowledge and his construction of knowledge?

How do we see knowledge? Built on foundations, brick by brick? Do Justin's foundations now need to be re-evaluated as to their validity? Or perhaps knowledge is within a complex web and as one thing is perturbed the whole system self-organizes into a new equilibrium? What other models do we have about knowledge? Does it even lie in our thoughts or is it embedded in our bodies? Hmmmm.

What was Justin doing? Working through this by thinking hard… or by just allowing? Did he just need space to get over his shock?

Was this a challenge to his fundamental worldviews? Or even to his deep sense of self? How could we tell?

Physics 1997

Meet Emily. She has just run out of my class in tears while we were doing circular motion. I look over in astonishment and wonder what might be wrong. I go after her, but she waves me back.

She had been working with Nathan on a worksheet that gets students to really think through the key ideas of circular motion and whether it has acceleration or not. Nathan had been helpfully explaining it to her but she just couldn't accept that something going around in a circle at a constant speed was accelerating because for her acceleration meant ***speeding up****. There was no change of speed here, only change in direction. So now she had to extend her view of acceleration to include acceleration caused by change in direction as well as change in speed. Everyone else seems quite unfazed about widening their view about this. But Nathan explains to me with concern how she had got more and more upset as he tried to justify the theory.*

I go home and tell my husband, hypothesising that this was challenging her to rethink what she knew about all her physics knowledge… that it had perturbed it and she needed to find new ways for the knowledge to sit together. "But would she have run out of the class in tears," he asks "there must be something deeper."

So what was her issue?

I began to know Emily a lot more over the course of the year, engaging in many conversations with her about where she was heading. Emily was putting herself through a really tough time that year; questioning her values, what was important to her, who she was and what her future could be. On one hand she was passionate about English literature and wanted to become a writer. On the other hand she felt she couldn't make a living from this, so she decided she was going to become an optometrist.

She thought in Physics she could just learn facts that would enable her to get the knowledge to help her understand optics. But I was asking her to not just learn facts but to make sense of them. She told me that when she was faced with the circular motion example, she realized that she might have to change her very fundamental views about facts and question all her prior 'knowledge'… and she just couldn't face it… she just liked her naïve view of the world.

After our talks (where I encouraged her to consider following her passion) she settled down in Physics, wanting to give it a go … adamant that she was still going to do optometry. But it was eating at her inside… something she tried to ignore or even suppress. I was very concerned about Emily, as I am sure you are. But what can you say to someone so determined? Should I have made Physics even more uncomfortable for her?

What happened to her? I heard from one of my other students that she was studying English Literature at university. You can't believe how relieved I was. I hope she is happy now. I wonder what helped her change her mind. Perhaps her whole issue with acceleration changing direction was a deeper metaphor for her soul need – a need to change direction herself – and perhaps when our souls talk to us with such deep messages we have to listen.

What was the transformation that Emily was going through? What should my role be in all this?

Journalism 1998

Meet Michelle. She is a really nice girl, innocent face, wide smile, often uncertain. You might describe her as someone who follows rather than leads. Her writing is big and round and she has a rather naïve view of the world. She wants to write about fashion, come up with fun quiz's and run an advice column just like her favourite magazine Dolly. She fits in really well to a magazine group who together are providing the range of stories and interests for a student magazine.

During the year her eyes are gradually opened to the media. In third term, she teams up with three others to put on a play for the class to provoke discussions about stereotypes in the media. There are three different characters which the group play to show how their actions at school and at home reflect what they read and watch on TV. She plays someone who reads Vogue and has a

picture of a fashion model on her fridge, so when she goes to get food from the fridge she sees it and stops.

Immediately after the performance Michelle says to me with deep concern "I am that girl! When we were making up the play these characters were just characters – not real. But when I played the girl conscious of her weight and her looks, I realized that was me. My whole life is based on trying to be an image. I didn't think I was influenced by the media at all. But I am!" She looked stunned.

For her *end of the year reflection* on what she had learnt from the course she wrote:

> Before I took journalism I think I was wearing shutters over my eyes when it came to the media. Also I never really understood some of it and if I was to be totally honest I still don't really understand some of it. So I guess my view has changed of the media from completely no view to that I now have an opinion. Take the famous Clinton scandal for example. I found it really interesting that when I asked my family what they thought about the media influence they said it didn't bother them, they had no opinion.
>
> So here were the two people who have always told me to speak my own opinions on whatever you like and they sit there and say "I don't really care." So I found myself giving them my opinion, telling them how I thought that the media went too far and showed too much. Dad told me to be quiet while he watched the news. And mum said "what brought that on?" So my view of the media and its way of working have intrigued me somewhat at the conclusion of the year.
>
> How have I changed as a person? Well I think that I have begun the long journey of crawling out from under my shell, so that is a start. I have become more responsible (even at home mum was very surprised) in the things I have to accomplish. I feel that empowerment is the urge to able yourself to grow, to push yourself to learn. Letting yourself learn more, wanting to learn.

What might you say Michelle's transformation was? Is it something we commonly see in Year 11 and Year 12 students… moving from *socialized mind* into *self authoring mind*? She is certainly a lot more self reflective, beginning to see herself as different from her parents and beginning to see the cultural influences on her own life. Was this easy for her? A gentle movement?

The Tao in Interesting Times

Chapter 3

Holistic Education – a panorama

Remember this…. You are a spiritual being in an interconnected reality

Questions:

What does Holistic Education look like and feel like?

What is the field of Holistic Education?

What are the essences of Holistic Education?

What are the implications for someone aspiring to be a Holistic Educator?

Introduction

Holistic Education is something that snuck up on me. First through my own exploration of the field of spirituality, then my introduction to Wilber in the early 1980's, then being inspired by the GATE visioning of Phil Gang in the late 1980's and then an introduction to an entity called 'holistic education' in the early 1990's. Since then the literature in the area has grown exponentially as well as the number of practitioners, schools, and university courses.

My husband (Roger Stack) and I established a Tasmanian network for Holistic Education (HENT) in the early 90's, hosting discussion groups, disseminating newsletters, establishing a web site – www.hent.org and discussion list, and then being invited to run workshops and conference sessions locally and internationally.

This web site, mainly due to the phenomenal efforts of Roger, has grown to over 300 pages, linking Holistic Education with similar concerns in education and other fields across the world. Roger has written papers and been in discussions to inform the curriculum visioning of the *Essential Learnings* (K-10), resulting in the inclusion into the statements of some key Holistic concepts, including the notion of a spiritual self and a sense of connectedness and wholeness. He is now a state-wide leader in the re-visioning process of Year 11/12 curriculum and is bringing Holistic and Integral concepts and processes to that discussion.

My role in this has been as a researcher of lived experience – making meaning of principles and pedagogies in practice, whereas Roger is more the theorist, mapping the area. Together we compliment each other, bringing both structure and meaning, learning from each other, and then being able to be involved in rich dialogue with others as we borrow from each other's experience. Yes, I am a structuralist too, but we think about it in different ways – perhaps a yin/yang complimentarity. So my understanding of Holistic Education has been very much shaped and informed by my husband's view and vice versa.

So now I am in the position of summarizing the field of Holistic Education in a mere 30 pages. It is a very messy and complex field, often contradictory and usually very rich – so it is hard to extract essences without losing that richness. But never-the-less I am going to have a go at it. It forms such an important part of my thinking as a teacher. In order to make better sense of it, I am going to use Integral Theory and Spiral Dynamics to help me organize it.

What does Holistic Education look like and sound like?

Imagine you are looking at a landscape comprising holistic schools and holistic educators. What would it look like, sound like or even smell like? What do you notice about the way teachers and students are interacting? What is the focus of learning that is going on? How is the curriculum arranged and who has control of it?

Would there be commonalities between these holistic schools or classrooms? Would these be informed by the same philosophies and world views? Would we see similar pedagogies? Would we see similar metaphors for the teaching and learning process?

How would you know that what you are doing is holistic or formed part of the holistic spectrum of possibilities?

Exhibit A

> *Here in this government high school (years 7 to 10) they have decided that students learn best through contextual projects or questions and have repackaged their previous curriculum (which was broken into disciplines) into question or problem centred modules which may include multiple disciplinary approaches. They are explicitly teaching systems thinking and encouraging students to bring to these focus questions big picture understandings rather than fragmented understandings. They*

have a common starting point for the students in a class, then encourage students to generate their own questions and go on their own negotiated journey of exploration. They are using the terms holistic, integrated learning, transdisciplinary learning and student centred and student directed learning to describe what they are doing.

Is this holistic? What are the underpinning paradigms of the teachers in this school?

Exhibit B

Now, let us enter this maths class over here in a government college for 16-18 year olds. There is a slightly stale smell as the classroom is air-conditioned with the windows shut. The teacher is standing at the board explaining ratio. Later she gives the students a worksheet and goes around and helps them.

As the class gets busy we find her sitting next to Joshua, a refugee from Sudan. She is asking him how he is going in his other classes and at home. She knows that he has to sometimes baby-sit his two sisters while his parents are working and often has to miss school. He is really concerned that he is missing key lessons. The teacher knows he doesn't have any friends (it came out of an earlier lesson on surveys) and is very shy. So she encourages another student, Brian, to sit with him and take him through what he has missed. Some weeks later he comes in with some DVDs that he shows to Brian while they are supposed to be working. The teacher is about to say something to get the boys back on task and stops suddenly as she realizes that perhaps this moment of connection between Joshua and Brian is far more important than maths.

This teacher considers herself informed by holistic principles but feels that she is being squeezed by curriculum requirements and can't articulate these principles in the way she teaches.

Is this holistic? What expectations does the teacher have about what it means to be holistic?

Exhibit C

Now let us enter this alternate primary school set in the bush with sweeping views over a bay. Specially designed buildings offer lots of light and provide an organic and vibrant working area. We smell the eucalypt trees which shelter the buildings.

Here there is a very specific curriculum for all grades that has been followed since the school's inception with little room for student negotiation or change by the teacher. What informs this curriculum choice?

We discover that it is based on a very precise and well articulated notion of what it means to be a spiritual being on Earth – how the soul incarnates or unfolds fully into the physical body through 7 year cycles which conclude after 42 years. We find out that to assist the soul/body in a healthy unfolding in each stage that the teacher needs to understand and come to know the student deeply and to provide experiences in line with the curriculum which assist the unfolding. Thus teachers will stay with their classes for 6 years. In the cycle 7-14 years much focus is placed on developing the feelings and artistic sense of students as this resonates with the needed soul energy. Extending the soul beyond its capacity at any stage enables disease to develop in later life.

In this school the teachers see their interaction with students as an opportunity for self understanding and transformation; since coming to know another really well requires knowing oneself. This school is one of thousands of Steiner schools around the world, and they are considered by many to exemplify a holistic school, though criticized by some as recipe driven.

Is it holistic?

Exhibit D

Now we enter another classroom. Oops. No-one is there. We go back down the steps and discover the students all blindfolded holding onto a rope walking down a corridor filled with student art work and the smell of paint. The teacher is asking them to imagine being blind and not seeing light, colour, shape ever….not knowing what a sunset looks like, or clouds floating across the sky, or the face of a friend as they express joy or sadness.

We come out into the open and the students are now taking off their blindfolds, most gasping as if they are surprised and as if they are seeing something they didn't expect to see. The teacher is asking them (perhaps a bit redundantly) to really look, really see this miracle of light. What sort of class is this? Mindfulness training? Religious studies?

They are now holding different lens and diffraction gratings up to the light, playing with rainbows. We see that some are really struck and really thinking. Some have a sense of childlike wonder and curiosity, eyes shining… others are quietly talking, retelling their experience and their insights. Are we seeing their souls?

We find out that this is a Year 12 pre-tertiary Physics class and this lesson is an introduction to light. Soon they will be learning Snell's law and calculating refractive angles but for now they are asking questions like "What really is light?", "How do we really see?", "Why are there so many colours?", "Why are things the way they are?", "Why haven't I noticed this before?"

Why has the teacher done this? She tells us: "Light is really something to wonder about, to have awe… our whole universe is like that really… but often when we teach a syllabus that awe is left out… we just teach the mechanics; the how, not the why. As students get into the nitty gritty I want them to take with them the big questions, to remember that physics is just one way of perceiving the world and that there are others… that with mindfulness we have the capacity to see and experience so much more richly. It would be nice to follow the path of all their questions and explore in an open ended way, but I have an exam to prepare them for getting into university, so this is a way of me bringing a sense of soul within a very specific and tight curriculum and inviting them to continue their exploration of soul for themselves."

So is this class holistic? What informs this teacher's beliefs about soul and learning?

Do we measure holistic by what informs teachers or schools in their teaching and design of curriculum and the way they articulate their intent? Or by what we see happening in students? Or how teachers themselves are undergoing transformation and self-realisation? Or…?

So what is *holistic* and how is it being used in the context of education?

Holistic is a phrase being coined by many people or schools, as well as being used in curriculum descriptions. You will find it in medicine, business, ecology and many other fields. *Spiral Dynamics* (Beck and Cowan 1996) uses holistic to describe a particular vMeme

(*Holistic* is Turquoise, second tier) as well as to describe an integrated experience that a person might have of a particular vMeme.

In education it can refer to education of the whole person, a certain set of pedagogies, principles or philosophies, a state of integration, integrated curriculum, consideration of many holon levels or consideration of whole systems.

The people who use the term could be coming from various worldviews or cultures. We might see some schools who claim to be holistic focusing on democracy issues, giving students lots of freedom in their learning. Others, like the Steiner schools, have considerable structure based on esoteric principles of child development.

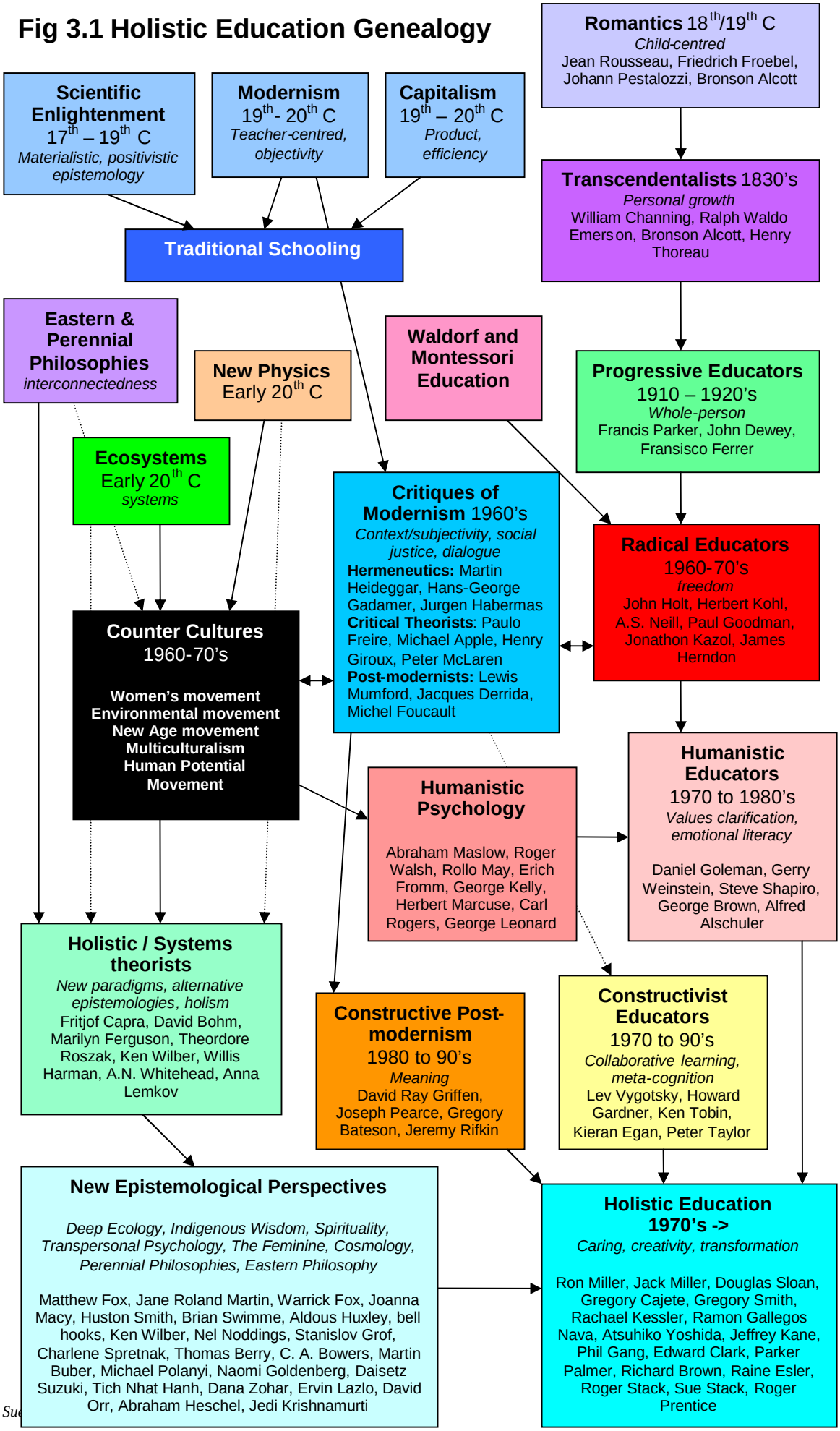
The main advantage that the term holistic has is that it is not precise and can be used in many different ways. And that to understand it we need to engage in dialogue with the users to find out what they mean. And in the process, we connect a little more deeply.

However, what might be common amongst the plethora of expressions of **Holistic Education** is the belief that *we are spiritual beings in an interconnected reality*. If you apply this requirement to the way it might be popularly used you begin to realize that more often than not it is being used in a more systems context – whole and integrated, rather than having an underlying spiritual philosophy. Holistic Education doesn't pin down exactly what *spiritual* means and therefore you might see Holistic Education in Catholic, Buddhist, Jewish, Confucian, esoteric, or non-sectarian contexts, to name a few.

Key thinkers in the field of Holistic Education are Ron Miller (1990, 2000) in the US, Jack Miller (1993, 1994, 1996, 2000) in Canada, Ramon Gallegos Navo (2001) in Mexico and more recently Yoshiharu Nakagawa (2000) in Japan.

Ron Miller (2000) describes the origins of Holistic Education as a counter response to spiritually denuded mainstream education. Roger Stack (personal communication, 5/7/2006) has mapped (see Fig 3.1) its genealogy based on Ron Miller's work, including some additional fields of influences. From this map you can see that Holistic Education is informed by many leading educational thinkers.

Fig 3.1 Holistic Education Genealogy



We could also look at how these thinkers might be loosely placed on Wilber's quadrants. For example, *Parker Palmer* (1983, 1998) has a key concern for teachers' interior spaces **(I),** *Nell Noddings* (1992, 1984) is interested in care in schools and creating caring communities **(WE)**, and *David Orr* (1994) is interested in making explicit the feedback from systems so we can learn directly from the ecologies we are in **(ITS).**

Possible location of various educationalists or theorists using Integral Theory (open to challenge)

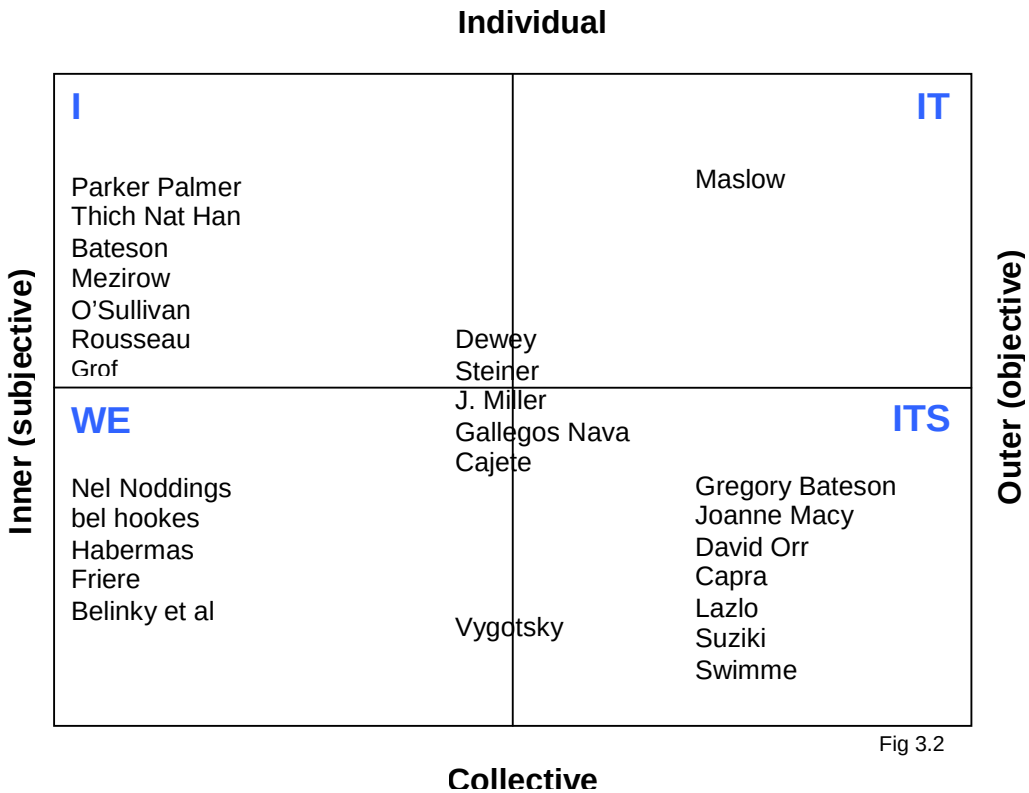


Fig 3.2

How is Holistic Education practiced?

You might see Holistic Education being practiced by individual teachers in mainstream schools, in specially visioned schools, in curriculum frameworks or encouraged through teacher education programs. Some practitioners might be focussed on doing the best they can within their classes and within the educational system they are constrained by, while others are challenging the very conception of educational principles and structures which inform those systems. Often Holistic Education seems to be more focussed on the spiritual aspects rather than others, mainly as a counter response to their absence. Here are some examples:

Fig 3.1

1. **Teachers or programs within mainstream schools.**

   There are many examples of teachers applying holistic education principles to teaching of classes within mainstream schools and the magazine *Encounter* is a good resource of such examples. Examples of programs might be Rachael Kessler's (2000) rite of passage program in US schools and Rachel Naomi Remen's program in Medical schools to help doctors reclaim their humanity (Remen 1999). We might see classes using autobiography, creating inner city forests and writing poems to trees.

2. **Whole schools or curriculum**

   Examples of holistic schools might be the Schumacher school in England based on the insights of Krishnamurti (1983), Steiner schools, democratic schools like Boorabong, Queensland and South Western University in the USA.

   South Western University provides a Master of Art Therapy course over two years. In the first year students explore themselves and the nature of self transformation through art work, study, performance and taking on the role for one month of a famous person who was involved in transformation work. It is a deeply soulful and personal experience. In second year they learn psychological theories and come to understand them through the lens of their own transformative experiences. This school produces highly sought after graduates who have deep sensitivity as well as intellectual understanding – integrating heart, mind and soul.

   Holistic schools are not just about delivering holistic programs; the very way they are run is based on holistic principles. For example, a key aspect of Steiner education is teachers using contemplative practice to understand their students while engaging in a deep study of anthroposophy – an esoteric program designed by Steiner. The Boorabong School which believes in students choosing what they study also have democratic processes for selecting teachers – the students are key deciders.

3. **University courses for teachers**

   Examples of these are Masters programs for teachers which are being run by Jack Miller (OISE, Canada) and Ramon Gallegos Nava, (Guadalajara, Mexico) and undergraduate teaching courses which are being run by Greg Cajete (New Mexico, US) and Atsuhiko Yoshido in Japan.

Jack Miller's program requires teachers to start their own contemplative practice and to observe the effects it has on their teaching, and the way they see their students. His notion of Holistic Education is that it has three key themes: balance, inclusiveness and connectedness. He recommends pedagogies which assist students in connecting self with body, nature, others, and inner self.

Atsuhiko Toshido's (2000) program at Osaka's Women University looks at how practices from Japanese culture – calligraphy, tea ceremonies, ancestor reverence, festivals – can be renewed and revisioned to provide opportunity for mindfulness, connection with others and connection to a greater reality. Thus helping connect a disconnected generation of Japanese back to their roots. His student teachers take up calligraphy and other arts, experiencing for themselves the discipline, grace and reflectiveness that these practices bring to their lives.

Greg Cajete has been working at creating whole-school curriculum for the Navajo nation in the USA (pop 400,000) and developing a teachers' course which centers Navajo teachers in their culture and develops self knowledge before completing a degree course at a mainstream university.

Through much dialoguing with tribal groups he was able to pull together the essences of tribal custom and create a vision of what it means to be a Navajo Indian in the Western world… combining holistic education thinking with the values and practices of his culture to create an educational framework. Two triads of *Mythic, visionary, artistic* and *environmental, communal and affective* are integrated in *spiritual/ecology*. Students are assisted on a path of growth and transformation in a context of community and ecological values.

In his book, *Look Towards the Mountain,* Cajete (1994) lists 42 elements characteristic of indigenous education. Many of these are inspiring principles for any Western holistic educator to consider.

Ramon Gallegos Nava's course in Mexico has three major pillars – perennial philosophy, grand pedagogy and new paradigms. His students come from education, business, ecology, activism, health. He encourages his students to embark on a journey of meditation and self knowledge – to free themselves of mental models and to be able to act in the moment with discernment.

He introduces his Masters students to the wealth of Western knowledge about education which he has categorized in Fig 3.3. He uses the multiple intelligences on the bottom axis and Ken Wilber's consciousness evolution holons on the vertical as a way of seeing where a researcher might be mainly located.

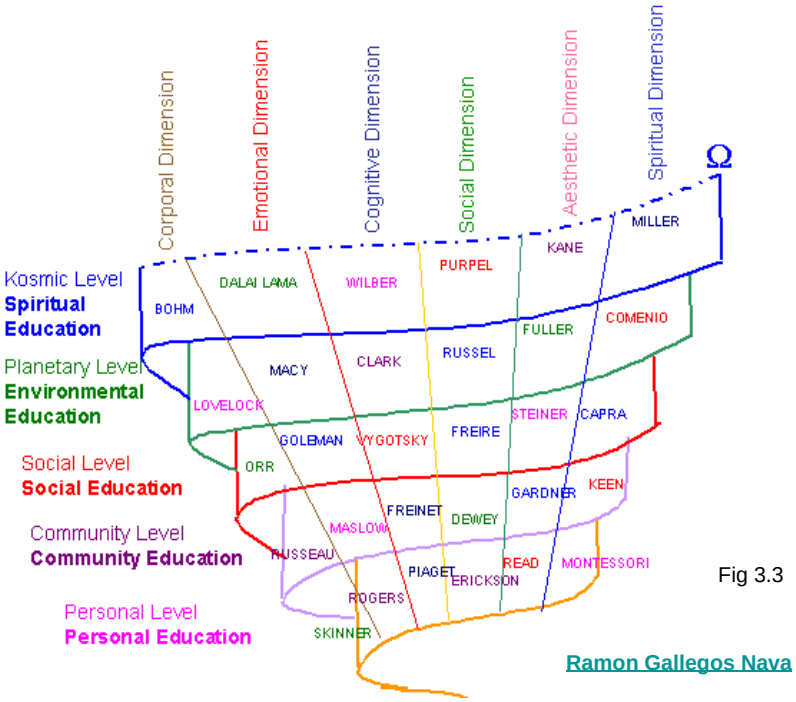


Fig 3.3

Ramon Gallegos Nava

He sees a Holistic teacher as being able to see all these dimensions and being able to integrate the different pedagogies in the moment of classroom practice – the pedagogies are complementary, rather than contradictory.

He sees teaching as a pedagogy of love (Nava 2001). Like many holistic thinkers he sees that everything follows from the teacher having a love for the child and creating a learning space which is filled with love.

I visited Mexico in 2000 as part of the *8th International Holistic Education Conference* and I met one woman in Ramon's course who was a midwife. She works with the family two years before the birth of the child and until the child turns 21 years.

I visited other Mexican teachers who were isolated holistic teachers within a school. One teacher had 50 Grade 1 students in her class. Her practice of Holistic Education was one of love – education with heart – which she expressed in her love and care for the children – finding time to see them fully, and allowing her love to be expressed in the moment –

turning on some music and the class dances. Her tape recorder was her prized possession… a marked contrast to the one sheet of toilet paper she handed to students when they left the room to go to the toilet. Her ancient culture – the Miztecs – was an important part of her identity and her sense of self.

I have met the key leaders in Holistic Education at various conferences; what strikes me is their heart, humanity, centeredness and vision. They walk their talk. A key to all holistic programs is the path to self knowledge that the teacher takes through reflective and contemplative practice. At the *Spirituality in Education Conference (Boulder 1997)* Parker Palmer said, "I need to create a spiritual space within myself so my students can share their gifts." And this sums up much of what Holistic teaching is about.

It is also interesting that a key approach to Holistic Education across different countries has been a renewal of culture; bringing their culture and their spiritual heritage into a modern context.

In Australia we are multi-cultural society with many different worldviews, customs and spiritual beliefs. In common is the consumer based society in which we live. In trying to be spiritual or value neutral in our education we have in fact allowed the dominant value system of rationalism and consumerism to prevail. Yet, an 2004 on-line survey by Roger Stack (personal communication) of Hobart College students indicated that 70% of students have some spiritual beliefs. The challenge then is to find a way to fulfill the promise that our education system gives – to develop the whole person – spiritual, emotional, physical, mental, social.

How can non-sectarian spirituality be an embedded part of curriculum frameworks? Not add-ons….but like the Navajo Indian education model an energy which infuses every aspect and is the integrating and creative force.

What are the key principles of Holistic learning?

The following represents a synthesis of various elements found in holistic programs, schools and teacher training courses:

Fundamental Principles	**Connectedness**	**Wholeness**	**Being**
Key Concepts	Interdependence Interrelationship Participatory Non-linearity	Whole systems Multiple perspectives Independence Multiple levels	Fully human Creative expression Growth Responsibility
Key Values	Compassion Community Ecosystems	Diversity within unity Sustainability Cultural identity	Love Responsibility Discernment Spirituality Wisdom
Social Issues	Cultural identity Globalisation Loneliness	Inclusion Ecosystems Poverty	Equity & equality Ethics Change
Curriculum	Inter-disciplinary Interaction	Integrated	Inquiry Identity Choice
Perspectives	Critical constructivism Contextual	Multi-faceted Multiple intelligences Cosmic	Constructive postmodernist Evolutionary Epic Metaphoric
Needs	Belonging	Self transcendence	Love Self actualisation

Process	Dialogical Relationships Collaborative Co-creative Co-operative Sharing Celebrative	Whole person Whole community Whole of life Systems thinking Meta-cognitive Multi-levelled Integrative	Experiential Reflective Questioning Imaginative Inspirational Transformative Journeying
Outcomes	Meaningful Positive relationships Friendly Trusting Belonging Serving	Healthy Whole Happy Caring Empathic Confident Independent	Expressive Curious Preferred futures Participation Resilience Competence Purposeful Participation
Teaching & Learning Strategies	Service learning IT&T integration Paradox & enigma Community based learning Play	Whole language Project based learning Experiential learning Open learning Whole brain Integrated Studies	Meaning quests Vocational education Enterprise learning Indigenous education Storying Visualization
Contexts	Ecosystem Community	Whole space/time Objective	Subjective Symbolic

Fig 3.4

What do we mean by connectedness, wholeness, being? Each of these could be examined philosophically, from different religious points of view or from the living meaning that Holistic Educators make of them in the presence of their students.

Although various holistic educators use different sets of words;

- Inclusiveness – balance - connectedness (Miller 1996)
- Creativity – care - criticality (Prentice 2003)
- Affective – communal - environmental (Cajete 1994)
- Love (Nava 2001)

there are some shared essences which transcend cultures and languages. These words come from not just our minds, but from our hearts.

I was asked to introduce the idea of Holistic Education to an interested group of teachers at a Tasmanian College in 2001. In the end it was a much smaller group than what I had expected. There were only the four of us, so I put away my CD which canvassed different aspects of Holistic education and its relevance to the curriculum.
"What is Holistic Education in a nutshell?" one teacher asked. "What one word could describe it?"
This was putting me on the spot and I answered tentatively, "Connectedness?"
"What do you mean by that?" she asked.
I replied, "Well I could answer you in words or I could show you." She asked me to show her. So I gave everyone a smartie or a piece of mandarin and invited them to do a mindfulness exercise. Please feel free to join in…

> *Put your smartie or mandarin on the palm of you hand and just look at it…. See how it changes with the light as you move your hand …. Be aware of your breath and your shoulders and begin to breathe deeper. Now stroke your smartie or mandarin and feel the textures… be aware of the sensation on your finger tips. Feel it on your cheek. Now lift it to your nose and smell it….take a deep breath in and other that smell to enter your lungs. Now put it on your tongue and just feel it there… what tastes and textures? When you are ready, bite into it and just be aware of the new taste sensation. When you are ready chew it and swallow it. What space are you in now? How is your breath? How are you feeling? What did you see?*

We were now in a different space… calmer… more aware. How did people feel? More connected, more peaceful, more aware of themselves and the space they were in. What did they see? They were surprised at how rich the experience was, how much there is to something if you take time.

What does connection mean now?

"This reminds me," said one teacher "of when my nephew was a baby and I was lying back in a chair with him on my chest. There was such a moment of connection. I was filled with love that I had never experienced before. It just felt like there was a flow of energy going from him to me and me to him. It was overwhelming but also felt like a miracle."

And so we began to share our stories of moments where we had felt connection… connection to others, to nature, to ourselves (the good times and the bad). What did they feel like, why they were so important to us? We were connecting to our memories; we were remembering, re-storying, re-appreciating our experiences. As we did so we became connected with each other, opening ourselves up to being more vulnerable, feeling that each person was holding us mindfully and compassionately in their hands and their hearts. We were in a place of deep listening, where the meaning is more than words, rather an experience of another's whole being – their feelings, their soul. This is a place of great kindness and warmth.

But what has this to do with teaching? Now the group moves into discussing the connections we felt with our students. What it is like to build relationships… the times when we felt something important had happened with a student, or when things were challenged. What were the dilemmas in creating close relationships with our students? Is it OK to love them or to experience a loving relationship? How did we deal with student depression, sense of failure and low self-esteem? What were our students yearning for? Deep connection? To be seen by others? What does it mean to be seen?

There is a Zulu traditional greeting where you stand before another and gaze directly in their eyes while seeing them with your heart. You say "I see you" and the other says "I have been seen." Then the other person says "I see you." And you reply "And I have been seen." Try it. It is one of the most powerful ways of connecting to another person, even strangers, that I have ever experienced.

So what does it really mean to see our students? To come to know them and for them to know that they are known?

Yes Holistic Education tries to go beyond words into the depth of the experience. Real experience that lives between you and me, now in this moment.

So what perhaps then is my aim as a holistic teacher?

I come to know you
Because that helps me
understand how you learn

I come to know you
Because that helps me
help you on your journey

I come to know you
Because I care
and want to be part of your journey

I come to know you
Because in that moment
I know myself

I come to know you
And discover in you
a shining spiritual being

and in that moment
you see your true self
through my eyes.

And the universe dances with joy.

Worldviews and underpinning metaphors

A key aspect of Holistic Education literature is that the authors ask us to look at what are the underpinning metaphors and worldviews which inform our current curriculum conception and pedagogies.

Fig 3.5

Why do we think it is best to put students into grades and levels? How do we think students learn?… sequentially? Why is normative assessment so widely used? Why do we split the curriculum

into disciplines, topics, lessons? Where do these ideas come from? What sort of research methodologies were used in finding out? (Do they include all of Wilber's 8 indigenous perspectives or just a privileged few?)

Perhaps underpinning our curriculum there is a legacy of worldviews that we no longer hold. And these worldviews are so messy and intertwined it is hard to know what comes from what. Mixed in with 17th C positivistic and reductionistic notions are 20th C notions coming from feminist, postmodern, spiritual, indigenous or ecological perspectives…. and then there is everything in between! As we develop new ways of seeing the world it seems this new understanding broadens what we do, rather than questioning the very foundations that we base education on.

> "Our values and sense of self are anchored in our frames of reference. They provide us with a sense of stability, coherence, community, and identity. Consequently they are often emotionally charged and strongly defended. Other points of view are judged against the standards set by our own points of view. Viewpoints that call our frames of reference into question may be dismissed as distorting, deceptive, ill intentioned, or crazy."
>
> Mezirow (2000)

For example, both Doll (1993) and Davis (2004) trace normative assessment back to the time of the positivists who rejected the previously held notion of education as helping to form *the ideal man.* The *ideal man* came from Plato's notion of ideal forms which projected their 'shadows' on our physical reality. The positivists said that the reality of the ideal forms was something they could not measure. What they could measure was man as he was, particularly using statistics and bell curves. So the *normal man* replaced the *ideal man*. An empirical solution, but perhaps not one that on reflection many people today would agree with. How many of us just try to be normal and how many of us aspire to higher ideals? Who does norm referencing serve now and what might be other ways of meeting these needs?

Worldviews not only leave footprints all the way through our education system, but permeate our own personal value systems…. they shape our metaphors for teaching and how we behave with our students. Davis (2004) has also explored metaphors for teaching, tracing their genealogy as follows:

educating nurturing fostering tutoring	disciplining indoctrinating inducting training guiding	instructing informing edifying directing lecturing	schooling inculcating conditioning training remediating	facilitating mediating mentoring modelling initiating	emancipation liberating empowering giving voice pedagogy	improvising occasioning structuring framing participating	conversing listening minding caring
Mysticism	**Religion**	**Rationalism**	**Empiricism**	**Structuralism**	**Post-structuralism**	**Complexity Science**	**Ecology**
Gnosis		**Episteme**		**Inter-subjectivity**		**Inter-objectivity**	
Western Worldviews							

Fig 3.6

Davis's categories appear to align with the 4 quadrants – gnosis **(I)**, episteme **(IT)**, inter-subjectivity **(WE)** and inter-objectivity **(ITS)**. While some of the teaching metaphors which we use are perhaps ones we would not *wish* to use if we knew their origins, we can see from placing the metaphors on the quadrants that each might have a place within certain contexts.

The *Essential Learnings* is moving towards a curriculum which is about giving voice, structuring, facilitating, participatory. Does Davis's model help us see the possibilities for Year 11/12 visioning of curriculum?

So what have we inherited in our education system and what might be a vision for a 21st century curriculum based on a holistic worldview?

19th Century education?	**21st Century education?**
Learning is about… o Separateness o Disconnectedness o Events and facts o Objective observer o Impersonal	**Learning is about…** o Wholeness o Interconnectedness o Shared meaning and stories o Participation o Personal
Engages… o Physical / Mental o IQ o Rational / logical o Philosophic	**Engages…** o Physical/ mental/ emotional / spiritual o IQ/EQ/SQ o Multiple intelligences and learning styles o Mythic, romantic, Philosophic, Ironic

Outcomes…	Outcomes…
o Information/knowledge o Skills o Answers o Qualification O Worker	o Multiple literacies -> deep understanding o Competence and wisdom o Questions, creativity, insight o Journey, growth, transformation o Enjoyment, meaning, purpose

Fig 3.7

We could ask how a holistic paradigm might inform the conception of an education system from scratch, but this system would flounder without teachers whose values and behaviours come from a holistic paradigm.

So how does a teacher move towards a holistic understanding (assuming that this is something to aim for)? It is not enough to *intellectually* adopt a holistic view. A sense of holism comes from deep experience of an interconnected reality. This can be developed through contemplative and mindful practice; whether alone, in communion with others, or in nature. It can be inspired through art, stories, wonder and love. It can be experienced in many different ways; from a sense of being fully present and centered to very deep transpersonal experiences.

Breathe in,

Breathe out…

Feel your body in the chair, feet grounded.

Be aware of your posture.

Feel your breath.

Begin to watch yourself…

Your thoughts running past…

Let them go…

Breathe…

Take your time.

Where are you now? What is this space you are in?

What do you see now, that you didn't see before? How might you act now, different to before? Can you sense me; my heart, my soul? Are we connected in this act of writing and reading, beyond time and space? Can I feel you?

Do you notice a change in perspective… a quietening of self, a more openness to what really is, rather than what you are used to seeing? A warmness in the heart?

We can deconstruct our worldviews and beliefs from the *eye of the mind*. We can transcend them from the *eye of the spirit*. But perhaps we still need the eye of the mind (and all the research) in order to differentiate what is going on in order to make systemic change. I have heard Parker Palmer say that "a transformed being in the world transforms the world." Is that all that is really needed? Is it really only that simple?

"I'm gonna wash that meme right out of my hair"

Can I transcend my messy partially articulated intellectualization of my worldviews and gain a holistic perspective? What insight does this give me on how to be a physics teacher?

I am not sure if physics should even exist.

What insight does it give me in the design of our whole curriculum framework for Years 11 and 12?

Does it even matter what insights I have if the other teachers are in another place?

I feel such a sense of urgency about the state of the planet and our continued headlong rush in unsustainable lifestyles. Holistic Education is not just about this nice development of the soul of the child. It also must have something to say about creating a future on this planet together. We develop the child in the context of our communities, ecologies and current

values while at the same time our future lies with the actions of this child who we would somehow like to have different values and higher consciousness.

We know where technology is taking our children, but where is the spirit?

Can we plan a curriculum for a future that is a viable alternative to now? Does the answer lie in changing structures and content of our courses or in changing the very consciousness of we teachers? Or both? How can one help the other?

Perhaps it is time to vision. But how can I vision something I cannot see?

Greg Cajete (1994) lays out the Indigenous cycle of visioning:

The Indigenous Vision Cycle

- **Centering place** - where the soul and intention of the vision is formed
- **Asking** for illumination
- **Seeking** for what we mysteriously yearn for and what we need and is missing. We need to expand our boundaries and go outside ourselves to find what is within.
- **Making** – creating something new as a result of the visioning, which has the power to effect the lives and souls of others
- **Having** – learning what our vision and creation mean and learning to accept and honour that part of ourselves – self understanding
- **Sharing** – where our vision becomes part of the life and spirit of the community
- **Celebrating** – the mystery of life and the journey that we each take
- **Being** – being joyous, thankful, reflective of the gifts of life and opening ourselves up to the centering place where our soul and spirit reside.

Cajete (1994)

What question would you ask to start your vision quest?

What is mine?

The curriculum planners enter the conversation:

"Sue, I am finding myself jumping around here. Trying to think of the big picture… our curriculum review process and what might be the implications in designing curriculum frameworks, but at the same time thinking about my own practice, my own beliefs. And knowing that any framework we design is going to be interpreted differently by each teacher because of their worldview."

"Yes. I found it is interesting that Holistic Education can be considered at so many levels – the classroom teacher to the design of whole curriculum. I was particularly interested in the Navajo nation curriculum – there is obviously a real value in having common values and cultural roots on which to begin. I know we have gone through our values and purposes at the beginning of our review, but I think we only scratched the surface, not really addressed the fundamental differences that teachers have in their worldviews. And because of that when we come to implementing the curriculum we are not going to get the leap in consciousness change we really need to be educators for the future. I feel such an urgency that we need to be more than just teachers of knowledge and processes, but also of consciousness… of mindful agency in this world of ours, so that we still have a world in 50 years time. We need a way of helping teachers go deep, to experience a consciousness shift for themselves… this seems such a crucial element of all Holistic Education teaching programs. By teachers experiencing their own transformation they are then able to assist students to transform and flourish."

"But should teachers be forced to agree to a single worldview? Holistic Education requires teachers to take on a spiritual worldview. Is there room for different worldviews in a whole education system? It isn't very pluralistic of us to wish 'consciousness growth' on others, is it?"

"Good point… you can't force someone anyway… we are all deeply embedded in our own paradigms and ways of thinking and it is not an easy thing to just switch to a new one. We think we might be articulating what informs us, but so much of what we do comes from habit or deep experiences in our lives which underpin our intentions as teachers. Perhaps part of a process of curriculum renewal is about assisting people to be more reflective of those things that have shaped them… introducing new models or lenses that could assist in that process, like Integral Theory. So it is not so much about creating a curriculum framework, as a process to

support and encourage those teachers who wish to take such a path of self-knowledge. Perhaps the new framework needs to have room in it to enable people to grow into new ways of teaching?"

"And perhaps it also needs to support those teachers who don't want to take such a journey; who still value traditional teaching approaches – discipline knowledge and sequential learning? While we realize that discipline expertise is important, it is clear that such expertise is needing to move from just discipline knowledge of content, to better understandings of the epistemological frameworks that shape a discipline as well as abilities to talk across disciplines."

"Yes, for some teachers, just moving from *instructors* to *facilitators* of communities of practice will be a very big ask. How can we assist and honor those journeys?"

"And how do we know how to start? Are there road maps? Guides? Exemplars? What could help us in this process?"

What has been my path towards being a holistic teacher?

Now with the hindsight of 15 years involvement with Holistic Education I can perhaps begin to see its shape and how it has shaped me. Keys to my own journey have been the following elements:

1. Coming with a **spiritual paradigm,** yet challenged to question this; creating a process of separating dogma from essence… trying to find those values and ways of being that transcend sectarian religion divides… searching for a universal spirituality. Searching for ways to incorporate spirituality in my teaching.

2. Searching for **new paradigms** and new ways of understanding the world – intrigued by the new sciences – deep ecology, systems theory, chaos. Looking for ways of reconciling the materialistic perspective of the world with the spiritual one… searching for an integrating theory.

3. **Self development** through meditation, interpersonal and relationship courses and healing courses … building capacity for reflection, self-awareness, insight, mindfulness, ethical action.

4. Coming with non-traditional educational perspectives and experiences of **pedagogies** as a result of experiences as a scientist, development officer, national enterprise workshop participant, coach. I started my teaching and curriculum management roles in a new College which fostered experimentation, innovation and collaboration of pedagogies. Searching for pedagogies which are consistent with spiritual and holistic perspectives.

5. Searching for **educational theories** which might help me understand learning and teaching better. Asking what is the purpose of education and what assumptions do these theories have? Which theories are consistent with spiritual and holistic perspectives?

6. Building **relationships with my students** – coming to know and appreciate them… creating connections… being more present with who they are, where they are and tuning into where they want to go. Seeing them as mirrors to my own self and self-growth. Developing compassion and love and learning to be with them in a loving space. Building learning communities based on belonging, generosity and shared sense of purpose. The space I create with the students is the place where all my ideology and pedagogy is put to the test. In learning to see with their eyes I am challenged to see my ideologies and pedagogies in new ways, challenging my assumptions and intentions.

> "Central to the goal of adult education in democratic societies is the process of helping learners become more aware of the context of their problematic understandings and beliefs, more critically reflective of their assumptions and those of others, more fully and freely engaged in discourse, and more effective in taking action on reflective judgments."
>
> *Mezirow (2000)*

7. **Deconstruction of self** ….bringing postmodern lenses to understanding myself, my culture, my history…. What has shaped me – my thinking, being and habits? Realising that my actions are not just shaped by one or two paradigms, but many conflicting ones and to understand self one has to understand the system one is in, the world one is in. Self is deeply entangled. What does it mean to challenge those long term habits and characteristics that might inhibit my own growth?

8. **Being part of a global community** with similar aims to my own– to explore what it means to develop education which values the whole person, including the spiritual self. Learning from the different perspectives and approaches of others. Engaged in discourse and coming to shared understandings. Being supported and inspired to go on my own journey, yet being challenged to look beyond my own field of view.

9. **Leadership in teacher and system transformation –** I have had a strong drive not just to change my own practice but also to be involved in teacher and system transformation, encouraging other teachers to embark on a holistic journey. So as I have learnt for myself I have passed this onto others… whether through informal conversations, teacher workshops, major collaborative projects, acting as critical friend, or through the HENT website (founded by my husband and myself) and writing. Through the resultant feedback and playing out of my understandings with others, my own understanding deepened; helping me develop new questions and search for answers in new areas. It also forced me to look deeper at what shapes ourselves, our teaching and curriculum metaphors; what constrains transformation of ourselves and the system.

These elements have emerged as a result of my journey, rather than something I deliberately and explicitly engaged upon. In hindsight these elements could form questions for any teacher interested in embarking on a journey exploring the field of holistic education (see over page).

Where might you ask such questions from? Your mind, your heart, your soul? You might get different answers depending on what aspect of yourself you are drawing on.

In 1997, I ran a workshop for a group of about eight teachers on *Re-enchanting Education*, starting with a visualization deep into our hearts, asking what was it that informed who we were as teachers. It accessed something deeper than just thinking about it and what teachers described were key experiences of themselves as learners that shaped their thinking, values and motivations. These were deep experiences which gave energy and meaning to what it meant to be a teacher; always present but not necessarily recognized.

For example, one teacher told us how she remembered an incident where her music teacher called her out from the chorus. How initially she was excited thinking she might be asked to take on a solo role and how devastated she was when the teacher asked her to mouth the

words. Now as a drama teacher, she was determined to give students opportunities to really express and explore who they were.

Another teacher told of how important it was for her to give her students a nurturing environment – she would cook food for them and encourage them to care for each other and create a real community. This came out of her own experiences of her family.

Another teacher told of the value he got from following an elite sport and striving for excellence, so he was keen to encourage students to do the same and had put in place a program in the school that was helping students experience success through discipline in a sport.

The session had the impact of helping two teachers clarify their own motivations, ending up in a change of direction professionally and personally. Even though we might be living in the mental world of teaching plans, educational theories and student assessment, perhaps our pedagogy is more informed by something that is sourced from deep in our souls and our hearts – our humanness – it is deeply embedded in our egos. So changing practice or conforming to new curriculum expectations could be in direct conflict with that self, setting up a deeply felt disharmony.

Perhaps through remembering deeply who we are and what shapes us can free us, and enable us to move on, while valuing who we were before.

On the cusp

Four different responses to the opportunity for transformation

Some initial questions for potential holistic educators

remember … you are a spiritual being in an interconnected reality

remember then to ask these from the depths of your heart and soul as well as your mind

1. How do you express your spiritual nature in your life and your teaching practice?
2. Who are you? What are your passions? What gifts do you bring to your practice? What do you think you are needing to learn and are growing towards?
3. What are your deep concerns and issues?
4. What tensions and paradox are you holding and how are you dealing with them?
5. What are your current worldviews and how do they inform what you think, do and be?
6. What is your current pedagogy and what theories and conceptions of learning are these based on?
7. What now is this dialogue between your practice, beliefs and deep being?
8. In what ways do you bring a transpersonal knowing to your understanding of self, others and the shape of the curriculum?
9. How do you gain feedback from your students and what do they help you learn about yourself?
10. How does the system and culture you are in provide constraints, opportunities, feedback?
11. What are your own questions?
12. Sit now in your own quiet space.
13. Where do you feel the urge to go now?

Are these questions all that is needed? Perhaps there is also a need to build the readiness, capacity and safety nets for one's own transformation, including a willingness to move and be surprised, having a supportive environment and self-building practices, and having a backup team! Perhaps there should be a balance between self-reflection and self-nurturing.

When there is too much self-reflection and dissonance can we get lost? Is it part of the growth process? Do we need to go deep into our own discomfort because this might be a spur to change?

Mezirow (2000) describes the nature of transformations. Transformations may be:

- focused and mindful, involving critical reflection,
- the result of repetitive and effective interaction
- the result of mindless assimilation -- as in moving to a different culture and

uncritically assimilating its ways of thinking.

- epochal - a sudden, dramatic, reorienting insight
- incremental - involving a progressive series of transformations in related points of view

How might we foster mindful transformation? What is mindfulness? Can this provide a supportive practice for the Holistic Educator?

I think that there are perhaps two aspects of mindfulness. Using Integral Theory there is an *inner* and *outer* aspect. The *inner* one is a place of presence and being - where one is fully mindful of the moment. (Thich Nat Han 1999). You can be fully in the experience as well as witnessing it. It can be a place of peace, interaction with others, sensitivity to the ecology you are in, a state of creativity and so on. The relationship between being in the present and witnessing it is like yin/yang and here is a descriptor I have used in describing the creation of my art:

> The Taoist artist moves into a state where her yin and yang energies are fully aroused, becoming highly creative and dynamic yet also focused and receptive. In this state of extreme aliveness and awareness she communicates the essence of force that she sees.

Now the *outer* aspect of mindfulness, I believe, is applying a critically self-reflective process to what you are doing. This is Torbert's (2004) notion of *action inquiry* – where one is mindful of the actions you are doing and can stand back and reflect upon them and change them. It involves the mind and thinking, whereas the inner aspect is almost no-mind, a place of pure presence. The outer perspective draws one forth, sometimes disorienting, challenging, providing dissonance. It is the transformative aspect. The inner aspect is the nurturing aspect that provides the ground for such development.

Perhaps the following integral approach is helpful in explicating the different aspects of how we can be more mindful in our intentions and actions with others as we develop as Holistic educators:

Mindful Practice of a Holistic Teacher using The Eight Indigenous Perspectives

Individual

Inner (subjective)		Outer (objective)
I **Inner:** connecting with my inner self, mindful practice, being a witness to myself. **Outer:** reflections about self, values, meaning, purpose, theories, worldviews and being explicit about my intentions.	**IT** **Inner:** being fully present in my body, my actions, and the greater cosmos. Mindfully embodying my intentions into practice. **Outer:** untangling my habitual actions and intentions and changing mindfully my practice.	
WE **Inner:** being fully present with others, being mindful of how I see and interact with others and the feedback I am getting. **Outer**: untangling the deeply embedded cultural conventions and worldviews which shape my perceptions and interpretations and mindfully changing my practice.	**ITS** **Inner:** being fully present to the universe, being mindful of all the ways the universe is giving me feedback, doing right action for the moment (Wu-wei), synchronicity. **Outer:** untangling my habitual responses to the systems I am in and being a mindful agent for change of the system.	

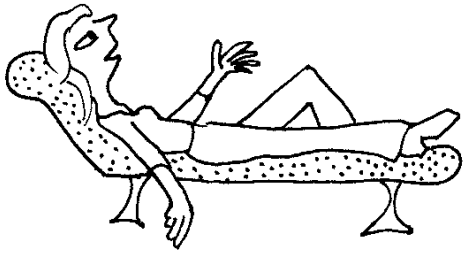
Collective

Fig 3.8

I am the Tao, I am the flow

Interlude 1: 1999. Now Sue, what has been the nature of your holistic journey?

Sue, please feel free to lie on the couch. Are you comfortable? I understand that you are going through a difficult time yourself. Would you like to explain?



Yes, thank you. I feel like I have gone through a major transformation, and perhaps many little ones. I am so tired from it all. I just feel I need to rest and do something else for a while. I think I have spent so many years pushing my own learning - being on my learning edge - that I have forgotten that I need space to rest and integrate before the next big challenge.

Like my students, I think I learn in spurts of intensity. While I was working in industry I could manage this… between the creative times, there was the tedious 'just get the data and analyse it' times. Teaching however, well the sort I do, seems to constantly require creativity and attention; there are no dead periods. I seem to be addicted to this learning spiral. This action inquiry cycle which I have adopted for my research now seems to be a way of life. The very act of being in relation with someone else, requires my openness, my reflection, my learning. It challenges who I am, my sense of self and I feel constantly in a state of disintegration. I think the only way to stop learning is to stop teaching for a while.

But surely Sue, learning can be gentle and integrative, rather than just transformational. What do you mean by transformational? What is it like in this space for you?

This space can be quite invigorating as new ideas and understandings make connections in such a way that emergent potentials arise. You might feel like you are seeing things with insight. You are drawing together things in new ways… like me trying to bring a *spiritual* perspective into my teaching of *physics*. I am faced with a dialectic, which I am resolving perhaps naively by dancing and intertwining the possibilities. But there comes a point where something challenges all I am doing. I see the limitations. I see I have been playing in a very small box, and while I have been doing the best I can in this box, I need to move into a

bigger one. But to make this move requires me letting go some big assumptions, some baggage you might say. But this baggage is so firmly part of who I am, my ego, that this letting go process is not a nice easy shedding of an outer layer, but ripping to the very heart of me.

The problem is, once I put myself open to question, this self of mine almost disappears… this self is very fragile and the boundaries between myself and the world do not seem to be there… I feel that I am like a leaf being blown about by the wind. Anything anyone now says to me, or I read, I bring into myself with very close questioning. And everything unravels. It is out of control. I know it is out of control because I am even questioning that centre of myself, that spiritual being, that essence which if I stop thinking and questioning I can just breathe and be.

How did this unraveling begin for you?

In June 1998 as part of my doctorate studies I was encouraged to write an autobiography of myself to reflect on where the contexts had come for my beliefs about curriculum and pedagogy. I spent three days writing over 30 pages, deeply reflecting on key incidents in my life and how they had shaped my assumptions about what life was about, and thus the purpose of education as I saw it. By the end of the three days I was so deeply involved in this storying that it got away from me and I spent another three days just lying in front of the fire with stories going around in my head. It was like a whole lot of things suddenly became significant. And I could see how much they shaped me. I questioned my earlier interpretations of them.

The idea which is so central to me is that I am a spiritual being with meaning and purpose. I had felt this strongly in myself from a very early age. I remember having conversations with God when I was seven about why we have to be good. It went something like this… "God, we shouldn't be good just to get a reward, to get into heaven, or because we might be punished and go to hell. Goodness should come from within yourself…because you want to be good, you feel goodness in your heart. Not just act good." Later when I was studying existentialism at university I went through a crisis of really questioning whether life was really just like Sisyphus pushing his rock up the hill and watching it drop, or whether it had

purpose and meaning. I spent two weeks sitting in my room, agonizing over this, incapable of attending to lectures or to life. I decided to vote for purpose and meaning and let the existentialists go and do their own thing.

In reflecting on this almost 20 years later, amongst many other aspects of my experience I started wondering whether my seeming uptil then unquestioned certainty that life was meaningful and had purpose was just a decision I had made, rather than a deep embedded knowing. What could I really know through my spiritual experience? In fact how much was this based on doctrine and what I had read and how much by direct 'I' experience? And how much was my 'I' experience interpreted through my understanding at the time (as informed by doctrine) and therefore open to question? Could I even trust my inner experiences? Aaaagh?

Sue, it sounds like you have just got into a relativism spiral.

Exactly, it is like before I was happily content with staying in the inner perspectives of **I** and **WE** and the inner/outer perspectives of **IT** and **ITS**, but as soon as I put that outer **WE** lens on myself, my whole world fell apart. I take things too personally, I know. But it seems I have to live these things to understand them. And I have certainly lived the disadvantages of rampant post-structuralism applied on myself. It certainly made me much more wary of stimulating transformation in my own students, without giving them the appropriate support.

I don't think my doctoral lecturers had any idea what was happening to me, and probably wouldn't have known what to do anyway. They were coming from a very detached view point – this writing is an academic exercise… not knowing that it could rip my very self apart. How can you honor someone going through this process? Certainly by not telling them that their writing needed more references… but through really reading what they had written and understanding that this was a birthing process and midwifery skills were needed. If we are in the business of assisting in the transformation of our students I really think we need to be aware of all the potentials… because if it is a true transformation it never is just about academic understanding; it is embodied and involves the deep self. As teachers we need to be able to read the clues that our students give us… in their conversations, in their products, in who they are and how they act.

At the same time that I was going through my self-questioning I was taking the rug from under my students feet in physics, encouraging them to go on their own journeys of

questioning what they really knew. “How do you know an electron really exists? Has anyone really seen one? What are you basing your knowledge on?” And while I was floundering, trying to find myself again, my students spent a small amount of time being anguished over discovering that their knowledge of the physical world was uncertain and then they actually enjoyed the uncertainty. I had a professional interviewer interview them at the end of the year and she was astonished by their comfortability with uncertainty and their flexibility. They seemed to cope with relativism very well thank you.

How could they gain that, when I was not coping with my own uncertainty? Did I help them, or was it just luck? Did they really challenge who they were, and if not would this exercise help them in future transformations?

But Sue, have you found yourself again?

On good days. On bad days parts of me are somewhere in Ursula Minor, the tree over there, or in a box at the bottom of a well.

Sue have you forgotten to breathe? Breathe with me now…

Hmmm, but first let me get the vacuum cleaner…

> *Stand tall.*
>
> *Breathe out, step out, push.*
>
> *Breathe in, step in, pull back.*
>
> *Breathe out…*
>
> *Breathe in…*

The lounge room is clean. I have lost myself in breath and flow, rhythm and service.

I am breathing long and slow breaths. There is an energized flow, through me.

I am permeable and open, but yet centered in my own expression of being.

Who am I? Where am I?

Here and now.

In the moment.

Clean, refreshed.

A vacuum?

Waiting to be filled.

Interlude 2: Mindfulness in teaching with two exhibits

Exhibit A - Maths 2004

It is the second week of class and I have just handed out a maths worksheet which I hope will help students construct an understanding of percentage, rather than just practicing problems. I hope it will build their confidence. This is a class of students who really struggle with maths and I am trying to address some of their fundamental issues with it. I hope the worksheet will help.

I am walking around the room helping my students, responding to their questions and some are quite demanding, calling me back again and again. Eventually I move around to Erin, who has been sitting quietly, unlike most of the others, and ask her how she has been going. She bursts out "This is a complete waste of time! I can't do it! Why are you giving me something I can't do! I hate maths!"

What am I feeling? On one hand taken aback, and wondering why she hasn't asked for help. At another level I am remembering other outbursts from her and how aggressive she sometimes gets with the other students. I am wondering what is happening. Where is this coming from and why. What can I do?

I step back in my mind and breathe. I begin to sense her energy and it is all spiky. I put my hand on her shoulder and say to her "Erin, feel how tense you are."
She shrugs her shoulders, almost trying to throw off my hand. I keep it there and say "No seriously, feel your neck muscles, they are as hard as a rock. You know when that happens your brain freezes and you just can't think."
She begins to relax a slight bit and she massages her neck. I sit down next to her and ask her to tell me what is going on.
"I was going alright and then I got to this bit and I just couldn't do it, which always happens. I just am not good at learning maths.
"What did you do when you got to the place that you got stuck?"
"I just sat here and got madder and madder."
"And I bet your shoulders got tighter and tighter, which made it even harder to think."
She is now rotating her head and easing her shoulders.
"Yeah, I guess I got myself all tense."
"Does this always happen?"

"Yes, I guess so."
"What about making up some strategies that you could use when you get stuck with something."
She looks at me sceptically as if I might be offering her a false hope, yet behind that seemed to be someone who *was* hoping… "like what?"
"Well, first of all is noticing when you start to get tense. Realising you are getting tense and then stopping what you are doing that is causing that. The tension is a signal. So you know then to ask for help and not try to do it by yourself. Another strategy is missing the bit you can't do and going on with something else… that way if everyone is busy you don't have to wait."
"Ok, she says "I'll try it."
"Do you want me to help you, so when I see you are getting tense I put my hand on your shoulder to remind you?"

So that is what we agreed upon and for several weeks I kept a close eye on how she was going and put my hand on her shoulder when I thought she was tensing up. I introduced some Brain gym exercises to the class which helps to strengthen brain-body connections. Erin soon began to recognise for herself when she was getting tense and became used to putting the hard bits aside until I could help her, or asking the person next to her. She started doing work at home, listing questions she had for me on the bits she couldn't do. Soon she didn't have many questions, or they were at another level. Within three months she had moved up two levels in maths ability – a major achievement. Her teachers noticed that she was much more confident, autonomous and had lost the aggression.

When Erin first exploded I could have taken any number of routes in 'handling the situation' and who knows what the outcome might have been. For other students, I know I have taken other routes and I wonder how our relationships might have been had I been more mindful.

Exhibit B - Journalism 2006

The class are supposed to be working in teams to produce a photo-story for a deadline as a quick exercise in team work. Ashley is on chat yet again rather than doing her work. I ask her mildly “Are you off task?”

She bursts into tears. “My friend has just died!” she says, “I am chatting to a friend to find out when the funeral is.” She looks at me accusingly. “I told you before I had to leave earlier to go to a counsellor to talk about this.”

Holy shit, she had said something about seeing a counsellor. Was I having a mindless day today?

Chapter 4
Spirituality and Soul in Education

Questions:

What do we mean by soul?

What can we learn from the literature on spirituality?

In what ways can soul be present in education?

What do we mean by spiritual literacies?

Introduction

Spirituality and soul are not easy concepts to define and everyone will have their own meaning based on their culture, religion or spiritual beliefs. Spirituality and soul are now named as important aspects in the new Tasmanian curriculum frameworks (both K-10 and Years 11/12). What do they mean and what could they mean? They are certainly central to Holistic Education and therefore a key aspect in my own journey of moving towards being a holistic teacher.

My own ideas about soul and spirituality have changed so much in the last 20 years, moving from a search for a *body of knowledge* and *development of self practice* to a process of *stripping my spirituality bare*; questioning my underpinning assumptions and dogma. In this new place I began to perceive *universal essences.* This movement in spiritual perspective was an outcome of my trying to come to understand what it meant to be a holistic teacher; living the tension between science and spirituality and trying to find some reconciliation in my physics classroom.

So in this chapter, after a quick look at some definitions of soul, I review the spirituality literature using an imaginative dialogue between fictional curriculum planners who are interested in how it relates to their teaching and design of curriculum. This enables some playfulness in exploring the different literature. I am not claiming that this is a complete review – I am certainly missing philosophical and religious perspectives – rather focusing on where education and spirit intersect. This is my understanding based on where I am now

(2005) which I hope the reader can use as a lens in interpreting my journey in Part 2 (which starts back in 1990).

Some definitions of soul (courtesy of Google):

- The immaterial part of a person; the actuating cause of an individual's life.
- The spiritual life force or essence, carrying an individual's personality and consciousness of actions
- An immortal and spiritual body of light
- The linking principle between spirit and matter
- The underlying foundation of human existence which is the true self as pure consciousness
- Personal identity; feelings, thoughts, memories, sense of self

How might you define it?

* * *

The Spiritual Landscape as a context for education

A discussion by some curriculum planners

Welcome back everybody to our continuing exploration of educational perspectives which might inform the revisioning of our educational frameworks. How are you today? I hope you have been enjoying exploring Holistic Education and how it might inform our curriculum review process.

I Meaning, values, heart, mind, transpersonal states, beauty	**IT** Body Behaviours Subtle energies
WE Community, caring, ethical frameworks	**ITS** Being part of a complex whole (nature, cosmos, Kosmos)

Fig 4.1

We are meeting today to look at the field of **spirituality and soul in education**. Now everyone has had borrowed some books over the last few weeks and I hope that reading them with Wilber's Integral Theory quadrant model in mind has been helpful in terms of positioning the literature.

Wilber would ask us to think about spirituality as more than just *qualities of being*, or as access to *transpersonal states*, but also as *development lines* requiring as much attention by educators as do the cognitive or ego development lines. He says that all our development lines move through similar stages or waves leading to transpersonal stages of being and consciousness. In helping develop the child we build the foundations which enable continued development of the adult. Activities which support the development of such consciousness are to be encouraged.

What does the literature say and what can we learn from it? Would you like to get into your groups, share what you have found and work out what you would like to present to the whole group? Great… would we like to do a group visualization first?

In anticipation….
Not knowing
Where it will go.

Does it matter?
Everyone has their own journey.
If I listen well and see theirs
And not to try too firmly to stick to mine,
I might be surprised,
Moved,
Perturbed,
Gain insight,
And just laugh
In the wholeness of it all.

I create a space in myself
To be ready.

"Our group found that the book *Thirst for Wholeness* (Grof 1993) is really useful in describing **general qualities of a spiritual person** – which is Wilber's notion of *spirituality as an attitude or as a quality*. This book describes how we have a craving for wholeness which is often expressed through addictive behaviours, rather through an ongoing relationship with a vast inner source. We found it interesting that many of these are qualities which we are trying to promote in our curriculum… yet perhaps they need to come about from a sense of one's own spirituality and place in the world, rather than being taught in isolated skill based ways."

Qualities of Spiritual Maturity

- Love and compassion
- Honesty and authenticity
- Physical, emotional, mental and spiritual clarity
- Serenity
- Responsibility and discipline
- Personal freedom
- Tolerance and patience
- Faith, trust and inner security
- Wisdom and understanding
- Gratitude, humility and willingness
- Hope, happiness, joy and humour
- Connection with earth and daily life
- The ability to live in the present moment
- Mystical worldview

Grof (1993)
Fig 4.2

"Yes, we wondered how we are succeeding in helping students fulfill their need for wholeness, meaning and connection in our curriculum framework. Is this about the quality of the experience students have, the teaching pedagogies used or the very topics we teach?"

"Well maybe what we looked at can help. Books like *Essential Spirituality* (Walsh 1999), *Contemplative Practitioner* (Miller 1994), *Going Home (Thich Nhat Hanh 1999)* suggest ways which help in **developing the spiritual line** through many different types of contemplative, meditative or mindful practice… both secular and sectarian. These are suitable for various age groups and help connection with self, others, nature and a greater reality. These can :

- Help us gain access to non-ordinary or transcendent states
- Help us discover our passion and gifts
- Help us gain insight into relationships and the world we are in
- Develop love and compassion
- Help us gain detachment and develop frames of mind that enable us to be more in more control of our lives
- Help us in healing body and mind
- Help us reprogram attitudes, beliefs and expectations

- Help our souls be more fully present in the moment, enabling us to bring our whole selves to what we do and what we experience and to notice with wonder the universe around us
- Help foster creativity and soul expression
- Help us to understand our minds and uncover the wisdom within
- Help us discover our sense of unique place and purpose in the Kosmos
- Help us to see the spirit in everything and to experience profound gratitude

"So contemplation is not just a practice aiming for something beyond this world – it is also a way of assisting greater wellbeing and wise action in the world. As the Dalai Lama would say it is about creating *a warm heart and open mind* – that is the secret to happiness and wholeness… and perhaps that is what we should be helping our students experience."

"And I guess coupled with the inner contemplative practice are the more reflective rational interpretations of those experiences. It is the practice of inner *being* coupled with that reflectivity which helps move us into *becoming*. *Being* is shining forth what is, and *becoming* is moving towards what is possible."

"Yes, self understanding is a key aim in many of these practices, and contemplation and reflection are key tools in going deep into one's own experience. So what does self understanding look like for different ages? Perhaps our encouraging students to be self aware learners (meta-cognition) is part of it, but are we missing the heart and spirit components of self understanding? Are we just emphasizing the rational?"

"I am also thinking about dream interpretation and how dream states are such an important part of our consciousness. How many students dream but don't know what they mean and are concerned by them? Perhaps helping students understand dreams should be part of what we do? I would be interested to know what might be *all* the possibilities in our tool kit to promote self understanding!"

"Well our books (*Doorways to the Soul* (Pearmain 1998), *Spiritual Literacy* (Brussat 1996)) might assist students aspiring to a sense of wholeness and could help promote self understanding perhaps by resonance – allowing what is within them to be called forth. They are more **inspirational stories which speak deep into the soul**… they might invoke a sense of compassion, or perturb students into new understandings, or contain the highest ideals, or show what is possible despite

obstacles. I am sure we could find stories like these coming out of many cultures so students of all backgrounds could identify with them."

"Yes, I am thinking about how other cultures have used oral traditions and their elders to pass on these type of stories. Do we have time and space for doing this in our curriculum? A passing of the baton of wisdom? Where are our wise elders and our stories?"

"Yes, and that reminds me how storying one's autobiography in the grand context of the cosmos has been such a positive experience for students. So coupled with contemplative practice to *touch* the soul is the need for *telling the story* of the soul."

"And in fact if we talk about what helps inspire students so their whole soul is present we could talk about singing, dance, creativity, being in nature, service to others… a more action based approach."

"Yes I like the notion of what activities are *doorways to the soul*. It would be different for each student… our job might be to help them find those which work for them and to use them. *What is your door and where is the key*?"

"I think creativity is such an important part of spirituality. I think **creativity is where the soul can be expressed**. It is an outlet for all that growth and becoming, which I guess is the ultimate act of creativity – evolving oneself! There might be a door which opens *into* the soul like contemplation – and a door which opens *out* – like creativity. I guess the trick is to enable that flow to happen – to keep the doors fully open! Because then there is positive feedback."

"And creativity is something that can be expressed in so many ways – individually, co-creatively, imaginally, artistically, practically, rationally. Perhaps creativity is a sign of a healthy soul?"

"So activities which allow students to be creative are perhaps an invitation to the soul? How does our curriculum provide opportunity and foster creativity? Do we give enough space or do we plan everything too much?"

"I can just see a creative curriculum. I feel it would be bubbling with laughter and joy. Yes please!"

"Well the books we looked at were far more theoretical. They try to explain the **nature of the soul and consciousness.** Wilber's (1995) *Sex, ecology and spirituality* describes the spectrum of consciousness including the shadow self. It looks at the emergence of different consciousness in our history and different cultures perspective's on consciousness. It also looks at where consciousness is moving to…. perhaps a world soul. This is a very complex subject and almost makes you afraid to do anything that could impact on a child's consciousness because we just don't know what we are doing!"

"*Consciousness Evolution* (Hubbard 1998) also looks at how consciousness is evolving and suggests that we are heading towards a more social collective consciousness. This ties in with the creativity aspect – it discusses co-creativity – beyond collaboration – people creating together in a way that flows interactively - going beyond the individual soul – a flowing and permeability into each other. That you become part of a bigger whole and one doesn't know quite who thought what or who did what… it is a product of the engaged community. This approach is very inspiring about what can be possible when we work together as a soul collective."

"Our books look more at **transpersonal realities.** *Transpersonal Knowing* (Hart 2000) describes transpersonal experiences from a phenomenological point of view – contemplative practitioners share experiences of what it is like to experience reality from different transpersonal states. This is a good start in helping it be less mysterious and more researched and supported. We can then compare our own experiences to others."

"*Spiritual Emergency* (Grof 1989) looks at peak spiritual experiences from a more 3rd person perspective… seeing patterns and common experiences. This describes experiences people have had in non-ordinary states which have been transformational - causing an emergence of the spiritual self. Typical experiences include seeing the creation of the universe, battling with good and evil and can involve visions."

"And we were pretty concerned about this. These spiritual emergency experiences are very intense and not something that can be achieved in a healthy way without development of all aspects of the self. I would be horrified if contemplative practices that we did in the classroom caused a student to go into one of these states. It is

okay if the contemplation assists self understanding and improves creativity and wellbeing… but how could you ensure nothing further happened?"

"Yes we would agree with that. We looked at books which look at the **development of the subtle energies**. Barbara Brennan (1987, 1993) and Steiner have models which explain how the physical and energetic bodies differentiate and develop through stages. It is clear that a child's energy bodies and chakras are not developed enough to cope with flood of emotional energy in the early stages."

"Yes, Steiner (according to Child 1996) is very firm in recommending healthy development of every stage before trying to move to the next too soon. For the age group 7 to 14 he recommends an educational approach which builds the emotional self (empathy) and nurtures the spirit using aesthetic based teaching approaches. Aesthetics are critical in developing a sensitive soul; one more attuned to beauty than expediency. This develops a *warm heart* which then integrates with the later development of the rational abstract mind, so action of the young adult can be based on *heart-mind* (wisdom) rather than just mind."

"Yes, I think we could say that a general principle would be that any age you need to take into account the capacity and development of the person. You wouldn't try to push a particular line beyond all the others … too fast development and health and mental problems occur."

"And underdeveloped lines could also be problems. Thomas More (1994) in *Care for the Soul* suggests that *depression* is in fact *suppression* of the soul… you could say an under-developed spiritual line."

"So we are treading a fine line here… we need to develop the emotional and spiritual lines as well as the cognitive and ego based ones which we have been happily doing, but we find ourselves with very little understanding of how to do it safely."

"We looked at Fowlers *6 Stages of Faith* and *Big Questions, Worthy Dreams* (Parks 2000) which are more interested in understanding **the development of a person's sense of meaning and faith**. Faith is meant as the central meaning we have that helps us understand our lives; it transcends mere thought and belief, and transcends and permeates existence. It is a motion in life which moves us on, determining our actions. It is stimulated by asking the big existential questions."

"Faith, like cognition and ego development, moves from following the beliefs of others to greater self discernment and then plurality of faith. We undergo crises in faith where our previous meaning no longer enables us to make sense of the world around us. This engenders transformation to a new perspective which enables us to see and interpret our realities differently to before. This is similar to Kegan's (1982) notion of ego development where the emerging stage interprets reality in a different way to the previous one."

Fowler's Stages of faith

1. **intuitive - projective** – follow the beliefs of parents and fantasize about religious figures in stories as characters in fairy tales.
2. **mythical- literal** – follow religious stories, rituals, rules literally. Beliefs based on an outside authority.
3. **synthetic- conventional** – conformist acceptance of beliefs with little self reflection.
4. **individuative – reflective** – radical shift from dependence on other's views to development of their own. Choice of beliefs, values and relationships important to their self-fulfillment.
5. **conjunctive** – person relies on own views but now accepts others and consider serving others.
6. **universalizing** – search for universal values such as unconditional love and justice. Self preservation becomes irrelevant.

Fig 4.3

"What we found interesting is that this emphasis on spirituality is more about *meaning, construction of meaning and how that shapes our perceptions and actions*. The meaning might come from spiritual practice and reflection, but this development of spirituality is more how the mind perceives the world. Other spiritual development models coming out of the east are more associated with spiritual contemplative states which perhaps create a change in *being* or change in *state* and seem more transcendent."

"Here is a comparison of different spiritual development lines from Wilber's *Integral Psychology* (2000b):

Average age of emergence	**Wilber** (spectrum of consciousness)	**Aurobindo**	**Mahamudra** (stages of meditation)	**Daniel Brown** (cross cultural stages of meditation)	**Fowler**
0 – 18 months	Matter Sensation Perception	Physical Sensation perception			
1 – 3 years	Exocept Impulse/emotion Image Symbol	Vital-emotional	**concepts**		1. Magical
3 – 6 years	Endocept Concept	Lower mind	And beliefs of gross mind		
7 – 10 years	Rule/role	Concrete mind			2. Mythic
11 – 21 years	Formal logic	Logical mind (reasoning)	Right beliefs	Preliminary practices	3. Conventional 4. Individual
21 – 28 years	Vision logic	Higher mind (systems)	**Foundations** Universal and ethical practice	Concentration with support	5. Conjunctive 6.Universalizing
28 – 35 years	psychic	Illumined mind	Meditation: **1. one pointedness**	Transcending gross perception	
35 -42 years	Subtle (archetype)	Intuitive mind	Gross union Subtle perception luminosity	Subtle perception Luminosity	
42 -49 years	Causal (formless)	Overmind	**2. simplicity** Cessation Emptiness	Insight cessation	
49 - years	Nondual	Supermind Satchinanda	**3. one taste** Unity form/formlessness **4. non meditation**	Enlightenment	Fig 4.4

"What Wilber is suggesting here is that the more advanced transpersonal states come way after we are concerned with student's education. What is our role then in helping develop the spiritual and faith lines? Are we perhaps preparing the ground by assisting with students developing their reasoning, formation of their own 'right beliefs' and sense of faith and meaning? Should we be assisting students to construct and develop their faith and meaning *explicitly*… or should we just be aware that they are doing this and support them when needed? Is this our job, or is it something that happens in their families and communities?"

"Maybe we could help. We were looking at a series of books on Spirituality in Education coming from England (Wright 2000, Copely 2000) - they come from a more Religious Studies background with a key aim to **foster ethical behaviour, attitudes and values**. By exploring different faiths and hypothetical ethical dilemmas students can explore what they value and develop their own values and morals within a context of virtues and moral values valued by the community. It encourages ethical attitudes through reasoning and inquiry. This is similar to Character Education in the US. You could say that the emphasis of this type of spirituality is in the formation of knowledge and reasoning which helps you act better in the world, rather than engaging in inner practice."

"And this development of morals is well researched by Kohlberg and others. It follows similar development ages as we saw in the stages of faith with a movement to more universal principles. Kohlberg suggests two approaches in assisting movement to the next stage; firstly, providing students with ethical dilemmas which perturb the student and force them to move and, secondly, creating a democratic participatory community where students are faced with ongoing ethical decisions in the way they relate to each other and what they do."

"Hmmm. Well we were looking at literature coming from feminist perspectives and they see **spirituality as caring**; a result of caring relationships, love in action. Women tend not to develop beyond Stage 3 in Kohlberg's scheme; not because they haven't developed ethically but because they have developed in a different way. Nel Noddings (*The Challenge to care in*

Kohlberg Stages of Moral Development

- **Stage 1 – Obedience and punishment** – do it because it is the rule and will get punished otherwise.
- **Stage 2 - Individualism and exchange –** Do it because it gives me an advantage – I'll scratch your back, if you scratch mine.
- **Stage 3 – Good interpersonal relationships** – Do it because it is the good thing to do - love, empathy, trust, concern.
- **Stage 4 – Maintaining the social order** – do it because the laws are there to ensure society functions.
- **Stage 5 - Social contract and Individual rights –** questions underpinning values and laws of society and may work democratically to change to more just laws

Kegan (1982)

Gilligan's Stages of Caring (based on research of women)

1. *caring for self*
2. *caring for others* – often sacrificial
3. *including themselves into their caring*.
4. *universal and abstract care*.

Fig 4.5

schools (1992) and *Caring; an feminine approach to ethics and moral education (1984)*) work looks at how women express compassion, love and care and through that derive a 'present moment' personalized approach to dealing with complex ethical dilemmas in their lives. Actions come out of care first (whether it is *natural care* (e.g. Mother love) or an *ethic of care*), rather than rational abstractions, universal principles and values. There is a danger in developing a purely rational approach to values which leaves the heart behind."

"Yes, a spiritual approach to values should develop heart and mind together."

"So we have a gender distinction here. This book could help. *The Hero Within* (Pearson 1989) looks at the **journeys we make as spiritual beings** and how at different stages of our lives we adopt different archetypal roles – *wanderer* (searching for meaning and sense of self), *martyr* (caring and sacrifice) and *warrior* (fighting for truth and what we value). The book describes how these start off being unbalanced, naïve and problematic and move towards greater integration into a magician role. So a warrior might stick up for what he values while putting himself in the role of a hero, fighting for the victim against a villain. He could impose his values on others and leave his family behind in his quest. As he gains a better sense of self and can incorporate a more caring perspective his view of the situation changes as does his actions. He begins to see the hero in everyone – his approach becomes more pluralistic and more informed by heart-mind."

"It is also interesting that the adoption of the order of the roles is different for everyone, but women are more likely to take on a caring and sacrifice aspect and men a warrior role. Women can sacrifice too much and not learn to look after themselves… they also need to explore the warrior and the wanderer."

"Yes, that is what is coming out of the feminist research into caring by Gilligan – that women move from ego-centric *caring for self* into a *caring for others* stage where they tend to sacrifice themselves for others. The next stage is *including themselves into their caring*. Then they broaden that into more *universal and abstract care*. There needs to be a place where caring and principles can meet. The trap for adolescent girls is that they can get stuck into the sacrificial stage and not move on to the next stages."

“And the trap for boys is that they can move on too fast to the rational development of principles and values without exploring the care aspect. So integral development would foster both aspects – care *and* values.”

“Some authors in the *Heart of Learning* (Glazer 1999) see spiritual development as coming out of a *practice* of caring and compassion. It is not enough to care *about*… one has to be an *agent* in acting with care - and not just give it and run, but really be part of a whole relationship with another. Through our relationships with others we discover our wholeness and our humanity. Plurality – coming to know the ‘other’ - is our greatest teacher. By engaging in acts of service – creative expressions of generosity and open-heartedness - where we are faced with ‘otherness’, we find we have to go deep into our humanity, deep into ourselves, and find our **vocation to be fully human**. The key to growth is then based on the reflective capacities we can bring to this experience – being able to go deep into our own experience of humanity to discover or uncover who we are and who we are becoming.”

“So contemplation in this case could be a tool then to help reflectivity, but not necessarily as an end in itself to acquire transcendental knowledge?”

“Yes, it is interesting isn’t it how the emphasis changes according to different authors? But it is so reflexive… one thing affects and informs the other, and everything grows as a result. You wonder whether it doesn’t matter where you start… or what you emphasize…that all paths lead to Rome?”

“That is assuming there is a Rome to go to!”

“Yes, well the eastern perspective would say there is – a self realized being

REAL + I + sation

… an awakened being.”

“What is that like then?”

“Hmmm. Let me get the book *Education for Awakening*. Nagakawa (2000) suggests that there could be considered 5 dimensions to reality:

1. **objective reality:** phenomenal, empirical world – BODY – *separation*
2. **social reality:** constructed by language and meaning – MIND – *inter-relation*
3. **cosmic reality:** everything dynamically and organically connected – fluid process of constant metamorphous, evolution, becoming, non-linear causes, emergent, systems, human being as microcosm of the macrocosm – SOUL – *inter-connection*
4. **infinite reality:** deepest dimension, one mind, absolute being, non-dual reality, enlightenment, awakening – SPIRIT – *oneness/nothingness*
5. **universal reality**: when enlightened consciousness sees *this* world – SPIRIT IN ACTION (manifest in body, mind, soul) – *inter-penetration*

There is a seeking and returning. The seeker is radically transformed when he experiences the infinite reality then returns and incorporates all dimensions. So the awakened being is someone living *in* the world and brings the spirit dimension and perception to it…. Not someone who is otherworldly.”

“So is that experience of *universal reality* an endpoint after years of contemplative practice? Can we experience the infinite reality momentarily and begin to bring that into our lives now?”

“I guess Wilber would call those momentary experiences *peak experiences* which can help us in transforming to new perspectives and higher consciousness, but we need to continue our spiritual practice in order to reach new levels of consciousness in a sustainable way.”

“Does an experience of the universal reality only come from contemplation? Can it come from holding a baby on your chest and feeling that non-separation, one experience of love? Or is that just an experience of the cosmic reality? Does care only get us so far?”

“But isn’t caring a sign of an enlightened being? Someone who cares for all things because it is their very nature… not because it is an ethic or a rule? I am so confused now!”

“And is this what we are really on about in education? Aiming for awakening? Isn’t that something that one could only hope to attain after lifetimes? ”

“But what sort of education could prepare the way, which could *encourage* the seeking and returning? What might help build the skills, attitudes and inclination for the journey? Should we encourage a sense of the mystery of life and an urge to find out more…a sense of the quest of the soul … or is all that innate and is expressed by the soul when it is ready? Or perhaps it is turned off by the dullness of school and life and computer games? And where does a job and family come into this big quest for enlightenment?”

“Isn’t it interesting that spirituality is so often framed in journeys. Trying to find ourselves, following the mystery, being drawn to search for wholeness. A turning away from the world and our ties to it. Parks (2000) suggests that the **coming home** is as important…. the need to marry soul with the wisdom of the sages in the everyday relationships and living in the world. She describes spiritual development as both **venturing and dwelling**….

> “*Becoming is not so much a matter of leaving home as it is undergoing a series of transformations in the meaning of home”*

… and as we progress through these cycles of separation and connection we become more visibly **at home in the universe**.”

“Well, maybe the *Universe Story* (Swimme & Berry 1992) has something to say here about helping people be more at home in the universe. How can we help our students have a **sense of place in the cosmos**? I guess this sense of place is not so much a connection with the *Infinite reality* as with the *cosmic reality.* Swimme suggests visualizations which help you orientate yourself on the earth, lying down, but feeling yourself suspended above the cosmos seeing into the possibilities. It is more than just connecting to the physical world or to the cosmic reality – it is also about giving students grand narratives. As we develop, our grand narratives might change but what is important is that we have them!”

“Yes, perhaps our job as teachers is to awaken students to the possibility that there are evolving grand narratives and to inspire them to seek them out… to look for meaning.”

“I am wondering how students of different ages might have different meanings of what it is like to *be at home in the universe*. What stories might speak to their souls?”

“Perhaps this is the difference between being and becoming – we need time to seek and time to be at home.”

“Going back to the notion of care. Previously we talked about caring for others as a path for spiritual development. What about caring for the earth? Macey (1991) in *Earth as Lover, Earth as Self* talks about **spirituality as a connection with nature** which fosters care for the earth and through that develops caring compassion in self. But more than that; the concept of self enlarges to embrace the earth… perhaps even we could say our *sense of home* is the earth. We even see the earth as ourselves. Can spiritual evolution of the soul come from connection and reverence in nature?”

“Good question. This is a key issue with Wilber. He is really concerned with the easy danger of reducing everything to one point of view… he calls it flatland. He critiques the deep ecology movement for mistaking a deep connection to the earth as a way of experiencing the entire spectrum of consciousness … he would say it stops too soon, not reaching the *causal* dimension of consciousness (the *infinite reality*). That many eco-spiritualists see GAIA as the Goddess and the ultimate reality to which they aspire to connect, which he believes is certainly not the case. He would also say that transpersonal states are something that come from inner contemplation practice and sustained in our waking life. However the eco-spiritual-feminists criticize the emphasis on the inner path as a masculine Hero journey to enlightenment. They would say that the *‘embodied in community’* or *‘embodied in nature’* journey also leads to sustained transformation and growth.”

“Yes, it all gets a bit precious really and we are stuck in the middle, trying to find the middle road… which is too often one where spirituality is ignored because of the lack of common ground.”

“But surely there is some common ground. Surely, despite the holes, dilemmas and disagreements we can make some generalizations about what spirituality is.”

"Yes, and our challenge is then to enable the spirit to be nourished and brought into the classroom and school. And in a way that honors student's cultures, stages and beliefs. Tricky!"

"Well we are not starting from scratch. We have found numerous books (e.g. Miller 2000, Miller & Nagakawa 2005, Kessler 2000) which look at the role of **soul in education** … not just from theoretical perspectives, but practical ways teachers have tried to bring soul into what they do…. these seem to involve all the quadrants… soul in the environment, in service and caring communities, in the body and in self. The educational journal *Encounter* also has lots of articles about how teachers have taken on board different aspects… there is so much inspiration for trialing practical stuff in our schools or classes. We don't have to try and incorporate everything at once. Although these programs might focus on one aspect such as developing heart through service, or storying, or developing a forest they result in integral development of the whole person. Because of their richness and depth other possibilities emerge."

Key Themes of Spirituality?

- **Meaning** – significance of life, sense of purpose and faith
- **Thirst for wholeness -** motivator for growth and quality of experience
- **Creative expression** - individual and co-creative expression of the soul
- **Acts of caring –** finding one's humanity in action
- **Values, principles & ethics**
- **Connection** – to self, nature, others, cosmos, bigger reality
- **Being** – being at home in the universe
- **Becoming** – going deep into experience in order to grow, transformation
- **Awakening / transcendence –** self realization, experience of a dimension beyond self

Fig 4.6

"And one thing we found out from it all; there is a lot of ambiguity in the use of the word *soul*… some people seeing it as what happens when you feel connected, or have a sense of wonder or awe, or in contact with your 'higher-self', while others are very pedantic with very precise definitions."

"But we don't mind that because it makes it more interesting… we had to spend quite a bit of time talking about how we thought about it… it really helps tease out for yourself what you have assumed and challenges you to critique those

assumptions. So we decided ambiguity was a good thing! We found it really useful describing experiences about when we felt soul was present."

"But we need to ensure that what we provide in our curriculum honors multiple perspectives on soul."

"Now, we don't think that everything an educator needs to know has been covered though… there is a real need to integrate this in a coherent way – there is so much learning out there and it would be useful to know in what respects each resource is partial, how the whole story ties together, what is missing and what needs to be further researched. We need to know a lot more about how student spiritual and integral development is influenced by educational activities so we can be much more intentional in what we do in helping to nurture and develop spirituality and soul. Where is the instruction manual?"

"Sorry, the soul doesn't seem to come with one!"

"So hopefully that doesn't mean you treat it like a video player, press every button and hope it will work!"

Soul in Education conference 2003 Australia – quotes on soul

Soul is energy and process. Although soul is mysterious everyone can experience soul.

What does soul look like in a classroom? The light in a child's eyes.

Soul contains our deepest longings. It is part of our journey to discover the soul's work. Soul finds its way though deep listening.

Soul seeks love. Falling in love is seeing the angelic nature of the other person… a moving away from geocentricism. Love is kindness and compassion. Divine love is love of earth, cosmos and aligns us with ultimate energy.

The soul sings. We need to express the singing quality of the soul.

Soul is used as a word to explain what is missing in education… joy, excitement, spirituality, intuition. It is possible to have ensouled intelligence and ensouled skills. We do not need to be in an either/or situation.

The life with which people rejoice and are content in is their soul.

Soul is the process of relating. Happiness is beneficial relating. Beneficial relating is one of oneness. But how do I overcome separation from the other?

I find "no place" where everywhere is sacred and all are there with me.

Fig 4.7

"Ummm. Well, I think the soul *does* come with instructions. It is called the inner teacher, or the wise self. We get clues from dreams and intuition. It is expressed in our passion."

“But how can you consciously access it?”

“Well for example, you can do guided visualizations which take you to a special place that you create for yourself. You then invite in your wise self and can ask them questions and get answers or receive objects or feelings which you can then interpret using dream symbols or the archetypal language of the subconscious. We have literacies for understanding number, art, and language. Perhaps there needs to be a spiritual literacy for understanding our inner selves.”

“A spiritual literacy – now what could that look like?”

Interlude 1: a poem by Nicole (age 16) written after a guided visualization in my enrichment course *Visualizations and Dream Interpretation*

Dreams

The light
Falling on my face
Passing through me
The energy
Steady and strong
My face warms
As the warm water
Runs into my soul
Into my heart
Refreshing me
Pouring into me
Mixed with the light
The ever growing light
There I stand
Water rushing away from me
In every direction
And the light
Falling on me
I stand
A statue of pure light
Taking it in and breathing it out.

I walk away from it
The dreamy water
Ever falling waterfall
Through the grass
The land around me
Every direction
Beams of colored light
Some strong,
Some weak,
But there…
A pool far off
Where silver laps
Silver shining waves
Ever so gently splash.

Each tranquil blue wave
Has a sparkle
A sparkle of silver

Silver in my eyes
Catching my dreams
Wrapping them up
And hiding them away
Deep in my heart.

A calm spot
A rock pool
I look in
Look past the ripples
And I see
A familiar face
He smiles and laughs
And keeps my eyes with his.

I turn
A tear in my eye
A silver drop falls
And then the sky cried
As silver drops fall from me
Onto my bleeding hands
The burning, tearing feeling,
Cooled by my silver tears.

I turn
My vision blurred,
There I see something
Coming closer
A voice
Although not spoken
I hear in my head
"Believe,
If not in yourself,
In your dreams."

Suddenly
Hearing that
The sky opens
Letting the light shine through
Letting it warm me once again
Feeling it.

I unfurl my hand
And find a copper key
Lying there
On my palm
Smiling in the sun
Shyly smiling.

I go towards the waterfall again

There I feel safe
Where I know
My dreams are safe
Dreams that are mine.

He is there also
Written down
Among the pages of my memory
Holding my dreams
And keeping them safe.

Reaching out
He takes my hand
Pulling me towards him
Towards the cool water
Towards my dreams
Towards my future
And the happiness passed
And the light is still.

Interlude 2: Some student postings on a College Philosophy Forum (2002)

Welcome to a forum thread, where you have to rhyme or you'll be dead. What is it that you believe? Can you please share with me…

Daniel

Hey I want to post
in this awesome thread
because my muse
is far from dead
My views are different
a tad askew
but if you ask
I'll give them to you

I believe in little things
like bees that buzz
and birds that sing

The Mighty Toenail:

i believe in small things too
but in all i think that me and you
are also small in the great context
a part of a bigger
larger…vest [umm]

Joker:

we are part of a cup of tea
a chair leg, and a bumble bee
some think they know

others have no claim
that we are smarter
and have a big brain
though we can question and debate
over if we choose or make our fate
i rather think we have no clue
if up is down or green is blue

Daniel:

just as we are forever small
we are also forever tall
forever thin forever fat
forever large and that is that
the little things of which I meant
are the tiny ones inside your head
simplicity's the way to go
those things make you smile you know
like summer rain or evening dew
like when your girl says "I love you"
like popcorn or fresh baked bread
the endorphins running to your head
are enough to make anyone smile
so why not sit and think a while
about why these things make you so glad
and why their loss makes you so sad

2006. What is my view of spirituality now?

When I was 20 years old I asked my Hindu friend what Hinduism meant to her – what were her spiritual beliefs and practices. She looked at me, surprised. "Hinduism is my culture; spiritual beliefs are not something separate that I have, spirituality *is* my life."

Back then I didn't understand. I was too busy trying to extract the essence of spirituality, applying a scientific process to looking at it, demarcating it into categories which have culminated in my artful description in this chapter. Have I tried to be so universalizing I have extruded something lifeless?

Because now I think I do understand what my friend meant. If you asked me now what my view of spirituality is, I think my answer would be similar to Daniel's; spirituality is in the everyday, small things as well as the grand and inspiring, the transpersonal and the mystic. It doesn't just *permeate* existence, it *is* life itself.

My husband and I read these student poems out at the Soul in Education Conference (Australia 2003) at the end of a session where people had got very disheartened about the limited opportunities to bring spirituality into education. We got a standing ovation and lots of hugs… because it reminded everyone that our students have innate wisdom and understanding about these things. They know. It is we perhaps who have forgotten.

So what is the benefit of demarcating spirituality in the way I have done in this chapter? Does it give us permission to remember and permission to include?

Mary Louise Smith presents
Botticelli's Primavera apasionado vistoso erótico, in D major.

Interlude 3: What does spiritual literacy look like and sound like in a classroom?

Praise and Grace - 1998

My journalism class is busy working, typing in stories, talking in groups about ideas or advertising. One girl, Jamie, grabs a printout of her story from the printer and gives it to me. "What do you think?" She goes back to her computer as I read it. It is for the first parent newsletter of the year. "It's good!" I say. The noise in the class stops and heads swivel around. Everyone looks at me. "But….?" says Kelly "There has to be a 'but'."
I look at her puzzled. "**But** nothing! It's really good, good exactly as it is, exactly what is needed. Jamie has done a really good job in a difficult situation."
"But teachers always, no matter how good something is, *always* give a 'but' – '*but* you could do this to improve it…' '*But* you haven't quite used these words in the best way', I can't believe you are happy with it as it is."
Everyone is nodding. I have obviously broken a deeply entrenched rule of teaching. I think it really sad that these students have obviously not been recipients of unconditional and unstinting praise.

At the time I was reading a book by Rupert Sheldrake and Matthew Fox (1996) called *Natural Grace*. I had just got up to the chapter on *Grace and Praise*. *Grace* is about unconditional love, and *praise* is an expression of grace. I read how they believed we had forgotten how to praise, had replaced it with criticism and cynicism. Praise is an expression of joy within, a recognition of what and who is good, celebrating the gifts of nature, significant moments. It's about changing your mindset so you can see the value in what surrounds you and what you experience, enabling you to express that. It really is a fundamental part of life, one that energizes, keeps the flow going, makes you feel that things are worthwhile. Are my students living lives in a praise-free zone? What can I do about it?

I had my half hour weekly pastoral care class coming up with a mixture of students from journalism and physics. We meet each week, sometimes I would choose particular themes which we would discuss or experience, other times we brought food to share, or had to deal with administrative needs of the school. We were gradually developing into a supportive group. I decided to do a session on praise and brought in my little bear.

We are in the big physics room and I ask them to sit in a circle on the floor at the front of the class. “We are going to talk about praise,” I say. I choose some snippets from the book to read and tell them about my journalism class and my concern that praise seems to be something of a novelty to them. I then ask them to think about how they feel about praise and what it means for them.

The bear is a talking bear – as each student goes to say something they hold the bear. Initially this draws nervous laughs, then it becomes something fun – what it does is change the mindset. As the students talk the discussion gets deeper and deeper, more anguished, then more hopeful and pro-active. I listen as Kelly explains that her experience of praise is of someone praising her, then asking her to do something - she now can’t listen to praise without asking “*what does the person want from me?*” She finds it really difficult to accept praise and has a severe distrust of it.

Ryan, says how everything he does is criticized, that he just wants someone to praise him, for himself, not to tie it to his achievements because he knows he never was going to be perfect or the best.

Julie says how important it is to understand when it is appropriate to praise and when it is important to criticize or suggest ways to improve – if everything she did was praised how could she ever learn? We discuss how teachers could tune into what students needed – how can you celebrate the person and the effort while still being helpful?

Aaron speaks about how he has nothing to praise in his life – it just is so drab and grey. Other students are horrified and we discuss the darkness within that causes us to see the world this way.

I then ask what might it mean and feel like to have a sense of grace and praise within ourselves? What can generate that sense of joy within, no matter how little? Perhaps we need to learn to praise ourselves and things we experience as well as other people. What might it be like to be active practitioners of praise?

Kelly asks for the bear and holds it tightly as she speaks. “I guess I have such scepticism towards praise that it would never occur to me to praise myself or someone else – it has never seemed like a meaningful thing to do. But now I wonder…. Maybe not seeing things as something to praise has affected the whole way I live my life, as if it is going to attack me!” Some students nod.

Ryan says, “Here I have been wanting praise, but thinking about it I haven’t really praised anyone else…” He looks thoughtful.
Ian says “The problem is it just isn’t cool to praise – people think you are weird or the teacher’s pet or something.”
Ryan says, “But why should we be confined by peer pressure, maybe we should be less cynical and sceptical and really say what we value.”
“Ooooh, too brave, too much emotion!” says Kelly.

“OK,” I say, “Who’s feeling brave then? How about actively thinking and acting praise in the next week and see what happens. To start, how about each of you think of something here and now that you could be glad about or feel joyful about. Could we go around the circle and each person say “I am glad that…”” My students look thoughtful. “Who would like to go first?” I ask.

“OK,” says Ryan, and takes the bear. He looks everyone straight in the eye and says he is glad that he has so many friends. Julie takes the bear, holds it and looks at, then very shyly starts to talk about what she would like to praise. And so it goes on, each person getting more confident, the energy and positivity in the room lifting with each turn.

Students are smiling as we leave. It is a start. I head down the corridor. Behind me I hear Ryan talking to a friend from another class. “We just had this really cool lesson on praise,” he says, “and I just wanted to tell you what a good friend you are.”
I smile.

I then begin to wonder about how much praise I am generating in my life. While I value and acknowledge some things, how many other things am I leaving unacknowledged? Although my classes are pleasant, cheerful and full of laughter I wonder if I am praising enough. How much is the notion of assessment restraining the way I praise or criticize students?

That night I have a wonderful conversation with a friend and he says to me “Thankyou for such a wonderful conversation… I feel so stimulated and full of energy.” I just look at him and say how wonderful I thought it was as well, and it usually is and how remarkable that I had never really seen it as something to be thankful and glad about – that it is wonderful to acknowledge the way someone makes you feel.

So now I am a lot more thoughtful about what I am doing, and in my classes I begin to watch what is happening more. I realize so much is happening that is worth celebrating. When someone asks a question I now say “That is such an interesting question, it has really challenged me…” Or, “That was such a good discussion, you guys are really thinking well today.” Or, “Gee, that was a great lesson, I really enjoy teaching you guys.” My whole attitude begins to change and it seems my whole life. In praising students or my peers I find that they became more energized and motivated, which energizes me and makes things easier to do.

Meanwhile my pastoral care students are practicing praise in my journalism and physics classes. It isn’t just me doing it – they are acknowledging others, their experiences. It takes on a momentum of its own. In journalism one day a girl sits down a bit late and obviously really harried. “Hi Leah, it’s good to see you,” I said, really meaning it. She just looks at me and bursts out laughing. “I really love this class, Sue,” she says, “just being here changes my mood from really really bad to feeling so good!”

Finally the journalism team are ready to assemble the many pages of the student magazine. We are armed with staplers, music and food brought in by the whole group. Everyone is busy folding, sorting and stapling over 300 copies. As we walked around the table, Kelly suddenly says, “You know I just feel so proud!” We all look at her, smiling. “Why, Kelly?” I ask.
“I just feel so proud of all of us, of our effort, of even myself, we have just done such a good job, we’ve really kicked ass!” She is highly emotional. I give her a hug, smiling. “We’ve all come a long long way in doing this,” I say, “Let’s celebrate!”

Dance of Life

Part 2 - My story

The evolution of my teaching of physics

Epistemological Notes: April 2006

The classroom is my mirror, my playing field, the opportunity for my deep questions to be explored. Only now, towards the end of my research process, can I perhaps see that what informs all that I have been through is *my deep yearning for wholeness*. This yearning, when framed in terms of teaching and learning, yields questions like:

> What does it mean to be a human being?
> What is the purpose of education?
> How can I help my students to learn, do, be, become?
> What does it mean to be a holistic teacher?
> What might Holistic Education look like?
> How can I integrate soul in my teaching of science?

So now I must be both *scientist* (in exploring these questions) and *artist* (open to the creative expression of my understanding) and *listener* to what my relationships with others tell me. Perhaps then I might learn something. Perhaps then I might live my way into wholeness.

I share now with you this journey.

I am aiming to tease out some of the key concerns of Holistic Education… the concepts of wholeness, connection and being. Rather than exploring these philosophically, I have tried to live them… what do they mean in my science classroom? I am hoping that in the reflecting and sharing of these lived experiences, you and I will gain a *richer* understanding of what these might mean in

a practical educational sense and what might be implications for design of curriculum frameworks. I am not trying to provide a complete understanding, but just one perspective based on practical wisdom.

My story is also the story of evolving science teaching practice … I am in the process of constructing *living educational theories* - these are contingent, being constantly perturbed, filling a need in me to understand what it is I am doing. Whitehead (1998) says that the meaning of such theories cannot be reduced to a set of interconnected propositions because the meaning lies in the living contradiction of the 'I'. And I am certainly a contradiction. The 'disorienting dilemma' that is fuelling my transformation of self and understanding, is the need to integrate my science self and my spiritual self. The pedagogical space of my Physics classroom enables me to explore these tensions for a period of 10 years – from 1990 to 1999.

And in the process of doing this I have found my way into conceptualising science and science teaching which includes soul. I have used Integral Theory as a framework in helping me articulate the different aspects of this. I am hoping that this living theory of mine might also resonate with others, beginning a dialogue where we might explore the implications for science teaching from K-university.

Action research and lived experience methodologies

What processes of investigation did I use in exploring my own teaching practice from 1990 to 1999? Although I didn't start my doctorate formally until midway in this journey (1996), I was using a simple action research cycle of Kemmis and McTaggart (1982) (plan – act – reflect) when I started my teaching in a school which supported pedagogical experimentation. I was also engaged in lived

experience inquiry – creating living theories to explain what I was doing. According to Whitehead (1998):

> The creation of living theories begins in practice. The creation begins in the kind of inquiries which I think you will have engaged in of the kind, "How do I do this better?" or "How can I help you to improve your learning?" or "How can I live my values more fully in what I am doing?"
>
> In the process of answering such questions, the action researchers find it helpful to use professional learning or action/reflection cycles of:
>
> - expressing concerns when values are not lived fully in practice;
> - constructing action plans with details of the data to be collected to enable a judgement to be made on the effectiveness of the actions;
> - acting and data gathering;
> - evaluating in terms of understanding and the effectiveness of the actions;
> - modifying concerns, plans and actions in the light of the evaluations.

When I first started this action research process my data gathering was based on conversations with my students, collection and interpretation of their work, observations of how they participated and engaged in class activities, and their comments about usefulness of activities and their own learning. I was able to be part of a rich dialogue of my emerging theories with my colleagues, engaged in peer observations and team teaching opportunities.

When I started my doctorate I moved to an *action inquiry* model based on Torbert (1991) which was based on deeply questioning one's assumptions – applying a 'critical subjectivity'. For example, in a simple action research approach one could ask *"How can I help students be better on tests?"* and then look for ways to do that. But using critical subjectivity one might ask *"Why am I valuing tests? What underpinning assumptions about education am I making?"* This suited me because underpinning my need to improve my practice was the big question *"What is*

education really about?" Asking questions about underpinning assumptions is a key in transformation to new perceptions, habits of mind and even perspectival levels (Mezirow 2000).

During this phase of my research (1996 -1999) I became much more rigorous in data collection – using interviews, questionnaires, learning environment surveys, a focus group with an outside interviewer, peer observation. I tried to create environments which enabled my students to give me honest and iterative feedback, checking the meaning I was making with them. I tested my emerging theories on my state-wide physics colleagues. I sought feedback from my students about the appropriateness of my tentative theories to their own learning experiences with varied results.

I kept journals which included lesson or topic ideas and plans, narratives or dialogues about what was happening in the classroom, my reflections, responses to my reading of theories and much theorising about how learning was taking place and where soul might be present. Cartoons, concepts maps, poetry, notes and stories.

I was keen to ensure triangulation in types of data collection as well as ensuring triangulation in perspectives of participants.

In 1999 I was co-ordinator to a collaborative action research project in a university physics department working with five lecturers to transform teaching practice. This enabled me to check my emerging theories in a collaborative setting with a large and rigorous data set of student and lecturer responses. It shifted my view of what I was doing from out of my classroom and into the bigger arena of science education transformation. So not only was I interested in exploring how to

improve science teaching for students, I was also interested in how to work with teachers in helping them transform their practice. And in doing so I opened myself to the greater issues of systemic transformation.

The validity of action research according Whitehead (1989) lies in whether the inquiry was carried out in a systematic way, whether there has been an inquiring and critical approach to the educational problem, whether assertions are clearly justified, whether the claimants have made clear what value judgements they are making as to what it is possible for them to claim, and that they have shown they have tried to critically accommodate their theories within the educational field of research.

I would also like to add another one - **praxis** – usefulness in helping me to be a more effective teacher, and usefulness for my state-wide colleagues in physics.

Auto-ethnography

I have described above the actual research processes I used at the time in exploring my teaching practice. Now let us move to 2004-2006 – the period of writing about those experiences. This written study is situated primarily in the field of **auto-ethnography** (Ellis and Bochner 2000) and **writing as inquiry** (Richardson 2000) where I reflect on the journey I have taken as a science educator. In order to reveal the processes and the dilemmas of this journey I am using a **confessional style** (van Maanen 1988) with reflections based on my perspectives *at the time* and my perspectives *now*. I contextualize my writing of realist events by trying to be as open as I can about the assumptions and values that I might bringing, though these are changing.

For most of my storytelling I write as if I am present in the moment. I am projecting myself back into both the situation and who I was at the time. I try to relate my thinking and feelings. However, I have come a long way since then; memory changes and is reconstructed. I am in a different head space and soul space now. So how can I bring authenticity to this prose? Ellis and Bochner (2000) suggests that events that were significant to us, which involved emotion and learning are ones that we can still inhabit despite the distance of time. We begin to inhabit them by remembering our feelings, seeing the environment we were in until we find ourselves in this time capsule.

This is what I have tried to do in remembering and re-storying. I have chosen significant pedagogical moments for me that caused me to rethink who I was and what I believed. I am stringing together these moments to make a story which I hope has coherence. The story in a way is chronological, but I have also extracted some themes which overlap in time. At times I move into an impressionistic writing style (Taylor 2002) to capture the essence of a situation.

Within the story are several subplots:

- my own transformation and reconceptualisation of who I am as scientist, science teacher, educator, and spiritual being
- my development of effective pedagogies in the teaching of science
- my development of *living educational theories* which explain student learning
- my reconceptualisation of what science is
- my reconceptualisation of what spirituality is
- my reconceptualisation of how we see students and what education is really for

- my efforts to help transform teaching practice and my growing understanding of the issues of transformation.

These story threads and themes are constructed. I am making value decisions on what is significant and this is informed by my perspective and agenda at the time of writing. I am orchestrating the meaning to be found in this complex experience of mine with the result that too often I feel that I am over simplifying. I am balancing this with trying to include richness, trying to unpeel meaning and trying to maintain the interconnections. It is very difficult.

To help me, I have in mind Henderson and Kesson's (2004) seven modes of inquiry or ways of knowing. These are seven voices that they suggest we should bring to any inquiry into education. They are like parts of a holograph - each has aspects of the other - together they create a wholeness.

Yes, I am interested in any inquiry process which values wholeness. Perhaps ensuring I engage in each of these modes of inquiry might assist in my own journey towards wholeness. As I ask questions in this writing process,

Seven Ways of Knowing

Techne – *craft reflection* – how do we do it?
Poesis – *soulful attunement of the creative process* – what is whole and beautiful in what we do?
Praxis – *critical inquiry* – what are the underlying power structures? Whose needs are being served?
Dialogos – *multi-perspectival inquiry* – different voices, enabling dialogue.
Phronesis – *practical, deliberate wisdom* - unpacking the reasons behind things.
Polis – *public moral inquiry* - what are the underpinning values and ethics?
Theoria – *contemplative wisdom* – what is the purpose of education, what does it mean to vision?

Henderson and Kesson (2004)

Fig 5.1

perhaps I can listen carefully to where they are coming from – which of these voices are asking this question - and perhaps then I can explore these questions with a bit more awareness and depth.

Now a few confessions…

This is my third attempt at writing this section. The first one was a major critique of why physics was not Holistic and why it was in a box, despite my efforts to be a holistic teacher. The second attempt oscillated in the other direction… I almost constructed a teaching manual (*how to* teach holistically) and was almost too self congratulatory as a counter response. I did these in 2005. This third attempt (2006) draws from both.

During my writing in 2005, I did a lot of reflection about my own experience as a scientist as well as a teacher of science, journalism, maths, and enrichment courses on spirituality, as facilitator of philosophy forums and my work with state-wide colleagues and the university action research project. Here was a rich source of material from which I could look at myself and my own transformation in a 20 year context. I began to see patterns. Then when I was introduced to the perspectival stages of Gordon (personal communication, 2005), something clicked. I could trace where I had been and wondered if many of my tensions were being caused by competing perspectives – I was trying to do something with my teaching because of the urge of my perspectival level, but science itself wasn't operating at that level. When I looked deeper at the collaborative action research project at the university I wondered then if some of the issues could be explained by spiral dynamics.

So an idea about how to integrate science and soul emerged and the more I wrote about my experiences the more I began to see how they might inform a way of thinking about Integral Science. My original aim was certainly not to do this – just to write about what it meant to try to be a holistic teacher in a physics classroom and to explore the resulting dilemmas.

So my purpose seemed to have changed as I was writing in 2005. I concluded with two chapters – one where I tried to integrate curriculum and soul, and another where I tried to integrate science and soul. Because this emerged from writing which did not have that purpose, the reader would be scratching their heads and saying, what is the purpose of this, where has this come from, you didn't tell me at the beginning! I was doing the emergent 'writing as inquiry' of Richardson (2000) where I was writing as I was thinking and gaining insight, and the reader was privy to those processes. But I had no thoughts of a reader as I was writing – it was really for myself and my own meaning making.

So now in 2006 I have gone back and tried to structure my writing so that it takes the reader on a journey to the conclusion. Unlike before, it has a much stronger chronological thread. I ended up writing far more than I expected and probably am including too much richness, given my now stated aim is to paint the shape of the environment. It is a difficult and iterative process in which I sometimes get lost.

It helped me early on in 2006 to see some grand themes in my practice towards being a holistic teacher which I have more or less stuck to in my writing. This streaming of experiences is constructed and ends up reconstructing my memory. In reality these themes – constructivism, meaning, questioning, significance, dialogue, ethics and enabling – were an interwoven part of my experience of teaching physics. Now that they have emerged as key threads I can go back and re-story my

experience in quick sound bites (see Chapter 2 introduction), but things were never that clear at the time.

So now I am bringing the 'critical subjectivity' of Torbert (1991) to my writing. I know I could write a different story of my experiences without the interpretive structures of Integral Theory and my themes – and in 2005 I did that. I am now concerned that my application of Integral Theory models to my experience might shape it too much, privileging some aspects while marginalizing others because they don't move the story along. I have to be vigilant that I am not ignoring disconfirming evidence. I try to look for it and include it. I still feel it is a bit of a Catch 22 when writing with a structure in mind, particularly when your interpretive structure becomes part of the solution.

However, even writing with such a structure in mind can be more than writing to get across certain 'endpoints' – as I am writing I am getting greater insight. I am wondering about the limitations and appropriateness of the models – I move from a naïve application of spiral dynamics to a more complex one. But it still is a simplifying device. But I tell myself that there is a role for demarcation and differentiation on the process of understanding the whole. In some cases I allow you to be party to my process of discovery, revealing *the process of writing* rather than the *endpoint* (Richardson 2000).

I have to be vigilant with myself in the process of writing not to be too self-congratulatory and therefore complacent every time I reach a new insight or perspective change. During this process I have had various conversations with others which might relate to the nitty gritty, the paradigm I am in, what I am trying to do and the meaning of words. For example, when a friend asked me *"What does feedback really mean to you Sue?"* I realized that my notion of

feedback might not necessarily be how other people see it and I need to explicate that.

These conversations have been critical in helping me clarify my own standpoints in relation to others, the significance of what I am trying to do and to see this thing called 'sue world' which is a construct of my own mind. I realize how much I had been in a cave in my first writing. Yes, I am a person who values feedback… I see it as a key way to test out ideas; through dialogue and seeing the effect of our actions (informed by these ideas) on others and the world. This feedback process is essential for growth and learning, yet in writing one can isolate oneself from this wonderful tool.

As I bring different lenses to what I am doing – whether it is applying an interpretive tool or asking the question *"How do I really know this?"* my standpoint is shifting. And I move in and out of feeling that what I am doing is useful versus that it is a futile exercise. The problem with too much self criticality is that it can be paralyzing. So I have chosen to plough ahead, recognizing a few of the epistemological pitfalls of what I am doing, and not really that pleased about them.

This type of writing has also helped me to come to understand my learning process in all this and realize that I am someone who is trying to include everything… an exercise which is problematic because of my temperament (which is prone to oscillation). When something new comes which does not fit or cannot be explained (no matter how small compared to this wholeness that I already have) it creates such a dissonance in me so that it seems everything is put into motion… a shifting of ideas, of self, and questioning my fundamental groundings. I am constantly in a state of transformation of one aspect or another, one level or another. And it is hard work.

However, this meta-cognitive process is helping me be a lot easier on myself. I begin to realize that I do have some foundations and as a result can now go back in and write with greater balance. I realize that there is wholeness at each stage of the journey, but here I have succumbed again to the seduction of greater understanding and wholeness waiting for me just over the next hill, despite my feeling that I had finished with all this processing last year.

In this process I am so much in my mind (which is constantly in doubt) that I forget that other aspects of myself, like my art, actually represent a very grounded spiritual view of reality. Now I begin to look to that to balance all this thinking I am doing. I am doing a piece right now of a reclining nude, naked to herself and the universe, with her surface peeling away. It is healing.

I have to remind myself to stop and give myself opportunity to enter another space and another way of being – to invite insight through meditation or incubation as suggested by Braud and Anderson (1998). There is also a playing out of the ideas in current events of my life and in reading fictional stories where I can interpret stories of others through the theories I am reading and constructing (which, according to Mezirow (2000) are important processes for someone experiencing transformation.) Yes, I need time to play with the ideas and let them sit.

So while *some* of my writing last year was what I called 'writing as therapy' I realize it was just the first stages…. The debriefing which included some analysis of the experiences. This next stage is enabling me an analysis of the processes and thinking which have shaped those experiences - another level up in perspectival awareness. So in my first round I was conducting an auto-ethnography (without

realizing it) where I examined the *education culture* which contextualized my experiences, now I am moving into examining the *culture of my mind*. I am getting closer to understanding self.

So this is a process of unpeeling many levels of different onions which interact with each other --- the educational culture onion, the spirituality onion, my personal onion, the science onion and the pedagogical onion. Too many tears from all this tearing apart? But tears are healing as well.

Here I am attempting to take the stance of compassionate observer, enabling myself to write with vulnerability and honesty. Am I coming totally clean? I am trying, but there are some things that even these attempts at self honesty are not able to penetrate. I also have to balance between divulging too much which is personal (for the sake of greater honesty, completeness, and cultural awareness) with the distractions that such self-deconstruction might take from the main story.

But I don't just stay as an observer; my writing moves in and out of 'present moments' and my current day perspectives, which at times might be indistinguishable. I am walking the tension of bringing too much analysis to an experience which could disrupt the continuing story with not enough analysis. I use epistemological pauses as breathing spaces to step out of the storying process as a possible solution to this dilemma.

Throughout this study I am describing students and teachers and making judgments about their behaviours; trying to apply my emerging theories to explaining what is happening. I am concerned about this as I don't like to judge others and am very wary that I might misrepresent who they are and even

denigrate them… an ethical tension. It is important then for the reader to keep in mind that these judgments are contingent and changing, and a necessary part of my process of coming to understand. I discuss some of the issues I have with this in my chapter on the Ethical Classroom (Ch 10).

To partly solve this, I have decided to use students' voice from their reflective journals as stand alones, without my interpretation, because in the wholeness of their voice there is a lot more to see than what I might extract and interpret. So now I hand over the ethical problem of judgment to you.

The student journal entries are unsolicited responses to what is happening in the classes and reflect what was memorable or significant for them. In contrast the focus groups, questionnaires and interviews are shaped by my own questions, needs and values. So these pieces of writing better represent the emergence of student understanding and being. I put them at the end of chapters so you, the reader, can apply the new insights from the chapter to your reading of them. As I read them from the place I am now, I see far more in them than I saw when I first read them. I am sure in another year's time I will see more. I invite you to go back and re-read them as you explore further chapters and note if you see new aspects within them.

Students only used these reflective journals in the last two years of my teaching but I have included some of their entries at earlier times in my chronological story because I think they represent the particular perspective I am trying to illustrate or challenge. You may well ask, how does what happens in my 'holistic classroom' in 1999 reflect what was going on in my 'constructivist classroom' of 1993? That is because I took the students on a journey similar to my own… starting with where they were at… which was a very pragmatic and authority based experience of

science (*how do you do it?, what do I need to know?*) … so during the course of the year their type of entries change to reflect more holistic and existential explorations which I then incorporate into those later sections. Also, I am engaged in a process of *transcend and include* in my teaching, so pragmatic constructivism still forms an important aspect of my teaching of science which I was continuing to develop right up to 1999.

In doing this placement of student voice I had to let go my need for chronological accuracy and it took me some time to be comfortable with this seeming sleight of hand. It helped to reconceptualise myself in this writing process from scientist trying to *'represent the truth'* to an artist *'expressing essences'* where the criteria for validity now becomes *verisimilitude* (how well does it convey a sense of the real?) and *authenticity* (aims to develop the reader's understanding and appreciation of their own views).

I use these student reflections as a way of illustrating, expanding and providing dissonance to what I have said. Yes, I am using a Bateson (1972) technique in occasioning your learning experience but not trying to make everything clear, not making all the inferences that could be made (which are never 'all' and therefore can suck us into believing we know it 'all') and through offering you different ways to experience what I am saying… through student voice, fictitious dialogue and through my artwork.

I am using my experience as an artist in creating 'space between' and depth and layering to offer the potential for emergent understandings. And I hope that this experience of reading might also be something that reveals an aspect of what I mean about Holistic Education.

Is this writing an integral art form?

According to **emrgnc** (2006) Integral art holds that:

- all perspectives are valid,
- some viewpoints may transcend and include others
- where you stand is what you see.

Integral art includes both the experiences of artist and reader and each can bring many different eyes to it. Integral art may help in both transformation of the artist and the reader. It may be an expression of transpersonal knowing which pulls the reader into a deeper connection with their higher self.

I allow you to judge how it affects you. It has already helped in my own transformative understanding and enabled me to call forth my own higher self, or so I think.

As I am writing about my own experiences I am also thinking of implications of the development of my pedagogy and my transformative learning journey for those Tasmanian Year 11/12 curriculum planners that I introduced to you in the earlier chapters. I am sure that given the chance they would have a lot to talk about in terms of implications for curriculum design, how to think about subjects and learning as well as issues with the professional learning of teachers. I invite you, the reader, to ask these questions as you read about my experiences. Can you imagine how curriculum planners might respond? I give them a brief opportunity during an Intermission.

There are also many more threads emerging from my stories that I could take up and explore deeply. I am aware, with the benefit of hindsight, of the shortfalls in

my action research throughout 1996 to 1999. I was a pragmatic girl. My goal was clear… to trial as many different Holistic pedagogies and principles as possible. To get inside the notion of Holistic by covering as many aspects as I could and see how they are inter-related. So this is a key element of this journey – an exploration across a large territory with the interconnections becoming in a sense more important than the parts. After all Holistic is about wholeness and connection and in my very inquiry I was trying to live my way into experiencing that.

But still I keep wondering now, what I might have found out if I had asked a deeper question or from other perspectives. But I could only ask from the standpoint I was in and the perspectives I had. The very act of asking questions has enabled me to be in a place now where I can see what other questions I could be asking. And I am well aware that even here in this place there are many questions I still don't know exist. I need to learn to be comfortable with that sense of incompleteness and enjoy the journey of finding out, just as my students learnt to do. Otherwise there would be nothing to look forward to.

In 1997 I became very distraught after hearing a conference speaker talk about the importance of going deep. Rather than digging lots of shallow holes, we should dig one and then go deep into the heart of our own experience, she said. I thought perhaps that in all this trying to connect many different aspects I was digging lots of shallow holes and avoiding the depth. Was my whole life shallow? I am such a generalist, pulling skills and knowledge across many different areas, whether it is careers, relationships, within teaching, or my own spiritual life. Should I be on a path of exploring one thing deeply? Perhaps I am, but the topic is not wholeness, or connection or spiritual development…. Perhaps the topic is me. So what tools might I bring to exploring this one thing deeply? Mindfulness, honesty, integrity,

compassion, ability to helicopter in perspective? And in exploring this one thing can I *discover and live my way* into wholeness, connection and spirituality?

Ethical considerations

My research can be considered in two stages – the **action research** stage and the **auto-ethnography** stage, each with its own ethical considerations.

In being engaged in field research, how does the very act of research impact on those people that one might be researching? What is the responsibility of the researcher to the well being of the participants during the course of the research?

My research of my physics classes was not that of an outsider coming into a classroom and getting data. Rather it was me, a practicing teacher, slowly changing my practice and ways of being and thinking as I tried to move towards being a holistic teacher. As a teacher, I already sought relationships with my students and encouraged honest feedback about my teaching. I had always experimented with teaching methods and in a sense all my students over the years had been inadvertent guinea pigs.

But now moving into action research I was explicit about this – asking my students for their permission to try new things on them and to participate more in giving me feedback through interviews and questionnaires. This process naturally impacted on my students. For many it was seemingly positive; feeling that they had a voice in their education processes as well as the development of self-reflective thinking and self-awareness.

The learning activities which I facilitated and the relationships I made also impacted on students, sometimes creating significant transformative moments for them. But how is this different to my role as a teacher whose aim is to foster student development and to support their sometimes messy transformations? In the process of doing such research I developed a greater sensitivity to my students' needs and voice, taking more ethical responsibility and developing a greater self capacity for care. It was a process which was not necessarily perfect but it was about growing into more ethical and mindful ways of being. I describe some key moments that helped my own transformation of perception in Chapters 9, 10 and 11.

Developing respect and care for my colleagues has taken longer. I describe the shift in my perceptions to my university teaching colleagues in Appendix 3 which gives some insight into the difficulty of developing humanity within oneself.

So what is my responsibility now in writing about these experiences? How do I represent the participants in this inquiry? Can I accurately reflect their stories or their meaning perspectives? How can I check my interpretations and enable their voices to be heard? Should I allow for greater collaboration in compiling multiple perspectives (the *dialogos* of Henderson and Kesson, 2004)? Am I showing sufficient care for them in revealing their vulnerabilities?

Certainly at the time of doing the field research I was keen to check my understandings with my students and refine my interpretations to more closely match their own interpretations. This was essential to my process of coming to know them and see them (an infinite well) so that I could perhaps dig deeper in myself to grow my own humanity. (I discuss this process more in *Appendix 1- Explicating my research process*).

But was I seeing **The Truth** (a single correct interpretation) or **a small truth** (a transient consensus)? In many cases it was a tentative seeing that enabled me to progress to deeper relationships with my students… a never-ending journey. At the time it held a certain amount of truth, or perhaps *praxis* would be the better word.

With the 'crisis of representation' in qualitative research (Taylor 2006), even member checking does not guarantee that **The Truth** can be revealed, nor that there is even one to be found.

Auto-ethnography addresses the crisis of representation by using critical self-reflexive inquiry. This research methodology recognizes that there is no one correct interpretation. The research area of concern is primarily a study of self in culture; it foregrounds the researcher's perceptions of the world as they interact with others. It is situated explicitly in the author's own interpretative perspective or worldview. Thus part of the process of inquiry is making these interpretive frameworks visible.

By bringing a critical lens to one's narrative, one is aiming for *verisimilitude* (making it seem real) while remaining aware of the dangers of claiming it *is* real. Thus one is asking oneself what other realities, perspectives or interpretations can be made. One is questioning one's own meaning making process and seeking to transform it. These questions enable the 'critical subjectivity' of Torbert (1991) which help to move one's current perspective into higher perspectival cognitive frameworks.

Thus in the process of writing narrative there can be several iterations whereby the stories are seen by the author from various interpretative standpoints; where

the author's unfolding and evolving worldviews are made transparent. Rather than collapsing this down to a single endpoint which privileges a particular interpretation, the author can use styles of writing (e.g. iterative stories, dialogue, dialectical reasoning (thesis to antithesis to synthesis)) which capture this process and enable plurality of meaning (*crystallization*). This can help the reader to also tread the tension of representation and interpretation; helping them to be more mindful of the situatedness of the author's interpretation with respect to the current state/stage of the author.

So auto-ethnography tries to be respectful of the participants in this way, rather than through the process of member-checking or multiple voice inquiry. Thus my responsibility is to be vigilant in this process – to be aware when I succumb to believing wholly in my own reality (and yes, it has happened a few times, but with help by my supervisor I was assisted in bringing new doubtfulness to my 'fixed' interpretations.)

So does this give me a license to make up stories about my students and other participants? I am trying not to, because although this is a self study I want to share with the reader deeper insights into the capacity and dilemmas of our students and the issues of transformation of science teaching. I want it to capture a sense of the real that can help create praxis in the reader – a self reflectivity and a desire to go find out for themselves. I want to provide *authenticity* (with the aim of developing the reader's understanding and appreciation of their own views) as well as *verisimilitude*.

Thus, I am trying to capture the essence of the experience *as I experienced it* or *as I **now** interpret* that experience. And this interpretation in hindsight now does not have the benefit of iterative checking with my students; it may seem quite

different to what they might remember of the experience this many years after the fact. So perhaps for some of the participants (both students and colleagues) they will feel these stories *are* made up or non-recognizable. They might not like how they are depicted in my interpretations. They might not like their vulnerabilities exposed. How will they feel in reading such stories?

There are so many stars and bit players now in this movie I have been making. Do I even try to check with them and ensure they are happy to be players with the lines I have given them? It just isn't feasible. So showing care for my participants is done by ensuring anonymity in my stories, through changing names and writing more impressionistically. Many of my students signed consent forms at the time (see Appendix 4) allowing me to use their focus group interviews and questionnaire responses in my study but I have not sought consent from the colleagues I talk about. Rather I rely on anonymity to protect their identities, or amalgamation of written characters.

I hope they can forgive me and just see what I write as saying more about myself and my interpretative world than who they are.

(But having just said that this research is based on my interpretative world then can I claim to know anything beyond that? Can I claim to have insights and recommendations which might inform science education? I would argue that the broader significance of my work is established by my links to the various research communities and through my addressing issues that they believe are significant.)

The other aspect of ethics in such an inquiry as this is one of **self-care** and this I have to say I was not very good at. I would recommend for anyone engaged in such critical self-reflective studies to make sure that you have a support team who

understand well the transformative process (spiritual, mental, emotional) and can monitor you and help you as you might open dangerous doors to the depths of being. Having a meta-understanding of the transformative process as well as a range of techniques to 'see' and interpret what is going on in multiple ways is also very helpful. These meta-understandings were something that I have only really gained as a result of my journey.

Where shall I start in relating 'my story'?

I shall start at the very beginning in 1990; my first year of teaching year 12 physics. So the first theme is **The Constructivist Classroom** (Chapter 5) and then that moves through The Meaningful Classroom, The Questioning Classroom, The Significant Classroom, The Dialogical Classroom, The Ethical Classroom and The Enabling Classroom.

Each chapter represents part of my teaching journey which roughly relates to moving through different memes of the spiral dynamic model. So from a Spiral Dynamic (Beck and Cowan 1996) point of view, The Constructivist Classroom starts in the **blue meme** of *teaching science by authority* and moves towards the **orange meme** which values *student autonomy in thinking*.

For many students entering college and university the **blue meme** is their experience and expectation of science…. And for many university science lecturers this is their expectation of *teaching* science, even though as scientists they might operate within an **orange meme** scientific culture. (see Appendix 3) So this first chapter of my journey aims to start at a place with which readers might identify – as something that is still current in their experience, or something they might remember but have moved on from.

Does bringing in Holistic perspectives help movement towards the **green meme** in teaching science? What are the implications for student growth? What might push science further? I explore these questions in the subsequent chapters, finding ways to flourish physics and students' experiences of physics. But I come to a point where I have taken physics as far as I can go within the current educational system. So I need to look towards integral solutions. If you want to see the result of this journey and its implications for science teaching as a whole go to Part 3, chapter 12 .

In going back in time and relating these different stages my writing as inquiry voice has also taken on these different paradigms… starting with a more modernist propositional tone (seeking answers, generalisability and methods) in Chapter 5 and gradually moving to a postmodernist tone (dialectical reasoning, not reducing complexity to single answers).

This labeling using spiral dynamics is just a construct but perhaps by using such differentiation it might yield useful insights which we can then integrate in new ways.

I now invite you to come with me on this journey…

Unpeeling the layers

Prelude: some musings about why it may be important to reconceptualise how we teach science

Exhibit A

August 2005

I have been reflecting a lot about my own experiences as a scientist in order to help me understand what might be missing in our high school and university science courses. Flashback…

> ***1984.*** *I am a scientist in a paper mill and I am really happy. Karen, my work colleague, and myself have just improved the efficiency of the mill by 30% during the winter months and the mill is now earning millions more, and jobs are saved as the mill can now compete with the cheap imports from Finland.*
>
> ***1987.*** *I am working as an economic researcher for the Tasmanian government researching the economics of the Australian pulp and paper industry. I discover that as a result of that increased efficiency, the paper mill now has more paper than the current Australian market can take, so it sells it cheaply in Indonesia. The old inefficient paper mills in Indonesia can't keep up and so they squeeze their wood suppliers to reduce the costs of wood. The wood suppliers have to cut down more trees to make as much money, sending woodchips to Japan. The destruction of the Indonesian native forests increases.*

Was it my fault? Should I have known? I decide to go over to Karen's place and discuss what I have remembered. I want to ask her what she thinks. She has continued to work in the paper industry and has been a researcher and lecturer at our university chemistry department for 18 years.

She is cutting up vegetables with her 10 year old son, Glen, in the kitchen. I tell her my story, piece by piece until finally I proclaim "So, I am responsible for the devastation of the Indonesian rainforests!" Glen is listening goggled eyed. "Is that all true? It really happened?" he asks. "Yes," I say, "that is the problem with doing science if you don't know the bigger picture and the impact of what you are doing."

"But Sue," says Karen really concerned that I am blaming myself "You couldn't have known at the time, you can't expect scientists to know stuff like that! And anyway, if you were to blame so was I."
"Yes," I quip, "It was your fault too…. **AND**…**WHAT IS WORSE** … you are still doing it!" She just looks at me, eyes wide open. "Am I? I never thought about it in that way." She shakes her head… but now Glen wants to tease it out… "So being a scientist is a lot more than just learning science at school, you have to know about world issues as well?" He nods wisely. "I think that is really important. It is like playing SimCity… you have to know how one thing you do affects everything else."

* * *

Karen and I have recently spent quite a bit of time together. She has just started an innovative unit for 3rd year university chemistry students which uses *Problem Based Learning* instead of the normal chalk and talk lecture format of her colleagues. It has been very difficult and she has found a similar resistance from the majority of students that we came across in the first year physics project. I have been acting as critical friend, debriefer, observer of classes, interviewer of students. We are beginning to realize how prevalent cultures work to resist innovation in teaching; in departmental structures and requirements, in students' past experience and expectations.

We are both shocked when students in interviews reveal the following conceptions of science:

> Chemistry formulae are carved in stone. Therefore they are best learnt from a blackboard in a lecture.
>
> My aim in my undergraduate degree is to get as much information as possible so that when I am working in industry I can just access what I need to know. I will have plenty of time to solve problems then. By doing a unit like this I am might be missing out on an important piece of information I might need for later.
>
> I don't need to learn how to work effectively in groups, I have been doing that for the last three years at university and I should know how to do it by now.
> *(from someone whose group interactions were woeful based on my observations)*

> Expecting us to come up with new ideas when we are at university is unrealistic. If we were working in industry there would be older people who could tell us how to go about solving the problem.

However, about one third of the class did get a lot out of the collaborative inquiry mode of learning; they came up with some innovative approaches, drawing on their expertise from other subjects as well as from what they learnt about surface chemistry in the unit. They find themselves moving from the bottom percentile of students in the course to the top. One student who is excellent at doing exams (through memory and regurgitation) now finds himself failing the unit as it is clear he cannot integrate information nor understand what bits are significant or not. He gives Karen major headaches as he protests to the department about his grades until she is forced to pass him.

Into whose hands would you like to put the future of the world?

Exhibit B

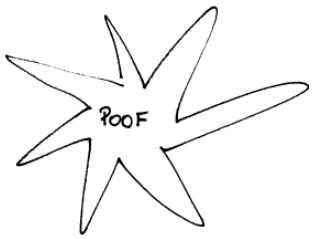


Fig 5.2

Exhibit C: A quick quiz

Rank in order of importance what you think might be important in educating students to be scientists within each of the following subcategories:

1.
- □ being able to use an objective empirical method
- □ having technical skills
- □ being able to move in and out of 'scientific thinking' to explore a problem
- □ understanding the limitations of a scientific eye to solving problems

2.
- □ having a good foundation of disciplinary information
- □ knowing what you don't know
- □ knowing how to get information
- □ system thinker

3.
- □ being an expert in your area
- □ effective dialogue with colleagues within your area
- □ effective dialogue across disciplines
- □ Understanding the role your discipline has in the greater field of human endeavour

4.
- □ Able to take on the perspectives of others
- □ Looks for and is able to see the repercussions of what you do
- □ Aware of the culture you are in which dictates what you see
- □ Have an altruistic and caring attitude towards others and the planet

In what way might a quiz like this close down thinking or open it up? What would you want to add? How might you reconceptualise it differently?

Chapter 5

The Constructivist Classroom - 1990 to 1996

Questions:

Who is this person teaching physics?

What do I have to know about this subject and what do I have to teach?

How am I going to teach it?

What does it mean to teach science as opposed to being a scientist?

What is scientific inquiry?

Introduction

Parker Palmer (1993) says that when we think about teaching we often think about the *what, how and why* and tend to forget about the *who* that is doing it. As a beginning teacher in 1990 I was naturally concerned about the *what, how and why* of what it was that I was being asked to teach. How I approached these questions depended very much on *who* I was. So I start this chapter by situating myself back in 1990, speaking with the voice of a naïve teacher coming to grips with their craft. I have one foot in the scientific modernist camp and the other in the spirituality camp and am trying to reconcile the contradiction of these through the development of 'living educational theories' (Whitehead 1998) which I am testing through praxis. Who am I in 1990? What are my contradictions? How does my journey unfold?

Who is this person teaching Physics?

1990. It is my first year of teaching and I have been asked to teach physics. I am in a brand new college (Year 11/12) and I am the only physics teacher. The light blue/green paint is barely dry in my physics classroom; it is full of light with lots of windows with bright red frames. It has desks which can move, power cords suspended from the ceiling, a door to a grass area outside and a large prep room filled with spanking new equipment. It would be a teacher's dream, or would it?

There is an assumption that I am a physics teacher (because I have a degree in physics) and that being a 'physics teacher' is a coherent entity with certain experiences, understanding, attitudes and pedagogy. But the physics course is the anti-thesis of all I represent – in pedagogical approaches and its ways of inquiring and being in the world. I am confused I don't know how to approach the teaching of physics. I don't know how to be true to myself. I just know that I want to ensure that my students aren't indoctrinated into believing that what they are learning in physics is a true representation of the universe.

With hindsight from my 2006 standpoint I can perhaps best explain the inner tensions by demarcating these into three different selves – my science self, my pedagogical self and my spiritual self.

1. **My spiritual self** – this is the self that is engaged in inner spiritual practice, trying to be a better person, wanting to be of service to others and the world, struggling to make meaning of the Kosmos, and wishing for enlightenment. This is my intuitive and reflective self.

   My spiritual self has been shaped by enculturation in my childhood into Anglican Christian perspectives, my denial of that after being exposed to other religions, a determined search into creating new meaning through study across a wide range of esoteric literature, and through a determined path of self development and self realization – relationship work, experience in different healing modalities, inner practice.

   My spiritual self struggles to articulate what spirituality looks like in education, initially confused between spiritual bodies of knowledge, spiritual being, and spiritual processes. My spiritual self wants to understand who we are as multi-dimensional beings and what this means in teaching. This self struggles to reconcile teaching for subject outcomes versus teaching for the whole person.

2. **My science self** – this is my disillusioned self, feeling that science is narrow, problem-making. Yet this is the self required to teach science well. This is the self that is struggling to juggle science teachers' perceptions and requirements of science teaching with my own critiques of science. This is my analytical self.

   I have been enculturated into thinking about science in a particular way through my experiences at school, university and then as a practicing scientist working in

industry… science is objective, 3rd person, methodical, analytical, validated, technically reported, independent of the researcher. However, my reading of spiritual literature has challenged this… subjectivity of research, other ways of knowing and being, other levels of reality, the issues with reductionistic and materialistic worldviews in creating world problems.

However, this scientific need for truth and answers, objectivity and generalisability is still very much a part of my make up. I might not be searching for truth in the arena of science but I am still searching for it in the broader Kosmos.

3. **My pedagogical self** – this is the self that wants to be a good teacher, creating good student outcomes. This is the self trying to reconcile good student outcomes required by the system with the good student outcomes that I believe are important based on my spiritual beliefs and my own positive experiences of learning. This is my pragmatic and action inquiry self that is on a journey of coming to understand my students, what learning is and what helps learning.

   My pedagogical self has been shaped by my previous experiences of learning. The very positive authentic learning experiences that I have had working as a scientist, economic researcher, coach and being part of a national enterprise team has shown me that there is a lot more to learning than traditional methods that I experienced while at school and university. I now believe that effective learning occurs through questioning and inquiry, collaboration, authentic projects, enterprise style learning, role plays, just-in-time training or just-to-late debriefing.

   This pedagogical self is also shaped by my experiences within particular school cultures in my roles as teacher and manager, by the metaphors which shape our state wide curriculum frameworks and conceptualization and by our western progress based culture, much of which are invisible to me at the time.

   This self is being challenged by my experiences in the classroom, by my trying to reconcile spirituality and science, by my leadership in the professional learning of teachers, my exposure to new perspectives and my processes of reflection.

My pedagogical self is I believe the 3rd space (Taylor 2006) which enables the playing out of the major dichotomy between my spiritual self and my science self – two distinct cultures. In

the past I have been able to compartmentalize my spiritual self and my scientific self, living reasonably happily. But in the pedagogical space of the classroom this is not possible.

In asking *how can I help my students to learn better?*, my spiritual voice might ask, *Why is that particular learning important?, What assumptions are you making here about what it means to be a human being?* and *What is your role in helping students to realize their being?* Tension is created as I reconcile one way of thinking with the pragmatic requirements of another way of thinking and teaching. This playing out of the tensions results in all three aspects of self being perturbed and transformed, creating new possibilities and perspectives.

But I am getting ahead of myself. Who was I in 1990?

A person starting on a journey. Let us open the door to the physics classroom. A possible place for reconciliation of science and soul.

No please, can you close it again! I don't want to go in there!

I really DO have a problem with physics!

My problem with physics 1990

> *Physics tries to explain the whole cosmos, without realizing that the way it is doing it is narrow – only looking at the material world, only using one epistemology.*
>
> *It believes that it can find the Theory of Everything (TOE) or Grand Unified Theory (GUT) and if we are lucky it will be a formula that you can stick on a T-shirt.*
>
> *Physics aims to break things into bits. When you see only the parts, can you see the emergent holons?*
>
> *Some people think that physics explains atoms which explain chemistry which explain biology which explain psychology which explain love.*

The Newtonian idea, that once we break the world into bits we can determine exactly what happens next, is a powerful metaphor which has permeated modernistic society, effecting how organizations are structured including schools with grades and standard tests.

While Quantum Theory challenges this conception of the world, it is not widely understood nor applied to contemporary life.

Systems Theory tries to unite the 'bits' in a web of relationships, but reality is still demarcated in parts, relationships and whole systems.

Even Quantum Theory and Systems Theory only examine the material world and can not tell us the nature of spiritual reality.

Many problems in the world today are caused by the partial views that people bring when applying scientific methods, and Newtonian paradigms.

My problem with 'my problem with physics'

How then can we see the whole of reality and come to understand it?

If one tunes in at gnosis level, seeing with the spiritual eye, could one build a bridge that would be safe? Would we even need bridges?

Should I be teaching students to tune into reality with the eye of the spirit in order to 'come to know' that reality and appreciate it? Would this experience be something you could 'understand' or do you still need to differentiate and unpack what you experienced?

When you look at the universe with a spiritual eye, can you appreciate what you are seeing better if you already know the formula for gravity, or does this limit what you see?

Does the spiritual reality leave footprints in the physics reality as clues to the meaning of life? Is it seen in the symmetry, the beauty, the fractals, the quantum connectedness? While physics only looks at physical reality can it remind us to look deeper into the very heart of the Kosmos?

My problem with teaching physics

Am I perpetuating the idea that when you break things into bits you can understand them?

The Physics course itself is a composition of bits. This topic follows that topic. A building up, bit-by-bit of knowledge. Is this the only way to teach physics? What metaphors about learning am I perpetuating here?

I am reading about North American Indians. They don't have a separate word for a tree, rather man and tree… because the way they perceive the world is in terms of relationships. I look at a tree and still see it as separate from me. So what informs this way of seeing the world where everything is automatically in relationship? Is it a spiritual knowing or something that is a cultural perception? It seems beyond a systems understanding of reality. What might it be like to be brought up in this culture? Would I see differently?

Who are my students and what deep insights do they have already about the grand nature of the Kosmos? What is a learnt habit, or a misconception at a mental level, and what might be a deeper inner truth?

If I can't see nature with a 'spiritual eye' or a 'relationship eye', how can I help my students to see nature in such ways? And how would I know when my students might be using such eyes?

The physics teaching culture 1990

While I think I might be able to close the door to my physics classroom and do what I want, I am being naïve; I am not an island, but a member of a community of teaching physics practice. The traditions, practices, attitudes and expectations of my state-wide science colleagues shape and constrain my own ways of thinking about how I teach, what physics is and my selection of practice.

My physics colleagues are all male and I am the only female in this community. I feel like I am a completely different species. In my conversations with the other teachers I realize that there are top dogs and these are the people who *know* the most. And are we actually having

conversations? One person states their view and another theirs. Information. And sometimes there is debate. I am on the outer, alienated, not part of this club yet. It seems I have different aims, ways of doings things and ways of wanting to be and talk with people.

As we share materials with each other I find I am given examples of instruction based experiments – here is the formula to be tested, the method to be used and then the graph that is to be plotted.

It exemplifies all that I hate about science. Closed, empirical, mechanical, impersonal. It is counter to my own experience as a scientist who was engaged in finding out the unknown through a range of inquiry processes; some relying on the scientific method, some requiring imagination and insight as well as dialogue with colleagues and negotiation with the wider scientific community.

It seems that I am in a culture of physics as a *body of knowledge* and science inquiry is following a recipe prepared by the teacher. The syllabus is a list of important knowledge that we have to get across to the students. The experiments are there to give students technical 'know how' and experience of the scientific method within the context of this knowledge.

We are a community of *tellers* of physics knowledge and I am a member because I can not yet conceive of any other way. The *telling* is based on a standard logical development of ideas with intermittent experiments timed to follow in the double period. Is there any real understanding of what is going on in students' heads by we teachers? It is assumed that when students regurgitate the correct answer in tests that they have the right understanding. In moderation meetings we look at students work and decide on their marks based on how well they meet the expected answer. There seems to be no reading between the lines to try to understand the thinking of the student.

Fig 5.3

Do I understand the thinking of my students? What do their questions tell me? Am I interested in *how* they are thinking about what I am *telling*, or do I see their questions as a way of guiding my telling – making it more efficient. Why are my students so passive? Why

are they afraid of tentative scientific ideas and want to know what the right answer is? How can I engage them in a meaningful process of inquiry into the mystery of the universe?
I feel that I have been sucked into a vacuum cleaner with no way of finding the way out. It is dark and dusty in here. I am in a box and the lid is firmly closed.

How did I and my physics colleagues move? A key force was participation in a number of workshops over several years which looked at constructivist research and teaching practice and challenged us to realize that what we thought students were thinking was actually not the case. The videos we watched, where students were interviewed after university about science ideas learnt at different stages through their education, were a revelation to all of us. Seeing students argue eloquently to defend their alternative frameworks despite conflicting evidence was incentive to find out what in fact my students really thought and how they constructed knowledge. What were they keeping to themselves that my current teaching practice hadn't enabled them to articulate and explore?

> "In order to be better teachers we need to understand how our students think."
>
> Parker Palmer

Practicing constructivism 1992

So here am I now participating in workshops on **constructivism** which are being run for science teachers state-wide, particularly with the aim of encouraging girls into the physical sciences. (Later I find out it is the *trivial* version of constructivism). We are informed by 'how to' and 'why' papers on constructivism such as Hart (1987), Yager (1991), Tasker (1992), McDermott(1993).

I am looking at ways to *build up* students' understanding of concepts, rather than just *tell* them the concepts. The students aren't a blank slate but are bringing their own ideas and knowledge to thinking about the ideas. The

Constructivist approach

Finding out what students know -
- initial explorations
- brainstorming
- challenging question, quiz questions
- think / pair / share

Using contexts that are relevant

Enabling time to process knowledge – reflecting, discussing, predicting, designing, theorizing, applying

Opportunity for students to discover and theorize for themselves - making their own meanings.

Showing the relationship between ideas and the whole

Experiments:
- connect to previous experiences
- reinforce or build key concepts
- avoid unnecessary jargon
- time to become familiar with technology and jargon
- opportunity to be creative
- students can focus on one aspect of inquiry cycle (explore, predict, design, experiment, apply)

Fig 5.4

meaning they make is not necessarily the one I intend but personally constructed.

So my role as a teacher in front of the class is to probe for students' previous understanding by using some initial activities which help them focus in on what we are doing… to remind them what they know already. This could be asking a question, giving them some case studies to think about, getting them to explore some different phenomena, asking them to brainstorm.

Then I look at ways to effectively *build* on their knowledge. As I introduce activities or explanations I test to see how students are making their meaning by asking questions and giving time for students to tease things out with their partners (think – pair – share). I am mindful of how I talk one-to-one with my students.

A sample of the types of questions which can cement understanding:

Paraphrasing –
- explain it in your own words.
- Imagine you are explaining it to a 9 year old
- What are the key points?

Apply it
- List things that could use this principle
- What are advantages/disadvantages for using it in this case?
- How might this application work using the ideas we have discussed?
- How could this idea be used in a completely new way?

Your questions
- List 3 questions you have about this
- If the discoverer was here today what might you ask?

Commitment
- Predict which of these possibilities
- Pre and after quiz.

Fig 5.5

So rather than just giving an explanation to their questions, I am first finding out what they know and guiding them to the process of coming to understand. The more I model this process of thinking, the more autonomous they seem to become in their thinking. I am making the process transparent (but not yet explicit).

The workshop presenters suggest that classroom scientific experiments are an opportunity to build concepts as well as to develop technical skills and I begin to reconceptualise them not as instruction based experiments but as investigations or inquiry into those concepts.

The workshop presenters also explain how students might take on board knowledge in the classroom in order to pass the exam, but go through life using a different set of knowledge. There is a compartmentalization… perhaps because the students haven't really understood the physics ideas in the first place and they are not connected to their everyday reality…. the ideas do not have meaning for them.

The way physics is often taught is using sterile metal objects, complex indecipherable equipment, denuded diagrams of abstracted objects; it is not stuff that happens to bodies and real things. Therefore, they say, providing real contexts, making it personal, building

understanding and eliciting and challenging misconceptions helps students to reach the agreed truth of scientific knowledge.

So science can be personal now? Is this giving me permission to think about science in another way?

I want to make physics more meaningful for my students… meaningful in that they engage with the subject knowledge, meaningful in that it speaks to something within them and engages their souls. To have the latter, I think, you need to get the former right. Students need to understand before they can be inspired by it!

How can I make it more understandable?

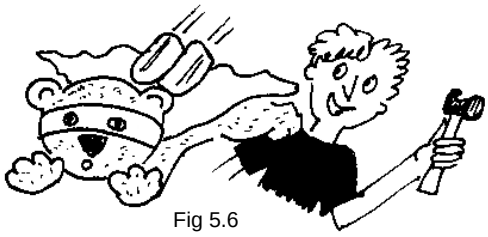


Fig 5.6

So I go to Kmart and buy bats, balls, dinky cars and skateboards. I look at getting students to use everyday items that they are familiar with. We don't use metal objects, but propel teddy bears through space. Students get to look and feel how these real objects move. They get into the spirit of this… they bring in a bear with cape, steel underpants and goggles for an adventure on a flying fox propelled by soda bulbs. They bring in Barbie dolls to sit in big toy cars that they will roll down slopes. They make up stories.

They are 17/18 years old but they seem to have discovered a second childhood of play and fun and there is a lot of laughter in my classroom. They vie with themselves to come up with the most quirky or creative thing and their presentations involve rap music or plays which are a context for their scientific explanations. The bear becomes the class mascot and even travels on excursions.

Students now also seem to be a lot more focussed on the 'real physics' – the worksheet problems (which now have Mr Bean and Raiders of the Lost Ark questions, so we can see whether some of those actions are really possible) and are more responsible in their learning.

I am beginning to see how much time I spend on *telling* the conventional physics story through my notes on the board, rather than allowing the students to discover and create meaning for themselves. I realize I am still spoon feeding, but in a much more effective way than before.

I look at making the experiments even more open ended, enabling students to explore for themselves rather than following my constructivist steps and get quite a shock in one experiment. I have asked the students to discover all the variables of an oscillating spring and one group comes up with too many variables, and can justify their conclusions based on their results. I look at the boy with lots of things running through my head, and finally release the need to have a pat answer. We then have a conversation together and I unconsciously move from *teacher* into *scientist*… looking at how we might find out why. Perhaps by me moving into this mode I gave him permission to be a scientist instead of a mere learner of ideas.

He went on to do a PhD in physics, I now reconceptualised my role in the classroom. I was teacher, constructor of understandings, designer of activities… but also someone who enjoyed the unknown and could trust in her skills as a scientist to explore what I didn't know with the students. And this very exploration opened a whole new way of teaching.

So now, when students ask me to help them with their physics problems I begin to listen to myself. How much am I constructing *their* understanding and how much is *my own* understanding being challenged? How might we be constructing understanding together? I find myself moving from saying *"Now how are you thinking about it? OK, so when I do this, what do you think is going on? What about when I do this? (disconfirming)… OK what conclusions can you make? …OK, how could you use this in your problem?"* to *"That is an interesting take on it… how could we test it?"* Or *"Let's tease that out more, what could support your argument."* or *"You know I haven't thought about that aspect of it before…. I wonder if…"*

Students are actively coming up with their own hypotheses and explanations of how things work and happen. I am doing less explaining. There is now a need to do quick experiments or checks outside the set activities to test these hypotheses and I usually have trolleys set up with lots of bits and pieces so students can cobble together what they need. I begin to give them free reign of the prep room (to the horror of the lab technician). At first they are proud to be given such responsibility and then it is just an expected part of what we do… we certainly don't wait for the double period to test things out.

Students now seem to be all doing different things within the context of our task for the day, and I realize that a classroom which has multiple activities going is actually very stimulating with lots of cross fertilization. There is now a sense that we share what we find rather than keep things to ourselves. The point is to advance the whole understanding of the group,

rather than for an individual to prove that their thinking is theirs alone because of assessment requirements. The marks of most students improve and they seem to value this collaboration.

As I start asking students to tell me what they are thinking I begin to realize the interesting ways that they have thought about things and how they put ideas together. I begin to listen more and hear beneath the lines. It makes me question what I know and I become a lot more thoughtful about the physics. I realize how much I have had an agenda in my head about getting across the *true physics* version without being aware of other possibilities. I had been seeing myself as *guiding* students into the *right way of thinking*, or correcting misconceptions rather than being co-constructors of understanding with each other.

Fig 5.7

At first my students' thinking process seems quite sloppy… like an unused muscle and then they get a lot better at it. I wonder how they think and the process of thinking. Can I be better at this if I knew more about how understanding is constructed? Is learning made in the head?

Yet I am also very much valuing learning from personal experience – after all I am teaching enterprise style pedagogy in my other classes. How does this supervised meaning-making fit in with the more holistic approach to learning that enterprise gives, where learning is something that emerges from the experience? How am I taking into account the wholeness of my students?

Where is the soul in all this? The laughter? The curiosity? The wonder? The meaningful questions? In the way students be? In my improved relationships and understanding of my students?

What is science now? Does science lie in the thinking that we are doing, as well as the content that I am trying to get across? Is what we are doing *scientific thinking*? It seems to be a whole lot more. Are we now becoming scientists as well as learners of science?

Hmmm. I am so involved now in teaching science well, have I enculturated students into a scientific worldview which I disagree with? How can I counteract that? By giving other worldviews? By providing other ways of experiencing the world?

We seem to be moving from *learning information* to a much deeper understanding of the ideas. I am still in control of the classroom and the activities that we do but the students seem to have a lot more control over their thinking. I think I am giving them enough space to think for themselves.

How am I feeling now? Energetic, creative, inspired, captivated and surprised with my students and their ideas. I feel free to move from the seriousness of getting across a science syllabus, to being much more playful and relaxed. Classes are fun.

What really is scientific inquiry?

Now during this time (1991 – 1993) there is a major change in the state wide curriculum framework with movement to *criteria and standards based syllabi* instead of students getting one final mark which is *norm referenced* (students ranked in their classes and across the state). Some good thinking has gone into the new physics syllabus – giving it some process criteria reflecting aspects of the scientific method as well as content criteria. The students still sit an external exam but now the internal marks have more relevance.

I have been part of a committee coming up with standards for the course so I have benefited from being part of the creation process – not just being part of the dialogue, but also gaining a deep understanding and ownership in the new way of thinking about science learning.

But many teachers are unhappy with the physics syllabus. For example, it has one criterion on

Physics Criteria:

1. **Acquire information**
2. **convey** information *
3. safely and correctly **use** a range of scientific **equipment** to gain data
4. **design experiments** to solve problems or test hypotheses
5. **perform** practical **investigations** individually or in a group
6. **analyse data** gained from student's own practical work
7. **formulate generalizations** and make realistic predictions based on data *
8. demonstrate knowledge and understanding of the ways that Physics impacts on technology, **society** and the individual
9. demonstrate and **apply knowledge and understanding** of terminology, definitions and laws, concepts, theories and models and uses of measuring instruments of physics *
10. incorporate techniques of analysis and mathematical manipulation to **solve** complex **problems** *

* examinable criteria

Fig 5.8

students' ability to hypothesize and design experiments which I am really excited about. But there are some other teachers who say they can't measure it.

The more I allow my students the freedom to think, the more I am seeing a greater ability to hypothesize… but how am I judging this… it is so subjective… but I think I am seeing a definite change into more rigorous and iterative thinking which is way beyond the initial simplistic thinking my students have when they start my classes.

But some other teachers do not feel comfortable using subjectivity to determine students' standards - it has to be objectively measured, they say. But the disagreements between my peers now fuel discussions in areas we haven't really talked about before. In our moderation meetings we find we are spending more time discussing the *processes* of science as much as the *content* of science. We are needing to tease out what each of us mean by hypothesis and inquiry and this is helping us to become more transparent about our expectations. It is difficult at first trying to explain things which up to now have been largely intangible… trying to describe what they might look like and sound like in a classroom but we are beginning to create comparable indicators of what these things are.

So what is the *scientific method*? I have never actually been *told* what the scientific method is. I have inferred it from how it was taught to me in school and university science classes… *an aim, hypothesis, method, experiment, data, analyse, error discussion, conclusion.* Usually the aim, hypothesis and method were something that you were given rather than establishing yourself.

Is this a *scientific inquiry process* or one way of *reporting* science? It seems that many of my colleagues also associate the *reporting* of experiments with the *process* of doing experiments… that is how their experimental instructions are written. However, this reflects neither the reporting nor the process I used as a scientist working in industry.

But now there is an opportunity to reconceptualise the science inquiry process. The central curriculum office for the state have been developing inquiry sequences for primary and high schools; disseminating diagrams which have *cycles*… explore – observe – hypothesize – test – analyse – share and compare.

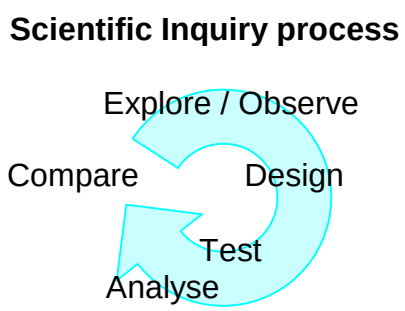


Fig 5.9

How is this model different to what we are already

doing?? A key aspect is the notion of *exploring* first, rather than jumping into doing an experiment. There is more a sense of ownership in the students investigating into something rather than following a set of instructions. This cyclic process seems to better reflect what I was doing as a scientist and I embrace it… again redesigning my handouts to encourage students to engage with this explicit inquiry cycle.

I begin to realize however that some students have certain expectations about the inquiry process when they come to my classes… some expect to have points falling along lines in their graphs rather than being scattered, some can't cope with error as they conduct their experiments and some expect that what they measure will be right, regardless of applying inappropriate theory or methodology to a situation. Most want to write their lab books *after* the experiment neatly, rather than seeing a log book as something that records what they are doing *at the time*. Most expect to write their reports as aim, single hypothesis, method, results, discussion, conclusion… despite my efforts to change this culture.

I encourage them to put themselves into their log books – to use 'I' and 'we' rather than third person objective voice – to be personal, because that is being honest about the ideas and theories that they are bringing to what they are looking at. I feel I have permission to do this as the quantum paradigm says that we are no longer impartial observers of science, but we actually influence what we try to find out. But many of my students are uncomfortable with doing that and stick to writing reports neatly in 3rd person voice weeks after they have done their experiments.

I want to help students be more flexible in their thinking rather than these seemingly black and white, right and wrong views I often hear. I want to break down their need to get something 'right' and open them up to the idea that when we experiment we are *discovering*, not *proving* or *pre-empting* and it is an iterative process of refinement.

I get students to predict possible outcomes for experiments and give their reasons. I give them time to listen to each other and change their minds and to enter an experiment with multiple views, rather than a single expectation of what they might find. Afterwards I encourage them to examine their hypotheses and ask how they can refine them and how these hypotheses might have influenced their thinking. It is iterative. I am wanting them to learn to take risks with their thinking, rather than holding onto a fixed viewpoint. It seems that by establishing a culture where it is OK to change your mind that students become more playful and collaborative with ideas.

Perhaps we are now moving from *playing with objects* to *playing with ideas*. Perhaps we needed to learn how to be playful in a concrete way with teddy bears, before we could do it in an abstract way?

I wonder how I can be more playful with my colleagues. My whole manner at our meetings seems to move now into this playful mode where I tease and laugh and throw in the unexpected. But being playful means being open to changing my mind as well… yes, I can do it and I find that there is a lot to gain from my colleagues as many like me are experimenting with their teaching, coming up with innovative practice. It seems that both the change in curriculum framework and the infusion of constructivist theories has created a renewal in science teaching in the state. And many of us are enjoying sharing what we have learnt, and are building on each others' ideas. And quite a few teachers who take away my worksheets and ideas come back the following year and tell me how they went – usually very well! I am heartened to continue experimenting with my teaching.

I now wonder about actually using the experiments as **morals** to teach about the *nature* of science inquiry. So rather than improving the experiments so that they have less error, or are less prone to having inappropriate methods used, I use these to point out the issues with empirical inquiry.

So the purpose of a conducting an experimental investigation could be to develop technical skills, to develop skills in the scientific inquiry method, to develop understanding of key concepts and to develop attitudes about science and science inquiry.

My view of the scientific method is becoming more flexible. However I am still regarding it as a sequential and rational process. I am far more explicit to myself about what science inquiry is and as a result I can make it explicit to my students.

The following year I worked with a University physics lecturer in helping him create a more constructivist

Morals of scientific inquiry?

Appropriateness
The theories and viewpoints that we bring to our design can dictate what we find – we need to be critical of the assumptions we bring.

Reliability
Error is a fact of life – we need to find ways to minimize error in experimental techniques – we need to know how to statistically handle data and what it tells us about what we can claim.

Iterative
Scientific investigation is iterative – we need to be prepared to modify and refine our methods and look for a range of feedback to help us.

Comparative
We can test our results by looking for consensus, repeatability and how it fits into current theory and practice.

Limitations
What claims are we making? What are our contexts? Are we over claiming?

Fig 5.10

learning environment….

1996. I am working with a lecturer as a critical friend in helping him improve his teaching of first year Applied Physics. He has designed an experiment for his students to measure the specific heat of oil as a way of supporting his unit on heat and different ways of heating.

It took him a while to think how to heat up the oil to give reproducible results. He has asked the technicians to make little heater coils to go into beakers which are enclosed in polystyrene insulation (cut down stubby holders). This lecturer is a theorist and just designing this experiment alone is a challenge, one he very much enjoys as he gets lost in the nitty gritty.

I have a class so I can't stay for the whole of the 3 hour lab session but come back at the end.
"Sue," he sighs, "It was an absolute disaster. Every group got vastly different specific heats and no-one was close to the real value at all."
Oh no, I think. I have not been very effective in helping him. This is a disaster.
"What did you do?" I ask grimacing anxiously.
"Well once they had all written their values on the board, we had a discussion about why they were different. I really had to think on my toes, but I asked them what methods they used during the heating process… did anyone stir the oil, or just leave it… could there have been heat loss? It turned out that each group did something different and we ended up discussing how important the method you choose is in determining the result."
"Wow" I sigh relieved, " in fact it doesn't sound like a disaster at all… the disaster of the experiment actually resulted in a very good learning outcome. You were really able to tease out some of the issues involved in experimental design."
"Oh. I didn't think of it like that. Now I come to think about it we ended up having a really good discussion about convective and radiant heat with the students asking lots of questions. It stimulated them to really think about what was going on."
"So it worked really well in helping them make meaning of the concepts you had been covering in the lecture. I wonder if the original purpose of the experiment – just to measure the specific heat would have got them to think about the ideas so deeply."

"Yes, I wonder what opportunities there are to develop the concepts further in our next experiment?"
"And what about looking at what new morals of science they can learn?"
"Huh?"
"Well, look at what they learnt today about the scientific method …. the fact that just because you are using empirical methods doesn't mean you are getting real data… you have to understand the theory behind what you are doing to ensure you are designing appropriate procedures to get the data you are aiming for. Science isn't infallible just because it is based on scientific methods?"
He laughs, "So experiments which fail are just as valuable as those that succeed because there is so much more potential for learning!"
"Yes from a pedagogical point of view, because if you think like a teacher and not a scientist you are looking for everything an experiment could teach you… about science, the scientific method, about the concepts."
"This is really good Sue, I think I would like to keep this experiment exactly as it is. I was thinking how to redesign the equipment so it would be failsafe, but now I am thinking that I would like to deliberately get my students to think about the method issue before we start. Maybe each pair could try a different method during the heating of the oil and then we could compare the results. I wonder how I can get them to predict what might happen for different processes and actually get a discussion happening on the different types of heating beforehand and revisit that afterwards"
"Excellent idea…isn't it interesting that if students had just written up in their lab books their results and hadn't shared them on the board no-one would have twigged to the reason why the results were so all over the place."
"That is so true. Of course as scientists we are comparing what we find with other scientists to validate what we do, but I guess I have never have actually used this technique in a lab class. Why ever not? It is a really good idea to mirror what actually happens in science."
"I guess the reason is that assessment has got in the way…. Needing to keep student findings separate to ensure they don't cheat."
"But I still need to worry about that..."
"Perhaps part of their reporting could include the gathering of data from their peers which they then do their own discussion on, comparing their results to the others and

explaining why they are different. That way you could see how much they have understood about the concepts of heating."
"Good idea."
"And by the way, do you think the students felt the lab session was a disaster?"
"I don't think so, but they might have if we hadn't had the discussion at the end. I think they actually thought it was part of the whole learning experience. It was only me who thought it was a disaster."
"Maybe we should look more into our disasters for opportunities then! I wonder now by making all these changes to the lab session, taking into account what we know now, whether we are preventing students from experiencing failure in science, which is also part of what really happens and is therefore a useful experience for them."
"Sue, I think you are thinking too much!"

What science isn't

So where is my spiritual head now? During this time (1992-95), I was also explicitly teaching spiritual ideas and processes in the enrichment course that I was running. It was called *Earth Mysteries* - where we explored mysteries like the pyramid and Atlantis, questions like life after death and reincarnation, and interpreted dreams and practiced visualization and meditation.

My notion of spirituality at this point of time is that it is a big thing, of which I am exposing students in my enrichment class to a small aspect, and something which is quite separate to physics.

What is my intent here in running such an enrichment program? Am I indoctrinating students with another view?

Students in these groups have their own ideas, experiences and questions just like my physics students... the weird and mysterious is something that has attracted them and already they might be experimenting with Wicca or séances or have had deep experiences or significant dreams. The point of this course is to examine some ideas from a more objective and critical view…. What is the evidence, how could we know it is true, what constitutes truth when we are dealing with these areas? How do we make meaning of personal experiences? How do inner practices help us and what should we be careful about?

The opportunity to put some of my ideas out there for discussion with the students, who definitely have their own views, begins to break down my attachment to set ideas, helping me to be more fluid in my thinking. All I have learnt about constructivism and playfulness in physics has helped me be less dogmatic and more open to what emerges. I realize the benefit of students' having a forum to discuss things that they often think about or play with but are not applying a rigorous lens to or knowing how to experience safely. They seem to be more discerning and self reflective as a result of the course, and feeling not so alone.

I am seeing this course as developing spiritual literacy, not just exploring a *body of spiritual knowledge* but also developing meta-cognitive tools for examining knowledge and how we know. (I don't yet know that this is called epistemology.) And I am wondering whether I can bring across some of this into the teaching of physics.

Hmmm. Bright idea! Perhaps by asking my physics students to explore a mystery like crop circles I can encourage them to think outside the square of logical thinking, leading to discussions about how we come to know and what is legitimate. I can get them looking at the scientific evidence as well as anecdotal stories, crackpot theories and come up with some theories of their own? But is it OK to do such a thing in physics?

I did it and it was amazing…. My physics students were as much interested in the weird and mysterious as my enrichment students. There was wonderful discussion, not just about the crop circle mystery but about knowledge and knowledge claims and it continued for weeks. In the end the class put on a performance for the rest of the school, creating a mock interview where different students took on roles caricaturing the different approaches, playing out the tensions between different ways of knowing. It was a highlight of the year.

Is there something in common about the physics path and the spiritual path? Do we need to bring as much discernment in considering both? What am I developing here? Critical thinking, discernment, the beginning of understanding knowledge paradigms, meta-cognition? How am I thinking about all this? Am I still in the black and white of *spiritual paradigm* versus *Newtonian* or is the playing out of these meta-considerations with students opening me up to a wider view?

I am getting more confident that these sort of discussions are a legitimate thing to do in physics. It is OK to bring in the mysterious (and non-scientific) as long as I do it for the purpose of encouraging discernment.

How else can I bring in the notions of paradigms? Not by telling students about them, that's for sure. One day I walk into a class and say to them "I think the earth is flat, prove me otherwise." They look at me stunned. Then they have a go at giving arguments for the earth being spherical but I counter every one of them with logic or stubbornness. At the end of about 5 minutes of arguments and counter-arguments they are looking at me, almost fuming but smiling as well. One asks "How can we convince you, Sue, you are determined to see all that we say from your point of view." Yes indeed. Thank you, now lets start talking about paradigms.

Meanwhile this meta-thinking of mine about science has helped me delineate now *what is science* and *what it isn't.* At this time I am a real fan of science fiction with favorites like *The Hitchhiker's Guide to the Galaxy*. Whereas before I felt that I was not being scientific by bringing in ideas about science fiction into my classroom, now I begin to see it as a way for us to think outside the square yet bring a critical lens to it as well. Students love quoting sayings from different books (*The thing you should know about space is that it is big*) and we use science fiction ideas to both tease out science ideas as well as to ask what science is and isn't. What is the physics of Star Trek and how plausible is it? Let's be imaginative and create creatures that could live on Mars and Jupiter … what might be their fatal flaws to existence?

I can now encourage students to use their imaginations and go where no one has gone before because in my head I know *what science is* and w*hat it isn't* and can make that explicit. It is like we are moving easily between wearing different hats, knowing exactly which one we are wearing and its limitations.

But some of my colleagues are horrified at what I am doing… "That isn't science!" while others see the potential for exploring issues and ideas in science in this way and they too get their students to design creatures that could live on Neptune.

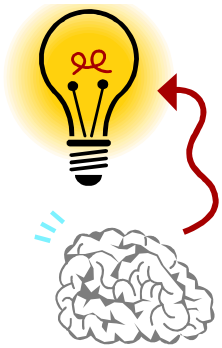
This use of the imagination frees me up to be imaginative in my design of classroom activities and to think outside the square of conventional thinking about how to teach students science. And perhaps it begins to infiltrate my notion of what scientific inquiry is.

Interlude 1: Two extracts from students' journals – reflecting on the circular motion topic (Second topic of the year).

My understanding of circular motion today

This morning I felt quite unusually energetic and I could feel my brain

TICKING! I've never ever actually felt myself thinking so well in physics before, but I think my brain must be making a lot of new connections as we are learning a completely new topic.



When we were asked to team up in pairs early in the lesson and find some words which give the definition of circular motion, I just suddenly came up with a good definition and I told Neil and Megan. As soon as I told them, they thought it would be the best definition and wrote it down. When Sue asked the class for their definition I was surprised most people came up with one word answers instead of a sentence. Neil told me that I should read out our group's definition since I was the one who came up with it.

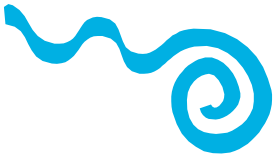
So after reading it out I found it was basically the correct definition! I was pretty impressed with my thinking this morning and I just hope I can think and contribute more in Physics lessons every other day.

Tom

(Note from Sue: I have added the clip art where he used diagrams and they exactly represent his drawings.)

Scientific Method and the Hollow Earth

The scientific method is like a rolling ball, a snowball effect. Sometimes it rolls you where you want it to go, but you have to get it exactly right for it to do it.



Scientific method has to be carefully thought out in order to eliminate errors as much as possible. Without a correct scientific method the snowball effect is unable to occur, and this is what I think is essential to science as a whole. Without a correct scientific method there is no analysis and therefore no experiment.

For me, a method needs to be planned exactly, all on paper, with aid of diagrams so that I can see exactly how I am going to do something before I attempt it. That way I can predict more elaborately rather than a small comment like hypotheses are.

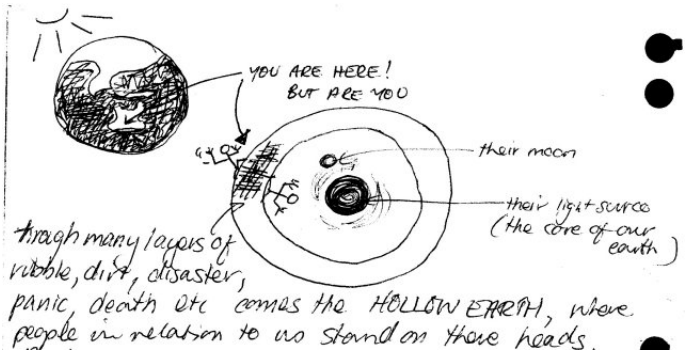
I like doing physics experiments, but I tend to hate writing methods, maybe because I am too much of a perfectionist and tend to find faults too readily. I like analysing though. Saying what I believe to be wrong – it makes me feel powerful. Why I feel powerful doing this I am unsure of.

I love dealing with unexplainable things as well. Lately in class, weird things have been discussed as well. Like the HOLLOW EARTH!!!!!

Now if there was a hollow earth would the people inside be like us? Or would the dinosaur bones and the dead organisms from the inside of the earth be flushed out by gravity and dug up by us? Or are we in the hollow planet and some other being is on the outside thinking exactly the

same as us? If so, would they be more superior as they are in a greater system?

Through many layers of rubble, dirt, disaster, panic, death etc comes the HOLOW EARTH, where people in relation to us stand on their heads. And if so is this like a parallel universe? Would the horizon be the universe, and could you still dig to China?



Would the people be the same size as us or smaller? Or did they create our system, to study how we live in order to redesign their corrupt world? Are people who claim to have seen aliens, just skipped through a dimension like the hollow earth and told things about us.

Deary me, I think I might have got a little carried away. Reality check, are you there Lisa?? Yep, I'd say it is time for bed….

April

Interlude 2: Seven metaphors for how thinking happens courtesy of Newtonian physics, and one metaphor courtesy of Deep Ecology.

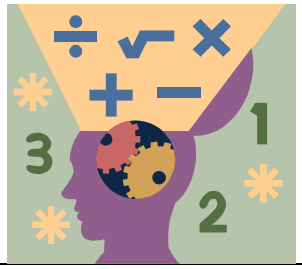
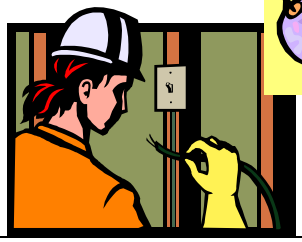
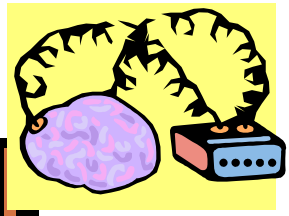
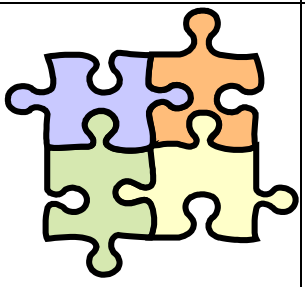
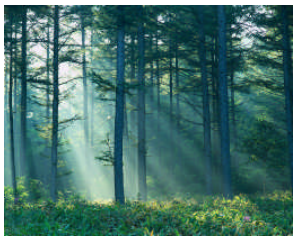
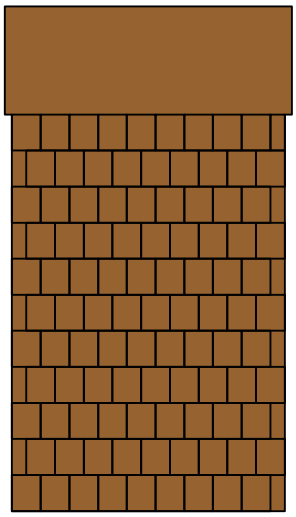
Thinking happens in the brain 	My brain is ticking over 
The wheels are turning 	I am making connections  
I can see how that all fits together 	My ideas are flowing 
Now that is an idea that just seemed to have popped up out of nowhere like a   mushroom in a rainforest	I am building up my knowledge 

Fig 5.11

Interlude 3: Don't Force Me! (First Physics topic of the year)

Welcome to my class

"Please come in, dear reader. Feel free to walk around and talk to my students. We are nearly finished the unit on forces, which is our first topic of the year. The students are working through this booklet with different case studies or problems to investigate. You'll have to step over Alex. Don't mind him lying on the floor. He has taken me at my word about having some brain dead time to allow ideas to percolate."

You notice two boys drawing up diagrams on the whiteboard, arguing. They turn to us.
"Which of us is right… we are trying to come up with a theory we can use to explain the safest way to suspend a Santa Claus decoration over the street?"
"Maybe you could test both of them and then see?" I suggest and they go "Oh, yeah, why didn't we think of that" and head off to the equipment trolley and start pulling things around.

You now head over to a group who seem to be making a device and you ask them what they are doing.
"We are making a kitchen scale… you see the way other groups have used a hanging spring with a basket, well we decided to see if we could make one which pushes down."
"Yeah, it was pretty tricky… we took a broken bathroom scale apart and saw they were using compression springs … but we only had extension ones so we have had to come up with another way of doing it … we are not sure if it will work yet… we have already had to change the spring once because the other one was too stiff."
"See here, we have to have a way of reading the weight. If the spring is too stiff the pointer doesn't move enough."
"You see Mark's over there – it is way too long… you wouldn't have room in a kitchen for that… but ours will easily fit under kitchen cupboards."

You ask them if they have ever done this sort of thing before.
"Well, I've made stuff in woodwork but nothing as mechanical as this…"
"I've never done anything like this, in fact I haven't really connected the stuff we have learnt in physics before with real things…"
"I never really thought about springs before and how they are all different."
"I went home the other day and took apart the iron just to see how it worked."

“Doing this certainly makes you think… it is one thing to just measure the extension of a spring and realize how weight and extension are related but another thing to actually make something which uses that.”
“Yeah, it is just as well we had three weeks to think about it. Well we haven’t spent three weeks on it… we started measuring a spring in the first week and in between our other case studies we have been thinking how to use it.”
“It was good seeing how other groups approached it first because we could see their flaws… see how this group’s basket doesn’t come off… how are you going to get your flour out? They are not going to get good marks on practicality.”
You ask them if this is cheating
“No, everyone is helping everyone else… we helped the group on the air track to set up the time gates.”

You move over to the group on the air track and ask what they are doing.
“Well, yesterday we were *disproving* Newton’s Law, not intentionally, but today we think we might have overcome the flaws in our design and might be able to see if it is true”
A girl opens her lab book, “See how the graph goes here, it is supposed to be a straight line, not this curve.”
You notice how messy the book is and ask about it.
“Oh, yeah, Sue has asked us to think of our lab book as a log book… that we record what we do as we do it, like real scientists”
“In the first investigation we wrote our data on a scrap of paper and Sue scrunched it up. She was making a point. She said put it in a book and sketch results as we did them to see what they were while we had the equipment set up in case we wanted change anything… not wait weeks to do a formal write up.”
“Yeah, my book now is really messy, but that is OK and it certainly saved us time; if we had waited to do a proper graph when we wrote it up properly we wouldn’t have spotted the flaw. Anyway, Sue says I can hand it in as it is… that she doesn’t require us to write a proper science report for this experiment … as long as we include a good written discussion.”
“Well, that is not going to be hard, we have certainly got lots to discuss.”
“It is interesting that you can take accurate results but still get the wrong result just because you haven’t understood the theory behind what you are doing.”

You notice something out of the window… a girl hanging off a balcony by a rope. Is it safe?
“Oh, that’s Lauren…don’t worry it looks like she has got a proper harness on – she knows her stuff. I think they are looking at what happens if an astronaut hits his space ship with a

hammer versus a screw driver… see the other piece of wood hanging… that must be the spaceship."
"She is swinging too much, that rope is not going to really simulate freefall!"
"I think her video crew have worked it out… look they have lowered her a bit."
"But I really wonder at whether that is the best way to look at it… you need to have a frictionless, forceless environment."
"Like what then?"
"Well the air track."
"But how could you simulate hammering a nail."
"I'll have to think about that."

You move on just as a group of three girls enter the room quite flushed, one carrying a bathroom scale. Well we did it… thanks for suggesting the commonwealth building, Andrew, the lift is amazing!"
"Yes, I lost 5 kg going down."
"We went up and down so many times… we got some really strange looks."
"I can't believe how it felt though… you really do feel lighter when you start to go down, and heavier when you come to a stop."
"It really made me think - as we were walking back I could almost feel the same thing in the way I walked."
"Better get to it, and calculate those forces."

And here is another group. What are they making?
"Oh hi, this is our demonstration of Newton's 3rd law… see we are going to strap this bear on this wheel which we are then going to propel using soda bulbs."
"Yeah, we hit the bulbs and they release gas one way and that forces the wheel around the other way."
"It's a kind of Ferris wheel… you see we have even made a little ticket booth for the bear."
"We were thinking of a flying fox, but another group were looking at that and we noticed they were having problems banging the tack into the soda bulb… we wanted to use a soda bulb."
"Yeah they are cool…"
"But we needed to think of a way of making our set-up more rigid so we could counterbalance the force of the hammer…"
"Because then it would be the hammer making it go forward, not the gas."
"So we came up with this…"

“We know we are using a similar situation to Alex’s group but we’ve done some research on rockets and we hope our explanation to the class will take a different slant on it.”

“Do you want us to demonstrate? We just need to get the tape and strap the bear in.”

“Don’t forget he needs to buy his ticket first!”

Epistemological Pause

Well, that took a lot longer than I thought and I didn't get very far in my story.

I have tried to write by projecting myself back into the time, tuning into the fairly modernist and sometimes strident voice of my 'gung ho' past self as well as remembering the significant events or questions of the time. But here, sitting in front of my computer, I am also in my present - writing peacefully and reflectively. Did I really think like that then? Was I so reflective and questioning? I must have been reflecting in some way because I moved in understanding and practice … but it wasn't using this nice gentle reflective voice… it was one that bounced around exuberantly very much like Tigger from 'Winnie the Pooh'.

I bounced my way into learning about the teaching of science; my experience moved through me often straight into action, in the same way as an artist might allow experience to be expressed in their art and then become an observer of the possibilities of meaning that emerge. I don't think I stayed still long enough to unpack an experience with depth… if I saw one thing emerging I would leap on it and take off again on this wild ride of exploration. I also need to acknowledge that this growth in perspective was not done in a vacuum; many of my state-wide colleagues were moving in thinking as well and that interactivity played an important part in my changing perspectives and understandings.

Between 1990 and 1996 I wasn't seeing myself as doing action research - it was prior to commencing my doctorate – but here we see a simple action research cycle of observe, reflect, plan, do, feedback. Sounds a little bit like the scientific inquiry cycle. I guess I was bringing my scientific self to the process of my teaching. Once a scientist, always a scientist?

Only with hindsight and perhaps a higher perspective can I piece together the meaning, make the connections and see the significance. And I remind myself that this is a construct, albeit one which I have tried to make as honest and authentic as possible. Perhaps I need to try harder?

Why is it so long? Well I went back in and added bits to better paint a picture of my thinking about science and science inquiry at the time, because I realize how problematic mere words are if you don't give examples of what they mean. How someone with a different value system may see *inquiry* or *questioning* in a different way. I needed to give examples of the types of questions I was asking then (I now ask different ones) because it reveals the pragmatic place that I was coming from which is perhaps representative of someone living in the world of *trivial constructivism*.

Needing to explicate this is the result of watching a documentary two nights ago called "*The root of all evil*" where Richard Dawkins (the gene scientist) critiques *all* Religion and especially Fundamental perspectives of Religion; not seeming to differentiate between various perspectives within Religion. He denies any other experience or understanding of the world that is not based on empirical evidence. He sees science as the only choice for rational people. Science he says is based on careful moderation between many scientists, bringing a sceptical eye to what they are doing, prepared to change ideas when evidence to the contrary is found. It sounds very civilized.

But the documentary was not and it was painful to watch a scientist expose himself as someone who was as firmly entrenched in his own belief system as those people he was arguing with and trying to ridicule. He saw science from within it, did not see it as one valuable epistemology within a larger range of epistemologies, nor was he able to critique the assumptions underpinning the construction of science. He also had no sense of the different cultural

perspectives (vMemes) that might be evident and how we cannot lump all religion in one box, neither all scientists.

So listening to this helped me contextualize better my experiences during the first five years of my teaching – where I had come from and where I was moving to. My notions of science inquiry that I started out with were in fact very similar to Dawkin's views about what happens in the scientific community. Which is no surprise because I was a real scientist for over three years and had been exposed not just to my own scientific inquiry within an organization, but also involved in the mediation of findings with other scientists on our team and through conferences with outside scientists.

What is interesting, is that although I had this experience in my own scientific inquiry I could not initially teach science *as inquiry*. From a spiral dynamic point of view (Beck & Cowan 1996), perhaps as a *scientist* I was operating in the **orange vmeme** (self authoring) but as a *teacher of science* I was operating in the **blue vmeme** (authority, right answers). By explicating who I was as a scientist I could then teach from my own experiences of science inquiry, breaking out of the traditional experimental straightjacket that many science teachers were wearing at the time.

However, because of needing to get 'right answers' for the exam I could not let go of me needing to *direct* the students to inquire…. If they had their own projects how could I guarantee *what* it might be that they would learn, and then how would they pass the exam? My experience of inquiry as a scientist was that you start with something no one knows and you aim to find it, rather than inquiring into something that is already known and coming up with the conventional understanding. You have no idea what you might learn along the way. So while I was thinking students were being scientists, it really was within a very small context of just bringing a sceptical and discerning eye to what they

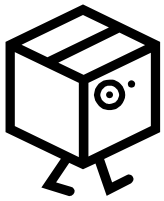
were looking at. There was no true creation of knowledge that is the aim of most scientists.

I was firmly entrenched in *Teaching for Understanding*. What comes after that? *Teaching for innovation? Teaching for action? Teaching for Wisdom?*

Towards the end of this time I was beginning to helicopter out and see science from a wider view; beginning to see it more than an inquiry cycle but also as a community of construction. It would take a few more years for me to fully explicate this to myself.

Now I don't want to pre-empt myself too much by this analysis from my 2006 standpoint. I need to get on with the story and see where science goes from here. We need now to bring in Holistic perspectives and see how those sensitivities interact with this thing called science and this thing called Sue. Can I begin to see out of this box called science, to see it with a different perspective, to see my teaching with a different perspective?

How does one start to get out of a box?



Chapter 6

The Meaningful Classroom - 1992 – 1998

Questions:

Who are my students?

How do they learn?

What activities can engage them and help them learn?

What activities can connect them to their deeper selves?

How does my view of what I am teaching effect the way I teach?

The story so far:

I am teaching a content bound science course, whose objective is to get students ready for an exam of 'right answers'. I am very focussed on helping my students to learn science and am interested in strategies that can help me do it better. At the same time I am wondering how to infuse my class with soul and spirit. Also at the same time I am teaching other courses using enterprise and experiential pedagogies (which are based on students learning and growing through 'doing' authentic tasks such as creating a fashion show or a college magazine) and I am wondering in comparison how am fostering student development in my science classes.

Now I am introduced to Holistic Education. (see Fig 6.1) I wonder how I can use Holistic Education pedagogies to help students gain greater understanding and meaning of the science. How can I foster their curiosity? How can I help them experience the universe as a whole? How might I incorporate non-sequential/logical learning strategies? How am I assisting in their development as human beings? What does it mean to be a human being anyway? What am I already doing well and what do I need to explore. Where do I start?

Holistic Education

Holistic Education is based on the assumption that the universe is an integrated whole in which everything is connected. This assumption of wholeness and unity challenges the mechanistic assumption that underpins most contemporary thinking and practice. The holistic paradigm counters the reductionistic approaches of the last 200 or 300 years that have led to a world view characterized by separation and fragmentation.

Holistic Education is concerned with the growth of every person's intellectual, emotional, social, physical, artistic, creative and spiritual potentials. It actively engages students in the teaching/learning process and encourages personal and collective discernment and responsibility.

Holistic Education is a quest for understanding and meaning. Its aim is to nurture healthy, whole, curious persons who can learn whatever they need to know in any new context. By introducing students to a holistic view of the planet, life on Earth, and the emerging world community, holistic strategies enable students to perceive and understand the various contexts that shape and give meaning to life.

Holistic Education recognizes the innate potential of every student for intelligent, creative, systemic thinking. This includes "students-at-risk" most of whom have severe difficulties learning in a mechanistic, reductionistic paradigm which emphasizes linear, sequential processes.

Holistic Education recognizes that all knowledge is created within a cultural context and that the 'facts' are seldom more than shared points of view. It encourages the transfer of learning across academic disciplines. A holistic curriculum encourages learners to critically approach the cultural, moral and political contexts of their lives.

Holistic Education values spiritual knowledge (in a non-sectarian sense). Spirituality is a state of connectedness to all life, honoring diversity in unity. It is an experience of being, belonging and caring. It is sensitivity and compassion, joy and hope. It is the harmony between the inner life and the outer life. It is a sense of wonder and reverence for the mysteries of the universe and a feeling of purposefulness of life. It is the moving towards the highest aspirations of the human spirit.

Fig 6.1

Learning styles and Multiple Intelligences

1992. I have become very interested in learning styles and multiple intelligences. These theories seem to say that we each learn in different ways, have different temperaments and different talents. A good teaching program should provide opportunities for students to learn through their preferred styles and demonstrate their learning across different intelligences. Poor performance by some students could be a result of teaching to their weaknesses rather than their strengths. Students who understand learning styles and the way they operate are likely to be more empowered learners who not only can learn through their strengths but understand how to build up their weaker areas.

The Holistic Education literature that I am reading is also supportive of pedagogies based on the multiple intelligences. They say that we are multi-dimensional beings who experience and learn via many different modes of being. Howard Gardner's multiple intelligences are seen as a subset of those ways of being, but are still valued as useful pedagogies in expanding our teaching practice. So will exploring these pedagogies help me in exploring what teaching for the whole person means?

So, what am I doing already? What does it mean to use other intelligences in teaching physics? What intelligences am I already using? Hmmm…. *Maths /logic* obviously. *Verbal/linguistic*. I am using *Visual/spatial* in some ways but could be doing more. I am doing *Interpersonal/social* – because we do a lot of group work where we discuss ideas.

Are there some intelligences I have been ignoring in the way I teach? What sort of learners are my students? What sort of teaching style do I have? What are my strengths? What have I been avoiding?

I give my students different learning style tests and discover that in each class there is a range of preferred learning styles and intelligences. Some students surprise me and I think "Aha, that makes sense, how can I do this in a better way for you?" There is some debate at the time amongst educators in

Multiple Intelligences (Howard Gardner)

- Kinaesthetic
- Visual / spatial
- Verbal / linguistic
- Mathematical / logical
- Musical / rhythmic
- Interpersonal / social
- Intrapersonal
- Existential

Kolb Learning Styles

- Reflective
- Theorising
- Pragmatic
- Experiential

Julia Atkin Learning Styles

- Detailed
- Logical
- Integrative
- Feeling / Intuitive

Kinaesthetic – Audio - Visual

Fig 6.2

Australia on whether we should be making individual programs to suit each student's needs (with the danger of entrenching them into a particular learning style) or whether the key lesson from this research is to remind we teachers to vary our teaching. I decide to vary my teaching, starting my topics in different ways… sometimes with theory or case studies, with an experience or something reflective. I am very interested in the McCarthy 4Mat model which takes the Kolb model further by suggesting we need to move through all styles as part of any learning experience so I look at marrying that to the inquiry process of science.

I too take the learning style and multiple intelligence tests and find to no surprise that I am a strong visual, kinaesthetic and experiential learner; yet also rate strongly across the board in terms of the multiple-intelligences. An all round person. So why haven't I been doing **it all** then? There are a number of reasons for this. It is one thing to do it yourself; another to reflect upon it and pull from it aspects that might be useful for others. Then there is a limit to what I have been exposed to in the first place. What a bummer if you are born with the talent to be a champion skier but live in a desert!

So what can help me then to get started? I find books like Lazear's (1991) *Seven ways of knowing*, Gibb's (1994) *Tribes* and books on accelerated learning (MacGregor 1994) give practical examples of how multiple intelligences can be articulated into classroom practice. I introduce music into my classes, concept mapping, multiple coloured pens, experiment with role plays and workstations, include guided visualizations, run 'fishbowls', 'jigsaws', create case studies and I am more aware of how I am using group work.

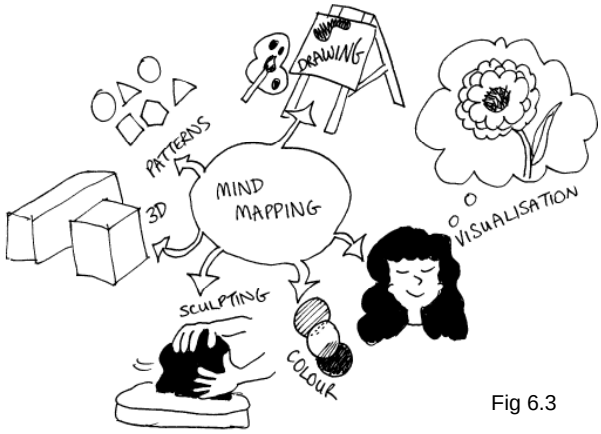


Fig 6.3

My College colleagues and I experiment in our meetings with different approaches in order to expose ourselves to new ways of experiencing and learning, and gradually build up confidence and skill in running such classes. I am lucky to be in an Australian lighthouse school which is only three years old. It is constantly re-visioning itself; we are engaged in thoughtful pedagogical discussions and keen to try new experiences.

This is a time of explosion of energy and creativity – both in the College environment and in my classes. I am very focused on **the how** to do it. I pour over examples from other teachers around the world on how they have used different activities in their classes (e.g. Flake

(1993), *Encounter* magazine) and my students are bombarded. Never a dull moment. Moving from desks to the front space of the class to engage in Mexican waves to demonstrate transverse waves; to slumping down on desks, eyes closed, embarking on a virtual trip to the moon and back; to working on physics problems while listening to the music of *Enya*; to taking on roles of scientists and debating from their point of view; to sitting in a circle listening to a children's story on the cosmos; to moving out onto the grass area doing silly walks and bumping into each other at different speeds to experience momentum collisions for ourselves.

My classes are energized, lively, engaging and **I think** the students are learning. There is some evidence to support my view as exam results are improving and students are telling me that they understand things well. For example, one ex-student came back the following year to thank me "You know Sue no-one in my engineering class at uni actually understands momentum. I felt streets ahead of them because of what we did." And I thought "Well that's pretty amazing, because I don't really understand momentum myself!" But he made me intrigued. What activities helped him and why?

So now that I have begun to master **the how,** I can begin to focus on other aspects of this pedagogy; I begin to be more observant and seeking of feedback of my students. I develop many self and peer assessment forms for my students to reflect on their own performance and how they learn and whether they felt that the activity was effective for them and why. Initially my questions on these sheets are pragmatic and unpack the learning only to the extent that I have unpacked it and understood it.

As I get more comments from my students, I am able to reflect better on the learning that is happening and my questions become more insightful and probing. When I look back at a self reflection sheet I gave to students in 1994 to help them reflect on group work (designed like a quiz from Dolly magazine (an Australian magazine for young girls) where you could score yourself and your partner) I smile at the indicators I used for good group work. I realize how far I have come in my understanding of group dynamics and personal interactions, moving from pragmatic *orange meme* notions of group work to pluralistic *green meme* ones.

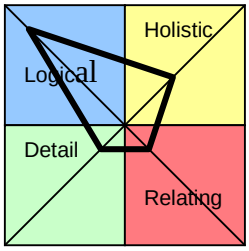
However, such a sheet made a big impact on many students at the time, some saying how they had never really thought what goes on in a group before. It seemed to help them be more aware of what they were doing that was helpful or hindering to group processes and to set higher expectations of what could come out of group processes. It seemed that students started to value the process of reflecting on their learning; they were beginning to understand

themselves better, take control of their learning and could be strategic in how they learnt for exams, at home and within the class. One year, I give the Kolb test (and its accompanying recommendations for strategic study) much later in the year than usual and some students were quite cross with me, saying "We should have had this a lot earlier… it would have helped us."

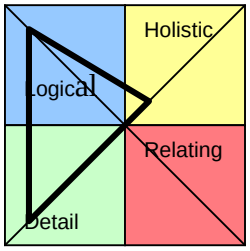
What do these tests look like? They are maps students can make to see how balanced they are across different learning styles. I have included the results of the two students whose journal entries I used in the previous chapter – April and Tom. You can perhaps see how their learning styles reflect their style of writing and thinking:

Julia Atkin's Whole Brain Learning Model Test

Students after a range of processes choose the best 7 cards that describe them and then construct their profile on the model. Here are the profiles for Mark and Lisa who wrote journal entries on circular motion in the last chapter.



April:
imaginative (y)
adventurous (y)
theoretical (b)
logical (b)
mathematical(b)
perfectionist (g)
friendly (r)



Tom:
organized (g)
hardworking (g)
artistic (y)
perfectionist (g)
logical (b)
analytical (b)
realistic (b)

April: "So we got our test back and I just passed Cr10. I really need to organize my time better instead of trying to learn things the night before. I need to keep asking myself *"how do I know this?",* rather than thinking I am understanding."

Fig 6.4

During this time I am still very much struggling to nail what learning is, and what good learning looks like (which isn't to say I can claim to know what it is now!) Gradually I began to distinguish between *energized participants* and *engaged learners*. I became more observant of behaviours and other clues students were giving me to help me understand the effectiveness of how they were learning, thus helping me to modify my approaches. For example, I realized that running a role play for students (e.g. where they are accelerated like an electron) might appear to engage students but unless we unpacked it and had a meta-conversation about it, it could lead to students being uncertain about what they were supposed to pick up from it. It could even inadvertently create 'misconceptions'.

I began to see learning as students not just learning *about the concepts* and learning *about the nature of science* but also students learning *about how they learn.* So when I ask the question on their reflection sheets *"What have you learnt?"* I now see students making comments at all these levels. I began to see that a particular task could have many different learning purposes.

Yes I am fully focussed on learning. Have I forgotten my other aim of development of the whole individual? It seems I am using multiple intelligences to serve the learning of physics, rather than physics to serve the development of the multiple intelligences? Or is it possible to do both?

The holographic classroom

At the time I am also reading different books on *systems theory* and so now I wonder how I can pull together these diverse learning experiences in a systems way so that the students are able to make connections, not just have connected experiences. How can I move away from the bit by bit logical sequential development of physics ideas? And in doing so, might I make my teaching more inclusive for those students who are not so strong in the *Mathematical/logical* intelligence?

I am struck by the metaphor of the hologram (Talbot 1992) – If you break a hologram into bits, each bit still gives a picture of the whole, even though it may be fuzzy. I wonder how I can develop topics in this holographic way, rather than introducing ideas one after the other. I start introducing some topics with a range of workstations that enable students to move around the room experiencing different concepts that we are going to come up with later in the topic… so now rather than building concepts up *one on top of another* I expose students to them simultaneously. Later we would explore them in more depth in bits but do it knowing their context to the whole topic. So we see the whole picture first and the connections in between.

These holographic investigations are quick and playful and enable students to move back and forward as they explore different ideas, testing out emerging theories and seeing underlying connections with something else. The white board is a shared place to write down connecting ideas, general principles and questions. Initially deducing generalizing principles from a range of different phenomena without me making the connections is difficult for the students

but with practice they are better able to discern patterns for themselves. I realize that in our linear (though cyclic experiments) that students do not have the opportunity to develop this skill of pattern recognition – a key one for any scientist dealing with complexity.

We now use concept maps of our questions to derive our path that we want to explore through the topic… though this is still very much directed by me. Students say to me now they can see where they are going, what questions to ask that might be useful in teasing out a whole topic and are now better able to make links and connections between ideas.

I am now using concept maps as the main way I take notes at workshops or meetings or in my own self reflection. I see concept mapping as a valuable tool and explicitly teach it to my students. I am expecting to see connections and look for ways to make links between what I do. I now see a lot of synchronicity in my life and the invisible web I am in becomes slightly more transparent and I start looking for it. I am now bringing a different lens to what I am doing and different standards… looking for *cohesiveness* and *interactivity*.

I am really keen now to encourage **feedback** so students get feedback from me and feedback from each other as well as giving me feedback about the effectiveness of their learning. Students mark each others' tests and their midyear exam to give immediate feedback. Students can get immediate feedback through concrete experience as well as conversation. My assessment moves to a more iterative model where students have a chance to reflect on what they learnt and are able to say what they would do now if they had the chance. I realise that just asking the question "What would you change now?" takes them and me into a new level of understanding about their task. For example, a student might hand in a task which might be a **B** standard, but their reflection on what they would do to change it with the benefit of hindsight indicates an **A** level of thinking and discernment.

Yes, what would I change now in this writing that I am doing?

Seeing inside the physics

I need to get back to role plays and visualisations because these now cause me to experience physics in a new way, challenging my perception that scientific inquiry is a rational process. Systems theory is already challenging whether it should be linear.

So here I am designing role plays and visualisations for students to explore science through their imagination and through their bodies, requiring them to move into new perspectives. In doing so I need to enter into the physics from an entirely different viewpoint to how I had been taught it at university - which was mainly through *Mathematical / logical* intelligence. I could give you the *equation* of the magnetic force, but couldn't really tell you what magnetic force *is* in order to help you get inside it. Now I am forced to do so and I am learning so much about physics.

I realize how much I don't understand and now some of the questions students had been previously asking me are beginning to make sense… I can begin to get in their heads and see from their perspectives much better. I realise how enculturated I am in seeing the world through a rational lens. How can I see it though other lenses?

Role Play in Physics

1. **using the body as a sensor** - where students physically experience things like jumping off tables and being really conscious of what it felt like at all stages… what does it feel like to move with a momentum of 130kg/m/s or to poke someone with a force of 20N?
2. **role play of a physical phenomenon** – where we simulate a scenario like the decay of an alpha particle in a nuclei where girls are protons and boys are neutrons
3. **taking on role of a person** – taking on the role of a particular scientist in a debate

Fig 6.5

I remember how I felt after coming back from five months in Finland where I got used to hearing people in the supermarket but never understanding their conversations. The first time I went to a supermarket in Australia after returning was a real shock… the noise made sense and I could understand what I was hearing. I had forgotten that I could do this. It had been as if I had lost one of my senses. So now I wonder whether perhaps I haven't had the 'sensory' perception to hear my students. Perhaps I need to develop new ways of perceiving and new perspectives to understand them. And could these other ways of perceiving be a legitimate part of inquiry into physics and reality?

$$F_G = Gm_1m_2 / r^2$$

$$F_E = kq_1q_2 / r^2$$

So as a result of using role plays, visualisation and stories I am gaining an intimacy with the ideas of physics that I never had before. I find myself awestruck… amazed by reality and our attempts to make sense of it. For example, one day I found myself suddenly struck by a formula that I was describing on the board – seeing Newton's *Law of Gravitation* not just as an equation for us to use in problem solving, but a major insight into reality. What is matter really? Why does it attract? Given that things with the same charge repel, why don't things with the same matter repel also? Is this anti-symmetry?

What is this attraction anyway… is it expressing the universal principal of love? And isn't it interesting that the equation for the attraction of matter is the same for the repulsion of charge? There is an anti-symmetry between electrostatic equations and gravitational equations. We had a fabulous discussion about this and it lingered on with some students, being expressed in their journal entries.

One boy, at the end of the year, when asked about how important maths was to physics answered by "If you can't do the maths you miss seeing the connections, the symmetry." Not, "Maths helps you solve problems in physics."

I remember suddenly looking at the **binding energy graph** which plots every atom against the energy needed to break the bonds between nucleons… to split the atoms… and suddenly wondering why it was that curved shape. If it had been slightly different then fusion and fission of elements would operate differently and we might not see the range of elements we have today. How were the elements produced anyway?…. Fusion in the sun?

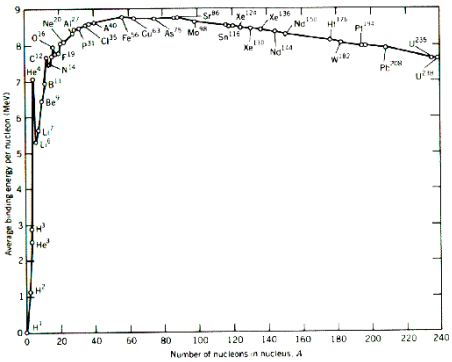


Fig 6.6


Fig 6.7

I then found out the elements in the latter part of the periodic table can only be constructed through the energy of a supernova, something I hadn't really known or registered before. Yes, I was made of star dust from the explosion of the star Tiamat. I am made from the cosmos.

I helped my students to see that they were too. Later I was to discover *The Universe Story* (Swimme and Berry 1992) which says how important it is to give students 'grand narratives' of themselves in the universe. Perhaps I was doing this.

I began to see that this universe we are in is really held together by a careful balance of the major forces… if the electrostatic force was greater than the nuclear force, the nucleus wouldn't be stable. I imagined a scientist trying to create our universe by trial and error… what sort of universe could be created if a particular universal constant was slightly bigger and smaller?

I asked my students to imagine that they were creating the universe and we were awed with the delicacy and complexity of forces that enabled it to exist. We laughed thinking about all the dud universes our scientist might have made first… what would happen if the gravitation force was too big? What might a universe be like in which the universal constants were actually variables? Yes we were using our imaginations, but now it seemed in a much more meaningful way … and naturally conversations like this lead to questions about god, the big bang, creation versus evolution, entropy, the future of the universe, Stephen Hawking's universe, string theory, black holes.

Jostein Gaarder (1999) has a beautiful idea about the universe.

> It has taken 15 billion years for the universe to evolve so it can see itself and applaud its own creation.

Yes we are the universe's eyes. And we are clapping.

Was I achieving another aim of Holistic Education … stimulating in my students *a sense of wonder and reverence for the mysteries of the universe which moves them towards the highest aspirations of the human spirit?*

So now while on one hand I am seeing nature with wonder, on the other I begin to find myself critically thinking about the physics ideas which attempt to explain nature. Had I really understood them before? And now with this new expectation of cohesiveness and connectivity I begin to see a problem with the plausibility of ideas which I had previously taken for granted. My notions of what constitutes scientific plausibility now begins to expand beyond the criteria I had previously been applying (supported by evidence, logical, self –consistent)…. I need more.

In realizing the benefits of *designing* such activities as visualisations and role plays in helping *me* to understand the physics, I now hand over to my students opportunities to design role plays and visualizations for themselves in order to test their understandings of ideas. This seems to take their learning to a whole new level. The conversations we have around the ideas seem far deeper than what I had experienced before. It seems that students really value these approaches to their learning. Now when I offer them opportunities to present group understandings in any way they want, some groups choose to take the class through a role play or alternative activity rather than just standing at the front of the class explaining something.

Tiffany writes:

> I can now visualize a cathode ray tube and how it works, rather than take it for granted that this really does occur, thanks to Adam, Robin and Matthew. I realize that there are some people who never want to join in everything, but I think the majority want to. Maybe these people are very self-conscious and shy. I know I was but I feel that I have changed significantly. One good example is when we jumped off desks earlier this year. A few years ago and I would never have done that. It was fun though. Doing practical things like that is a way I learn rather well. Being able to experience what happens when an electron does this or something is really beneficial because then I can revisit that situation and remember it.

This is a very pragmatic reflection, yet further on in her journal is a poem about light (stimulated by a blindfolded walk we did – see Chapter 3) … which indicates the sense of awe she has in the nature of light, but not the physics which describes it.

Light

Light can create emotions…
A warm bright yellow creates happiness,
youthfulness.
White light signifies purity, brilliance.
Soft pink and yellow light is inviting,
sensual, romantic.
Black is depressive.

Light is not just light,
with a velocity of 3×10^8m/s in a vacuum.
Light, green light, is used by almost every plant
for photosynthesis.
Light promotes vitamin D formation.
Light provides us with warmth,
security and comfort.

I've just realized the healing power of light.
Indigo for pain relief
Sun gold for depression.

So the physics definition of light is missing
just a few explanations
of the mysterious abilities
of Light.

What am I seeing and learning?

Jack Miller (1996) suggests that pedagogies such as role play and visualization can help students connect in a greater way to the deeper self, to their body, to the world / cosmos and to their lives in general. Can I claim that my activities were doing this? I think so.

What was I seeing? A boy who told me about a trip in a bus where he felt the vibration under his bottom and tried to understand what was causing it, saying "Before I did physics it never occurred to me to use my body as a sensor." Emily who ran out of the class in tears after role plays which constructed a perturbing notion of circular acceleration causing her to reflect deeply about where she was going in life (Chapter 2). The wondering and existential questions generated by students. Their greater physical and social intimacy with each other. Their passion and emotional investment. Their deep questions? Ex-students who after many years tell me of significant things from their class or even how something in class caused them to change their direction, their worldviews or their appreciation of life.

Were these indicators of body mindfulness? Of connection to the cosmos? Of connecting with deep issues of the self? Hmmm. I believed so. How do you measure such a thing? Some teachers talk about the light in students' eyes, the brightness and energy they bring to what they are doing. Yes, I believe I saw these things.

But there were some students who didn't participate well in alternative learning activities. Although I was giving students a range of everything, the very way I was doing it was fast paced with multiple activities in one lesson. Compare and contrast with a three hour ceramic class where you might sit quietly molding some clay, listening to music with desultory chatting to the people around you.

Space.

My physics classes weren't for quiet and passive souls…

Oops, sorry, I forgot that you might actually prefer some longer periods of extended peacefulness and space. I am giving you space in the think time and sleep time between classes… isn't that enough?

Now my take on multiple intelligences during the time I taught physics was really from two viewpoints – using them as a tool to help conceptual understanding of the physics and as a way of creating a more holistic and connected experience. A key aspect of multiple intelligences is the notion that they are developmental and can move through various stages. I was oblivious to these stages; I had honed into the word 'growth' and believed that I was helping the growth of these intelligences. Now with the hindsight of Integral Theory I realise I was engaged in the flourishing of some (e.g. kinaesthetic intelligence, artistic intelligence), and perhaps through asking students to reflect on own their learning I was helping them to advance through stages for others (e.g. interpersonal and intra-personal).

It wouldn't have occurred to me that I might have a role in the *flourishing* **and** the *transformation* of *every* intelligence, nor what indicators of development I might look for and that there might be an art to such development. So although I expanded my teaching pedagogies beyond *Mathematical / logical* intelligence, really this was the only intelligence that I was explicitly looking at developing. Inadvertently I think I was developing social intelligence through the meta-cognition I was encouraging my students to bring to their group work, but this certainly wasn't a valued part of the syllabus.

Should a subject teacher be concerned with development of a broader range of intelligences than is traditional? Should syllabi explicitly value the multiple intelligences? Or will this just remain a 'take it or leave it' pedagogical approach at the discretion of the teacher, rather than the main game of education, as is suggested in Integral Theory?

So how is my view of science changing now? On one hand I am engaged with it far more. I am being seduced by the deeper meaning I am gaining from exploring the concepts in these different ways. On the other hand I am beginning to question the plausibility of the concepts, which I have previously taken for granted. Rather than just standing back and criticising science from a different worldview standpoint as I have done in the past, I am now getting in, my feet wet and critically thinking about it from within it. But at the same time I am expanding my thinking of what those critical thinking tools might be. What is scientific inquiry now?

I really value this critical thinking and inquiry process that we are bringing to coming to know the physics. I feel this is a skill that students will have long after they forget the facts of physics. If this is the case then perhaps I should be thinking how I can use the physics' *body of knowledge* as a vehicle for developing these *inquiry processes* and ways of thinking.

The facts serve the acquiring of processes, as well as the processes serving the acquiring of the facts.

I am also wishing that I can teach complexity and systems explicitly. I feel that this is a crucial part of any science course and should not be left to university study. Understanding feedback, I feel, would be such a useful tool to have to apply to one's own life, not just to science.

I also am now beginning to see the potential within the ideas of physics to inspire a sense of wonder and inspiration of this amazing universe in which we live. There has been a real shift in my perception because previously I just saw formulae as letters relating to constants and variables that we use to solve problems, not an insightful commentary on the inner workings of reality. To inspire wonder you really do have to see it yourself first. How can I be more mindful of the wonder around me?

My students' needs seemed to have changed also. Previously their need was to understand the physics. Now it seems that just like me they need for it to be plausible. And they also expect to be inspired by it.

It seems such a paradox or irony that these other ways of knowing and experiencing physics can be such a stimulus for greater *thinking* about it.

> "An enchanted world is one that speaks to the soul, to the mysterious depths of the heart and imagination where we find value, love, and union with the world around us. As mystics of many religions have taught, that sense of rapturous union can give a sensation of fulfilment that makes life purposeful and vibrant."
>
> **Thomas Moore**

Where is the soul in my teaching? Is it in the deeper connections and experiences of my students? Is it in the WOW! (Wonder Of the World)? And does this WOW, help my students to feel more fulfilled and have a greater sense of meaning and purpose?

Have I moved beyond *Teaching for Understanding* to *Teaching for Meaning*? What else might be possible? What might it mean to *teach for wisdom*? Does wisdom require a sense of wise action? How are my students articulating their meaning into wise action? Are we developing a sense of heart and ethics… or just an aesthetic appreciation? Can an aesthetic appreciation of life encourage ethical behaviour? How are my students ethical agents in the use of science? How are they ethical agents in their relationships with each other? How am I giving them opportunities? Is it happening beyond the classroom? How are they wiser and how might I tell?

And where is the wholeness in all of this? Is it coming through with my modelling of my teaching practices in a systems and holographic way? Could students be having a whole experience, bringing their whole selves in this complex interactivity of different ways of knowing and being? Are they beginning to see the larger whole of reality and their place within it?

> "Most of us have lost that sense of unity of biosphere and humanity which would bind and reassure us all with an affirmation of beauty. Most of us do not today believe that whatever the ups and down of detail within our limited experience, the larger whole is primarily beautiful."
>
> **Gregory Bateson**

And how am I thinking about spirituality now?

Despite the sense of soul present in my classes I feel that I am still not making spirituality explicit in my teaching. Even though I introduced my students to visualisations I am aware that these are just tastes of using the inner eye and in themselves are not a path to enlightenment.

I still think that 'teaching spirituality' is something you have to do outside normal curriculum which I continue to do as part of the enrichment program. But the name of the class has changed – now I call it *Dream Interpretation and Guided Visualisations.* Yes, isn't it interesting how this has changed, just like my physics teaching into a more *process oriented approach*? In my enrichment class I am now developing the *tools of inner practice* and reflection, rather than exploring a *body of spiritual knowledge.* I am helping students to discover their inner voice and their inner purpose. How can I help my physics students discover their inner purposes?

Yet, if you had said to me at the time that my science experience was modifying my notion of spirituality I would have laughed. How might these two views continue to interact with each other?

What is also interesting is that in my visualisations in my enrichment course, the aim is to give space for the students to connect with deeper aspects of themselves, experiences which we then *explore through art and poetry* and then discuss and make meaning of in a very gentle and reflective way. Yet in my visualisations in physics I am taking students on a prescriptive journey… it is using the imagination to conduct a scientific thought experiment, not really allowing space for a deeper connection with reality. Afterwards we *brainstorm questions*. Still in the left hand side of the brain. Hmmm. Why haven't I transferred my spiritual approach across? I seem still to be compartmentalising.

And how do I understand learning now? Is it something that happens in the head? If so, it is a lot more complex than I previously thought! Perhaps it is a system where parts are in a dynamic relationship with the whole, being constantly perturbed until another emergent whole is formed? Is it my job then to perturb my students to increased understanding?

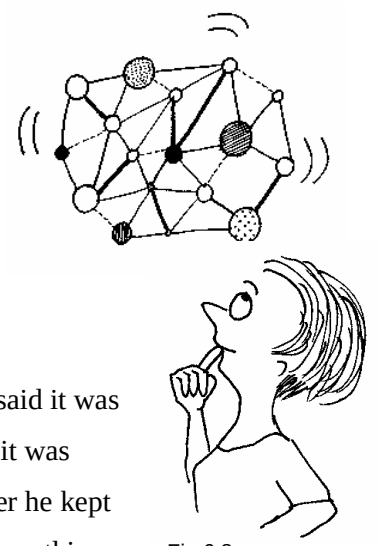


Fig 6.8

What about the boy who could never start a problem because he said it was like having the whole world in his head and didn't know which bit was needed for a problem… as soon as he started to think of an answer he kept modifying it to try and include other perspectives. His answers were this *and* this… *but* that… *and* this… he could never write succinctly in a scientific way. Is science thinking too simple? Is he in fact seeing things with greater understanding than most scientists, even though he cannot capture and snapshot that understanding?

I am beginning to pay more attention to how my students talk and write and what it might say about how they think. Have I been too dismissive of some of my students before? I had thought I was listening well before, but now there seems to be more to see.

How do *I* think? I feel like the boy with the world in his head when I am trying to make sense of this incredibly complex thing called learning! Would it help for me to start thinking about my thinking processes? …. how I come up with ideas and develop my thinking…. The way I like working with disparate threads and allow them to interact, rather than being focussed on one line of thought. How important this dialogical thinking is in helping me be creative and see things in new ways. How do my students like to work? Are they multi-taskers? Is this scientific inquiry cycle too linear and simplistic? Does it need to have more interactivity between the different aspects? Be in dialogue?

And even thinking of understanding and meaning as something you construct in your head is too limiting! Is meaning made with the whole body, mind, soul? That student who has zoomed on a skateboard for one hour claims to really know momentum. Does he really? What is this ineffable thing called learning? How useful then is constructivism (with the notion that we *build up* concepts) in helping us to understand how our students learn? Maybe *social constructivism,* which seems to acknowledge the social interactivity of learning, is a better model for helping me to think about learning? But how does that take into account *deep knowing*?

How does this theorising about learning helps me to be a better teacher? Am I able to design more effective learning opportunities? Am I able to see and understand my students better? Or does this theorising put me in my head and out of the actual presence of my students? Ooops. I have to remind myself to be present so I can really see them with my heart and not just my head.

Perhaps though, it is useful scaffolding which help me on my journey of understanding. I have to remember not to love this scaffolding and be prepared to let it go. Is there a way that all these different perspectives about learning could co-exist? Do I need to use trivial constructivism in some situations and other models in others? I just need to learn how to be more flexible and not seduced into one 'right' way. Phew. This is hard work… learning to helicopter and move around. I think it is a valuable skill though. Should I be helping my students to develop this as well? What might help them? Perhaps I need to talk to them about how they model their learning and thinking processes?

And let's be pragmatic now. **How has this benefited the students?** I am seeing outstanding exam results (much higher than state average) and an increasing number of my students want to continue on with physics at university (in one year students from my class represent 15% of the 1st Year university pure physics intake despite my class being only 1 of about 30 in the state).

Excuse me, what did I just say?…. How has this benefited the students? I will ask this again and wonder what it might be like to answer it from a different perspective. What am I valuing above in the response I just gave?

The exam results – an artificial indicator of **ONE** of nine intelligences. What about the other intelligences… what has happened to them? Am I valuing the growth my students have experienced in their *whole being*? But that isn't measured, and if it isn't measured then is it valued?

Pathways – yes I am valuing that this course helps move students along a career path. What about one student who moves into the tourism sector who says to me "Every student should experience physics because it helps you to really see and appreciate the world you are living in. I wouldn't have missed this experience for the world!" And another who says that "The purpose of school should be to *instil wonder!* That is what is important!" Isn't that notion of

greater appreciation of their world an important thing to value…. Should it be a goal of our courses along with the pragmatic ones?

What other perspectives could I take here?

What am I still missing from this construction of my teaching of science?

Remember what you are made of… stardust

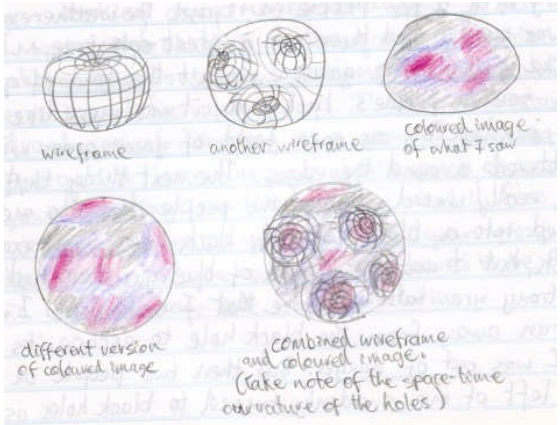
Interlude 1: An extract from a student's journal

The universe dream

This afternoon, after watching an episode from a video called *Stephen Hawking's Universe*, I decided to take an afternoon sleep since I was feeling tired from a busy morning. After falling asleep I had some weird dream about black holes and the creation of the universe. I think I will try to explain as best as I can of what I remember of the dream, even though it may seem very abstract.

To start off with, I was in some kind of garden party with a few people in it, and the weather was fine, it was sunny and there was a great oak tree in the centre of the garden. The garden wasn't the kind of garden you see in people's backyards, it was more like it was surrounded by an open field of green grass with forests scattered around the edges. The next thing that happened was really weird. One of the people close to me suddenly turned into a black hole. The black hole wasn't exactly black, but it was like a ball of blue gas that had such a strong gravitational force that I could feel. I managed to run away from the black hole to escape its gravity so I was out of danger. Eventually people on the right and left of me suddenly turned to black holes as well. They became orange and yellow coloured black holes and I found I was standing directly between them (by this part of the dream, I was no longer in the garden, but I was in outer space). While standing between the two black holes I could not feel any gravitational force from either of them. I assumed that they both exerted the same gravitational force on me, so the gravitational forces were annihilated (cancelled each other out) at the point in space at which I was standing.

Later, I did something weird. I grabbed both of the colour black holes with my hands (they were the size of basketballs to me) and pulled them together to form one big black hole. Now, the next part of the dream was completely out of this world. I saw that the newly merged black hole had formed some weird and wonderful spherical like shapes. These are hard to describe in words, so I will try to sketch them (think of these sketches as computer-generated images because that is quality of the image I saw in the dream.) The shapes keep changing.



After a while, I felt I was being sucked towards this anomaly as it had an extremely strong gravitational force. As I got closer to it, it seemed to shrink and become unstable and violent as it kept changing shapes. All of a sudden, it stopped pulling me in, and became a singularity (infinitely small.) Just a few seconds after it shrunk, it suddenly made a huge gigantic explosion that made me recognise it as the 'big bang'. As it exploded, I could see visions of elementary particles flying past me (quarks, atoms, radiation, neutrinos). Then seconds later I saw the universe as we see it in the night sky today.

I think immediately after I saw the creation of the universe, I had some kind of uplifting feeling that made me think I had the ultimate answer to how universe was created. Immediately after that I think I must have woken up because the dream was a bit of a shock. Well, I spent most of dinner time trying to make sense of the dream and trying to convince myself to write this all down. At the moment I don't think I'll try to interpret the dream to any sort of meaning, because I am running short of homework time for other subjects. Anyway, this dream probably contains something very important which I shall find out later. For this is probably the way the world's greatest minds like Hawking and Einstein get their great ideas - through dreams.

Tom

Interlude 2 which features three voices, a role play and a photon played by Kathy

(and apologies if this is saying the same thing twice… but as a teacher I know how important it is to explore an idea in a different way. It enables us to get inside things more.)

The disappearing photon

I have just explained the photo-electric effect to the class with pictures and graphs on the board and now I have set up a role play where we can look at the photoelectric effect in action. I have a group of photons (girls), who each have different energies, waiting to strike the metal. The metal is composed of some 'free' electrons (boys) loosely held by some positive metallic ions (bigger boys).

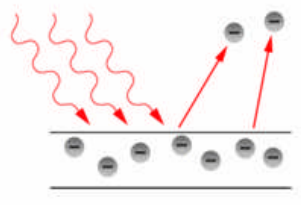


Fig 6.9 en.wikipedia.org

Lauren is a low energy photon. She walks up to the metal but doesn't have enough energy to pull away an electron (Adam) and just leaves again.

Kathy is a high energy photon and bounces up to the metal and drags Adam away from his bonds and they both walk away from the metal.

"Hang on a minute," says Sam who is watching. "Kathy shouldn't exist anymore!"
"What do you mean, I shouldn't exist?" says Kathy, hands on hips.
"Well you had to give up ***all*** *your energy to release Adam from the metal or* ***none at all*** *… that is Einstein's rule."*
"That's OK then," says Kathy, "so, I have given up all my energy… but I still exist!"

The rest of the class is listening intently…
"But aren't photons ***only*** *energy and nothing more?" wonders Nick…*
"Yes, if you gave up all your energy there would be nothing left… There is no shell or ghost of the photon… it completely ceases to exist," says Sam.
"I don't like that at all," says Kathy, "how can something just disappear?"

"Let's do it again", says Adam, "Come on Kathy."
So Kathy bounces in again and releases Adam from his metallic bond.

"So some of your energy goes into releasing me," says Adam, "and the rest I get as kinetic energy and I can zoom out of here." Which he does. "You see, the energy is transferred… it doesn't disappear."
Kathy is standing in the metal now, looking bereft. "But I, the photon, do disappear… POOOF!" she crouches down. "It can't be much fun being a photon then."

Students are now talking amongst themselves, some arguing. This has obviously struck a nerve. I pull them together and ask for comments and questions. Some want to see what happens if less energetic photons hit the metal and we try it out with some students taking the role of conductors and narrators. Some are still questioning what a photon really is and what energy really is. I didn't expect such controversy when I set this up but I am an interested observer waiting for what happens next.

I am very interested in the fact that the role play has taken on a life of its own. It is like a play where a drama can be played out to give new meanings. I wonder how prescriptive I have been in setting them up previously which may have suppressed opportunity for emergence. I think about systems theory which I am currently reading and realise that role play can be like a system provided it is given enough opportunity for interaction, feedback and iteration. Perhaps this is where the part and the whole divide can be reconciled?

I wonder now about asking the students as revision to design their own role plays to look at key phenomena because I think the discussion that happens when we try to make the role play work really helps us to get into the concepts and understand them.

What surprises me most is the big idea which has emerged from this exercise… not the ***quantisation of energy*** *(the foundation of quantum theory which this phenomenon is all about) but the* ***nature of energy*** *itself. We have been using the concept of energy all year but never really questioned it to this depth before…I guess we have taken it for granted. When you come to think about it, energy is pretty amazing. I think the students are beginning to be amazed as well, questioning their prior blithe acceptance and assumptions. Is this a sense of wonder?*

The more I think about this disappearing photon, the more I wonder if we are seeing evidence of the ' true' nature of reality… the notion of the Tao…the nature of reality is flow, change and impermeance. But how can physics say something about spiritual reality?

It seems I have three voices in my head, each with their point of view. What would happen if I give them free reign…

Science Head: Well, I am not sure about the way Kathy anthropomorphised the photon. In fact I am concerned that the role play gives the wrong impression entirely about the nature of photons. And I am really concerned about the validity of role plays in exploring science ideas.

Pedagogy Head: But that is the beauty of this role play. The students already had different ideas about the nature of photons and the role play brought those out for examination and discussion. Also, some students 'knew' intellectually that the photon was just energy, but until they saw it played out this intellectual knowledge hadn't really connected at a deeper level.

Science Head: How do you know that it connected now?

Pedagogy Head: Well I know it is a big assumption but there is a change in the level of their conversation and their questions following the controversy. It seems that this phenomenon is a lot more meaningful to them. It started out as a mere physical mechanism of minimal innate interest, but now it has almost turned into a philosophic question…. *What is the nature of a photon?* And the fact that the photon is just energy is now problematic. What is energy anyway and how can it simply exist as a bundle or wave packet? What happens to light now? It has really opened up a can of worms… where we are getting to the heart of what things mean.

Science Head: Hmmmm. But those are the questions we just don't ask in science because they are unanswerable.

Pedagogy Head: But they are the interesting ones!

Science Head: Only if you are interested in philosophy and teach science **as** philosophy.

Pedagogy Head: Well I think perhaps that is what I am doing… teaching physics as philosophy, but I think I am also teaching it as physics.

Science Head: Well you need to make it very clear for the students that this bit is **proper** physics and this bit we are now deviating into is philosophy.

Spirituality Head: Perhaps we are also moving into the spiritual realm as well? Physics as spirituality? I recently heard John Gatto, at the Spirituality in Education Conference, talk about 'the sacred'. John felt that we should be encouraging students to experience the sacred in nature… to have a sacred experience… one of reverence and deep connection …to appreciate that all of nature is sacred. Are they experiencing a kind of wonder here that is a sense of the sacred?

Science Head: But what is sacred here? You can't tell me that a photon is sacred? It doesn't have feelings! I think what we are seeing is intellectual curiosity or intellectual wonder… not sacred wonder or a deep connection.

Spiritual Head: What about Kathy's identification with the photon? Does Kathy's concern for its annihilation indicate a connection at that level?

Science Head: Or perhaps it is just because she was acting as the photon for a short period of time so she identified with it and thus projected her own self and feelings into it. She was afraid herself of being annihilated!

Spirituality Head: Or perhaps she had begun to *inhabit the space of the other* and as a result felt connected to the other… a breaking down of separation between self and other.

Science Head: I disagree… perhaps you might convince me if you could claim she had a gnosis experience of the photon, not that I believe in that.

Spirituality Head: But perhaps imagining yourself as the photon and putting yourself in its place is a first step in developing capacity for gnosis experience. Perhaps we could be encouraging students to exercise their spiritual muscles to help them develop another way of knowing and being which they can bring to inquiring into the world and their experience of it?

Science Head: If so, you need to help students distinguish between levels of such experience… what might be self projection and what might be true gnosis and how could they tell? Otherwise you are just encouraging self indulgence and a lack of objectivity. Science is about objectivity after all and surely in a science class they should be learning how to be scientific and objective.

Pedagogy Head: Yes that is an interesting point… in the teaching of science there is a confusion between what assists **learning about nature** and **learning about science** with what actually is the **scientific approach to investigating nature**. It would make good sense to put some scientific criteria on examining our personal experience which we have as learners. To make explicit for our students the different ways we come to know…. To ask what might be rigorous in terms of *philosophic inquiry* about a photon, *scientific inquiry* and *spiritual inquiry*.

Science Head: Yes, make explicit the different 'hat' they might be wearing at any one time.

Spirituality Head: I am wondering about insight now. Perhaps insight is *the space between* all those different inquiries. If you demarcate inquiry into small boxes you shut out the opportunity for insight coming from the interaction of multiple perspectives. Even Einstein said *"Imagination is more important than knowledge."*

Pedagogy Head: So perhaps these pedagogical techniques for helping students come to an understanding of science could also be valuable tools for scientists who are exploring the natural world… stimulating insight?

Spirituality Head: Yes, because isn't **insight into nature** the actual aim of science?

Science Head: But done scientifically.

Spirituality Head. I was just remembering about the guided visualisation we did last term where students imagined they were an electron and then went on a journey through different devices and types of fields with different forces acting on them. Do you remember how Kathy said that she felt that as an electron she had no control, she was just at the whim of the environment around her? She said how disconcerting it was to experience that. She seemed to have had a big insight about the nature of an electron within electric and magnetic fields. It seemed to give her a whole new perspective about the workings of the subatomic world. Perhaps insight or new perspective taking are also steps to gnosis? Unpeeling the layers and seeing more clearly. Perhaps it is a continuous process of greater and deeper realization until one gets the point of gnosis… total realization, non-separation.

Science Head: Surely she was just using her imagination. And yes, like Einstein, I believe that imagination is an important tool for a scientist. It is important to be able to have a visual picture in your head about phenomena… and then modify this picture or do 'thought

experiments'. It would be very useful to encourage students to develop imagination of this sort, but also to look at what they are doing critically. What is an analogy and what is real?

Spirituality Head: Well I think it is interesting that in developing imagination for purely a scientific purpose it might also have the effect of developing a student's capacity to meditate or visualise for spiritual purposes… or even give them the tools to project themselves into the perspective of another person …. thus building their moral capacity. Perhaps imagination building is something that we should explicitly teach?

Pedagogy Head: Well I am interested in the fact that Kathy has invested herself in the process of learning and coming to know and the personalisation of it was a key factor in that. It reminds me of *women's ways of knowing* (Belenky et al. 1986) where women respond to learning experiences which are personal and empathic…. Called *connected knowing*.

Do you remember the class conversation we had after the electron visualisation where we discussed whether as humans we also were subject to invisible forces or fields we might not see? It was a very engaging dialogue and many students were very thoughtful. We teased out how much could be influencing us, touching on implicit worldviews and paradigms that we hold that could be colouring our interpretation of our reality. It interested me that a physical phenomenon could have parallels with or resonate with our own human experience. It certainly made me wonder how to make better links between physics phenomena and students' lives. I believe that as a result of making such connections students are not only much more engaged learners but also more self reflective, thus encouraging self development and even perhaps helping them to become more self-realized. It seemed that the boys were engaged in making the links between themselves and the physics as much as the girls.

Science Head: Hmmm. Interesting. Perhaps I have been too scientific…. I have found the stories in physics to be too distracting and not really relevant so I have deliberately taken them out and just constructed a course of facts and ideas. Perhaps I have used an anecdote about a scientist in places but more as a humorous aside.

Pedagogy Head: Yes, the facts by themselves can be interesting as we saw just with the nature of the photon, but just imparting the facts gives some false impressions about science and how it is constructed. Students could end up with the notion that science is all there already, a body of knowledge floating in space, with no history, no foundations, no controversy, no iterativeness, no dialogue between scientists, no paradigm shifts.

Science Head: Well the stories that I have read about science don't actually show those either.

Pedagogy Head: Well perhaps it is up to us to ask what are the characteristics of science, and what stories reveal these? What are the grand themes and who are the players?

Spiritual Head: Yes, I like the idea of stories. I think stories help us to reclaim our wholeness.

Pedagogy Head: Perhaps then activities like this role play… stories in action … create wholeness within the actual lived experience of the actors.

Perhaps….

Epistemological Pause:

May 2006

Whose voices are these? Yes, these are my voices. I am trying to capture different aspects of myself held in tension at a particular moment of time. It is a snapshot of a conversation between 'people' who are at a certain stage of understanding and in the process of evolving. If I was using a science self or spiritual self from my current standpoint it would sound very different.

Can you imagine your own contribution to the conversation and how it might change it?

Could I have written a conversation like this back at the time to represent the tensions I was feeling? Yes, but it is likely to be different to now. Now, I have the hindsight to separate out the perspectives and contrive them. I think they can be more playful in dialogue now. They might have throttled each other back then, ending the conversation prematurely. In fact, at one point of writing this I put myself in role too much in the spiritual head and *did* want to throttle the science head! I would have had to spill tomato sauce on the page.

But is this a useful device? What might it lead you to understand and what perspectives are missing? Is this what I want to be understood? Different voices enable possibilities rather than agreed meanings. Is this OK? Do I always need to make the links and draw inferences as a scientist would or can I be an artist and just put stuff out there and sit back and enjoy all the different reactions it promotes?

I realise that while I am a strong believer of creating situations which give students feedback, I have really not sought much feedback from my own writing. What impact might this piece have on a real scientist or a teacher?

I decide to email it to my friend, Dr Jaci Brown, a climate scientist and applied mathematician (who loves playing with mathematical models) who is currently working at Yale. I ask her what she thinks of it… how it makes her feel (like cross) and what it causes her to think about.

She emails it back with comments in red and explains:

> Hi Sue,
> I read through the photon discussion. I didn't go back and change what I wrote – I just responded as I read. I'm at work reading it, so I really do have my scientist hat on! I'm not sure I got the whole spirituality argument but hey, that is why I'm a scientist and you're an educationalist! Anyway it should have some fodder for you to comment on in your thesis. Mostly I agree with your scientist, though I think she gets it a bit wrong sometimes. I have not tried to understand what you are saying – just given gut reactions to it and the first thing that comes into my head.
>
> One of the best bits of my science degree was the science philosophy course I took. It made everything come together and have meaning.

I look at what she had done to my writing. She had added comments to the Science Head – expanding, agreeing or disagreeing with my stance.
"That is not what I meant you to do," I think! "I want to know what it made you think! Hmmmph, typical scientist approach, hmmmph. This is *my* Science Head not yours!"

But I look again and realize that Jaci is better reflecting who I was back then. She *is* my 'head'. I put all her suggestions in and they cause me to reflect further and add new insights. I then talk to her on the phone and tell her how useful it was. But did she gain anything else from it?

"Well Sue, as you know, I really just let all that spirituality stuff wash over me, so I don't think I really got what you wanted me to. But it did make me think…"
"Oh," I ask intrigued, "in what way?"
"Well, I'm having to take over from a lecturer next week in his grad class on Climate Change. I was feeling really pleased with myself because I had just spruced up all his slides (which were pretty bad), but after reading your piece I

really wondered what I else I could do. I had made them prettier and more understandable but they were still just formulae and graphs. It made me realize that I could be a lot more creative."

"Any ideas?"

"Yeah, I am thinking of linking this graph of El Nino effects over the last hundred years with the impact on Australian farmers, to get the students to see how a farmer on the land would feel and how it would effect his planning of crops and management of his finances. So we do more than just look at the maths of the models."

"Sounds great… maybe they could role play?"

"I don't think so Sue, this *is* Yale you know!"

But later she tells me she got a student to wear an Akubra hat and speak in an Australian accent, imagining himself from the perspective of a farmer and it went down really well. Later in the lecture when the grad students asked her what might be the future impact of El Nino on the world, she realized that she couldn't give them an answer and opened it up to the class for discussion which turned out to be really interesting and engaging; the students saying how much they got out of the lesson. The role play had actually generated another perspective beyond the mathematical meaning.

And the moral is….

Perhaps the value of writing (or even teaching) is not so much that it is understandable according to the aims of the author, but that it creates **praxis**… an urge to do something, an ability to see in new ways. And what an extra benefit that this *urge to do* might in its turn create in others an urge to think or do? Perhaps as author/teacher we need to let go of the need for the reader/student to make the meaning we want… it is not going to happen anyway… so let's not stress over it…. And just enjoy what emerges.

Now if I had written a dialogue between my different selves from my current standpoint, would I have engaged Jaci? She no doubt would think I am disappearing up my arse and would not be afraid of telling me. So these snapshots of dialogue do not have to represent 'best thinking' to create praxis. Even Richard Dawkin's dialogue with the Religious Fundamentalists created insight and praxis in me.

I remember having a dialogue with another physics teacher in a corridor while we were waiting to go into a workshop. I was telling him about what I had been reading about - holographic notions of sight- which suggests we might see in *interference patterns*, not as a slide show. It is our brain that constructs our slide show picture of reality. Perhaps true reality might just be interference patterns. What did he think? What was our current notion based on and could it be wrong? He was really intrigued and we ended up exploring it in some depth together.

I didn't realize that we had an audience. A year later another physics teacher told me he had eavesdropped on our conversation in total awe and had followed us surreptitiously down the corridor. He had never heard people discussing physics ideas in such a way and it had totally inspired him to think about physics in a new way. So perhaps there is advantage of listening into dialogue that can move you into new possibilities and perspective levels. Am I doing it with my students?

And how important is this breaking down into different aspects? To see things from different stances? Without this differentiation would we move to a new level of insight and integration?

Perhaps Bohm's (Talbot 1992) notion of the explicit and implicit order as a fundamental property of reality has some meaning here. He says that it is the constant dual reciprocal actions of making explicit and then integrating which creates the wholeness of reality. Differentiation is not an end point… it is a process… one part. Perhaps this is where science and the critical mind can excel…. helping to differentiate. But the problem is when science thinks it is the only epistemology that we can use to differentiate. Does it need to move out of the maths and put on the Akubra hat as well?

And what helps integration? Perhaps this is the being and living in the space in between.

Does science need to find partners then in the pursuit of the **whole** truth?

But I am thinking of science here as something separate from the human endeavour of doing science. Perhaps the integration of science lies in scientists like Jaci, who are open to other perspectives and prepared to live their way into them.

Chapter 7

The questioning classroom - 1994 – 1999

Questions:

How do I encourage and manage questions?

What do they reveal about my students?

How do questions become the texture of science?

How can questions be a spiritual quest?

Introduction

In 1990 I had a revelation as I was teaching physics. I thought perhaps there were three levels or types of learning. The first is where the teacher gives you an unsolicited answer - information. The next stage is where the teacher questions you so you are the one discovering the answers for yourself (the Socratic method). And the third stage is where you are now asking the questions and finding the answers. My intention then in 1990 as a teacher was to empower students to move into the third stage.

Thus, questioning and encouraging questioning became a major theme for me during my teaching…. finding ways of empowering students as well as finding ways of *being* that enabled me to listen more deeply to their questions and to manage them. And somewhere in that process the type of questions changed as well as the way I responded. So no longer were student questions just associated with constructivist meaning making but were more holistic, existential and related to personal being and becoming. So who am I becoming now as I listen to my students' questions?

Dealing with questions

1996. I am running a session for Dip Ed science students where I take them through a physics lesson introducing the concept of circular motion as an exemplar of an approach using multiple intelligences. I start by taking them on a guided visualization on a rocket ship which orbits the earth and then heads to the moon,

experiencing take off gravity and then freefall. I ask the students to write down all the questions they have as a result of this and they fill several pages of butchers' paper.

I then get them to share their questions and I say how I would pull these together in a concept map to design our topic on circular motion. One student says to me "But what do you do with the questions that don't fit? What happens if that question was really important to the student but you didn't let him investigate it further because of your need to develop the topic in a certain way?"

Hmmm. I say… well …

1994. As a result of these deeper activities that I am now doing in my Physics class, there is generation by the students of so many questions. Students are looking at their investigations with new eyes and asking each other what is going on and why. They are interrupting me as I explain things on the board, because they need to get to the bottom of things. They are not interested in just the surface anymore. This is in sharp contrast to my first year of teaching where only one boy seemed to be asking questions and where students were cross at me if science couldn't explain things.

Then there are the really big questions, the profound and the bizarre. How do I cope with all of these questions and how do I honor the students and their process? I really like questions, I have always been a great questioner myself, but how do I balance the need for students to have answers *now*, the need for me to get through course content, and the fact that other students might not be interested in their peer's questions? How do we use these questions in another way?

I feel that I am doing a good job. I am gradually changing the culture so students enjoy the fact that questions might be open and continue to be mulled over, rather than having a quick answer. I have set up a *The Bastard Book of Physics Questions* where only the very problematic questions get entered and students feel very proud to have a question put in it. Each year it seems that classes stew over particular big questions - *What is the nature of the edge of the universe? Can we have parallel universes?* There is a lot of wondering going on. I wonder how I can find the intriguing and deep questions *within* the course that I am teaching, not outside it.

I think that students are comfortable with questions and I am surprised when Michael comes up to me. He has just completed a self paced topic on *sound, waves and music,* where the students are given some investigations to do (some more open ended than others) and some big questions to think about. He is really bright and has done really well, extending the material and coming up with some innovative procedures and applications.

"I still have so many questions," he says to me. "My friend in the other class (who covered the topic through the teacher giving notes) doesn't have any and I am afraid that I haven't learnt enough to be able to pass the test." This takes me aback but then I start to think about what might be happening. I use an analogy - that when you are taken on a journey through a tunnel you can't really see anything other than what you are expected to see and therefore your questions are limited. But if you can go anywhere, of course you are going to have lots of questions.

He thinks about it and several days later tells me "I talked again to my friend about waves and do you know, Sue, he hardly knew anything. Even though I still have lots of questions I know so much more than him." I now see Michael change into someone who exuberantly asks questions, seeming to delight from questioning things to the nth degree. I begin to realize how important it is for students to learn to manage openness.

At the end of the year I ask the students to put some of their most tricky questions on a poster for me to display at the annual physics teachers' conference. Michael has a paradoxical question which he puts down with pride. It is interesting the responses that physics teachers and lecturers have to this poster. Some try to answer the questions looking for one answer, some say that the questions are ridiculous and why am I encouraging my students to think that way, some are amazed by the inventiveness and passion of my students and others start sharing their own unanswered questions. What do these teachers' responses reveal about their assumptions of the nature of science and science teaching?

What story of science am I telling with this approach to questions in science? It is OK to not to know something? Science is tentative and iterative? It is OK to ask the tough questions? Students now start saying to me that they should be marked on the quality of their questions. I think they have a point. At the end of the year, I give each student a certificate saying that they are masters of *Boldly asking questions where no-one has gone before.* The students are pleased and excited; it seems like a rite of passage - a celebration of what we have achieved in a way of orienting ourselves to the world. Many years later a student tells me he still has it on his wall.

Yes, I am hooked now on this journey of asking questions. And I begin to be more aware of the processes I am using as I manage these questions. I encourage students to articulate their questions in class so everyone can hear and understand and be involved in thinking about them. I give them time to think of questions and to frame them and to tease them out with their peers. I give them think time between lessons, introducing what I will cover the next lesson through a series of a questions at the end of the current lesson. I find that students begin to ask questions from a much deeper perspective in the following session.

Students seem more aware of framing questions so that they help in our shared understanding. I am using the whiteboard as a space for students' questions, where we tease out ideas and possibilities. Students are comfortable coming up to the board and writing up questions or explaining them to each other.

I become aware of how some questions can close down and others open up discussion, how some 'way out' questions are actually helpful in giving us greater understanding of an idea, and how helpful the humorous extension of an idea might be. That we begin to understand not necessarily by getting to something from a linear building up to it but can come at it from different angles and perspectives.

Yes, my role here is a mediator of the various questions coming to me. I am orchestrating them. And I begin to realize that I have been valuing some students' questions over others…. The questions which fit with my own agenda of getting certain material across or capture my own curiosity or are within my capability of understanding and managing. Hmmm. It is so easy to be dismissive of student's questions when they don't seem to fit. Is this an issue for them? Do I need to discover within their questions something of significance for what we are doing now? Is it OK to have multiple streams of questions occurring in the classroom, sometimes connecting and sometimes not?

I find that the simple technique of listing everyone's contribution on the board, even one's I might have previously dismissed out of hand, helps me and the other students in making meaning. In writing all thoughts down I often see ways of linking them as part of the story we are developing and realize how useful they are in helping me begin to see more out of the box. I wonder whether previously I had not been

Types of questions
Playful
Imaginative
Existential
Humorous
Wondering
Speculative
Iterative
Self-aware
Connecting to experiences

Fig 7.1

listening to all the questions and looking deeper into the meaning behind them. What did they reveal to me about my students?

I am also becoming more aware of the nature of questions… the ones which might have a deeper philosophic meaning and those which are just requiring pat answers. The difference between a student asking *what is magnetism really?* and *what is the formula for magnetism?* Initially such questions throw me but then I really enjoy discussing them with my students, and encourage them to think philosophically as well as scientifically.

Questions which go deep

At the beginning of the next year I ask my students to write for me on a piece of paper the courses they are doing, their goals for the year and questions they might have.

I am really surprised by the responses; the range of questions, from the mundane to the meta-physical, pragmatic and existential. I have heard physics teachers saying that students are just doing the physics for the marks to get into university, but their questions reveal to me a whole new side to my students. They are coming with a deep curiosity and a wonder about the meaning of life. The issue is not so much how to help them experience wonder, rather how not to stifle it.

Some students say to me after this exercise how teachers have never asked them what their questions are, just poured information into them. They say it is very refreshing being invited to share their questions and in particular to be able to pursue them in their individual presentations to the class (which

Students Big and Little Questions

- Will humans exist in another star system?
- Could time ever stop?
- I wonder if we are all creating our own destinies with every decision we make, or is life already determined for us?
- Looking at stars and seeing light they emitted thousands of years ago - a star could be a white dwarf already but no-one would know.
- Why is an orange orange?
- Is there life on Mars, in other galaxies, in the universe?
- Is matter composed of what we think it is?
- Are there any very large planetary bodies bigger than our sun?
- Where is my life going and why is it going there? Why am I here? Why are any of us here, at this point in eternity and for how long?
- What more is there to find out? What happens when we find out everything?
- How do scientists come up with theories/ideas which have never been initiated before?
- How big is the universe?
- When the leaves drop from the branches, why must they drop right to left and left to right?
- Why and how did Daniel Benoulli think up his idea on fluid dynamics, especially given the fact he did this 200 years before the Wright Brothers flew their plane?
- What is the point of life?
- Does God exist?
- Why are there so many thousands of people on this planet and why are things like World Hunger an issue when there must be more to life than sorting out Life Problems?

Fig 7.2

is not a compulsory requirement of the course but something I had established as an important part of my teaching early on as a way of bringing current science into the course.)

These presentations are seen by many of the students as one of the most interesting aspects of the course because of the wonderful variety of topics that they choose to explore - from black holes, to submarines, kayaking through river eddies, String Theory, the physics of Star Trek, music synthesizers, to arguments against the big bang.

One girl, Jenny, says in an interview:

> In other subjects passing the exam is the motivation. In physics it is our curiosity – wondering why and how.

One boy runs up to me in the quadrangle before the start of the year and says:

> Sue, you don't know me, I'm Nick, I am going to be in your physics class, and I just wanted to tell you I have already worked out my topic for my presentation – it is going to look at ….

One boy, John, writes on the back of an end of year questionnaire:

> Having never previously thought about the meaning of life and whether the sky was blue before, it was nothing short of an exciting time in my life to think about all the possibilities and all the constants and all the enormous numbers and smallest particles. My indifference has been replaced with something else…. Dare I say it; a desire to know more.

As I read John's response I can sense that light in his eyes. Yes, I have done well in helping my students to wonder and *ask* questions. But have I empowered them to *manage* them … to orchestrate multiple perspectives and infer meaning and significance? This means helping them to see questioning from a meta-cognitive level. Hmmm. Not yet, *I* have to master it first.

I now wonder how I can better facilitate my students in being able to bring their big and small questions into the everyday of the physics learning – not just in their special topic. Is it in the awareness I bring of what questions might be possible, inviting students to disclose what they care about and might be vulnerable in thinking? Is it the way I listen to their questions and hear the deeper ones inside and encourage others to do the same? Is it having a computer in the room so they can look up questions quickly?

I wonder how students can follow through their questions, reflect on them and extrapolate. It occurs to me that something like a reflective journal might be useful. I call it an 'I wonder' journal and it seems that for the students who choose to create one it becomes a refuge for

deeper questioning about life, the universe and everything. It is also becomes a window for me into their very being – their feelings, thoughts, imaginings, concerns as well as for some their very personal concerns.

In inviting students to participate in this journal I incorporate what I have learnt from my enrichment session on *Dreams and Visualizations*… the importance of other ways of expressing self rather than just reflective writing… poetry, drawing, play, dialogue. I use what I have learnt from journalism in how to tactfully respond to students' journals. I take from an inspiring conference session (Remen 1999) at the Spirituality in Education conference (1997) questions like *What inspires you, intrigues and surprises you?*

What goes in an '*I wonder*' journal?

New ideas
What has surprised me, intrigued me, inspired me?

Questions
What bothers me? What questions do I have… big and little?

Explorations
What are key concepts, processes or beliefs about science I have grasped?
How has my knowledge changed?

Reflecting on my learning
What helps me think and talk scientifically?
What helps me be motivated?
What do I value about certain activities and working with certain people?

Playing
using imagination, prose, dialogue, poetry, scripts, concept maps, cartoons, feelings, what I am reading, experiencing

Fig 7.3

And as a result I am astonished by the creativity of my students and how these different modes of expressions enable students to explore and express different perspectives of science and their experience of it. I rush into my supervisor's office and show him with amazement the poetry, dialogue and imaginative writing in which students seem to bare their souls. I feel privileged to be allowed to see this wonderfully rich world into my students' lives, thinking and being. What does it mean to hold such insights into another in one's hands? Who am I as I read their words?

Previously I have worried that perhaps I was too prescriptive and not giving students enough space within activities and within the class, but now I realize that students are finding the space. That learning is happening outside class, being mulled over for months, or popping up way after something occurred in class. I am not the controller or facilitator of their learning… just the occasioner.

Where is science now? It seems to be more than just a scientific inquiry process. It seems that we are still keeping with a scientific desire to *inquire* into something, but now we are

bringing other lenses to it… philosophic, existential. We are using our imaginations, linking to our feelings and angst, and exploring with many intelligences. Is it still science? It feels that it is, but some of my colleagues don't think it is.

Where is soul now? Soul sings in the questions. It lies in the students' investment into the questions and the passions hidden in the questions. Yes, soul is clear and present. And those existential questions, about god, life and meaning? Well aren't those the sort of questions one might ask if one is on a spiritual path? Am I providing a place where students can nurture those questions within? Am I helping to develop *existential intelligence*? Is this quest for meaning a *spiritual quest*? Has spirituality somehow infiltrated the physics classroom?

I wonder how the questions that students are asking might reveal their deeper soul purpose and help them to articulate soul in what they do. They seem passionate… is this revealing their deep passions? Are passions an indicator of deeper purpose?

> "The spirit is fascinated by the future, wants to know the meaning of everything, and would like to stretch, if not break altogether, the laws of nature through technology or prayer. It is full of ideals and ambition, and is a necessary, rewarding, and inspiring aspect of human life.
>
> "By confronting us with irreducible mysteries that stretch our daily vision to include infinity, nature opens an inviting and guiding path toward a spiritual life."
>
> **Thomas Moore**

Where is learning now? Is learning in the freedom to ask questions? The freedom of the students to pursue their own thinking and meaning-making? Rather than me constructing a path of meaning, are they doing it themselves, guided by their own questions? Is this possible within this heavily regimented content? Perhaps learning is in the freedom to express who they are and all they understand in the praxis of their questions?

Where is my notion of constructivism now? During this period I begin my PhD, starting in 1996, and am inducted into the academic world of constructivism ranging from pragmatic classroom practice (Treagust et al. 1996), research into how students construct alternative frameworks (Driver et al. 1994) to more philosophic discussions and critiques from trivial, social, critical and radical versions (e.g. von Glasserfield 1990, 1993, Eger 1993, Claxton 1996, Mathews 1993, Taylor 1997 and many more (eyes glaze over)).

In my first session on trivial constructivism I am astonished when the visiting lecturer 'probes for understanding' in such a way that streamlines our responses and ignores the

wealth of experience in the room from myself and my experienced co-educators. His agenda has shut down any possibilities emerging.

It seems to me that there is a spectrum of constructivism – including versions which are barely removed from directive information sessions to other versions which invite participation of the wealth of understandings and ways of being of everyone… which is co-constructive and co-creative. (Perhaps from a *spiral dynamic* point of view (Beck and Cowan 1996) this might be the difference between constructivism practiced within the pragmatic, goal oriented *orange* cultural meme and that practiced in the *green* meme of postmodernism and open space technology.)

I am concerned about where I really am on this spectrum in my teaching of physics. Do I too have too much of an agenda? An article by Tobin (1993) challenges my thinking further, questioning the roles I take in the classroom. Even though I am inviting student questions am I still directive? Am I shaping too much what can be asked and what is heard? How do my metaphors of teaching limit who I can be as a 'teacher'? Am I limiting or stifling my students in the same way I feel stifled in some of these PhD coursework sessions?

Just asking these questions lifts me to a new sensitivity and vigilance. I begin to see how much the type and ways of using questions has changed in my teaching over the past few years. I realize that it isn't enough to empower students to ask their own questions; it is equally as important to foster a place which opens up the type of questions that can be asked. The paradigm we are in dictates what we see. The *eyes* we use (spiritual, mental, physical) dictate what we see. The way we are together dictates what we share and reveal to each other and to ourselves.

So while *critical constructivist* discourses take into account student voice and negotiation in their learning I feel that there is something missing. It seems constructivism is based on assisting students to *come to know* **mentally** this subject that is being taught; it focuses mostly on epistemology – the ways that meaning making is framed and legitimized. Where is the ontology? Sometimes there is mention of *being*; helping students to *be* scientists and thinkers. But what about holistic knowing, including more than just the *mental eye*? What about holistic *being*? What about the value of relationships and experience? What about development of the child?

It seems in this journey of encouraging questioning in my classes that my role of teacher has changed. I am far more than a subject teacher finding ways of improving my craft and

improving student learning of my subject. I am now wanting to build relationships with my students, to care for them, help them flourish and help them extend their current capacities and explore others. I have come to know them through allowing them the freedom to express their questions, their passions and themselves and this creates a sense of compassion, connection and greater responsibility in assisting their holistic well being.

So, as I read the various constructivist literature I find myself looking for where the author is coming from. Are they bringing a spiritual or holistic sensitivity? What assumptions about the purpose of education and the development of the child underpin their research? It seems that much of the academic debate on this topic is like two old dusty men squabbling over pennies when someone nearby is exuberantly handing out hundred dollar bills. So while I am using constructivism in my physics classroom as a basic tool of my craft, I find it lacking as an explanatory theory of student being and becoming. I find myself a little frustrated with the mind games of the debate and I turn to theories of Holistic Education (J. Miller 1993, 1996, R. Miller 1990, Moffat 1994), Steiner (Childs 1996), Dewey (1966) and Egan (1986) to now try to understand deeper into the heart of education and what it is for.

I write to my supervisor in 1997 about where constructivism fits into the directions I want to take in exploring holistic principles in my teaching:

> However, all that other part of the constructivist stuff that we had to do (as part of your course) does not really fit in. It annoys me excessively. I understand it, I disagree with its emphasis on intellectual knowing but I have no urge to argue it. Because I have set up a different context, even raising it and debating it is irrelevant to my plot.

Yes, I want to detach myself from this thing which seems to have colonized science teaching and focus on what I think is more important. But I can't because the constructivism debate is part of the science education culture of the time and to be part of a scientific teaching community I need to connect in some way to what is the key concern of my peers. I am heartened also by my supervisor's own response to the epistemological focus of constructivism – his attempts to bring notions of *being* and *values* to 'value-add' the debate about *knowing* (Taylor 1998).

So despite my concern (or perhaps because of it) this foray into the worlds of academic constructivism from 1996 to 1998 leaves its mark. I am inducted into postmodern discourses, relativity of meaning, interpretative lenses. These cause me to reflect on my own teaching and teaching journey and to question my own assumptions and actions. It helps me bring rigor to my thinking about spirituality, helping me to be more vigilant in listening to the

language I use and making explicit the underpinning metaphors that I might be unconsciously buying into.

This academic journey into constructivism also helps me hone my craft, enabling greater self-awareness of what I had begun to do naturally as a result of integrating earlier learnings from our state-wide sessions on constructivism. So I am able to bring a more critical eye to my practice and move above it, beginning to play with it more – not owned by it. And while my previous learnings of *trivial constructivism* now seem to be surpassed by more mature versions of constructivism there is an essence of trivial constructivism which is worth retaining and makes a good starting point in the journey of *coming to see another.*

This is the permission to move into the perspective of the student – to ask what they know, to invite their questions, to try to understand their thinking. I have value-added it, through my engagement with Holistic Education principles, giving myself permission to enter even more deeply into their *beingness* as well as into their thinking. However, having opened the door into students' souls is a bit like opening Pandora's Box and I will talk in later chapters about the responsibility that brings.

When in 1999 I work with university physics lecturers to help them improve their teaching practice I start with *trivial constructivism* as a means of initiating the process of helping them move out from behind the lectern into ways of understanding and coming to know their students more deeply. I talk about this process and the difficulties in more detail in Appendix 3.

But to be honest, many of the deeper philosophical arguments about epistemology, *dasein*, hermeneutics and feminist politics went over my head at the time. When I look back now in 2006 at the many papers I had available to me then, I realize how much I have discovered for myself through 'hard won knowledge' that was already there for me to take and use, but I had not yet grown into a place where the findings were understandable, relevant or meaningful to me. But my learning style is one where I need to learn from experience rather than have it merely told me… I need to live my way into my questions and I suspect one of the reasons I got very ill in 1999 was because I was trying to live my way into far too many questions at once.

Now with the hindsight of Integral Theory I think I can look at the literature and tentatively map where it might be on Wilber's (2000) quadrants and levels, or on Beck and Cowans'

(1996) spiral. I might be able to better appreciate the 'partial truths' in each and how they might integrate into a greater whole.

For me now the various levels of constructivism seem to have an evolutionary aspect, so one size doesn't fit all, but rather suit the perspectival level or cultural meme that someone might be operating at. Thus assisting transformation of a teacher would involve assisting them into looking at a more mature version of constructivism than they might be currently operating at which can help them see what they are currently doing from a greater distance, thus dis-identifying from it and being able to grow to a new perspectival level (Kegan 1982). As Vygotsky says, it is through play that we can bridge that gap from where we are now to where we have the potential to be. So perhaps it is by playing with these constructivist theories which act as temporary scaffolding that we can move across the gap. They are useful when they assist our own transformation and openness to further possibilities, and less useful when they cement us into a fixed position or paradigm about science education.

But I am again getting too ahead of myself…. Back to my 1998 'head'… or heart?

Where does wholeness lie now? Does it lie in helping students express their deep existential selves? Does it lie in the *integration* of various aspects of themselves in what they do? Is it in the *being fully present* and *fully alive*? And what do I mean by *fully*? And what is this thing called integration? Am I seeing integration in them because perhaps I am experiencing it in myself… the beginning of reconciliation between my spiritual self and science self? What is the process of explicating who we are and then integrating? Do we become wiser, more self realized?

And what is the key to this process of becoming and being? Permission to bring one's own passions and questions to what you are doing? Being in an environment where others are doing the same… stimulating you and interacting with your own passions? Do we need a community to inspire, intrigue and surprise us… to perturb us and support us… providing the synergy for growth?

Am I really reading too much in all of this because I want to see soul and spirit in everything?

Who am I becoming now?

And how am I feeling? Humbled and inspired by my students. Playful and laughing. Joyous and energized. Inspired by the questions we are asking. Increased sense of awe and wonder in not just the universe and the way we try to describe it, but also in us, the human beings who are experiencing it. Life is good and I love opening the door to my classroom.

Yes, if you were to ask me the question "What intrigues, inspires and surprises you?" I would have to answer "my students." And in the words of John, I would probably say "It was nothing short of being the most exciting time of my life." This openness to be surprised seems to energize my soul, and remind me of my humanity. It is something which today (2006) I dearly miss about not teaching physics – now I have to cultivate an openness in my life to be surprised without being in the energizing presence of 20 students who are discovering what it means to be enchanted with the Kosmos. Perhaps I can remember the essence of this and try to bring back some enchantment into the lives of my current journalism students, some of whom are suppressed / depressed. Perhaps I can even bring a sense of enchantment in writing my thesis. But hey, let's not go overboard!

?

Interlude 1

A quote by Albert Einstein followed by three extracts from my students' 'I wonder' journals

> *"The important thing is not to stop questioning. Curiosity has its own reason for existing."*
>
> Albert Einstein

Robots and other thoughts…

What is the real purpose of momentum? Can physics explain how people get teleported in star trek? Why does the blood rush to the top of your head when you hang upside down, yet nothing is abnormal when you are the right way up? Where does the matter go when it is sucked into a black hole? Could a black hole be an opening into a parallel universe?

From Robot Dreams:

> *You've made a positronic brain pattern remarkably like that of a human brain. Human brains must dream to reorganize, to get rid periodically of knots and snarls. Perhaps so must this robot, and for the same reason*.

I am reading some of Asimov and am thoroughly enjoying it. Could I do my talk on some of his ideas?

Amanda (early in the year)

* * *

What is the meaning of life?

What is the meaning of life? Do we have a designated purpose that each of us has to fulfill before we are released into the spiritual world?

I went to a philosophy seminar which spoke about "Emptiness is the key to reality." Does that mean that reality does not exist behind us? That reality is

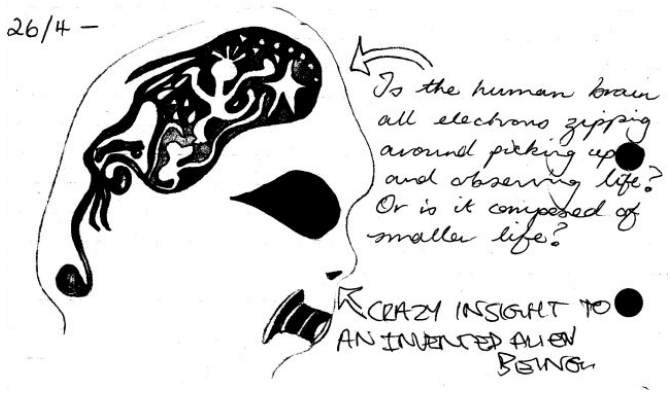
only what we can see? Therefore is it possible that we are all a figment of each other's imagination?

My brother was trying to convince me the other day that the universe did exist as different matter beforehand and then someone figured out the key to the universe. As a result of this the universe collapsed and now new complications have formed. If we figure out the key to this new universe, what will happen to us? Would it collapse and would it reform? Is this concept believable at all?

Amanda (mid-way in year)

* * *

What is reality?



Reality is what we believe to be real. However, do we really know what is real?

There are so many possibilities, we could be living on a hollow earth, all atoms could be galaxy's, human beings could be combinations of infinite galaxies, we could all be figments of our own imagination, all be someone else's dreams, singularly matter and not any mind, and if so what do other people perceive us to be. Are we all lumps of mass that people view and create our own personalities for?

Are colours colours? Do people see the same? What would it be like to see the world through another person's eyes? (get people to go in pairs and one to close their eyes. Draw a picture on the board and get person to describe it, then people with eyes closed to open them and see if it is the same as what they thought it would be)

What would happen when all the planets aligned? Will the gravitational effect be so great that we would be sucked into the middle of the earth, or would the effect be so balanced and great that we would float?

What are people? Are they bodies wandering aimless around the earth looking for a purpose they can never find? Are they real? Do they appear the same to everyone? Am I always the same to everyone, the same matter, but different mind? And if so, how can we say that we know someone, if we can only really define their matter. And even then, matter appears different to every one. What is beautiful to one person can be the inverse and opposite to the other. That is the way the mind works. It is different to every one. I view my mind as my own, something secret kept hidden under rocks and stones for no one to see. No one ever sees the real me, my mind. It is fucked as all shit. Hidden under a lot of grass, in which no one can ever graze. But if no one can ever graze it, is it really grass. If it's not grass what is it? An un-comprehensible cover that no one can understand and interpret. And if no one can interpret it is it real?

What is temperature? Is it a fragmentation of our own personal experiences. Hot is associated with extreme feelings, whereas cold is hardly any feeling at all. It is the expression of nothing. Therefore if it is the expression of nothing, then does that mean that I feel nothing as my circulation is poor. What does that say about me? Am I an ice object, someone who does not feel anything at all?

What is a feeling? Is it an expression, a stable form of our mind, an unexplainable being, influencing what we believe to be so?

April

* * *

Who are these people, these souls?

What privilege I feel in being given glimpses into their inner being.

I wonder at what else might be hidden, what I might be suppressing with my agendas.

Yes, what is it like to *create a spiritual space within us so we can accept our students' gifts?* (Palmer 1997)

Interlude 2
Two different takes on questions courtesy of two physics lecturers

Take 1 - 1999

I am sitting in on a first year physics lecture as a researcher/observer as part of a project at the university to improve teaching and learning in first year physics courses. There are about 60 students in this lecture theatre which could take 200. The lecturer, Dan, is down the front giving a talk on optics, using a power point presentation which carefully constructs the concepts using well designed diagrams. It is the third lecture of the year.

Dan would like to use more questions in his lectures to cause students to think about what he is talking about and to make it a little bit more interactive. I am there to give him feedback about what he is doing already.

Dan asks a question. "Another application of a prism is…?" I look around at how the students are reacting to this. They are shifting a little in their chairs, some are tilting their heads or looking at their friends, some are leaning forward. They seem to be thinking and now hands are going up from all around the lecture theatre. One student says "a telescope?" Dan says "No… well yes, but that isn't the one I am after …. So another application of a prism … is ….a …?"
Another student tries but it isn't the right answer and finally Dan says "Another application of a prism is …. The eye!"

There seems to be a change in energy in the room. It seems colder.

A bit later on Dan asks another question which is also closed. This time students are holding themselves, waiting. Non-committal. One person right at the front puts up their hand.

Take 2

A quote from another physics lecturer:

> A scientist needs to ask questions in such a way to allow for surprise. That is the joy of being a scientist … to be surprised… to find out something that you completely didn't expect. If you have in mind what it is you want to find out, then your questions might shut down the possibilities of what you might find.

Take 3

I am in the morning tea room talking to Dan about what I observed in the lecture theatre. "Actually Dan, I noticed that you asked quite a few questions. Did *you* notice how the students responded?" Dan says how he doesn't really see what is going on because he is so focussed on remembering what he has to say next.
"Are you aware of the difference between open and closed questions?" I ask.
No, he hasn't really thought about it. I explain how the students seemed to shut down when they were expected to come up with the one answer that he was thinking of. Perhaps the issue isn't how many questions you ask but the type of questions… giving students an open question that could have several possibilities, encouraging them to be more speculative, allowing for different approaches, valuing any thinking they are doing… that way students are encouraged to participate. I am warming to my theme.
But Dan is looking horrified. "I can't ask them an open ended question." he says. "I wouldn't know what possibilities were reasonable and what weren't. I would have to work out all the possibilities before I could ask a question like that. I can't think on the spot … I need time to think. I would be totally stressed." He is getting more and more agitated.
Hmmm. "When presented with several possibilities perhaps you could imagine yourself as a scientist then, rather than a teacher… what techniques do you use to decide whether something is plausible… look for justifying theory, test it out, do a thought experiment? How could you ask your students to be scientists with you?"

Dan is not convinced that he could carry it off but he says he will go away and think about it. A few days later, he tells me of an open ended question that he might use in the optics lab session the next day. He feels there are two options for his question and that he would ask the students to test these out.

The lab session starts with Dan up the front giving the students instructions on putting together optical benches, lenses and mirrors to see different aspects of optical theory. There is not much discussion between students in their pairs… just practical conversations… "look through this", "place this here", "where has that bit gone to?". There are three other lecturers in the room observing, standing back against the walls.

Dan now asks his open ended question and asks each group to discuss possibilities. There is a lot of discussion and then Dan asks for ideas. There are three main possibilities that students come up with. Dan writes them all up on the board as I have suggested. He is

looking very uncomfortable as he writes up the third one. He then asks the students to think how they might test each of these out and to go ahead and work out which one might be the best explanation.

The energy of the room changes… the students seem fully engaged, theorising, exploring, testing. The observer lecturers are drawn from the outskirts of the room and start engaging with the students as they are trying to come up with theories… these lecturers seem to be enjoying the dialogue… challenging students to be more analytical as well as speculative. One student, who I have interviewed several times over the last weeks and is getting to know me, grabs me and says "Sue, I have been thinking how this might be relevant to… and I am wondering…" I am really pleased and think that this is now an inquiring classroom.

Dan is still up the front of the lab looking at his next lot of notes, head down. Oops, it is supposed to be him having these sort of conversations, not me.

Dan now calls everyone to attention and asks students to share what they have found out. There is a good discussion and he eliminates all but one possibility from the board and then gives the formal explanation.

After the three hour lab session I ask him how he feels his open ended question went. "I was not happy," he says, "When that third possibility came up I panicked. I couldn't think whether it might be true or not. I remembered what you said and I wrote it down on the board, but I really didn't want to put it up there."
"But it was such a success… the students were really engaged in some good scientific thinking. It seemed to be the highlight of the session."
"But I ended up running out of time. It took a lot longer than I thought. Now I have to cover more in the next session."
"Could you cover less content and give yourself time to do something like this?"
"I am going to have to think about it. I really don't feel comfortable with this sort of thing."

How can I help Dan to be more comfortable about this? Practice? Is this just about pedagogy, or does this reflect who Dan is? Can he change who he is, his very nature? Should I be expecting him to?

Interlude 3

An extract from a student's journal, an interview with three students about their journals, followed by a quick quiz and a reflection

> "Feeling pretty down at the moment, so I thought I would escape to the sanctuary of physics. It may sound crazy to an individual but at the moment it is an escape into another place for me."
>
> Amanda

* * *

Nina: "We had to write journals in high school and I hated it. We had to do exactly what the teacher wanted. I was really unsure about doing this in physics. I didn't know what to write. I was wondering what you wanted. And then I thought, "Hell, this is for me. I'm going to start one. I will write what I feel like." What was important, Sue, was that you didn't judge; there was no right way or wrong way to write in it; I could write down my ideas even if they were wrong. But I held myself back for the first couple of entries before I felt really confident to just say what I liked."

April: "This journal saved my life. I was going through a really tough time, broken up with my boyfriend and I was spiraling into depression. I found that by writing in it, I could let things bubble out. I remembered that when I was young I had a diary and I loved it. As well as the physics one, I started my own personal one. It was a release. But then I became too reflective and started to be depressed again. It was time to stop. I now know it is there. When I have problems again, I will use a journal… "

Amanda: "I liked the way I could just imagine… write down what I was reading and muse about it… I liked the way that you interacted… suggested other books… took my ideas further… it was a conversation."

Quick quiz:

1. How do you mark a student's 'I wonder' journal? How do you value what they are doing? What criteria are you thinking of as you read the journal?

2. How do you balance the need to allow students to gain confidence in speculating with providing a reality check if they are showing misconceptions of physics ideas?

3. What are you going to write in the journal? Whose space is it? The student's? A shared space? How can you be sensitive to students' own aims for their journal which may not be what you originally had in mind?

* * *

Yes, the 'I wonder' journal is a space for students to reflect about physics ideas and their learning of physics, isn't it? Then why am I also reading about girlfriend, boyfriend problems. Deeper issues. Do I allow it to continue or remind students that this is a **physics** journal? It certainly is giving me a deeper insight into my students, and a reality check for me if I think Physics is the be all and end all of people's lives.

The notion of the journal as a place of sanctuary is really interesting. It seems that this is the case for several of the students…. … a place where they can be *at home* with oneself… it is home in terms of the sanctuary of the inner imaginal life… home in the trust they have in me to hold their interior spaces with kindness, with non-judgment and a deep interest. Here am I, a person who sees them… and there is a sense of home in that. Is there an intimacy here between me and my students in the pages of their journals as I hold their words and perhaps their souls in my hands?

And those students who are not writing journals, how can I also look more deeply as we interact together inside and outside the classroom? How can I help them discover the best ways to express themselves?

Chapter 8

The significant classroom - 1995 – 1999

Questions:

What does it mean for something to be significant?

How is physics significant?

What are the various ways that physics can be significant to students?

Introduction

So far in my story I have come a long way in my teaching of physics. I am helping my students to understand the physics better, I am beginning to look for greater plausibility and give what I do meaning and enchantment, linking to students' questions and passions. But is this enough? Have I really made physics *significant*? I soon discover the answer to that – not enough. But I will get there in a minute.

What makes something significant? Perhaps when it has a direct impact on us, when it is related to our own goals, when we see how it is connected within a bigger whole helping us to see in new ways, when it helps us to solve issues in our lives, or when movement or change happens.

How might physics be significant for me? How might it be significant for my students? How do I even begin to think about this?

Students' goals for doing physics

- To understand physics.
- To be challenged.
- To boggle other people's minds with lots of facts.
- To find out some interesting things.
- To be more aware of the world around me.
- To get into my course at university.
- I want to know the things around me… I want to be able to talk to myself and think about how it happens.
- To widen my personal knowledge of physics and apply them to my own applications.
- To do something good for the world.
- To enjoy and learn.
- To enjoy, enjoy and ENJOY!
- I am intrigued by Einstein and his theories on quantum mechanics and I want to understand more about them.
- Strengthen my strong interest in it, provide a science side to my thinking to equal out my ideological side, hope to be able to join the two sides when needed.
- To acquire a thorough understanding of the physical world/universe and the changes that take place in it.
- To learn a whole lot of new things and meet new people.
- To pass and decide whether or not science is something I am really interested in.
- To use the wind tunnel that I saw in the prep room.

(written in second lesson of the year from 1998 and 1999 classes)

Fig 8.1

Students' goals for physics are mainly based on how it can help them understand the world better. Does physics have any more significance for my students beyond that? Can it help them understand themselves better? Can it help them grow and change? Are they only thinking of understanding the physical world, or can physics help them understand the world of constructed meaning as well?

Let me ponder this for a while. Perhaps all the ingredients are there and I just need to wait until somewhere in the nether regions of my mind a cake is baked. Hopefully the oven temperature is on the right setting…

Ingredient 1 – the collapse of plausibility

It is 1995. I have a small class of 12 students. It is the end of the year and we have just finished exploring Quantum Theory over four weeks. One boy, Benjamin, is really interested in Michelson and Morley's alternative view of Quantum Theory which he had been reading about and sharing with us during the topic. It was creating a lot of debate in class, as he was taking the stance that Quantum Theory is wrong, so I suggest that we put Quantum Theory on trial.

So students choose their roles in the trial – some taking the roles of the key scientists of the time, others of prosecutors (Benjamin) and lawyers for the defence. I give them time to research their roles, and they now come to the 'courthouse' in role - some with wigs and lab coats. The room is set up with a jury of some students from my Year 11 Physical Sciences class sitting in chairs high up on one table and I am the judge on the other side of the room sitting in my elevated chair with my look-a-like gavel. We start.

Each quantum scientist is brought to the stand, and is examined by both prosecuting and defending lawyers. They are trying very hard to answer the questions and explain why their ideas are feasible. Einstein, played by a cheeky boy who has a matt of white cotton wool on his head, is questioned mercilessly about the veracity of his theories. He finally gives up justifying them and says in a deep European accent – "It is my job to come up with the theories and your job to test them!" pointing at Benjamin accusingly. Yes, it is very funny and we are all laughing, but now we move into a greater debate where it seems that even science and truth are being put on trial - what constitutes proof, is it 'science' when Einstein comes up with a theory that is yet to be tested?

Planck (Courtney) is now called to the stand. She falters under Benjamin's cross-examination, unable to justify the development of the idea of *discrete wavelengths*, the underpinning concept of Quantum Theory. The jury of Year 11 students are looking on with amazement (and say to me at the end of the trial that they can't wait to do Physics next year), but it seems they are unconvinced of the case for Quantum Theory. Is it because Quantum Theory is really that unconvincing, or just that my students didn't understand it enough to justify it under the agile questioning of Benjamin?

At the end of the role play Courtney, who played Planck, comes up to me quite upset. "I looked at the text book and based my defence on that," she says. "It seemed reasonable when I was reading it, but as soon as I was cross-examined I could not see the logical reason why it had to be… it just did not seem plausible."

I look at the textbook with new eyes. "You are so right. It doesn't really explain why Planck had to make that paradigm shift in thinking. What could make it plausible?"

We then discuss what she might have needed to know. It wasn't so much that she needed the text to be plausible and coherent (which it wasn't), but also she really needed to know which bits were significant. What were the key things that required the shift in thinking that Planck made?

I go back to my university texts and realize that even here the significant moments are not made clear. I remember at university I was just trying to understand the complex ideas and didn't even look at it from this point of view. Now I am looking at it with another lens.

Ingredient 2 - The Day the Universe Changed – a documentary series

1996. I am quite taken by a series on television called *The day the universe changed*. It is looking at key moments in history which created major shifts in thinking. Quite a few examples from science are being used and I am amazed to see the far reaching consequences in social and cultural structures. I hadn't really thought about physics in this way before, but I can see the possibilities.

I am interested in how the authors determined that these moments were significant and how they deduced all the effects coming from them. Was this a 'true' representation of history or

a construction to make a nice story? I remember when I was 14 years old asking my father, an historian, how the first world war started and it took him weeks to explain it. Mainly because he started back in Ancient Greece. To understand the intricacies of Balkan and European politics you had to go back to that time. How can you tell then which events were more important than others if it is an interconnected web?

Quite by chance I have discovered a book by Asimov at a second hand bookshop. It is a history of scientists and what is really interesting is that it has a number system (similar to web hyper linking) that interconnects scientists and their discoveries with other scientists so you can trace lines of experimental thinking. It really is an interconnected web, with scientists in one area actually being influenced by thinking in other areas. The more I read, the more fascinated I become with the historical construction of science. Books on famous scientists don't really get across this interconnectivity of science. There is also a lot of politics going on with ideas accepted because of who you are and how much power or respect you have. I wonder what our society might be like now if the photovoltaic effect was discovered before the steam engine…. Would we have bypassed completely the need for fossil fuels? Hmmm. How can I use this?

Ingredient 3 – Concept Challenge Theory

1996. I have just completed a workshop on **Concept Challenge Theory** which comes from *Trivial Constructivism* (see Chapter 5). Basically the theory says that there are three stages students go through to change their current theory to a new one.

1. Is the new theory understandable and clear?
2. Is it plausible?
3. Is it fruitful? Does it explain my world any better?

Students may understand a theory or even see that it is plausible but unless it actually does something for them why should they replace or value-add an old theory which has worked very well up to now?

Hmmm. Activities like roles plays have moved us beyond *understanding* phenomena and theory into being concerned by the *plausibility* of those ideas. Do I need to now to move to the next step? Is fruitfulness really about significance? Is this what Courtney was looking for…and is this search for significance a natural progression if you go deep enough into an idea or a topic? Can you see the significance of something if you don't understand it?

I thought I was going deep before, but now I wonder. What is the difference between being *meaningful* and being *significant*?

Ingredient 4 – Egan's development stages

1997. I have just got hold of a book by Keiren Egan (1986). Egan suggests that we need to ask not just what student's *know* (the constructivist concern) but also *who they are* and what are their native ways of *being* in the world. I like this slant, as *being* is something that is emphasized in the Holistic Education literature.

Egan has a development model of 4 stages, nominally every 7 years, wherein he suggests that at each stage students have a different way of experiencing and processing their understanding of the world. He says that we should teach according to how the student experiences the world, providing the appropriate cognitive tools for each stage.

Each subsequent stage encompasses the ones below and just because a student might be at one stage doesn't mean they can't be stimulated by techniques of earlier stages.

I am struck by his examples of how we can use stories which speak to the **mythic mind**. What are the grand narratives of science? What might be the story of the beginnings of science… *Human beings searching for security from a wild world?* What are the grand narratives now? Does *physics* have a grand narrative? And if these stories also include transformational heroes, can they then speak to the **romantic mind**? Do my students already have a grand narrative of science? Who are their heroes in science? Einstein? Hawking?

Egan's Stages

1. **mythic** - binary opposites and metaphor stories
2. **romantic** - inspired by transformational heroes, immersing yourself in depth and exploring the edges, feelings
3. **philosophic** - constructing meaning making frameworks… perturbed by anomalies or paradox into more complex and richer understandings
4. **ironic** - being able to deal with big picture *and* particular…. an understanding of the limitations of generalizing models

Egan (1986)

Fig 8.2

How am I helping my students move beyond the **romantic** stage into the **philosophic** stage? Are they seeing physics (and their other subjects) as disconnected bits or are they connecting the parts together in larger knowledge frameworks? How might I be perturbing these and helping them to create richer and more complex structures… am I seeing a moving from

‘black and white’ thinking into shades of grey? How have my past activities, such as exploring paradigms, helped in growing these frameworks?

In the past I have looked at creating activities which have contexts that students can relate to, or are relevant to their daily lives. But now, Egan’s model has given me a new way to ask what might be relevant to students. I wonder at the success of the Crop Circle Mystery …did it speak to the Romantic mind of exploring the weird and the edges of science? I wonder how I can now use activities I already have in my pedagogical toolkit much more deliberately… metaphor, concept mapping, paradox, anomalies, stories. What other activities can I bring in?

And in doing all this am I touching something deeper within my students, because I am starting with *how they be* and not only with *what they know*?

Ingredient 5 – Visit to South Western College, New Mexico, USA

1997. I have just visited a holistic university and met with one of the directors, Greg Cajete (author of *Look Towards the Mountain* 1994). The university is very small, providing a *Masters in Art Therapies*, but has gained a very good reputation. It is a two year course which uses a lot of experiential pedagogies similar to what I have been using across all my classes but in a much more purposeful way. They are all geared to help create, support and debrief student transformation.

In the first year of the course students are encouraged to experience transformation for themselves in order for them to be able to understand deeply the transformation issues of their future clients. They do this through remembering their past journeys and transformation passages. They then embark on a journey of self exploration. They choose a transformative ‘hero’ from the past, taking on the persona of that person for one month where they try to live their lives through the eyes/heart of this person’s perspective. They have to imagine how they would see, do and be. It is a way of calling to the ‘highest thought’ and fostering deeper understanding. Journals are an important part of recording experiences, thinking and change.

What might it be like, I wonder, for students to experience perspectives of different scientists… to be an Einstein or a Newton? Hmmm. Do they need to live as that person for one month? How else could I do it? Can I simultaneously foster students’ connection to the stories of science as well as use these stories to foster changes in perception or perspective? Hmmm. I wish I could do more than that.

Ingredient 6 – My perennial concern about wholeness

1997. My perennial concern is one relating to wholeness. I am teaching physics bit by bit. Physics looks at the world bit by bit. What does it mean to teach physics as a whole?

Does wholeness lie in the interconnections we make?

Does wholeness lie in the stories we tell and the way we see the significance of the parts to the whole?

Does wholeness lie in the wholeness within us …. the integration we make as human beings living in the world …and the ripples we send out in the world as a result of this being?

Is asking the question *how to teach physics as a whole?* problematic, because physics itself is actually a construct? What does it mean to see nature as a whole, then? Do I have to take things apart to understand them or can I understand them through another way of knowing? Does wholeness lie in the nature of the questions we ask and the way we choose to try and answer them?

Creating Grand narratives

Creating the physics story

How can I see physics in a new way? How can I move in perspective so I am not just seeing the parts, but also can see the whole? What are the big themes in physics? Is there a chronological story to be told? Why did one thing follow from another? What are the significant moments?

I now look at my notes for the whole course and wonder how I might construct it better. What topics lend themselves to development according to history, what ones lend themselves to engaging directly with the contemporary understanding? What could particular historical anecdotes reveal about the *nature* of conducting science? And what about my experiences as a scientist? Do they have a place in this story as well? Can I put myself in this physics story?

Can I make better connections between what I do? How might topics flow from one to the other by using key questions? How might topics be replaced by significant investigations or

concerns that are likely to uncover the big ideas of the topics? What are the big ideas anyway?

Concept mapping now becomes an important tool for me in not just brainstorming questions leading into a topic, but also in linking together concepts, showing their relationships, significance and limitations across topics. I have now moved from just teaching ***for*** understanding of the concepts to teaching ***how*** they came about, ***why*** they came about and their claims to validity.

What were their claims to validity? Why are some discoveries more significant than others? How do different discoveries or theories become accepted while others do not?

From being uninterested in the history of science I begin to read more about it. The more you read, the more you begin to see patterns. I begin to move out of seeing science as this dry objective act of investigating the material world into seeing it within a context of human endeavor which is not objective at all. And I begin to realize that there are many places in the course where I can bring in this grand story of human endeavor, the nature of science revolutions, the impact on the political and social landscape of the time and the political and social construction of science.

An example of an essay topic

The space race

During the cold war of the 1950's to 80's both Russia and the US spent trillions of dollars on space missions. What were some of the key missions and their claim to fame or importance? What was learnt?

Why was it so important to be first to the moon? What affect did it have on the nations' psychology, economics etc?

What are the costs and the benefits of space missions? Can we justify the cost of such scientific research when people are starving in the world? Who should decide what research is funded? What sort of research do you think is important and why?

Fig 8.3

Lets go back to Quantum Theory. How can I teach it now? What are the morals to be learnt? Can I help my students get into the eyes of the scientists at the time and walk through their journey?

I try to do so and I am astonished with what happens. Not only do some students come up with Planck's theory for themselves, but we begin to explore the nature of anomalies which push us to new understandings. We discuss how contingent science is and how one system of understanding carefully built up over centuries can be torn apart in paradigm breaking

research. There is a fragility to scientific knowledge as well as a door opening to our own participation. Perhaps we too can challenge the foundations and look for new ways of conceptualizing phenomena. Perhaps we can be *creators* of science by just thinking outside the box?

So now, are we beginning to gain an *intimacy* with the subject through inhabiting scientists' minds as they come up with their discoveries? This is the intimacy with a subject that Parker Palmer (1998) suggests is needed to go deep…. being able to inhabit what it is we are coming to know. There is a sense of inhabiting which is direct physical, emotional or spiritual experience, another which is about inhabiting the perspectives of others, another which is getting inside the concepts through playing them out as in a role play or hypothetical. What might be happening here? How can I use this more intentionally?

How do I see science now? I now see myself as a teacher not just of physics concepts, but also of a physics story. I am not just teaching my students to think scientifically, but to also think historically – where they are beginning to see the political, social and historical construction of science and realize how difficult it is to step outside of a paradigm.

Science now feels open rather than closed down… open to sudden changes in perspective as well as the usual building on what we already have. It seems more open now for students to *be scientists*, not just in terms of *thinking* scientifically, but in participating in the collective *creation* of science understanding. What do I mean by this? Before, students were creating their own meaning with the aim of *understanding* the physics or questioning its *plausibility*; now some are looking at theories and their anomalies with a great interest in solving the issues. Apparently now their other teachers cannot stop them talking about physics in their classes. I have created a monster! Or have I? Perhaps creating solutions to anomalies is actually something students do in their lives but just haven't had the permission to do it in science… or if they did, I didn't notice it before, because it was off topic.

This view of science knowledge as open to new perspectives is freeing for me. Whereas before I had felt science was closed down, resulting in me wishing to explore the Kosmos through another perspective (the spiritual one) now I am feeling science might have some potential after all for moving out of the materialistic. Yes, Einstein and Planck have inspired me with Quantum Theory. I wonder whether the next paradigm shift in science might be one where it might integrate subtle realities with physical reality? Would this then be called science? What role might I have in being a creator of such new paradigms?

However, as usual, there is a downside to my new approaches and attitudes. With all this connecting between ideas it is not so clear when a topic starts and ends – students need to know this for the exam. And what about the history… some ask what bits do they need to know for the exam – "These historical stories are interesting but will they be tested?" So I am trying, sometimes unsuccessfully, to balance the needs of the exams with a deep development of the course. I try to make things clearer. I never seem to get it right for every student at once. Perhaps that is OK; they all have different learning styles and not everything will work for everyone.

But is there a bigger narrative of physics?

Now that I see the stories *within* physics, can I see grander themes? What really is physics? I now develop a metaphor of physics where I see it as a foot which moves us forward in understanding and predicting how our world works. The toes each represent the different lenses we bring to seeing the world. But we are just looking at one foot of possibilities – waves, energy, forces, fields and quantization… what might be on the other physics foot? (It is a little play on TOE (Theory of Everything)).

Fig 8.4

I put a poster of the foot at the front of the class, continually referring to it, asking what lens we are using now and what lenses are appropriate, what are their limitations in bringing one particular lens to a phenomenon compared to another one? For example, forces is a good lens to use when we are interested in looking at the mechanics of something, but breaks down when you look at the *very big* (cosmology), *very small* (quantum), *very fast* (relativity) and *very complex* (chaos theory).

This seems to make a big impact on students… physics isn't just a list of things to be learnt, or a confusing concept map… but clear tools which can be applied and which have limitations. Students become used to asking what lens might be useful to apply now and the problems with using the wrong one.

And where does the 'physics foot' sit within the bigger context of human knowledge? Are my students integrating what they learn in physics with what they are learning in other subjects or experiencing in life? Do they see where the physics lens is useful and where it isn't? How can I help them think about the connections?

In 1997 I am introduced to Wilber's 4 quadrant model from *Eye of the Spirit*. I see that physics is part of a greater whole… and my spirituality and physics dichotomy seems to be solved in one foul swoop. It seems the answer is to recognize they are different lenses and to agree to a demarcation. Hmmmph! Here have I been concerned about making physics whole, when obviously I can't! I have been trying to bring **I** perspectives into physics when physics is really an **IT**. Perhaps by trying to integrate the two I am in fact causing more problems? But in trying to make the links between the whole and the parts am I in fact engaged in an exercise within the **ITS** quadrant?

I Spiritual Interior	**IT** Empirical Physics
WE Shared meaning	**ITS** How it fits together Significance

Fig 8.5

Despite my angst, at the end of 1997 I decide to introduce the quadrant model to my class, asking them how they organize all their different bits of knowledge. How useful is it to think about knowledge using the quadrants? We discuss different metaphors for knowledge and I realize that many see their different knowledge as separate unrelated boxes, some see them as a jigsaw puzzle. We also remember the metaphor of the blind men trying to understand an elephant and getting it wrong because each can only feel one part. Some students say to me how they have never thought about this before and how useful it is. Even though I present integral theory on the board and think I might be pushing it too much, students do not feel I am forcing them to take it on … it is one of several knowledge metaphors.

This intrigues me now. The notion of helping students to reflect on how they construct, demarcate and integrate knowledge through exploring and playing with a number of metaphors. (see Chapter 2). It is the play between the metaphors that appears to perturb students out of their pre-conceived ideas of knowledge. It seems to be a very fluid process. I wonder how I can use this more deliberately. Is this helping them gain a more *ironic* understanding of their *philosophic* state of being? What meta-cognitive tools could I help in this process?

And what about significance to the students?

We seem to have gone beyond significance that is based on ideas being relevant to students' daily lives (e.g. not a good idea to lean your forehead on the microwave oven while watching popcorn pop.), or related to their goal to understand the world (physical as well as constructed). We have now moved to something that perhaps has significance for their

growth as human beings. They seem to be developing greater meta-cognitive capacity, they seem to be moving from *romantic* to *philosophic* to *ironic* stages. What is causing this? My deliberate activities or the very story and nature of science which is percolating in the background?

What am I teaching now? Physics or philosophy? Do we need to cater to the students' own growth in the style of our subjects – as they move from the detail of the **romantic** stage (taking stuff apart, interested in submarines and bucky balls) to the **philosophic** stage (needing overarching frameworks to make sense of the profusion of detail) do we need to move into a different style of subject teaching?

If someone now said to me "Sue, you need to remove content from the course", I would be really anxious, because now I see the significance and potential in all the physics concepts for greater learning about self , the universe, the nature of science, the particular physics lenses that we apply to the world and the construction of knowledge. What could I take out?

I need to have electrostatics because I need to ask them the question *"How do you know an electron truly exists?"* I want to perturb their romantic view of knowledge, for them to question where their knowledge comes from and what they truly can know. I want to support them in their process of painful deconstruction and help them learn to deal with uncertainty. No, I certainly can't get rid of electrostatics.

I can't get rid of light or Quantum Theory either. I need my students to experience a true paradox that will challenge their logical thinking and cause them to move towards more dialectical reasoning.

But there really is a problem now. Seeing all this significance has filled up my course so much that there is really now no space for something that might emerge out of students' interests…. Like the Quantum Theory trial back in 1995, which we were able to do because we had time. No time for anything like that now, I am sorry. No time for students to **inquire into** their own new science creation, only time to **think about it**.

If someone said to me, "Physics should no longer exist.... we should move to interdisciplinary inquiry based on issues in the real world", what would I do? I believe that such open ended problem based inquiry is important in experiencing agency as scientists… yet I am in love with the beauty of my subject… not the exams… but the meaning to be found it. I feel that there is so much to be learnt from it. Can we do both?

I have even mapped out next to each topic what aspects lend themselves to revealing the morals of science inquiry, the philosophy of science, the wonder of the universe, the different lenses of physics, the political construction of science or the development of the self. I wonder if this can be applied to other subjects as well. Could each discipline teacher find aspects within their discipline that speak about their discipline as well as to the stage of growth that students are at?

Lenses to apply to a subject

In what way might particular topics in your subject reveal your discipline's:

- Inquiry processes
- Lenses and constructs
- Epistemology
- Nature and purpose
- Political construction
- Philosophy
- Sense of Wonder

In what way might these help in students' development?

Fig 8.6

I now wonder if the story of science resonates with students' own journeys. How might I map these journeys and see how they overlap?

Nature of Science	**Personal Story**
Science knowledge is constructed from experience, observation, experimentation – theories are best fit and tentative.	The construction of personal knowledge is an ongoing process which is contingent and is expected to change.
Anomalies, enigmas and paradoxes force us to question current theories and come up with better ones – sometimes these are just extensions, other times completely new ways of thinking.	Challenges to our beliefs are opportunities to review these beliefs and test their currency and worthwhileness. Paradox forces us to think outside of 2 dimensions and into other perspectives.
Science is a journey involving many processes in an iterative cycle. All processes are valuable parts of the whole, but by only doing one part may give you a skewed understanding.	We are on our own personal journeys which we expect to be a continuing iterative process. We value all aspects and look for ways to integrate our whole experience into meaningful understandings.
The purpose of science is to move society forward – better understanding, better quality of life, solving problems.	Where do we see our own purposes? What is the meaning of our lives? Are we aiming to move forward?
All knowledge is constructed within a paradigm. We need to be aware of the paradigm, its limitations and the privileged perspectives it is enabling. We need to look beyond the paradigm and explore other perspectives and use discernment and selectivity. (eg. By designing an experiment with a particular theory in mind, can get skewed results.)	How are our own views of the world modified or influenced by the media, society, parents, school? What do we take for granted that we should question and challenge? What do we believe for ourselves? How much of our actions are our own? What might it mean to think and act being totally aware of the paradigm we are in?

Science is a collective human endeavour with controversies, serendipitous discoveries, heroes, villains, competition, collaboration, wrong turns, painstaking investigations. It is done in context with the world and society, not just for the pursuit of absolute truth – it has an ethical dimension and human failings. To understand the ethical consequences we may need to change from our scientific experimental perspective/process into others – systems thinking, qualitative research.	The process of inquiry can be done by anyone. We are not alone and can use others and other knowledge in our own pursuit for meaning. However, what we do has ethical ramifications – we are not an island and need to think about the consequences of our actions. How can we know what these might be? What ways of viewing the world can help us?
Science has a privileged status in our society. Often other ways of looking at thinking about the world have been given less credence in decision making. How do we reconcile different ways of knowing?	How do we think about all the different types of things we do and learn – how are they organized – what value do we give them? Consider meta-cognitive tools for thinking about organizing different ways of knowing.

Fig 8.7

Where is the soul in all this?

Is it in the enhanced sense of meaning the students are making which goes beyond understanding individual concepts into seeing the connections within a larger whole? In the increased intimacy they have with the subject? In their expectation that there is deeper significance to be found in things… meaning to be extracted. Is it in the resonance between their selves and this thing called science?

Am I being seduced now by the meaning I am making into this construct called physics? Am I seeing significance in everything? Am I imposing my view that life is significant and interconnected (not chaos) on my students? Am I leading them into seeing significance without asking them to critique the assumptions behind such constructions? Is seeing significance a spiritual belief? While seeing significance in something might make it more meaningful and enhance our experience, might it also limit what we perceive from experience? Am I too much in my head, in a world of constructed stories?

What stories am I missing in my grand narrative of science? Other cultural perspectives? Hmmm. They aren't in Asimov's book of science… maybe I need other resources to help me understand Western science in context with sciences from other cultures? I just don't have a big enough picture to see how I can fit these alternative narratives into my teaching of physics. But wait, am I expecting to have understood significance and connections between things before I teach them… how can I let go of that need and just play with the parts again,

and see what emerges. Is this need to find significance me being trapped in the *philosophic mind*… wanting to have meaningful frameworks all the time? How can I move to the equanimity of the ironist, and the openness of Zen master?

Am I allowing my students the space to find significance for themselves?

> "The Tao is like the emptiness of a vessel; and in our employment of it we must be on our guard against all

My understanding of learning now is well and truly moving to the rainforest metaphor where we can't predict in a linear or even a systems way what is going to happen… mushrooms might just pop up in a totally unpredictable way. I become very interested in Bateson (1972) who suggests that educators need to create a variety of experiences - some with dissonance some with resonance, that we need to speak to many levels of being through multiple forms of expression - metaphor, dialogue, lecture, experience, rational, dance, poetic - and then we allow the meaning to be made by the person experiencing it. Allow them to live their way into the meaning, not seeing it as something that happens then and there with a fixed view of the needed outcome.

Yes, but I have a point to make haven't I? I have particular things for students to learn? But what do I really know what my students take from experiences? What do my students' 'I wonder' journals tell me about their learning? It percolates, pops up, is mulled over, it goes to one extreme and then another, different ideas in tension held at the same time from their physics world and outside life act to propel them to new insight. Ummm. Where is my role in all this? I no longer *facilitate* their learning but perhaps now I am *occasioning* their learning? Do I really matter in all of this?

And in this focus on significance am I forgetting that wholeness is a whole lot more? Or is this process of looking for significance and stories enabling myself to experience and immerse myself in another way of being? Where might it lead in my own flourishing of self? What new questions might emerge?

How am I feeling now? Stimulated. A sense of activism or agency. Political. Ready to stir up my colleagues. Watch out, here I come!

Interlude 1: What are students' beliefs about science? How can these be transformed? A reflection…

In 1997 I began to listen to students' questions and issues in a new way, realising that behind these were certain assumptions about the nature of science. I became very interested in my students' beliefs, wondering where they came from. I was shocked at the beginning of the year when some students' views of science were the notion that anything that is based on measurement must be true, that the scientist plays no part in the truth of the discovery, that science is unassailable fact. Many had no sense of where science comes from, the rich history of construction and development, nor the sense of contingency. It was as if science is a body of knowledge floating on air with no foundations. I was very keen to use my pedagogical toolkit to challenge these views and designed many multi-purpose tasks that could simultaneously encourage critical thinking about the concepts as well as about the nature of science itself.

As a result of doing this all through 1997 I was amazed at how the students had grown. It seemed that making *what science is* explicit also assisted in empowering students to think for themselves, to make their own decisions, to choose what they do and don't believe, to be comfortable with dualities and uncertainties, to ask questions and to be very critical about answers they find.

A big claim, I know. I surveyed and interviewed different students in my class at the end of the year and it was interesting hearing how they pinpointed key things that made them change their understanding of *what science is*… a particular teacher, or the way they were allowed to investigate something for themselves… but most often they said it was only since they were in my class did they begin to really question and understand what science is.

When I met my 1998 class, the difference between their perspectives and attitudes and those of my previous class was really brought home to me. Whereas my previous class would enter into activities of any sort with assurance, curiosity, criticality and creativity, this very passive class seemed to only want notes on the board and prescriptive experiments, not the open ended investigations that I was wanting them to do. Many seemed to have no sense of what it meant to act as a scientist or to think for themselves.

What could I do? What was the issue here? I assumed that part of this passivity was a limited view of what science is and what their role might be as student/scientists. I also thought that

perhaps they were in Egan's *romantic* stage as compared to my previous class, which by the end of the year had moved through the *philosophic* stage and into the *ironic*, as far as I could see. Yes I really had underestimated the journey that the class of 1997 had come on. Now I had to vision the journey that I could take this very different class on.

How could Egan help me? Egan recommends perturbing students from one stage to another by moving into their current stage and using the ways that they relate to in that stage with appropriate challenges to their thinking. Romantics love detail, are inspired by heroes, are affected by emotion and the personal and are still close to the mythic love of a good story with binary elements, plots and morals. Hmmm. Let me think….

I designed a performance/role play called *Isaac Newton - This is your life*, relying very heavily on Asimov's book on Scientists as my guide. This book enables the reader to connect concepts and scientists across the centuries, seeing how different experiments and ideas influenced others, and best of all it includes all the juicy bits - the controversies and the infighting.

I asked one student (Richard) to play Isaac Newton and I was the compère taking 'Isaac' through his life, introducing him to other scientists who influenced him, from the past and his current life, as well as scientists from the future who were effected by his theories (e.g. Huygens wave model of light took 100 years to replace Newton's model because of the stature of Newton). I set up artefacts around the room belonging to key scientists (e.g. Galileo's telescope, Aristotle's angels pushing the earth, Boyle's colour chart) and asked students to play these scientists. Some had words to read or had to improvise. It was interactive, yet obviously I was guiding the story.

Newton's development of his theories is very interesting with many examples of how he built on other scientist's ideas, perhaps only slightly modifying rather than creating new theories out of thin air. He put his Theory of Gravity aside when it didn't seem to work because of inaccurate measurements of the radius of the earth. He then brought it out again many years later with the encouragement and financing of Halley (of Halley's comet fame) when better

"I do not know what I may appear to the world, but to myself I seem to have been only a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the

measurements were made, only to embark on major fighting with Hooke (Head of the Royal Academy of Science) who was trying to get his own version accepted. And then there is Newton as alchemist, mystic, and head of the Royal Mint. What a life! The student playing Newton read out some of his famous quotes at different stages including "If I have seen further than other men, it was because I was standing on the shoulders of giants."

What did the students think? They were mesmerised, amazed. So many said to me it was the best lesson of their life. So many were stunned at this man Newton. Many said to me how amazed they were at how many scientists it took to help Newton get to where he got. They had just thought it was one man who had come up with these things out of nothing. I wondered then if science had been seen by them as something you only do if you are brilliant… that ordinary people don't do inventive science.

Immediately afterwards I saw a change in their attitudes to their experiments. A complete turn around. A willingness to experiment for themselves, to be creative and work with others to share knowledge. Perhaps science was now something they felt they had permission to do and could do. There was so much enthusiasm in the class and they continued to talk about the Isaac Newton experience. Even months later one girl wrote an *Isaac Newton, this is your life* spoof in her journal, a complete surprise.

Why have I spent so much time relating this? I guess this is an example of a grounded approach to challenging perceptions about science… not through philosophy, but through an experiential activity. It was very interesting to me at the time that I could take what I understood about the nature of science and Egan's development levels and design such an activity for the direct purpose of challenging perceptions. The fact that it had such a big and immediate impact stunned me, but also encouraged me to believe that my thinking about pedagogy and science had some value. Does the effectiveness of an activity justify the reasoning behind it? If I continued to use that reasoning in activity design could I build further evidence of its usefulness through the resulting growth in student capability and perspectives?

How would I really know students' perspectives? That year (1998) I decided to ask an independent researcher to interview a focus group of my students. She had been interviewing Year 11 science students as part of a study being conducted in the state to look at why students dropped out of Year 11 science. She was amazed by my class… the way they worked together as a group, their sophisticated attitudes towards science, their confidence in dealing with uncertainties and their ability to articulate their views. Her interview notes (see

Appendix 6) and the video footage give ample examples of students' ease in discussing paradigms, contextualising and qualifying their knowledge as well as their own self understanding and reflectivity.

What is more difficult to determine from this is what assisted in this transformation, but this was one question that she didn't ask them, unfortunately…. It certainly would have been interesting hearing their take on it. (The reason she didn't ask many of the meta-questions I had provided for her was that she herself was certain the students weren't capable of answering these, which was obviously not the case.)

At the end of 1998, having spent two years explicitly designing a range of activities to perturb students' beliefs about science I now wondered whether I could also challenge teachers' beliefs about science. I had my own preconceptions of what these must be, based on my interactions with teachers in the past, and seeing their best practice.

Interlude 2: December 1998 - Beliefs about Science Workshop for teachers

I am standing up here in a large room in the University Chemistry Department. There are about 30 physics and chemistry teachers and lecturers sitting around tables with about six people per table. It is the last major session of our annual two day end of year conference. I am running it. I have invited seven students from my 1998 class to be part of the discussions.

I am passionate about it. I tell the audience the story of Lauren in my 1997 class who was keen to have a class T-shirt. We were discussing what should go on it and she says to me "We have to have *Imagination is more important than knowledge*". "Oh, why?" I ask. "Come on Sue, she replies, "Einstein said it… it is on the poster in our room."

Yes, it is… As I put notes on the board and explain them to my class I am looking directly at it. A bit ironic that, me telling students *bits of knowledge*, while Lauren obviously has a sense that science is imagination.

Where do our students get their beliefs about what science is? From posters, from the way we teach, the type of experiments we do, the stories we tell? What messages might we be inadvertently giving them? Are we really aware of how *we* think about science? Are we explicit about saying what science really is? Might we be giving conflicting messages? What notions about science would we like our students to take away with them after studying our courses?

So what is this seminar about today? It is about making explicit what beliefs we have about science and looking at the implications for our teaching.

I now ask teachers to pick up a survey on their tables and to have a go at filling it in. It is the *Beliefs and Assumptions in Science Questionnaire* developed by Peter Taylor at Curtin University. Teachers start looking at it warily.

I would not have dared to run a seminar like this two years ago, but my reading of post-modern critiques of science (Guba and Lincoln 1994) has made me a lot more confident that my own 'subversive' beliefs about science have a rational and legitimate base, solidly backed by postmodern discourses. I believe I can do this with this group of science teachers

because I have built up some goodwill in running other sessions in previous years which people have said to me that they value.

What is my agenda here? I am keen to challenge science teachers' world views of science. I want to move them from seeing science as a fixed body of knowledge to seeing it as tentative, socially constructed, value laden, relying as much on intuition from scientists as it does on rationalism and empiricism. I am hoping that if science teachers shift their beliefs in science then they might shift the way they teach it and what they value in the syllabus.

I am not sure that what I have planned will help transform perspectives that people have. I have brought in seven of my 1998 students who have developed quite sophisticated views of the validity issues of science as a result of our discussions throughout the year and I hope this might challenge participants to realise how capable our students are at thinking at this meta-cognitive level.

But now a group at one table waves me over.
"Sue what do you mean about *beliefs* about science?" asks one person shaking their head over the title of the questionnaire. The rest are looking at me attentively and puzzled.
"Yes," says another teacher. "Are you asking us for something like our *spiritual beliefs*?"
I am absolutely floored. "No, no, nothing like that…. It is just asking what you *think* about science and what science is."
"Not what we *believe in*, then?" asks one person.
"No, how you *see* science… the nature of science."
"Well that word *belief* just shouldn't be put in the same sentence as science then! It just isn't appropriate."

My heart plummets and I think this is just not going to work … haven't they ever thought about science at this level before? I go around all the tables and field questions until people settle down and fill out the questionnaire. The body language is not good and obviously there is a high level of discomfort. People do not look as if they would be willing to share and discuss any of the questions they have answered. The questionnaire probably gives the impression that there is a right and wrong answer and teachers are probably afraid of being seen as a wrongheaded. Not a good climate for emergent discussions. Shit. Have I blown it?

I pull them together and say, "OK, I have given you a questionnaire which has forced you to think analytically about how you think about science. Now I would like to get you to think about it using the other side of your brain and see what happens." They look at me, some

with puzzlement, but the goodwill is back. “How do you really think of science? Can you put that in a picture, or a symbol or a cartoon? There is no right or wrong… just let your intuition speak.”

I get a few looks with eyes narrowed, but people start taking paper and coloured textures. And soon conversation arises as one person sees what another is drawing and asks questions. I formalise this by encouraging them to share and explain their pictures. There is laughter, tentativeness and it seems real listening is happening.

One university chemistry lecturer has drawn a person standing on one side of a chasm looking to cross it. The people at her table are intrigued at this picture and ask her to explain it. She describes how when she starts investigating something she has no idea what she might find, she feels nervous and uncertain.

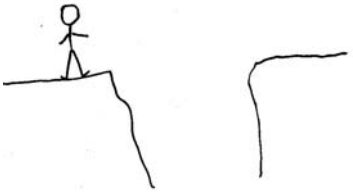


Fig 8.8

How does she leap across this huge gulf? She says how she has to work out appropriate methodology and questions that might help her start to bridge the gap. But she might be on the wrong track… she doesn’t know if her choices will actually get her across the chasm and sometimes you just have to take a leap of faith and go with it. The table erupts in conversation.

I think what a wonderful perspective to hear from a *real* scientist… as teachers we are not doing that… crossing a chasm into something we don’t know…. Because we are teaching what we know… and perhaps forgetting that the act of doing science is about leaping into the unknown.

Fig 8.9

I listen into another table where a teacher has drawn a cartoon of a teacher saying to his students while laughing “A hundred years ago, people used to believe in atoms!!”
A discussion then arises about whether atoms could ever be disproved and teachers are giving examples of complete turn-arounds in knowledge in the history of science. One person says, “Well perhaps we shouldn’t be teaching things so much as facts, perhaps we should be upfront about how tentative it is.” Another

person argues that there are degrees of tentativeness and really we are pretty certain about some things. Other people look uncertain about that.

At another table a person is explaining the infinity sign he has drawn.
"Why did I do this? Partly I think because I feel the more you look the more there is to find. Science is never going to run out of things to look at or questions to ask. We haven't touched the surface yet."

Fig 8.10

"Yes that's what I think too," says another teacher showing the group his question marks that he has drawn.
"And the question of infinity also opens up a whole lot of questions for me… it is a concept which intrigues me and puzzles me whenever I try to get my head around it."
"Yes, I think that science has that effect on me too," says another person, "there is so much to be in awe about."
"How do you keep that fresh when you are teaching the same thing year after year though?" another wonders.

Fig 8.11

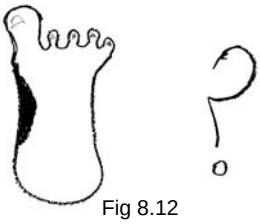


Fig 8.12

At another table a group of teachers are asking one of my students to explain her picture which is a big foot. She explains "the foot represents physics which is trying to understand the world better to move it forward… that's why it is a foot. And these toes here are the different ways physics chooses to investigate and explain the world… through an energy lens, or forces, or waves, or fields… but then that is just one foot…. There are lots more toes and other ways of looking at the world. You need to choose which toe to use based on the system you are looking at."

I can see the teachers' faces, eyes open, leaning towards her, some shaking their heads and asking her how she came up with it. I think to myself, "Oh, oh… I have indoctrinated her into my view of science… one which is subversive and not generally accepted." But no, it seems that they are shaking their heads with appreciation and amazement. Perhaps they underestimate the interest students have in understanding science as an epistemology in context with other epistemologies.

At another table a teacher is leaning towards one of my students who is wearing the 1998 class physics T-shirt along with his other peers in the room.
"I just have to ask… why have you got *we don't give a rat's arse* on your T-shirt?"
Scott replies "It represents how we think about physics … We don't give a rat's arse about whether it is really true or not, we just really enjoy the process of finding out."

The table is momentarily speechless.

I continue to move around the room. It is upbeat, with lots of discussion. I feel that people are intrigued and surprised by their colleagues' views and ways of representing them. "Thank god," I think, "that I got them to draw a picture." The questionnaires just sit desolate on the tables.

I pull the groups together and ask each table to summarise the essence of their discussions. A common theme is the surprise they have about the fact that their views of science are so open with such a sense of awe and sense of possibility. Like me, I think many have felt that their own views might not be the party line of science and have kept them to themselves. They are surprised to find many others thinking the same. This session was almost a confessional. One young science teacher stands up and says to the whole group. "Well if we value imagination and possibilities, sense of awe and the unknown in science why aren't we teaching it that way?"

Yes, a very good question. I expected to come here and perhaps challenge science teachers to move to a state where they might begin to see science differently. But most teachers here seemed to already have aspects of a critical constructivist view of science. Why wasn't that being articulated into practice? Habit? Perpetuating teaching methods that had been *done on them* as science students? Not realising that it was OK to articulate their views into the way they taught? Not seeing how it was possible? Being constrained by the curriculum and syllabi structures? Not believing students were capable of discourse on the nature of science?

We had some time for groups to brainstorm ideas and write them up on the board and butchers' paper to share. It seemed very vibrant, purposeful and open with lots if interesting ideas. One person even mentioned using poetry, saying how interested he was in the way our picture opened up discussion whereas the questionnaire closed it down. What other teaching approaches open us up to intuition and insight?

I was feeling really excited. Perhaps all we needed was the stimulus to talk openly about our beliefs?

The workshop was over. People still milled around, chatting animatedly. The convenor of the conference came up to me and said that he had just been asked not to let me run a session again as I was too progressive and that that this workshop was a waste of time. My heart plummeted. I could not believe it and then I could. I asked him who had said this. A couple

of teachers and yes I know who…. Two very conservative, yet influential physics teachers (males). I was astonished that he would pay so much attention to them given the feeling of the workshop and what I thought were some very positive outcomes.

They had obviously been sitting silent during the excitement of the others. I collected the *Beliefs about science questionnaire* and had a look at what people had said. It was clear that there were a number of individuals there whose notion of science was very positivistic. Perhaps these were the detractors. How naïve of me to think I could challenge anyone's view of science. The role I ended up taking was just to help the group, who already had constructivist science views, to explicate them, while the others were possibly marginalised. Hmmm. How could I have dealt with it better?

What would you do?

Beliefs About Science and School Science Questionnaire

(results of a survey of 22 year 11/12 physical science teachers and 6 university lecturers from Chemistry and Physics – Dec 1998)

Process of Scientific Inquiry

percentage

	Seldom	Sometimes	Often
1. Scientific observations depend on what scientists set to find out.	4	32	68
2. Scientific inquiry involves challenging other scientists' ideas.	4	42	54
3. Scientific observations are affected by scientists' values and beliefs.	14	36	50
4. Scientific inquiry involves thinking critically about one's existing knowledge.	4	8	88
5. Intuition plays a role in scientific inquiry.	4	23	73
6. When making observations, scientists eliminate their beliefs and values.	36	24	40
7. Scientific observations are guided by theories.	8	62	30
8. Scientific inquiry starts with observations of nature.	0	26	74
9. Scientific investigation follows a well-defined method.	7	37	56
10. Scientific ideas come from both scientific and non-scientific sources.	8	29	63

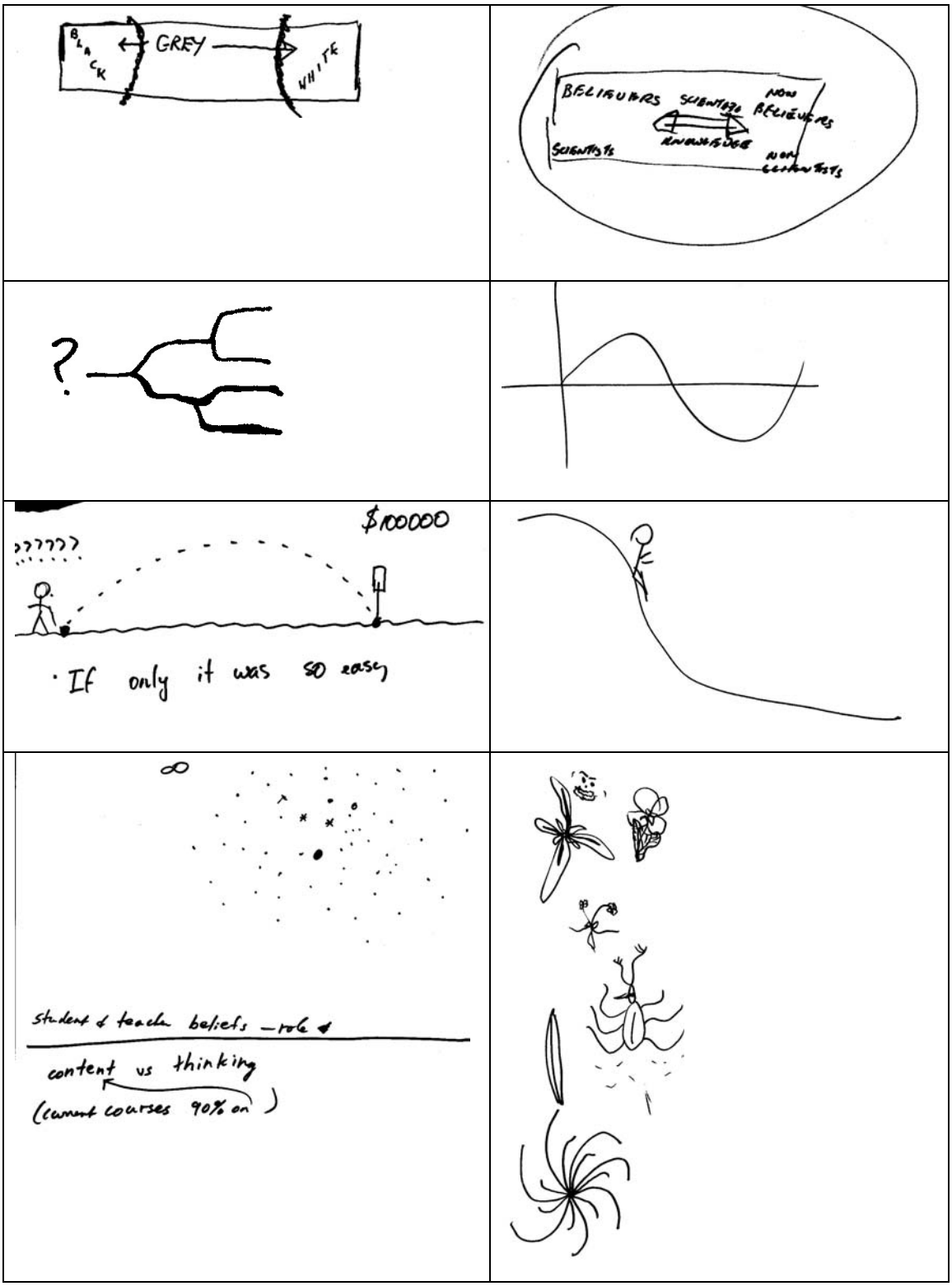
Certainty of Scientific Knowledge

	Seldom	Sometimes	Often
11. Scientific knowledge gives a true account of the natural world.	12	46	42
12. Scientific knowledge is tentative.	4	38	58
13. Scientific knowledge is relative to the social context in which it is generated.	31	19	50
14. Scientific knowledge can be proven.	31	31	38
15. The evaluation of scientific knowledge varies with changes in situations.	15	31	54
16. The accuracy of current scientific knowledge is beyond question.	63	18	18
17. Currently accepted scientific knowledge will be modified in the future.	7	7	86
18. Scientific knowledge is influenced by cultural and social attitudes.	15	23	62
19. Scientific knowledge is free of human perspectives.	73	15	12
20. Scientific knowledge is influenced by myths.	50	42	8

Fig 8.13

Beliefs about Science – Teacher's pictures

(Teacher responses to asking "How do you see science?" Draw a picture, a symbol or a metaphor to represent your view.)



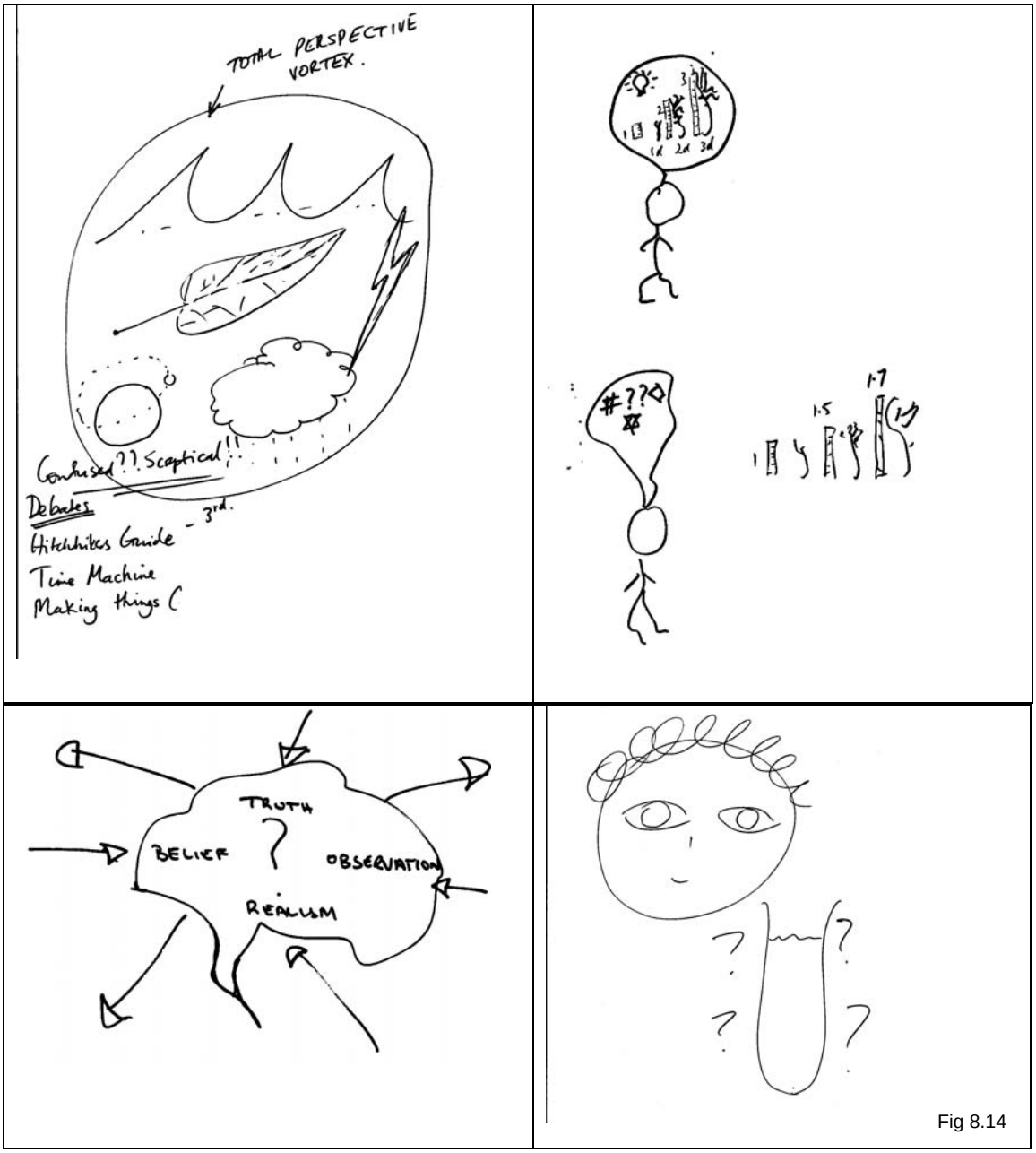


Fig 8.14

What do these pictures reveal about teacher's beliefs about the role and nature of science?

What do these pictures reveal about how teachers see nature?

What do these pictures reveal about how teachers see the relationship between scientists and nature?

What picture might you have drawn?

What picture might an American Indian have drawn?

What inhibits teachers from fully being able to articulate their beliefs about science into their teaching practice?

Interlude 3: An extract from a student's journal

Isaac Newton - This is Your life!

Mike Munroe (MM): So Isaac, how does it feel to be here tonight?

Isaac Newton (IN): Well actually, I'd rather be back in heaven.

(Nervous laugh from MM)

MM: So Sir Isaac, you were born on the January 4th, 1643 at Woolsthorpe, near Grantham in Lincolnshire. You had a very disrupted early life, with your widowed mother remarrying when you were three, leaving you in the care of your grandmother….

IN: (interrupting) Yes, Mummy was like that, always leaving me in the care of someone else.

MM: (continuing) You were sent to grammar school in Grantham and then, in the summer of 1661, you went to Trinity College, University of Cambridge. There you met your long time friend (perhaps your only friend) and he has a few words to say…

Voice over: Isaac, old pal. Gee, you look better than you did when you were alive. Well, anyway, you have a good night tonight, through this séance. You probably thought no-one would ever call you up, right? Either that or you refused to visit.

IN: Who's that?

MM: Isaac, it's your friend George Tilnay. (GT hobbles out.)

GT: Isaac, haven't you made a name for yourself! Too bad I was never remembered. Just in passing. Why weren't you at my funeral?

IN: I, er, um…

MM: So George, tell us about Isaac, what was he like at Cambridge?

GT: Well, Mike, as you can see, Isaac never cared much about his appearance. It took me ages to get him to go anywhere. I almost had to bathe him.

MM: Hmm, So Isaac, after 4 years you received your bachelors degree. You were elected into a fellowship 2 years later in 1667, and in 1668 you received your masters degree. How did you feel then?

IN: (irritated) well I felt pretty good actually.

MM: Yes, er, well. In the autumn of 1666 you developed the fluxional method, known today as calculus. This was a new and powerful instrument that carried modern mathematics above the level of Greek geometry. However you did not publish your findings. The world wants to know why?

IN: (exasperated) Well I didn't want to, OK?

MM: I heard because you were fearful of criticism.

IN: Yeah, well you didn't hear right!

MM: OK, well in 1669 you were approved as Lucasion Professor of mathematics at Cambridge University. In 1695 Gottfried Willheim Leibniz arrived independently at what he called the differential calculus. He published his method and the world of mathematics learned his notation and Leibniz's name. How did that make you feel?

IN: (heatedly) I felt quite annoyed of course…

MM: Well, you became entangled in a violent dispute with Leibniz over who developed Calculus first. This quarrel lingered nearly until your death. Well, tonight, let's put all these ill feelings to rest…

GWL voice over: So Sir Isaac Newton. I really hate you. You ruined my life, my reputation. But at least I'm remembered for Calculus, not you as you were so scared of criticism. So there! But no hard feelings, OK? I was told I had to say that.

GWL walks on…… (continued)

I don't know what inspired me to write this. Probably, I'd ask Isaac Newton all these questions like "Why were you hated so much?" like Mike Monroe did. I heard that Isaac Newton was a really horrible man who basically jumped up and down on Leibniz's grave. If he did this, it is probably no wonder he had so many enemies. He looks to be an arrogant man.

I think I wrote this because I remember that role play Richard did earlier this year. I also remember I did a "This is your life" of Martin Luther in grade 10. I still remember all this stuff about him – the 95 theses, the church in Wittenberg, his excommunication etc. Maybe more things like that will help me to step back into time and face all the difficulties and questions these people did, especially during the Renaissance, and periods of change. It makes me appreciate more how big these people's discoveries actually are.

Isaac Newton's Top 10 songs (in no particular order)

Creep – Radiohead

Charmless man – Blur

Manic Depression – Jimi Hendrix

Knockin' on Heaven's Door – Eric Clapton

People are strange – the Doors

The Boy in the Bubble – Paul Simon

Their Law – The Prodigy

Cool to Hate – The Offspring

There's nothing I won't doubt – JX

Mine – Savage Garden

(He was probably a nice man, its just history doesn't record him as being that agreeable.)

Tiffany

Intermission

A break for a cup of coffee and a piece of cake (moist poppy seed drizzled with a warm orange sauce) … a chat with some curriculum planners

Yoo-hoo curriculum planners…you can come back into the room now…. You have been waiting patiently since Chapter 4…would you like to make any comments?

“Sue, you have certainly been on a journey… taking physics from just the delivery of facts and ideas to helping students inquire into those ideas…. Then bringing in their own questions and feeling comfortable in being tentative and creative with the ideas… to then asking them to inquire into the construction of science itself.”

“Yes, it seems that you are moving into a critical constructivist point of view of science teaching. I kept wanting to give you a book to read on it when I saw the dilemmas you were in but I guess at the time you were in a culture of trivial constructivism and had no exposure to postmodernist perspectives of science. What I find interesting is that you didn’t just adopt someone else’s say so about science… you actually worked it out for yourself… and possibly because of this you have been able to construct activities for your students that are meaningful for them. It makes me wonder about the value of ‘hard won knowledge’, rather than something that we might read which doesn’t have an impact with us because we really need to experience it for ourselves before we can really come to know it.”

“I guess there is vicarious knowing. I think Sue took *me* on a journey of asking what science is. I guess I have never thought about it that way. My experience is one of learning out of a text book and doing set experiments. I have never seen it as something tentative as the way my discipline of history is and I now wonder whether I am getting this notion across in my teaching of history! Do my students see history as tentative and politically constructed or have I enculturated them that it is a body of uncontested historical fact because we have immersed ourselves in coming to know a particular historical time period?”

“I am surprised that the students are able to engage with this level of inquiry into the political construction and epistemologies of science. It seemed that a key was giving students a real experience of a particular issue, like meeting your flat earth assertion, and then unpacking what was going on. I wonder whether we too often believe that this type of thinking only can happen at university - that our job is to lay the ground work by giving the theories and the facts rather than developing this helicopter critical thinking.”

“I am interested in the richness of what you are doing and how it stems less from the choice of activities but rather from the attitudes you are bringing to what you are doing. How important it is that you are constantly reconceptualising your notions of science … constructing something that for you which is self consistent and justified and how you are layering that within each activity.”

“There are so many layers of meaning that you are trying to construct for your students. It would take an enormous amount of energy to juggle so many different purposes in mind. I am interested in this balancing between the whole and the parts … and the whole here could be seen as whole student, whole course, whole relationships, whole of reality.”

“I too am interested in this process of reconceptualising that you are doing. It really seems to be the key in changing your practice and I am wondering about the implications for other teachers engaged in professional learning. How much is our teacher training about just applying a technique and how much of this actually shifts their view of their teaching? It seems that the tension between your science and spiritual selves is being acted out in your practice, with the students playing a critical role in giving you feedback. What tensions might other teachers bring into their teaching and how can we harness these dilemmas. They could be existential, pragmatic … it doesn’t matter… perhaps the key is finding an issue and helping them to explore it.”

“Yes, it is interesting that you design activities based on one line of thinking … but in the action of it unexpected experiences result which perturb your thinking even more. It is such an iterative process and it is interesting how your values and assumptions are shifting. Did the students realize how important they were in this process?”

“I have been listening with interest to how you are interpreting your students’ experiences and am wondering how much the paradigm we are in shapes what we see in our students. You are obviously creating some very special experiences… on one hand I feel sometimes you might be over-claiming – interpreting too much through a lens *expecting* holistic outcomes – but on the other hand it makes me wonder if we close our eyes to the *immenseness of being* inherent in our students.”

“Yes, it is easy to apply scientific perspectives to looking at these experiences… find one non-shifting standpoint and interpret from that perspective…. But, Sue, you are moving the lines constantly which makes that difficult.”

“What are the implications for our curriculum framework?”

“Well, I am interested in the way Sue brought in students’ passions. We are talking about *personal pathways* and *extended studies* as enabling students more flexibility in finding their own path according to their interests and passions. I was interested in the boy who came to class with no big questions and then ended it with “dare I say it, a desire to know more.” It reminded me how students’ passions need to be nurtured and revealed. So many students have no direction and we need to create an environment which is inspiring, as well as the flexibility in the curriculum for students to do their own thing.”

“Yes, it reminds me of the ‘means and ends’ argument. Sue here seems to be meeting many ends with a particular ‘mean’ that we might not have seen the potential of. It makes me wonder that if we looked with new eyes at what we have already whether we could also find such rich possibilities.”

“I think some subjects lend themselves to enriching but some really are not appropriate and should not exist… for example some maths classes.”

“What? Can’t get rid of maths.”

“Perhaps we need to re-conceptualise our subjects and ask what purposes they might have in terms of student flourishing and transformation as well as what information and skills they get across?”

* * *

Hang on a minute.

Hang on a darn minute.

What have I done? Is this what I really want my curriculum planners to think?

This conversation is CANCELLED!

I have pushed the box of science so I am peeping out. I am beginning to realize its contextualization. I am beginning to be more explicit in teaching that in my classes.

Sounds terrific.

Yes, lets make our subjects more purposeful, enriched, meaningful, self critical. Yes, there is lots of room to *flourish* what we are doing. But this isn't *transforming* education! The curriculum framework is still there. We still believe in standardization, in grading, in subjects. We are just doing better within the constraints of what we have. We are not moving those constraints, we are not opening the curriculum box!

Yes, and that question about the students knowing about their importance in my process. Where are they in this story? They are still the learners, the people who I am *doing learning to*. I am learning in this relationship, but am I sharing this with my students other than thanking them and using what I have learnt *on* them? How are we sharing in the development of our learning? What is this box of teaching and being a teacher and what might it mean to re-conceptualise it?

And where is holistic in all this? I have begun to explore what holistic might look like within the box of my classroom, but what does it mean in terms of *whole of education* visioning?

Sue, Sue calm down… take a deep breath. You always tend to get into either/or rather than and/both. Just sit with the dilemma for a while and see what emerges.

Yes, I am deeply engaged with a paradox, struggling with it, but yet to find myself in a new place.

A Paradox in two parts

First part:

A Zen Koan:

> A man puts a very small gosling into a glass bottle. It grows until it fills up the bottle. The man wishes to take it out but doesn't want to kill the goose or break the bottle. How can he do it?

Koans are used in some spiritual traditions to create a dissonance in self. One tries to solve the paradox within current paradigmic thinking and fails. The only way to 'solve' a koan is to change perspective or the self. It is the engagement with it and the investment in it which helps to precipitate the person to the edge of insight. Walking away from it doesn't get you anywhere.

> "The ability to perceive or think differently is more important than the knowledge gained."

Nicolescu (2002) sees paradox as an opportunity to create a third reality which enables the either/or to coexist as and/both. He calls this *the included middle*. In one reality and/both is not possible – in another it is. It might be a new physical reality or a new abstract construct of reality. But then what is the difference? The 'included middle' is now being used in exploring ethical issues.

Dialectical reasoning is a process of moving from thesis to antithesis to synthesis. Maintaining a creative tension between two polarities in any proposition or phenomena can result in progressive and qualitative change through the creation of a new entity which is more than the sum of the parts. This is the result of synthesis.

Second Part: Physics class 1996

It is the start of the third term and we have come back from a break of two weeks. A student, Will stands up in class pleading with great emotion "Sue you have to put me out of misery. *Is* light a particle *or* a wave?" I am so surprised at the angst in his voice. He goes on to explain how it has been the dinner topic of conversation for months. I am stunned. It is the first year that I explicitly pre-empted the wave particle dilemma through linking what we were doing in light with what we would be about to do in quantum theory.

It suddenly occurred to me that this was the first time a student had been so troubled by the wave –particle paradox. Why? To be concerned about it you really need to buy into the fact that light *is a wave*. And then buy into the fact it *is a particle*. Only when you were convinced of both did the paradox become alive. Perhaps finally I had actually taught well enough for the students to understand? And Will wasn't the only one. His question started a major discussion which went over many weeks about how we might find out.

What were students' responses to the paradox? Some really needed to find *one* answer. It was an *either* light was a particle *or* light was a wave. Which one? Some felt it might be something else entirely. They were even more disturbed to find that an *electron* could also be both wave and particle, because an electron was somehow more solid. But whenever you tried to test it the electron *either* behaved as a wave *or* as a particle. A group of students spent ages discussing ideas for experiments which might trick an electron into being both wave and particle simultaneously.

At the end of the topic some students became blasé about the paradox, comfortable that something could be and/both, while others still wanted one answer.

Reflection 2006. Were students engaged in dialectical reasoning? Did students move in cognitive maturity as a result? Did they experience a change in perspective about the nature of reality? Did they see the descriptors of waves and particles as just metaphors or models describing reality, rather than reality itself?

Is being comfortable with *and/both* a numbing of the potential for insight, realization and transformation? Should I be encouraging pluralistic thinking or encourage increasing angst

leading to something beyond? Can I do and/both? Do I have any say in this or is it really where my students are at that dictates what happens?

What is the potential for paradox in my teaching? What creates dissonance for my students?

How do I use paradox to motivate my own growth? Tensions seem to be permanently present in me, whether my big duality of physics versus spirituality, or issues that I am facing in thinking about my students and my teaching. Am I trying to solve things by finding one right answer, by allowing both possibilities to co-exist, or by deliberately keeping the tensions alive? Perhaps sometimes I find myself seeing from new perspectives or have lived my way into a new way of being in the world.

And isn't there another way of dealing with paradox? Wilber no doubt would suggest that we look at how we can transcend and include.

Epistemological Pause

May 2006

It's about time I reflected on the epistemology I am bringing to this narrative. There are several layers.

First perhaps is the layer of epistemology I was using at the time that I was experimenting with my physics teaching. In 1996 I started using action research formally. This meant deliberately applying principles or techniques in my teaching and observing students' behaviours as well as actively seeking their feedback. Based on this I would theorise about students' learning and development. I could build up a store of anecdotes which would help me test theories I was reading and ask how do these theories apply in this situation or that. This enabled me to get inside the educational theories in the same way I was getting more inside the physics theories.

I then might ask students to give me feedback about these models I was developing to help me understand their thinking and learning. While some students found them intriguing or useful, for many others they had no relevance. So was the relevance of these models just for me as temporary scaffolding? Were they helping me to be more intentioned and reflective, resulting in being a better teacher…. the aim of action research? Did they reveal any real truth about how students learn? What was I really trying to do here?

What research should I have been doing if I wanted to find such 'truths'? How 'true' was the constructivist literature that I was reading which just focused on one lesson, or student dialogue, or some student interviews or a learning environment survey? Each of these were bringing a certain theoretical lens to

making sense of what was happening… yet in my reading of the original research data I was not necessarily seeing the same things as the researchers.

It really does depend on your underlying theories about education and learning as well as your values, worldviews and perspectival levels as to the meaning you can draw. I was astonished at how researchers confidently interpreted student dialogue, or drew conclusions from interviews and learning environment surveys without any discussion of the standpoints they might be bringing.

What did I gain out of reading all these articles? Perhaps the view that trying to understand learning is problematic and that sharing what we teachers /researchers know and think is part of an ongoing conversation enabling emergent yet individual meaning making. It is not so much about 'truth', but about opening oneself to different perspectives which can heighten self-reflectivity.

Yes, learning is rich, complex, dynamic, individual, over time…. dare I say *ineffable*. Yet here am I trying to understand it. And did my need to understand and model learning mean that I was stuck in Egan's *philosophical* stage, needing to find grand generalizing frameworks, rather than moving into the adult world of *ironic being*? Yes, I am aware of the dangers of my proclivity to model, but it does seem to have its benefits… because I find that things are working rather well. Is this a result of teaching with models in mind, or because of the flexible thinking I am bringing in the classroom – my openness to feedback from the students, to responding *in the moment* to what is happening and my deep listening? Hmmmm.

I am now doing two types of *action research*… the one which is more staged - giving time for planning, implementation, feedback and theorizing - and then

the *action inquiry* of Torbert (2004) which is action research *in the present moment* – a mindfulness in action.

Perhaps it is the play between the philosophic models, reflectivity and present moment awareness which enables the development of 'practical wisdom which is the praxis of such research. This practical wisdom is 'ironic' in that it can only be applied in the situation at hand rather than being generalized.

So now in my narrative about this process of action research and action inquiry I have to be aware of the epistemological claims I might be bringing. I am writing anecdotally, about my process of reflection, about my changing perspectives, about my many models in process (which I haven't structured as learning environment questionnaires to be statistically tested… yes, you may well shake your head over that in disappointment… but rather have 'tested' through their transient usefulness to me as a teacher).

Now this approach might be fair enough if I was just doing a self-reflective, culturally aware study with the purpose of enriching audience understanding of the life world of a science teacher, where standards of rigor might include authenticity, self-reflexivity or 'truthfulness' claims of auto-ethnography. However, I am intending to draw from my experiences, my reading and my reflections in order to come up with a grand vision for science education as a whole. It concerns me then, as a scientist, that I should make such generalizations about science from such a limited research field and mode of research.

But perhaps all I am offering is a certain insight, from my clearly stated standpoints (as well as not so clearly stated), which in itself might result in praxis for others, and opportunity for testing of the model. This is the dilemma of hindsight, because at the time of doing action research my main aim

was not to come up with the grand unified theory of science teaching but to just explore the question *"What does it mean to move towards being a holistic teacher?"* The grand vision emerged at the end as a result of this question and my need to make models of my process… and now I am scratching my head and thinking.... hmmm where is the scientific rigor? If I was starting again from where I am now, I would be offering different 'proof' other than my own process of getting there. I am getting ahead of myself. But I wanted you to see the dilemma I am facing… to be true to my process, but to meet the needs of the emergent theory for rigorous justification.

Richardson (2000) would say that when one *writes as inquiry* there is a freshness of self-reflectivity and self-reflexivity. One is capturing self at a particular time, and in the iterative process of writing one begins to see in a new way and a new self is being created. The reader is party to the creation of this self which can be quite moving, creative, insightful and inspiring. The reader can perhaps identify with the processes and be encouraged to reflect about their own experiences. When one starts writing with something to say, then one is writing from a 'science consciousness' …. writing comes from the past… the writer is merely documenting the already changed self, rather than revealing the process of change.

I am perhaps trying to do both with the result it can be merely confusing! For example, I took out my reflection based on the curriculum planners limited comments, deciding it was unimportant to the argument I was creating. But then I have decided to put it back in to reveal better this process I am taking… it is not as well defined as the words appear on the page…. I am struggling towards an understanding yet to emerge.

Back to my role as writer. I am well aware of the orchestration role that I am taking in the construction of this story. How as artist and constructivist I am

selecting anecdotes, student journal entries, and themes in order to take the reader on a journey of vicarious experience and reflection. I am aware that while in some cases I am deliberately leaving the reader to make connections and to analyse for themselves (to enable access to the inherent richness), my manipulation of text no doubt influences the possible meaning to be made. It is tricky. If only you and I could have a dialogue about the meaning you and I am making from this writing. Because most of what I write are starting points for conversations… rather than conclusions.

In the process of writing this for an audience I too am making insights… it is pushing me in perspectival understanding (another explanatory model!) and I am interpreting student data and my own experience in new ways. I see many threads I could pursue further; there are lots of questions I have and I think it would take a lifetime to research them. I am aware of how focused I was at particular times on aspects of learning and science; how it had its own inexorable momentum and direction… but now I wonder what might have happened if I had asked a slightly different question back then, or not moved so quickly from one concern to another. Writing chapters in themes has the benefit of enabling hindsight exploration along a thread (depth), whereas at the time there was far greater interactivity between each of the aspects I was exploring (enabling a sense of breadth).

Questions:
How relevant is my experience of teaching physics to the teaching of science to other age groups? What are students' needs, goals, questions? What experience of science aligns with their personal journeys?

How do teachers' beliefs inform practice in both conscious and unconscious ways? What have been various approaches in transforming science teaching practice and what are the issues with these?

Who else has had similar experiences to me and what insights have they had?

Fig 8.15

I had a dream at the time which perhaps explains the method of my journey. In my dream I found myself in a room with lots of doors, all with different aspects to explore. I opened one door and headed off down a corridor, opening

other doors into rooms where I stayed a while and played and learned. I came back into the main room and continued to go through each door and explore what it had to offer… but after a while when I opened a door I found I was on the mezzanine level looking down on the maze of corridors and connections.

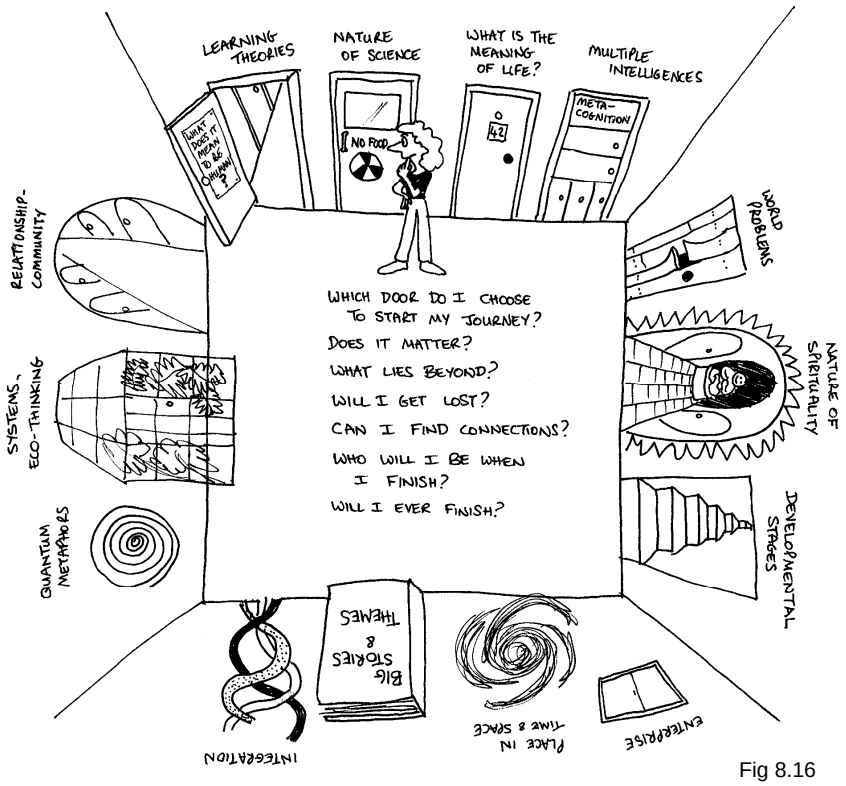


Fig 8.16

I could see my earlier self moving around at the ground level, not really understanding how each aspect linked to another one, but blithely exploring. But from this new height from the mezzanine floor it was clear how one corridor led to another and how they shared common rooms. I felt excited that I could have this perspective about the interconnectivity of what I was doing. I began to see how they all related to each other to create this ineffable thing called learning.

Then I looked up. I was in an enormous 3 dimensional maze only having covered one small part. I saw the potential of where I could go… I could follow corridors deeply, or try to cover more ground. Does the process of interconnection of my

Fig 8.16

experiences lead to greater perspectives, gaining higher floors? My dream seemed to be telling me that was the approach to take. To see how what I had learnt already interacted. And this is what begins to happen in a big way in the next few chapters.

Now there are several subplots moving through the previous chapters… I will mention two at this stage….

My own transformation.

The dialectic of physics and soul is causing me to re-conceptualise my ground of meaning. In terms of Fowler's *Stages of Faith* I have moved from **individuative** (choice in own beliefs, values) to **conjunctive** (incorporating views of others and wishing to serve others) to the beginning of **universalizing** (search for universal values, common essences). My view of spirituality has moved from an emphasis of *seeking truth and meaning* (dogma) to the *essence of being*. But this is very much still in process. My perspectival level is also moving into more pluralistic perspectives but is yet to be truly challenged and flourished.

The shift in my focus from *content* of science and *content* of spirituality to extracting the *essences* of science and essences of spirituality now enables me to marry soul and science to some extent through the nurturing of soul within a thinking classroom.

Is the process of analysing myself against such stage models helpful? For me I think it clarifies my different standpoints. Being a 'holistic teacher' who is coming from 'a spiritual paradigm' is in fact not a definitive entity. I could claim I was a holistic teacher at different stages of my journey but these would be quite different, mainly because of the perspectival stage I was in, my notion of spirituality and how I conceptualised what a holistic teacher is.

So in 1994 my focus might be caring for students and developing a sense of wonder, in 1999 it is the creation of Sue's wonderful world of physics with a truckload of innovative holistic pedagogies, and now in 2006 I have let go of the notion that holistic lies in the types of pedagogies you are using, rather I am focusing on the student and using what percolates up from my reservoir of pedagogical experience.

Yes, this change in standpoint is problematic. No wonder when I read student journals now I see new aspects to them that I didn't see in 1999.

My changing role as a teacher of physics.

This can be best explained using the metaphor of the goose in the bottle.

When I started teaching physics, the gosling (the spirit of my students) was outside the dusty bottle of physics. I was engaged in opening up the heads of my students and pouring the content of the bottle inside whether they liked it or not. I then began to discover a physics I hadn't known before… I scrubbed away the dust and in the process the bottle got bigger and more transparent. I found now that the bottle was only partially filled with physics content and there was room for the gosling inside, floating on the liquid.

I then found a sense of awe and wonder in the physics and the contents glowed with vitality which permeated the being of the gosling. It started to grow. It had its own questions and now drank deeply of the content of physics.

But then I began to see the significance of physics and I expanded the content to include philosophy and nature of science… the bottle is getting very full… with a growing gosling and no space to go.

There is a problem now. How do I get the gosling out of the bottle of physics without breaking the bottle or killing the gosling?

What is the next step for me now? What structure of curriculum could help me with my dilemma? How might I see my classroom, my students and my role as a teacher?

Am I moving from *teacher directed* to *student centered*? And what do I mean by student centered? There is a sense I already have been concerned about my students and trying to see through their perspectives, but perhaps there is more to see?

Meditations on geese

Chapter 9

The Dialogical Classroom - 1997 -1999

Questions:

What does good scientific dialogue sound like?

What facilitates good dialogue and dialogical opportunities?

What impact does a dialogical classroom have on student learning and being?

Introduction

So far in relating my journey I have kept to some sort of chronological order. While particular threads might overlap in time there is still a sense of a movement forward in my own understanding and questioning. This chapter is concurrent in time with the last one (*The Significant Classroom*) but is now looking at a different thread - exploring the issues of creating a dialogical classroom. This draws on my previous play with constructivism, meaning and questioning and is contextualised by my concerns to make physics significant.

What might it mean to develop pedagogical tools for helping students to immerse themselves in scientific and inquiry based thinking? What mind shifts do I need to help me in this process? And what might I see and wish to question as a result of such mind shifts?

I ended the last chapter in confusion, wanting to break out of the bottle. It remains to be seen whether this chapter can help me in reconceptualising myself and the bottle in order to find freedom to become something more… or whether it just adds to the confusion.

Is dialogue happening in my classes?

1997. It is the beginning of the school year and I have a new physics class. I am reading a range of constructivist literature, some of which (Driver 1994) includes students' dialogue within small groups in their science classes as they try to make sense of a concept or an experiment. As I read the different case studies I wonder about my own students… are they teasing out ideas as well as the students in these papers when they are working in their

groups? Am I giving them enough open ended opportunities to do this? What does good scientific dialogue sound like? What fosters it?

I decide to listen into group conversations with a new sensitivity. Previously, I have *participated* in conversations, listening not as a *researcher*, but as a *teacher* whose aim it is to encourage students to tease out ideas, to apply more rigor, or to ask *"what if?"*

The first thing I notice is that I am very good at stimulating group conversation… in fact as I go around the room interacting with groups there is a wave of thinking and activity following me. I am the catalyst, but it seems that I haven't empowered my students to initiate good dialogue for themselves. I realize that this is also true in my journalism class when students come to me saying "I have no idea what to write about next". I bounce ideas with them and they get all excited, but still come to me next time when they are stuck, rather than being empowered to generate ideas for themselves. Hmmmm. Yet, it eventually does rub off on my physics students… after a month or so of modelling inquiring dialogue students begin to get better at it. But is there a shortcut?

I decide to say to groups after we have had a good conversation to think back to what questions helped us in our thinking about the ideas. How could they use these questions deliberately when discussing their next issue? I have just initiated some meta-cognition about dialogue and as I listen into conversations now I hear students asking questions like *"How might we test that?", "What do you mean by that? Can you explain further?", "So, if that theory applied what would we see?", "How could we model that?"* .

At the same time, I decide to design an activity based around the concept challenge process (Duit and Confrey 1996) to reveal and challenge 'alternative' views that students might have about concepts of motion. I ask the students to individually work through a revision quiz which has multiple choice options, some of which relate to typical student 'misconceptions'. I ask them to select what they think is correct, to rate how sure they are and why they think it is true. They then get into groups, sharing their answers, their degree of certainty and their reasons and try to come up with a group agreement about what the answer might be.

As I go around the groups I listen in to their conversations. Most groups are teasing out the issues quite deeply. Students say to me how surprised they are about each other's views. What particularly interests them is to hear the 'uncertainty' factor. Some girls tell me that for the first time they feel comfortable talking about their tentative ideas - usually the boys seem so certain about physics ideas that as a result they (the girls) often will not express an

alternative view or participate in the conversation, hanging back, unless they are really certain. However, in this exercise, even the boys are admitting when they are uncertain, rather than acting as if they do know. This freedom to be uncertain and tentative seems to open up new possibilities for discussion and the girls now seem better able to read other people's seeming confidence (bravado or bluff) in a new way – sceptically!

I ask one group what questions they found most helpful in their discussion. They all said the question that Mary had asked. She said "I felt really dumb asking the question, I felt I should have known the answer, but I realized that I didn't… *what really is momentum?"*
"But it wasn't a dumb question at all", said Nathan, "we realized that none of us knew it either, we just thought we should know it and were afraid to ask!"

Between 1992 and 1995, I was part of a state-wide group which looked at ways of encouraging more girls to participate in the physical sciences. The 'solutions' we looked at then were using more essays, more ethical and social issues, relating physics ideas to more personal rather than mechanical contexts, and helping girls be more comfortable with the technology. But what I was beginning to see here was that a major barrier to participation by the girls was the nature of science discourse and ways of knowing which seemed to come from a culture of 'knowing' and 'telling' – it was based on propositional claims to know and usually debated in a logical and rational fashion. One that had indeed disempowered me, when I first became a member of the physics teaching culture.

When I started including more 'girl friendly' pedagogies in those early years of teaching physics I found that not only did they benefit the girls, but that the boys too became very engaged, enjoying social and ethical issues. So now I wonder again, can I make the culture of scientific discourse more inclusive and what might that mean?

Now I think perhaps there is a **WHAT** of good dialogue and a **HOW** of good dialogue. We can learn effective questions to ask, or active listening skills, but perhaps we also need to bring a *state of being* to the process…. A state of tentativeness, a state of willingness to look deeply, to be open to surprise, to nurture those who are tentative. So critical scientific discourse needs to be balanced with care, mindfulness and openness.

And how could I model this? How could I be more deliberate in facilitating this? What sort of discourses am I experiencing and what makes them work?

Now begins a period where I am listening into many different conversations – eavesdropping as well as analysing at a meta-cognitive level conversations that I am having. I am listening to the patterns of conversation, the types of questions, the body language and tone, the energy of the conversations, the outcomes and how people are relating with each other.

Some conversations seem to be a sharing of information which seems to go no further, while others enable the participants to gain in understanding or perspective. Sometimes just talking to another enables one to order one's thoughts, and the feedback from the listeners enable greater clarity. Some conversations seem much more propositional and debate oriented, entrenching participants in their own views, while other conversations are more speculative and inclusive of non-conforming views. Some seem creative and generative and others seem to deepen the relationships between the participants.

Cycles of Discourse

I wonder if the patterns of conversation can be described using the Julia Atkin model for Whole Brain Learning? Perhaps **inquiry based conversation** has a cycle?

For example, one cycle (**Relating**) could involve finding ways to connect to the others in the conversation – find a shared language, experiences, perspectives. You might share personal anecdotes or look together at particular incidents and in doing so find common ways of exploring these. Then you could move onto a more **procedural** phase where you can extract patterns, meaning or essences from those experiences or anecdotes – these anecdotes then become a common language which help make the abstract concrete, constantly being referred to and deepened in understanding. You can then begin to **analyse** and theorise. Then you might go into **creative** mode where you imagine possibilities, take risks with your thinking. There would be a reflexivity between the different aspects as you move back and forth.

Julia Atkin's Whole Brain Learning Model

Logical Deconstructs Analyses Theorises "Why, how?" "How is that feasible?" "What is the evidence?"	**Creative** Takes risks Possibilities "What if?"
Procedural Detail Method Patterns "How do we do that? "How do we find out?" "What are we seeing?"	**Relating** Feelings, intuition Sharing "How do you feel?" "What is your experience?" "What do you mean?"

Fig 9.1

Good dialogue might feel different for the different stages. When you are being creative in a group there would be a sense of excitement, playfulness, energy and even synergy. When you are listening to each others' ideas or stories there might be a feeling of receptivity (or perhaps for some people they might experience impatience). When you move into a more analytical mode then you would expect to bring a critical lens to things and possibly would start hearing some debate. This could feel uncomfortable unless you learnt to separate yourself from your ideas which are being criticised.

For me, the conversations I value are ones that move me forward in understanding while deepening the relationships I have with the participants. These excite me because I feel myself and others are engaged in *insight making*. It is a very co-creative process and one which gives me a sense of experiencing the 'other'. Although we might be talking about something abstract in order to come to understand it better, the very process of doing so opens us up to each other. There is the sense of 'being with' the person in such a way that brings a deep respect and interest in them and their ways of thinking and being.

I remember conversations I had in an academic group where we carefully nurtured a person in helping them to articulate and birth their ideas before opening up the ideas to a general discussion where we might critique the ideas, theorise, leapfrog from them, compare to our own experiences and create together deeper understandings. I wonder whether I can help my students to recognise when students are vulnerably trying to make sense of something – to realize there is a time and place for critique or debate. Perhaps you need to signal that you are in the birthing stage… using language like *"I wonder….", "Help me express this…"* And then perhaps you need to signal your readiness for the others to play with your idea taking it into the next stages.

So the language and body language could be quite different for the different stages. For example, *"That reminds me of that…"* could signal to the conversation participants that this is moving into the anecdotal stage which has an important role in building up group stories. So rather than thinking *"hurry up and tell your story"* perhaps we need to listen to it for the richness of itself, honouring the other person, as well as how we might be relating it to our own experiences, and also what principles we are beginning to extract from it.

I wonder how I can help students to successfully experience these different stages through setting up specific activities which develop skills of a particular stage – e.g. **Community circles** to improve sharing of anecdotes and listening to others, **brainstorming** which

emphasises non-judgement, group **concept mapping** where you are looking for patterns and connections, **critical thinking** which seeks plausibility.

How I can encourage students to create rich discourse cycles leading to greater insight and meaning? Do we need to have a structure like De Bono's six hats where we together put on a certain hat or visit one of Atkin's quadrants? This enables movement away from debate or defending point of views. It reduces ownership of ideas and everyone can participate in each stage – equally coming up with ideas as well as finding flaws in them.

6 Hats

Blue hat: what processes are we going to use?
White hat: what information do we have?
Red hat: how do you feel?
Yellow hat: positives
Black hat: negatives and obstacles
Green Hat: possibilities

Fig 9.2

Or can we operate as a complex diverse system interacting in such a way that enables emergent understanding?

How can I make the processes of scientific and inclusive discourse more explicit with my students? Is it just as easy as saying "I notice you are stuck in a debate – what happens if you move out of this mode and brainstorm some solutions to the dilemma you have?"

I am also quite interested in how girls and boys converse and whether there is a gender difference. Are boys naturally more propositional, monological and assertive about their ideas whereas girls are more reflective, self-doubting and dialogical? Do some students have greater flexibility in playing with ideas – a sense of distance - while others seem to entangle their sense of self with their ideas; some becoming very defensive while others feel stupid and dumb.

Here are some comments by some girls from their journals at the beginning of the year:

> Sometimes I feel really intimidated in class, especially by all the guys who have done electronics or something similar.
>
> Sometimes I am really annoyed by Scott interrupting people in the middle of what they are trying to say, and then he won't even have the courtesy to let them finish. That is one thing that really pisses me off about him. I know he is really smart and all, but that is just not on. OK.
>
> Freaky science people in this class make me feel dumb. They don't make me feel dumb, I make myself dumb.

I become interested in *Women's Ways of Knowing* (Belenky et al. 1986) and wonder what sort of *knowing* my female students are experiencing. How many are silenced by the monological propositional authority of science? How many have confidence in their own voice?

Do they, like me, wish to experience a more *connective knowing* of what they are learning – needing to understand how the ideas arose, what they mean and needing to create personal relationships with the authors of the ideas? (Remember how Tiffany wrote dialogue for Isaac Newton and gave him a song list in the last chapter.)

Are they coping with multiple inner voices and self doubt and trying to reconcile these? Are they identifying too much with their ideas and yet to find objectivity? Are they seeking to remove compartmentalization and find integrative explanations?

What do their journals tell me? How can I listen harder to 'between the lines'? What strategies can I give them that might help them move into *constructed knowing*?

Women's Ways of Knowing

1. **Silence:** total dependence on whims of external authority.
2. **Received Knowledge:** receive and reproduce knowledge.
3. **Subjective Knowledge:** truth and knowledge are conceived of as personal, private, and intuited.
4. **Procedural Knowledge:** rely on objective procedures for obtaining and communicating knowledge as well as connected knowing based on empathy.
5. **Constructed Knowledge:** view all knowledge as contextual. Seeking integration of heart and mind - communion.

Fig 9.3 (Belenky et al. 1986)

Creating a shared meaning – the language of physics

How can we begin to discuss ideas in physics without having a common language to do so? And how can we develop this common language? Is it a matter of having the opportunity to talk, or is it something more? How do we build up shared meaning? What sort of questions or activities promote this? What tools might help us?

What is the language of physics? In articulating explanations in physics, students need to draw on various physics tools – using terminology with precision as opposed to everyday usage, visual representation of situations, vector diagrams, mathematical equations, logical development, extrapolation, interpretation, data manipulation and representation.

Somehow from the beginning of the year to the end of the year my students become competent in use of the language. In a group there will be a shared piece of paper where students are drawing diagrams, writing formulas or sketching graphs as they are talking to clarify to the others what they are saying. They are checking that everyone is making the same meaning, building on each other's ideas.

But at the beginning of the year there is not this ease in using diagrams or visual prompts as they speak. Language is used far more sloppily and there seems to be little attention to how others might be making meaning from what they are saying.

I wonder what it is that I am doing that promotes this change in competence. Is it the expectation I create for the class that we should all understand? Is it the activities I do or the way I do them? I wonder now about the students who drop out of my class. Perhaps they haven't mastered the language?

There is one activity which I do at the beginning of the year where students as a group have to come up with an explanation of a physics action using physics terms like energy, momentum and forces. I notice that this activity is in fact problematic. Students begin to discover that they each use these terms differently, some inappropriately and some equate concepts like energy and force. I wonder whether this activity is problematic because students are having to draw upon learning from several individual topics which they did in Year 11 Physical Sciences - having to compare and relate, rather than being given a question that can be purely situated in one way of thinking. Perhaps we only begin to interrogate our assumed meanings when we are put into such problematic situations?

I wonder then at the power of conversation as a testing place for the meanings students are making… I become interested in Vygotsky's theories about the role of language and conversation in learning and I wonder how I can give more opportunities for students to learn in conversation from each other. For example, writing answers on a piece of paper for a teacher doesn't seem to give students the immediate feedback as to the rigor and understandability of what they are saying. How do I encourage conversation around solving problems?

I become aware of how I am modelling this with my students… how I use diagrams or physical demonstrations to get across my ideas and how I encourage students to come to the board and draw diagrams of their own or to grab props to demonstrate what they are saying.

I have butchers paper and textas ready when we go into groups so that students can use the paper as a place for shared workings and diagrams.

I use very well set out exemplars of how to solve problems so students see how important it is to explain their process and reasons to an audience as well as merely doing calculations to solve the problems. They begin to do problems this way which is further reinforced when they are peer assessed on their tests. As I go around the class listening to pairs marking each other's work I often hear someone say "What do you mean here?" After listening to the explanation the student might make suggestions about how their partner could better write down their answers so the examiner can understand them. Their working on tests improves very quickly as does their verbal explanations.

I also begin to realize the power of stories. How each experience we have together - such as jumping off desks to explore momentum - becomes something that can be referred to again and again and almost seems to become part of our mythology. So when we move into abstract thinking we have concrete experiences which we refer back to as we converse. It seems that the language of physics is a living thing which grows. While one might expect the language of physics to be objective, for each class its meaning actually rests on different experiences and shared learnings. We have our own 'in house' speak. But there is also a rigor which can be transferable to new situations and people.

Am I moving into a *social constructivist* classroom? What might happen when I introduce critical thinking into this mix?

A Meta-cognitive model for critical thinking

In 1997 I started to experiment with the concept challenge process (Duit and Confrey 1996) to help move students from their 'alternative view' of the world to the 'scientific view'. The key to this process is that the new theory needs to be shown to be more useful for them in their lives than the one they currently have. So to get to that point you need to ensure that students first understand the scientific view, find it plausible and then can see where it is more useful.

Concept Challenge Theory

- Is it clear?
- Is it plausible?
- Is it useful?

Fig 9.4

But then I remembered back to 1994 when my top student said to me he didn't really believe in Newton's 3rd law. I questioned him and tried to explain it better …. use real contexts …. put his body into an experience of it. "No, no, Sue," he said, "I understand it, but I am just not convinced about it. I have a philosophical problem with it. But don't worry, I will write the correct answers on the exam."

I think there is a difference between naïve understanding based on ignorance, or undiscerning felt experience, and then that discerning critical thinker who makes up her own mind and creates her own theoretical frameworks. Myself, I don't really believe in quarks (after having three years of solid Quantum Theory and particle physics at university under my belt). Surely I have a right to my skepticism? Einstein was critical of Quantum Theory to the very end.

The concept challenge theory doesn't seem to take this into account – the room to allow someone to determine their own beliefs. But my students, at 17 and 18 years old, are at the stage where they are moving out of the family influence into determining their own values and standards – the *self authoring* stage. Surely then we should be encouraging them to make up their own ideas about science? Or is that scientific anarchy?

I decide, however, to introduce a modified concept challenge process as our *everyday process* for discussing new physics concepts, putting forth our own ideas and exploring our understanding. I call it **critical thinking**. It is based on four stages of questions and I ask students to be explicit when they ask a question to designate what stage they are asking it from. We begin to use it in listening to each other's presentations, students use it to challenge me when I am explaining stuff and begin to use it in dialogue with each other.

Critical Thinking

1. **Is it intelligible?** What further explanations or experiences can help me understand it?
2. **Is it plausible?** How is it convincing, logical, relevant, authentic, trustworthy, connected, supported by evidence, practical, meaningful, intuitive, humane or fit a bigger picture? What might be the flaws or limitations?
3. **Is it useful?** How does it have greater explanatory or predictive power compared to other models? How does it have more elegance, simplicity, order or symmetry? How does it fit into other ways of explaining the world? How does it uplift, inspire or advance the world? In what ways can it be ethically applied? How is it significant?
4. **Is it believable?** What are my underlying beliefs and values about the world and how do these new ideas interact with these? How much of this idea am I willing to take on board and with what provisos? In what ways have I been convinced to accept this idea and am I happy that the type of validity claims are appropriate? Does this idea challenge my own fundamental beliefs and values and what new ones am I moving to?

Fig 9.5

What does it look like in a class? Here is an example:

1998. It is the 3rd lesson of the year in Physics and students have been doing a quick revision exercise of what they learnt last year where they examine 8 physical activities like walking or whizzing a bucket full of water around their heads. They need to come up with scientific explanations of what is happening and why; using ideas from forces, momentum or energy as appropriate. Each group is going to present one of the 8 activities, so all activities are covered.

The first group are about to present their findings – a group of 3 boys holding up a big sheet of butcher's paper with diagrams and white board markers at the ready. Before they start I say "As we listen to this presentation I want you all to ask – is it clear and do you understand it, is it plausible, is it useful and do you believe it?" *I write those up on the board and explain them further. I also say that the presenters can also participate in critiquing their own explanations.*

The boys now present their explanation of why water stays in the bucket as it is whizzed around your head – but in a confusing and complex way. I am sitting now at the side of the room and all the students in the audience look at me expectantly when the group are finished. What are they expecting me to say… "Any questions, no, well thank you and next group" or "Well, to summarise that…" or "Well, there were a few flaws with the presentation…. Here is the correct version." But I say none of these.

I can see that many of them didn't really follow the presentation and are just sitting politely as part of the ritual that we go through for this sort of thing. There is a lot in the looks that they are giving me, or so I believe. They don't really know me yet and what I do now will set the tone for the whole year. I smile inwardly and perhaps a little diabolically.

"OK", I say, "how many of you understood the explanation?" They look at me surprised. About half the class put up their hands.
"Ok, those of you who didn't, what sort of questions do you need to ask to make it clearer?" And so students start asking questions and gradually we get a clearer picture.

"Now," I say, "how many of you find it plausible?" Now about a third of the class put up their hands and I ask them to ask questions again or to say why they think it is implausible. By this time no-one is looking at me for approval or for closure. The focus is on the presenters and the board where they are expanding their theories. I can see the students

transformed from a passive audience waiting their turn, to people really engaged in teasing out this issue… after all everyone has done this activity so they have already thought about it.

"How many find it plausible now?" Well, this time there are even less people putting up their hands. I then ask how useful it is… does this explanation help us in predicting more complex situations?

By now the group members are arguing amongst themselves as well and we all pretty much agree that the explanations so far are not very useful - they are overly complex. We discuss why some explanations might do the job for one situation but unless they can be applied to others, or help predict they are not that useful. Other alternative explanations are proposed but no-one is really happy that their theory meets the requirements for usefulness or plausibility. "So at this stage how many people would take this explanation on board… would believe in it?" I ask.

"There is no point believing in something if you don't have the evidence for it, or it if it doesn't offer a useful way of explaining the world!" one person sums up. Excellent!

"Well what is the explanation they all ask?"
"Do you think there is a right answer?" I say. "Don't you mean; what is the best explanation at this stage which is the most useful? Hmmmm, can I leave this one open and not answer it now… can we see it as something that in the next month we will find a useful answer to as a result of our explorations?"

And the lesson finishes. We have spent 30 minutes just with one group. I am not sure I will have time now for all the other groups to give a presentation. Perhaps that doesn't matter because I feel that this has been a very significant exercise creating very positive habits of mind. I thank the group for being guinea pigs and congratulate them on being such good sports in the face of all the criticism. "It can't have been easy standing out there and being grilled like that. Thank you for providing such a good example to start with… it enabled us to have a really good conversation where we could tease it out. Excellent!" I say.

Next lesson I come in and the 3 boys are already sitting down, heads together, drawing diagrams and totally engaged in figuring something out. It is still this issue with circular motion but now one of them has come with another example. For the next three weeks in

their spare time they are working on more and more complex examples that they are trying to explain.

In 1998 and 1999, I use the critical thinking model explicitly at the beginning of the year and then it just becomes part of how we talk with each other in examining our physics ideas. I use it as part of a discourse cycle and I progressively hear student conversation become a lot more rigorous, precise, complex, speculative, generative, imaginative, engaging, and supportive.

Not every student is the same; each bringing particular skills or different levels of maturity. However, I believe I see an increase in this critical discourse ability over the course of the teaching year. I am constructing in my own mind indicators for good discourse which I am modifying and adding to as I listen into student talk. I am theorizing what activities or explicit instruction helps students become more aware of their discourse and helps them improve. I am looking at how this type of discourse is affecting the way we do science and think about science.

In previous years I encouraged inquiry through asking the weird and big questions of life; now it seems that inquiry can be stimulated by the actual course content. It seems that everything becomes problematic and I don't need to create interesting and complex problems to initiate discussions. I feel I am in an inquiry based classroom even though we are not doing any long term open ended project inquiry based on student choice. We are still moving through a content bound course. But is this real scientific inquiry, or just conversation?

In my constructivist classroom we were interested in exploring contexts and running on-the-spot experiments to test emergent ideas and hypothesis. We are still doing this but going deeper. I now hear students question the appropriateness of applying theories to particular contexts and then begin to question whether the underpinning physics theories themselves are correct. It is an iterative process of investigation into the very building blocks of what we know or think we know. In finding out we are using many tools – role plays, experiments, research, conversation.

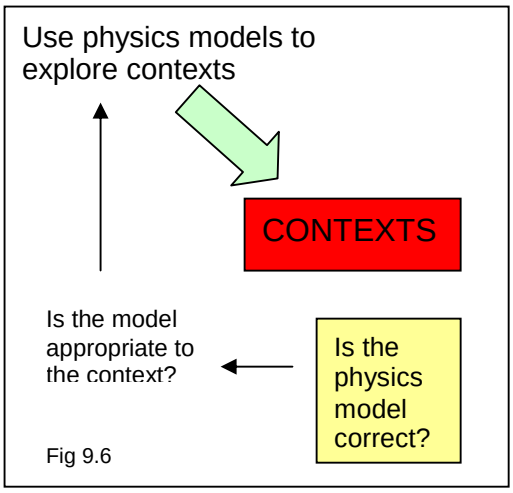


Fig 9.6

It seems we have moved from learning *about* physics to being engaged in a rigorous critical inquiry *into* the physics concepts. Am I moving towards Doll's (1993) notion of *curriculum as conversation*? Physics becomes the object of our conversation. We are moving from merely ensuring we have a shared meaning to now inquiring into the viability of that meaning.

I find that some students become completely engaged in the questions that come up; some go to great extent to pursue things further, choosing to investigate it as their major presentation, playing with possibilities or getting into chat groups. Students come early and stay late and continue on discussions into their next classes. Discourse into physics seems to be a vibrant living thing.

On one occasion I had a boy model the diffraction properties of light by writing a computer simulation. It was an extremely intelligent and creative piece of work, probably at the level of 3rd year university physics and completely unexpected. Luis told me "I just felt that the topic didn't go deep enough. It wasn't enough just to see the patterns that waves made around objects, I really needed to understand why that happened. What caused the curves? How do the wave fronts move? Why does light act like a wave front? I thought by computer modeling it that I would work it out. I had to define for each pixel where it would go next and how it was related to those on either side. I just kept modifying the formula I had come up with until the wave pattern looked like it was supposed to be. So now I wonder whether this computer formula has any relationship to what is actually happening. Because the relationship between pixels would be different to what is happening in matter."

To say I was astonished and in awe is an understatement, particularly since prior to that Luis hadn't really excelled in class assessments, not being good at writing and putting his thoughts on paper. I was pleased that my deeper coverage of previous topics had set up an expectation of him wanting to fully understand something, but I wondered now whether our assessment processes favor some intelligences rather than others. Luis was demonstrating understanding way beyond the questions on tests, yet he still had difficulty doing these.

I also found it very difficult to understand what he did in order to have an intelligent conversation with him. It really stretched me and caused me to think deeply about the physics. And this is now happening more and more often as a result of this critical discourse– it is no longer me sharing my understandings and knowledge with the students –

it is me and the students creating our understandings together. There is a democracy and recipricocity to it.

In end of year focus group interviews of the 1998 class, a student said: "In physics we learn *with* Sue – in other classes you learn *from* the teacher… learning *with* is far better." Another said how much help it was to debate ideas and think critically about them. Another said "It takes time to understand a concept really well, but once you do it certainly saves time later."

I asked some students whether this critical thinking and discourse was a skill they could transfer to their other classes and they told me that in two of their classes they didn't have the opportunity to talk – either they had to sit quietly when working or the teacher was the talker. I realized then how important it is to give plenty of opportunity for discourse as well as building up the capacity for scientific discourse.

Parker Palmer (1998) in *Courage to Teach* discusses how we tend to think of teaching as either *teacher-centred* (where knowledge comes down from on high from the teacher) or *student-centred* (where the students find whatever truth they can and the teacher is a necessary evil). He suggests a third view – that of *subject centred* where the classroom is focused on the great thing (the subject) which keeps both the teacher and the student honest.

Has the critical thinking process helped me to shift into a *subject-centred* approach? Can I be *teacher-directed*, *student-centred* and *subject-centred* at once? What might it mean to be *soul centred*?

Now where does *trivial constructivism* (see Chapter 5) come into this? Surely I have moved beyond a trivial constructivist classroom? (That is a problem when one progresses in development stages – one is inclined to reject the previous stage as being wrong rather than transcend and include.) But we are using constructivist techniques as we develop shared understandings - we are using probing questions to determine what each other already knows, we build up ideas, sometimes using logical sequencing.

But something has changed. Rather than me being the director or conductor *owning* the constructivist process… taking my students on a journey *with my ends in view*, the students now seem to *own* the process for themselves. I hear them construct understandings for others as they frame questions, give explanations or give presentations. They add questions in their explanations to the class to encourage audience thinking and promote discussion.

Once we have built up the explanations so we all understand them we can now move to the next stages of exploring plausibility, usefulness and believability. In these stages it feels like we are *playing* with ideas … critiquing, imagining, looking for alternatives, exploring the edges, looking at consequences. So we first need to develop a body of knowledge that we can manipulate and trivial constructivism provides a vital role in helping us do this. It is a reflexive process – as we play we build up greater understanding which enables us to play in new ways, seeing new things.

We can play with the explanations because these students are able to manipulate abstractions as well as the concrete. Not only do we play with the explanations themselves but we start playing with the underlying rules and examining those (the philosophy of science). We are now moving into *critical constructivism* (Taylor 1998) where underlying paradigms and ways of knowing are being questioned. The students are now involved in several levels of scientific discourse and meta-discourse.

Perhaps because of this philosophical viewpoint of the tentative nature of knowledge it is a lot easier to separate self from ideas… ideas do not define who we are… we can play with them and be *playful* with them. Students do not now need to explicitly say how uncertain they might be about ideas to ensure a speculative conversation because we are together oriented within a particular mindset. Though there are some students each year who find it difficult to be playful with ideas. These students might be less mature, or are less able to work at abstract levels, or have poor social skills or self esteem issues.

What is the impact on the girls? It is hard to say whether discourse alone is the cause of improvement in their confidence as scientists because I am using such a broad range of holistic pedagogies in my classes. However, throughout the year, I see girls become a lot more confident in conversations with boys; more empowered to voice their viewpoints and a lot more resilient to the critique processes.

Some seem to think naturally but privately in dialogical ways – multiple voices in their heads, as evidenced by their journal entries. So now, rather than having to speak in one voice and be propositional, or be silent because they feel too confused, I hear conversations where they enable all these different voices to take part no matter how contradictory. They also seem to be more confident in naming what is happening in group discussions which might shut down or marginalize others… not just writing it in their journals but taking action to challenge behaviours of their peers.

As well as assisting students in becoming critical and articulate thinkers, the Critical Thinking model also seems to encourage students to think critically about their own **belief structures**. By just asking the 4th question of the Critical Thinking model - "*Do you accept this?"* - students are challenged to relate the new models they are exploring to what they know already. Sometimes the new information perturbs the old, causing them to question their underlying paradigms, sometimes it fits right in. Sometimes the students reject new information choosing to use it but not to believe in it. From Tiffany's journal:

> **"God does not play dice with the universe"**
>
> What a dumb quote. Albert Einstein, you are an idiot. How do you know? That's one thing I can't stand about good old Albert. He was so arrogant. He refused to believe in an expanding universe, that black holes would form etc when his theories pointed to it. And now in quantum he says lets make this photon thingy. It has no mass, no charge, but it does have momentum and energy.
>
> Correct me if I'm wrong, but I thought to have momentum you had to have mass. Even if it is 1/10 ^{100th} of an electron, that's still mass. If a photon doesn't have mass how can it move? P= mv, so mass must be present as in $E_k = ½ mv^2$ and $E_p = mgh$. Anyway forget that. I've just got to, at this stage at least, accept it. Later I will worry about it in more depth.

Yes, we are all aware of the exam. Even though we might be coming up with rich speculative versions of physics theories we have to also have an exam version. For most students this is not a problem; they now see the exam as a small subset of what we are actually learning in physics, but for the less able students it can be confusing because they are still grasping with the concepts and trying to apply them successfully.

I notice that some students experience more self-questioning than others and that it might correspond with much broader questions they are having about their own identity and values. Some seem to compartmentalize physics from their bigger lives and then something may happen which perturbs this compartmentalization and opens everything to question.

How am I supporting this process? Being there as someone who they can talk to, who is caring of them and their issues. By helping them build up a meta-language to understand the processes they are going through as they question their belief structures, for example by developing understandings of the nature of paradigms and paradigmic change (as I have discussed in the previous chapter.) Some students are very articulate and confident in discussing physics in this way, while for others it seems quite foreign as they seem to be more situated in Egan's (1986) *Romantic knowing* where they are interested in detail and

concrete things, rather than philosophic ways of knowing (see Chapter 8). But even with these students I see a shift – one boy saying to me that initially he thought the philosophy stuff was a load of bollocks, but now he actually likes it and finds it is important to be able to think in that way.

My students are at varying development levels and respond in various ways – so one size doesn't fit all when it comes to the effectiveness of my activities, yet this critical thinking model does seem a useful one in helping students move across Egan's stages.

Jenny wrote on the back of a questionnaire I gave the 1998 class at the end of the year:

> "Your teaching has taught me not to accept things just because we are taught them, but because we believe, understand and agree with them. I have always questioned things that I don't find acceptable, but when a teacher encourages and promotes this questioning it truly is an inspiration."

Jenny is someone who seems to be going through the self-authoring stage; determining her own values, trying out different identity roles (being a Goth), rebelling. So perhaps for someone in this stage we need to provide a style of teaching which matches their needs; giving them the right to negotiate their own meanings and thus give them the freedom to develop.

Perhaps I am moving into the area of *critical constructivism* which is interested in the power structures within a classroom – how are students able to negotiate within a classroom? (Taylor 1998). But in my classes students are not so much negotiating what they do (because I am still very much directing the learning), but what they believe.

I have been thinking that I have been empowering my journalism students through enterprise learning, whereas I have been disappointed that I haven't been able to give my physics classes similar experiences in science. But now I begin to wonder if there are different types of empowerment. While my journalism students seem to be empowered ***to do***, perhaps my physics students seem to be empowered ***to think*** and empowered ***to believe?*** And perhaps this is even more important for this age group.

In 1998 one of my ex-students, Kimberly, told me of an incident in her first year university lecture on Psychology. As she listened to the lecture she started to question the underpinning paradigm – the concept of the human being which the lecturer was using. She felt that the lecturer was situated within a limited view that caused her to interpret along narrow lines.

She went up after the lecture and asked the lecturer about the research paradigm that the case studies were based on. The lecturer told her it was a stupid question and not to bother her with stuff like that. Kimberly then went away and did some research which critiqued the approach and presented it to the lecturer who got very upset saying "This is what we are studying and that is that." Kimberly dropped out of the course.

Kimberly is demonstrating here sophisticated understanding – to listen to an argument and be able to unpack the underpinning paradigms… and to expect that this is what you do. She voted with her feet when being forced to go back into the conventional thinking box. What way of teaching at university level would have supported her?

This stage that Kimberly is at seems to correspond to aspects of Stage 5 of *Women's Ways of Knowing* – **constructed knowing** :

> Once the knower assumes the general relativity of knowledge, that their frame of reference matters and that they can construct and reconstruct frames of reference, they feel responsible for examining, questioning, and developing the systems that they will use for constructing knowledge.
>
> (Belenky et al. 1986)

And could this process be one leading to emancipation and self realization – a path to spiritual freedom? Hegel suggests:

> Freedom in itself carries with it the infinite necessity of attaining consciousness – for freedom, by definition, is self-knowledge – and hence of realizing itself: it is itself the end of its own operation, and the sole end of spirit.
>
> (From Childs 1996, pp 170)

So although our scientific discourse is based on abstract ideas, with the main purpose to gain understanding and insight, I am beginning to feel that what we are doing is part of a spiritual journey. That building self-reflective capacity is an important tool for that journey and part of the evolutionary process. My role as a teacher of science can be both building up scientific capacity as well as developing the human being.

So now let us just go back to the notion of student transformation and examine it from my 2006 perspective. Now during 1997 to 1999 my notions of transformation were limited to the development models of Egan and Steiner. Now, in 2006, I have a greater understanding of the integral development spectrum and transformative learning theory. I can see that I could have been a lot more pro-active in seeing and supporting student transformation, and helping

students become aware of the nature of transformations. So while making explicit the idea of scientific paradigms and *nature of paradigmic change* was helpful in giving students a meta-language, I could have been a lot more explicit about the *nature of personal development*.

Indeed I should have been aware that in asking students to question their own beliefs with my Critical Thinking model I was setting up situations for self-transformation, not just creating a tool to improve their learning of science theories.

Mezirow (2000) describes transformative learning as follows:

> Transformative learning refers to the process by which we transform our taken-for-granted frames of reference (meaning perspectives, habits of mind, mindsets) to make them more inclusive, discriminating, open, emotionally capable of change, and reflective so that they may generate beliefs and opinions that will prove more true or justified to guide action. Transformative learning involves participation in constructive discourse to use the experience of others to assess reasons justifying these assumptions, and making an action decision based on the resulting insights.
>
> (pp7,8)

Transformative Theory

Transformations often follow some variation of the following phases:

- A disorientating dilemma – also paradox, enigma, anomaly
- Self examination with feelings of fear, anger, guilt, or shame
- A critical assessment of assumptions
- Recognition that one's discontent and the process of transformation are shared
- Exploration of options for new roles, relationships and actions
- Planning a course of action
- Acquiring knowledge and skills for implementing one's plans
- Provisional trying of new roles
- Building confidence and self-confidence in new roles and relationships
- A re-integration into one's life on the basis of conditions dictated by one's new perspective

The transformative process may also involve:

- Encountering a "missing piece" that provides the integration necessary for a transformative experience
- A revisioning of self in the eyes and responses of similar others
- Making public, primarily for ourselves, the historical dimensions of our dilemma - and confronting it as a difficulty to be worked through.

Mezirow (2000)

Fig 9.7

Transformation can be incremental or discontinuous; it could be caused by meeting a paradox, or just the process of critical reflection of underpinning assumptions.

> ... we transform frames of reference -- our own and those of others -- by becoming critically reflective of their assumptions and aware of their context… Assumptions on which habits of mind and related points of view are predicated may be epistemological, logical, ethical, psychological, ideological, social, cultural, economic, political, ecological, scientific, or spiritual, or may pertain to other aspects of experience.
>
> (pp 19)

By encouraging students to critically examine their paradigms I was opening the doorway to transformation, perhaps without understanding all the ramifications. It was lucky for me and

my students that I also had created a supportive learning community and deep relationships that could help us pick up the pieces. But understanding transformative theory would certainly have assisted all of us in the sometimes difficult processes we were going through.

Was I seeing transformation in my classes? In the case of Justin, who we saw staring into space in Chapter 2, his transformation related to both his understanding of science but also the way he thought about knowledge. Emily, who ran out of the room, was going through a painful examination of self and self purpose and direction. What I saw with most of my students was perhaps both flourishing and transformation – becoming more self-authoring, self-determined, self-discerning, and moving towards being pluralistic and relativistic.

Developing a meta-cognitive tool for the scientific inquiry process

Since I first started teaching physics I had thought long and hard about what science really is, and what scientific inquiry looks like, relating back to my own experiences and that of other scientists I knew. Prior to 1998 I thought I had a good handle on what scientific inquiry is - a spiral of inquiry going through different phases. But in 1998 I was perturbed afresh through my reading of the critiques of Guba and Lincoln (1994) about science and Wilber's (1998) diagnosis of the scientific method.

Wilber's take on the scientific method:

1. an injunction to do something
2. do it
3. compare it with others

Fig 9.8

Wilber's notion of the scientific method is a very condensed version of the scientific method which is taught in our schools (Observe, question, hypothesize, design experiment, test, analyse, conclude, compare). The science that Guba and Lincoln were describing was also quite limited – in terms of Wilber's quadrant model, they had firmly situated it in the **IT** quadrant. Yet my own experience of science as a working scientist was that I couldn't separate the **I** from the **IT**.

Science on the Quadrants

I Personal meaning Existential questions Connected knowing Insight and creativity Sense of wonder My beliefs and values	**IT** Measurement Information Inquiry process Critical Thinking Problem Solving Modelling
WE Discourse – shared meaning Natural caring Philosophy and history of science Science paradigms and metaphors	**ITS** Significance Connection to big picture Ethical, social, political consequences

Fig 9.9

The **IT** of my research would not happen if I was not bringing my reflective, intuitive and creative self to the party. Yes, science happened because of the **I**, but this aspect of it was not considered as 'science'. Was it possible then to put the **I** back into science? And what about the **ITS** and the **WE**? These now were both important aspects of my *teaching* of physics. Could they be made an explicit and valued part of the *science story*?

And what is scientific inquiry anyway? I decided to really reflect on what I was doing as a scientist while working in the paper-industry.

What was the process of inquiry that I was engaged in? When I think about the different projects I worked on they each had a different style of approach. I was dealing with a complex multi-variable mechanical/chemical/human system. The application of a cycle of inquiry (Observe, question, hypothesize, design experiment, test, analyse, conclude, compare) was probably very good for particular experiments in the laboratory which we sometimes did when we wanted to check the relationship between two variables we had isolated, but was inadequate for dealing with complex data sets within an interactive environment.

I didn't necessarily do things in a logical order… there was a lot of simultaneous experiencing of the machines, getting data, thinking and talking to others. There was time for incubation, hunches, and times when doing something on a completely different task suddenly generated understanding about another. For me there was a difference between the notion of *science as empirical method*, *science as a cycle of inquiry* and the messy being/doingness that was *science in action*.

In teaching the more rational and empirical notions of science to students, were we in fact giving the wrong impression of what happens *as someone does science*? Yet, in my teaching pedagogies I was valuing all these non-rational ways of knowing as a teaching tool, but not actually being explicit to my students about their usefulness as part of an inquiry process.

I wondered then if the scientific method could be explicitly taught as something broader. Both the Kolb *Learning Styles* and Julia Atkin's *Whole Brain Learning* model (Fig 9.10), which I had been using in my classes to help students understand their learning styles, suggest a cycle of inquiry.

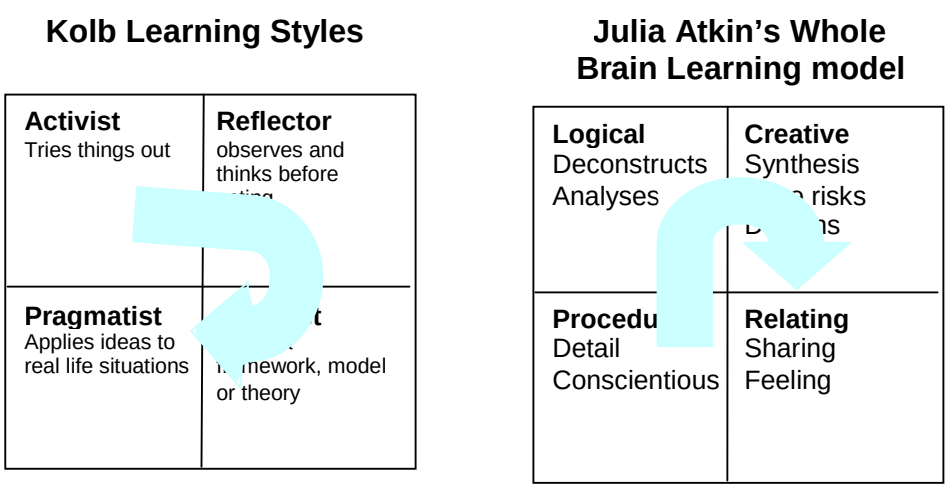


Fig 9.10

Based on these approaches, I had been designing open ended case studies using different learning style entry points or different entry points into the inquiry cycle. I had noticed that it didn't matter the order I had set, the students would skip a bit if it didn't engage them, and find an aspect which did. So a student, say, who was firmly operating in the logic quadrant, might actually turn over to the back of the handout and start with the concluding problems.

Initially I got quite cross at this… "Start at the beginning," I would say… "you can't do it without doing the investigation and developing the theory." But I soon realized that just because I had given a range of investigations with different starting points, didn't mean I had actually catered for the entry point individuality needs of students.

So here I was at the end of 1998. I had Wilber's 4 quadrant model on my mind as well as the Kolb and Julia Atkin models and I just doodled cycles around them trying to explicate how I did science. I just couldn't get my process to fit and in the end I thought "Why do I need to think of this as a set iterative cycle? Perhaps it is more like chaos theory where there is a whole lot of activity which as you map it you eventually see a strange attractor and that might be different for different students and different types of problems?"

Then I took elements from all of the quadrant models, modified them a bit (as one does), and came up with an 8 sectioned model where I allocated specific **aspects of scientific inquiry**.

I then asked myself what *plausibility* might look like for each of the sections, using notions of plausibility from various types of qualitative research (Denzin and Lincoln 1994) which I

have marked in italics on the map (Fig 9.11). (These notions of plausibility I then used as part of my Critical Thinking model.)

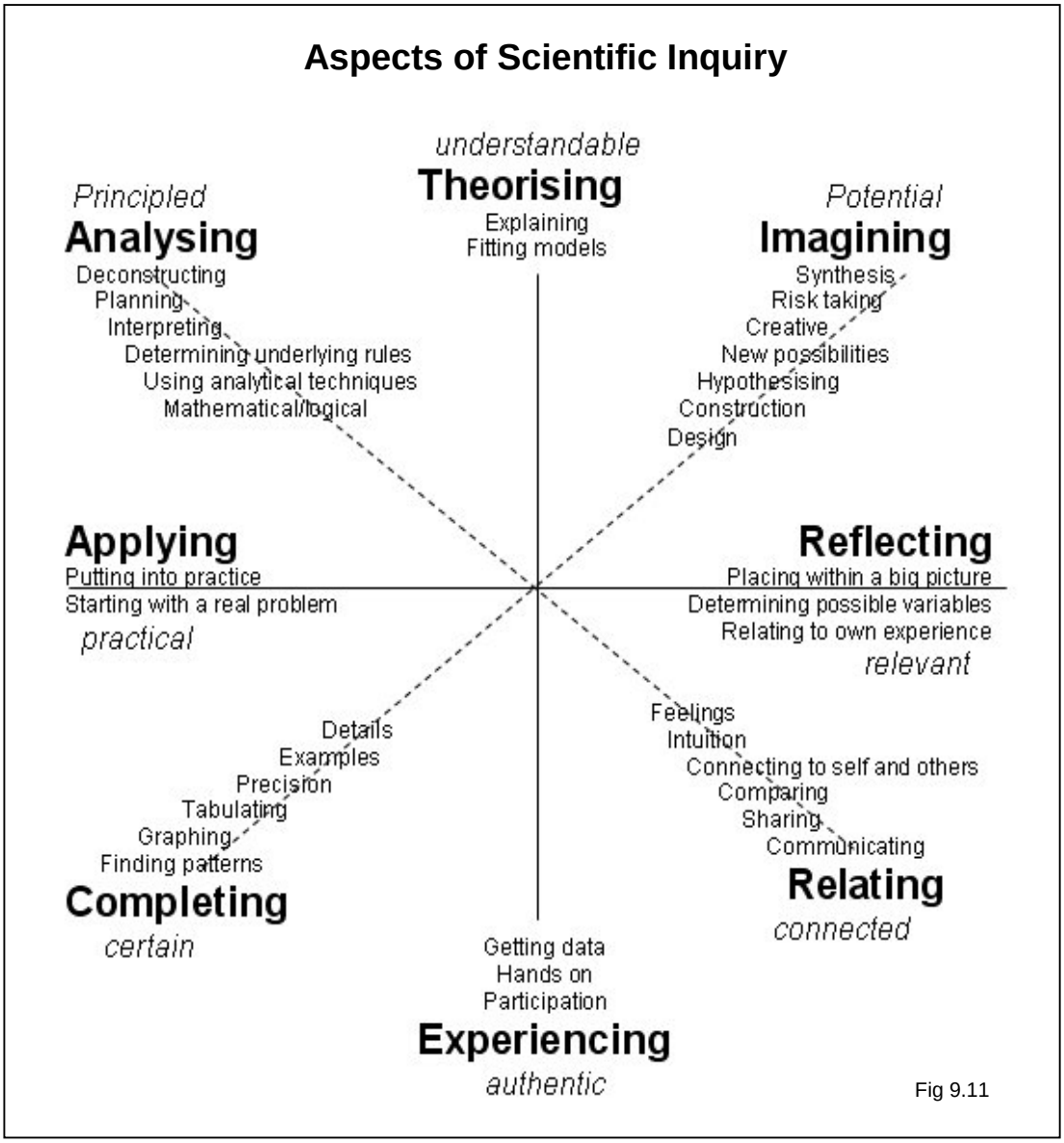


Fig 9.11

How do you use this inquiry map?

> *The key part is that you map on it your journey as you are inquiring about something. Circle the word that applies to that stage of the process and then move to the next process you used drawing a line in between with a directional arrow. Continue.*
>
> *Now sit back and look at it. Is there a habitual pattern? Is this how you normally do this? Does this particular process of inquiry help you to learn and investigate better?*

What sections of the map have you missed and should you be visiting them? What are the obstacles to doing them? What words might you add?

How do different people in your group operate differently and how can you use this to be a more effective team? How do you mediate your differences?

What can you learn about your own learning as a result of using this map?

In my 1999 Physics class, I introduced the students to the *Scientific Inquiry Model* by first playing the Julie Atkin *Whole Brain Learning* game after we had already completed a week of open ended investigations. The students seemed to make sense of the inquiry model straight away and got right into mapping different investigations they had done in big arrows around the map. They looked at each others' maps with interest, seeing how each had different routes around it and we discussed that it didn't matter the route, just that you covered the territory.

But could they actually apply this understanding to future investigations?

1999. Beginning of the year. I have just given the students some case studies to investigate. Here are two boys arguing in their group about what they think might be happening in the case study. This is supposed to inform their experimental design. One of the group members, Rachel, comes to me asking me to come over to their group "We just aren't getting anywhere. They just keep arguing. Please help."

We both go over and listen. I turn to Emma and ask "Can you summarise their key arguments?"
She thinks about it and then comes up with a very concise and insightful explanation of the differences that they have. "Oh," she says as she finishes explaining , "I can see it now, they are both right; they are just coming from different perspectives."
The boys are very surprised at her insight and now include her in their discussions. I go away feeling that now they would be able to move onto the next stage – the experiment.

Later I come back and I ask them how their experiment has gone.
"Oh we didn't need to do it," says Travis airily, "We've got a theory which now explains what is happening and we are quite happy that it is right."

I try not to grimace. "Hmmm. Okaaaaay, that's interesting." I ask them to look at the inquiry map and to look at their process so far. What have they been doing?

Rachel says "Oh, oh…. we have only done the theorizing and hypothesing stages."
"Do you think that that is enough? What does it mean to be scientifically rigorous? Is it OK to do just one aspect of this map, or do you need to cover all aspects?" I ask.
Travis argues that theorizing is enough but Rachel thinks that science is more than that – you need to get evidence for your theories. "I think we need to cover ***all*** *of the map," she says.*
Travis eventually very reluctantly agrees.
"What part of the map do you think you need to do next?", I ask. "Is it important that you do it in a certain order?"
"I think we now need to test our theory", says Daniel, "and then perhaps after we have analysed the results we could ask other groups what results they got so we can check our findings."
The others agree on this and they start talking about how they are going to test their theory.
"What do you think you have learnt from this?" I ask at the end of the lesson. And I am pleased to hear that they have taken the lesson to heart… they all assure me that in their next case study they will be using all aspects of inquiry.

So for a while I explicitly use the map when I move around groups, encouraging students to refer to it when they are stuck or when they are having difficulty in their groups. I use it to help debrief them after they have done an experiment. It seems that the more practice students have in using the chart, the more autonomous they become and the quality of their investigations improve. After a while we don't use the map – there is no real need to refer to it. I hear students asking different questions from the different aspects of the map without needing to be prompted. It seems that it was a stepping stone which helped make something explicit which then became integrated 'know how'.

In using the map with my students I wasn't really saying anything different to what I had been saying to them before as I had gone around and talked with different groups. What was different then about it? Before, I had owned the process – wearing De Bono's blue process hat – trying to facilitate my students to find the questions that help effective experimental inquiry. Now, they had something which gave them ownership of the process - a schema, based on a pattern, rather than a list of questions that you might forget. Perhaps now they could wear their own blue hats. However, it was still my map – I didn't really invite them to play with it, question it or value-add it. I did ask for feedback on how useful it was:

> Nina: "I needed to feel things first, hold it in my hand or actually do it, then it clicked, but at the same time I also wanted the theory, I needed to do both. In chemistry we were given a lot of demonstrations by the teacher… I never got to do it myself, like titrations. I realize now how important that has been for my learning because I totally failed in the titration competition."
>
> April: " I needed to do several things simultaneously… theory, experience, needed to imagine it. The map helped me see where I could go next rather than get stuck in my head like I often do."
>
> Amanda: "Well, before I saw the map I thought I was very bad at science because I couldn't do the logic part. It was really good for me to see it was only one small part and that in fact I was good at the others. It gave me the confidence to develop that aspect."
>
> Sue: "What helped?"
>
> Amanda: "It was really important that you could come along and see what I was doing and be able to say whether I was leading somewhere useful or not and ask me questions to help me think about it. It put me on the right track and I began to trust my own judgment and realize how close in fact I was. I realize that I had given up too early before if I wasn't getting the right answer. It was good to know that there could be several ways of going about things – it didn't have to match your solutions."
>
> Sue: "Are you doing this now in engineering?" (They are all first year engineering students)
>
> Amanda: "No, because the tutors only know the answer the lecturer has given. They can't see if another way could lead to a good result. There was never enough time to do it my way in the tutes and work it out for myself…. We were onto the next problem. I had to give that up and learn the correct answer."

Now in the same year (1999), one university physics lecturer who I was working with as part of a project to improve first year physics teaching at university also introduced this map to his first year applied physics students as part of an experimental project they were doing. However, he didn't construct an understanding of it and as a result his students did not use the map as he intended. Perhaps heuristic tools are only useful if you understand them, feel that they are plausible and useful.

I look back on this model from my 2006 standpoint and see its flaws, yet it served a purpose in moving students from a naïve view of the scientific method to a more complex one which could still be strategic and rigorous. It was certainly an important transient model for me in helping me be much more explicit about teaching scientific method. What model might be appropriate for the next level of development? How might one include incubation or integral theory?

Dialogical Community – the soul of scientific discourse?

Fig 9.12

Between 1994 and 1998 there was a strong sense of community in my classes. Relationships weren't just between me and the students but also between each other. They valued the sense of community in the classroom… celebrating this with parties and designing class T-shirts with the big questions, jokes and quotes that the classes had enjoyed. We were a community at many different levels… a community of learners, of inquirers, of reflectors, scientists …. of souls.

When I see ex-students, this sense of community is something that they really remember, often reeling off the names of people in their class and wondering what they are doing now… or telling me what they are doing because they are still in contact. They tell me how important their T-shirt is to them. Some say that they have never again experienced that strong sense of collegiality, caring and community. And I wonder how I could have empowered them better to create such communities for themselves.

How important was discourse in fostering such a sense of community? Is discourse more effective when there is a strong sense of community and caring? Did the practice of discourse assist in developing a sense of community?

I first introduced this formal approach to discourse in 1997 to my physics class. There was a high degree of homogeneity within the class in terms of stable student family backgrounds and ways of being and operating. With little work on my part (some initial mixing of groups), this class knitted together into something very special… a very caring and close group who ably supported one of the students whose brother died during the year… and were very supportive of me during a very difficult year.

When students were in conversation with each other there seemed to be a *natural sense of care* underlying their critical thinking. So rigorous scientific discourse was taking place within a caring community... and the discourse itself helped build that sense of community – a reflexivity.

However, my 1998 class could be best described as an eclectic mix of individuals, with some quite opinionated speakers more interested in the ideas than in people. It was a real challenge to get a sense of natural care underpinning the scientific discourse. But, as a result of participating in discourse and meta-discourse processes, many students began to be more flexible not just in their thinking about ideas, but also their thinking about other people…. able to appreciate others and their unique views and perspectives… to value how the different perspectives added to a whole understanding. From just grudgingly putting up with others, it seemed that many students moved to a point of appreciating the 'otherness' of their peers. So while some students might be pedantic or know-it alls, or some moody, or others very shy there was accommodation for everyone…. there was a sense of inclusion.

Perhaps here we were seeing each other and allowing space for that person to be themselves. So while not all students had or developed good interpersonal skills, never-the-less they valued the sense of community and participated in it in their own style.

At the end of 1998 I had an interviewer interview eight students from this class in a focus group with a two hour video recording. She had been interviewing science students around the state and found my class an absolute surprise. She said to me afterwards that their language was so inclusive – using 'we rather than 'I'. They were very caring of each other. As they spoke they were naturally helping each other to make a point, building and clarifying, finishing the end of another's sentences. When I look at the video again that sense of community stands out, and I am also taken aback with their competence in manipulating physics concepts, their discussion of paradigms, self-reflectivity and articulateness. The interviewer wrote in her summary of the session (see Appendix 6):

> There was a strong collective identity to this group that seemed to centre around their learning of physics. They had enjoyed helping each other and taking responsibility for the achievement of the group. They really enjoyed sharing their information and expertise.

She asked the students *Did you feel part of a group?* "Amazingly so". "This is a tough course and we need each other's input." "There is a real team spirit." "We are so comfortable, we ask each other."

How effective were the group building exercises? They responded that they were quite surprised at the time by these activities because it wasn't physics, yet in retrospect they really valued it for breaking down barriers and getting them co-operating early on.

Students said how important it was to ensure that everyone understood… in helping others to understand, it helped them to understand.

They also saw themselves as *scientists*, not just as *learners*.

I wondered how I could make this sense of being part of a *scientific community* more explicit for the following year's class.

1999. A new year, a new class. It is the second lesson of physics. I say to the class "I would like to invite you to be part of a community of scientists."
"What is a community of scientists?" asks one student.
I have just spent the holidays really thinking about this; what scientists do, how they think and how they work together. I say something like this…

> "Basically there are teams of people collaborating on research projects, aiming to understand phenomena, coming up with new ideas or inventions, with purposes generally to help improve the world. They have dialogues with colleagues to tease out their understandings, sharing their information on internet and at conferences. They aim to build on what others have done and to explain their understandings in such a way that enables others to understand, inviting ongoing dialogue, new ideas and critique.
>
> "The value of what they are doing is judged by their peers – the ideas have worthiness if they promote discussions and research as well as being able to stand up to scientific critique. Scientists work as an organic system, each one contributing to the whole through networking which encourages the emergence of new perspectives and understandings.
>
> "Scientists are inquirers, questioners and critical thinkers. They are reflective and creative. They are driven by a passion for understanding the world and making it a better place. They have a sense of wonder and intrigue. They can also be activists, recommending action or change.
>
> "So what might it feel like to create such an environment in our classroom?
>
> "We will not be learning just facts, but investigating deeply the ideas of other scientists, critiquing them and coming up with our own ideas. We will be developing the skills of scientific discourse in order to help each other tease out the ideas. Each of us will take responsibility to ensure that everyone in the class understands and can participate in the discussion. We take responsibility for our own understanding – we will ask questions. We will be bringing our own big and little questions into our inquiry.
>
> "We will be able to do our own research into something that fascinates us and present it to the class. Our purpose is to help inform our class of latest ideas and stimulate class discussion. We will be working together on major issues, each finding out expert information and sharing this in symposiums. We will be involved

> in a class internet discussion list. We will be doing quite a bit of peer review and feedback as well as reflecting on the rigor of our own thinking….”

I now ask students to write down their big and little questions as well as a response to my invitation. What do students think about being invited to be a community of scientists?

> I think it is a good idea to act like real scientists and have big discussions. It allows me to see what other people in the class are thinking so that I can relate to them.
>
> Conversing seems like a good idea because everyone has such different perceptions of things and therefore by communicating we can give and receive ideas. It’s also a much more interesting way of doing physics.
>
> It makes me feel more comfortable about discovering, about sharing my thoughts, means I don't cope with physics alone! Conversing helps my own thought processes and gets the cogs turning and changes incorrect views.
>
> I am thinking that these teaching methods are quite unorthodox, although I can see the implications of this type of approach. I've never thought of the class as a group of scientists, and the idea of the responsibility that comes along with that title. I think that this new title that you have given us is an attempt to raise spirits and have a new different perspective that should provoke new achievement.
>
> No other teacher has invited me to be part of something like this before. I am looking forward to finding out what it would be like.
>
> It’s great that we are actually going to discuss what we are learning as we will learn it more thoroughly. I was surprised - it is not like any other class.
>
> The sharing of information, the questioning of life and our understanding of it, as members of a scientific community is a valid and worthwhile effort, from which will arise a great deal of hypothesizing and questioning to vitalise our stagnating minds.

Ironically, although this class did feel like a community of scientists, it didn’t have the very close sense of community based on natural care that my previous classes had shared. I believe that was partly due to the fact that I found it very difficult to break up some of the cliques (I hadn’t mixed up the groups as much as usual because students adamantly wanted to work with friends), there were a group of very immature boys in the class who had all come from an all boys high school (some of whom were quite egocentric) and there were 5 mature age students who came when they felt like it, making it hard for groups to have a sense of continuity and unity. (I was also quite ill during the year and wasn’t able to make it to the end of the year, missing the last 7 weeks.)

Although the students had achieved a high level of scientific discourse and critical thinking … a scientific community … it didn’t seem to be a community of the heart. That isn’t to say

that individuals within the class weren't caring… but that caring wasn't the glue that held the class together. Thinking and discourse was.

So what does a caring classroom feel like? I can tell you that when I stopped teaching because of illness the thing I most grieved for was the sense of community I had shared with my students.

A friend and I were musing over why we missed our classes so much and we said "We must need our kids to love us"… and then we decided that it wasn't so much needing the students to love *us*… it was about being in a place where love or care is present and flowing. And when there is a group of people as large as a class this is a very powerful feeling.

Being in a caring place I feel myself become permeable to others around me … there is an exchange of energy …an intimacy … love… this is a place where my heart is open, where I laugh and feel joyful. This is a place where I feel I am at home.

Here I am in relationship, connected. The relationship comes not just from my care and interest in the students – greeting them as they come into class and finding out how they are going, or helping them with issues, or finding out who they are (how they learn, their questions and passions) – it also comes from this **being with** them as we engage in this activity called physics. For them it is a place where they can be themselves and be vulnerable and they have put this self in my keeping. I hope I don't abuse their trust.

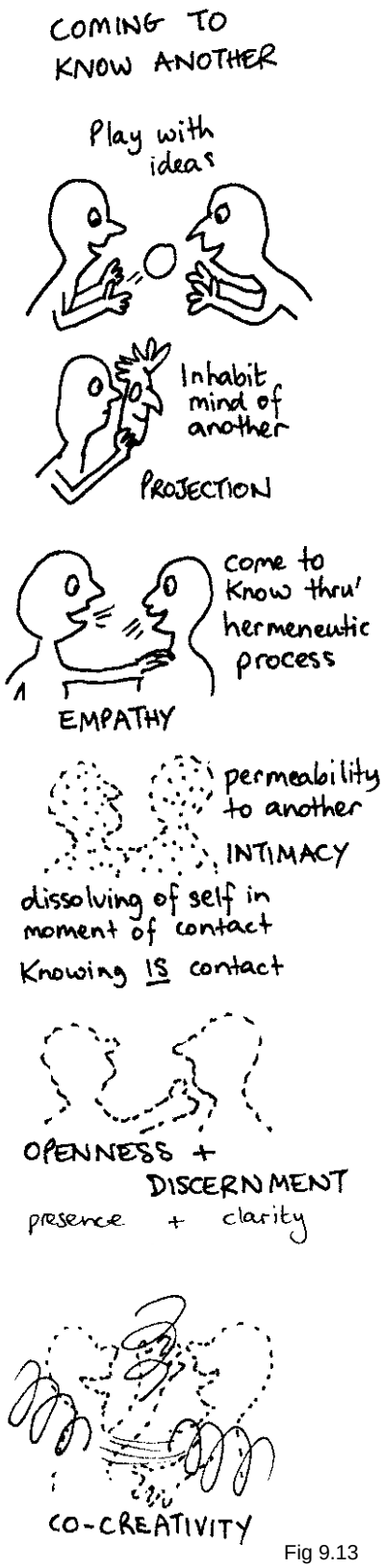


Fig 9.13

I believe that giving students the opportunity to move beyond critical discourse into co-creativity is where heart and mind integrate. The bridge is humor, trust and letting go the need to be right. When you trust others you can take risks and allow all parts of you to begin

to participate. When you are just participating with your rational mind, there is a holding back from the 'other' and disconnection from the heart. Perhaps co-creativity is care in action. When heart is present soul is close behind … an expression of spirit in relationship… a calling forth of passion.

Steiner (according to Childs 1996) says that education should develop the abstract mind *after* students have developed the emotional and aesthetic self. Thus the will is based on both mind and heart and a person can act wisely, with ethical freedom and emancipation.

Is it the responsibility of science teaching to ensure development of heart and mind hand in hand, or is science just responsible for development of the mind… let someone else develop heart elsewhere?

> "The purpose of education is to develop *clear mind* and *warm heart*."
>
> Dalai Lama

And somewhere in all this community and discourse we need to allow space for individual reflection, connection to the inner self, connection to the present moment and connection to the Kosmos.

Conversation gives us the opportunity to test and build our understanding, but we also need opportunities to infuse this understanding with spirit or we are just batting the same ball around, albeit it might be getting bigger.

Indicators for effective discourse

So what might be indicators for effective scientific discourse that I now look for:

- Ability and commitment to create shared meaning – construct understandings, shared language, using humor and small talk, creating shared spaces, moving into perspectives of others, engaged in hermeneutic process
- Rigor in scientific process and thinking – moving around the inquiry cycle into different voices and modes of inquiry, applying critical thinking, iterativeness
- Tuning into the different stages of idea development and facilitating mindfully in that process, using openness to new ideas and criticality appropriately

- Being inclusive and caring of others – listening, empathy, giving time, recognizing and meeting the different needs of others
- Being self-reflective of the discourse process - meta-cognition, recognizes the limitations, can use 'blue hat' in discussions with others to name and challenge what is happening and move to alternative discourse methods.
- The product of the discourse – new ideas, new or deeper understandings, deeper relationships

Some of my students are more capable than others, some forget in the heat of the moment, but we are all learning. At least now we have some guidelines. I see a clear improvement in **the how** we discuss and as well as **the what** of discussion (quality of ideas) from the beginning of the year to the end. I notice the shy students becoming more confident as they participate with ease in discussions, and students becoming more able to challenge the mode of the discussion as well as the ideas.

Where is my notion of learning now?

1999. I seem now to be moving towards *social constructivist* notions of learning. Learning lies not just in students' experience or meaning they make for themselves, it is culturally situated in language and mediated by the feedback and interactions with others. I see my dialogical classroom also as an *ecological classroom*, using principles from Capra (1993) – interdependency, partnership, diversity, energy flow, co-evolution, ecological cycles, sustainability.

But how does this fit with my other notions of learning – learning seems to come direct from physical experience – it is embodied, or that learning is made in the head, or that learning might come from the soul?

Perhaps I can summarize my understanding of learning so far by mapping it on the quadrants.

Learning using The Eight Indigenous Perspectives

	Individual		
Inner (subjective)	**I** **Inner:** learning as personal meaning making, insight, inquiry **Outer:** Critique of one's meaning-making processes, understanding of one's own stage of awareness	**IT** **Inner:** learning as sensual, taken in from environment, feedback, know-how (action *is* understanding) **Outer:** making explicit that which is embodied.	Outer (objective)
	WE **Inner:** learning through discourse mediated by language, inhabiting space of other **Outer**: critical examination of how cultural conventions shape our understanding and interpretations	**ITS** **Inner:** learning as part of a bigger self organizing system, community interactivity, natural adjustment to the environment **Outer:** critical evaluation of how one's environment, relationships and systems influence behaviours	
	Collective		

Fig 9.14

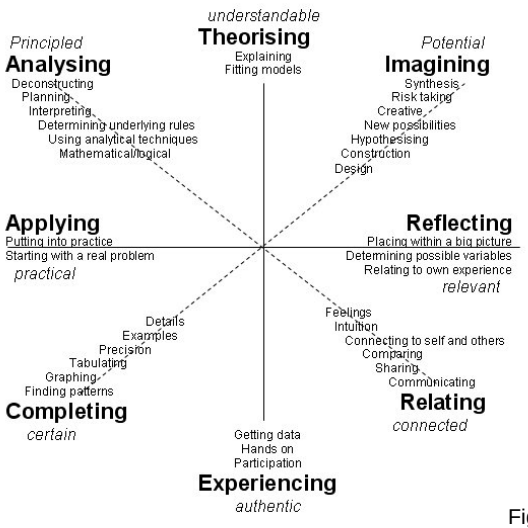
Perhaps this helps demarcate as well as integrate the different learning theories. Perhaps *social constructivism* is more aligned with **WE** (inner), *critical constructivism* with outer aspects, *embodied learning* with **IT** (inner), *meaning making* with **I** and *ecological learning* with **ITS**.

Interlude 1: What do scientists think of the 'Aspects of Scientific Inquiry' map?

1999. I am working part-time at the university Physics Department, coordinating an action research project with five physics lecturers with the aim of improving first year physics teaching.

We have been spending some time unpacking what it means to be a scientist, to think scientifically and engage in scientific inquiry. I have been using the *Aspects of Scientific Inquiry* map as a heuristic device to help the lecturers tease out what it is they do as they engage in their own inquiry processes. They have mapped different inquiries they have done and compared the different routes that they each take and what territory they tend to cover. They have become intrigued in those aspects that they value in their own processes but which they haven't previously thought about as being part of the scientific method.

Aspects of Inquiry Scientific Inquiry



A theoretical physicist's inquiry route

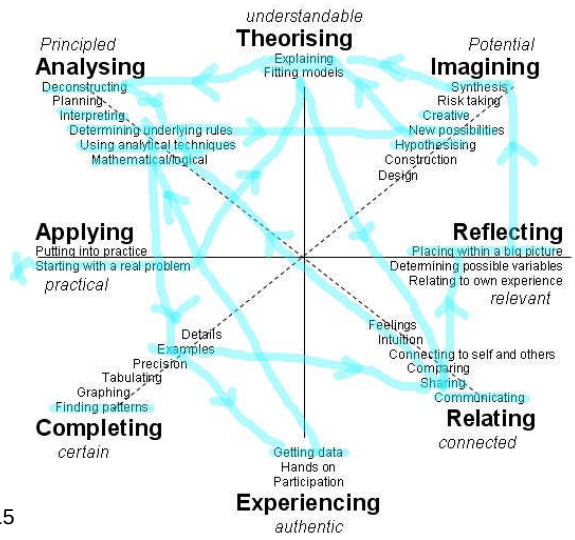


Fig 9.15

This has become a starting point for thinking about how to redesign lectures to enable more room for students to engage in inquiry as well as how laboratory experiments might be redesigned. Two lecturers, in particular, find the model very useful and organize a workshop where I can introduce it to their colleagues in the other science departments at the university. They hope this will stimulate their peers to reflect on what they value in science and how they might better articulate their values into their teaching.

So in June 1999 I am leading a seminar attended by 17 science lecturers (from biological, agricultural and physical sciences as well as mathematics). They are sitting a little uncomfortably in a semi-circle in a tutorial room. As they come in I have to work hard to stop them sitting at the back, inviting them into this circle.

I start off by asking the group to *Write down three words to describe how you see science.* As the scientists share their words with the group I write the words up on the board putting them mentally on the inquiry model.

There are the usual words you might expect for science – experimenting, observing, categorizing, precision, hypothesizing, theories, analysis, modeling, logic - and also some you might not expect – inventing, imagining. Then one biologist says with great passion: "I wonder, I WONDER, **I WONDER**!!!" We look at him amazed and there are smiles around the room and suddenly people are beginning to talk freely. It is as if he has reached down into our souls and reminded us about the passion of science. I feel like we have entered another space now where we can perhaps talk a little differently about science.

I now draw the inquiry model over the scientists' words and explain the basis of the model while fielding questions. It is clear when I do this that the scientists have left out a major section when coming up with words to describe science. And this is when the discussion really begins about what science is.

Now, earlier this year, I had done this exercise for a group of 20 Dip. Ed. students who were all science graduates. It was part of a workshop I was giving on constructivist and holistic teaching practices in science. Below I show the how the different groups saw science:

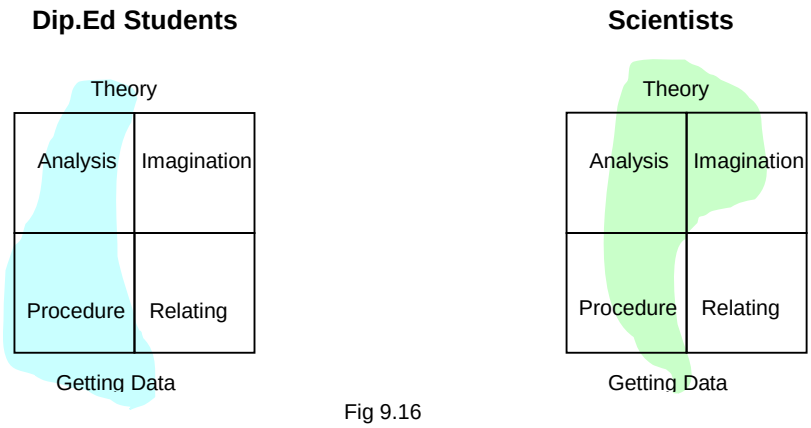


Fig 9.16

You will notice the difference between the groups. The scientists did not in this exercise give any words that could be put in the **relating/sharing** category. When they saw what they had said compared to the inquiry model they started discussing why they had missed this section, most saying how important dialogue was in their work as a scientist - from corridor conversations, research group meetings, to email with overseas research groups in their area, to conferences, to peer review. One biologist said that she uses group sharing sessions as an essential part of her mentoring role with her post-graduate students, but not with undergraduates and now she wonders why she only starts after they graduate.

When I showed the science lecturers the results of their past science students (the Dip. Ed students) most were quite shocked that the students should have such a narrow view of science. Where could such views come from? So they started discussing how their teaching methods might have inadvertently given that impression. Could it help to make explicit what we value in science and then ensure it is represented in our courses? This is the process that the physics lecturers believed was very useful as part of our collaborative action research project in physics.

I then asked the scientists to think of something they were researching and to map their inquiry route on the inquiry map. In most cases the scientists were visiting most of the aspects on the chart iteratively – their maps were covered with long curves going back and forth. We had quite a discussion comparing each other's maps which lead us to wondering if the discipline you were in had more emphasis on particular aspects than others, causing you to spend more time in different inquiry modes.

So sometimes a biologist might spend more time at observing, collecting data and then categorizing, whereas a physicist might spend more time using principles to solve problems or make predictions which they could test. Since scientists were working in research teams they might focus on particular areas while their colleagues on others. An example might be the human genome project where there are scientists working on measuring the characteristics of genes, others creating maps of the data and others creating the underlying structures for the maps.

The *body of knowledge* in a discipline is also perceived differently – to a physicist the body of knowledge might be a set of universal laws and the mathematical methods you apply to developing and using them. To a botanist it might be a body of information about nature.

So a first year physics student might sit in a lecture and learn a physics law, examples of how it is used and be expected to solve problems using it, while a botany student will sit in a dark lecture theatre watching a slide show of various types of plants and their characteristics and be expected to be able to use the language appropriately in seeing differences and similarities.

Now despite these differences, one thing in particular that the scientists seemed to agree about was the importance of **imagination and creativity** which they saw as being essential in helping make the insights necessary to create new science. Perhaps these scientists saw a key aspect of their role as scientists as *creators* of new ways of being able to understand the world? Many of the scientists said that the driving motivator for their research was a sense of wonder, curiosity and awe about the world. Should this be on the map or is it what drives our movement around it?

It was a concern to the scientist group that the Dip Ed students had missed imagination and creativity from their map. I told them about the students' responses - how one person disagreed quite angrily with my model - "*Science does not cover those aspects… it is the scientific method and that is logical and needs evidence. Imagination is not science!*" But other Dip Ed students were interested in what imagination might look like in a science classroom. Was it about fantasy or was there a scientific way of imagining?

So now the scientists begin to discuss how they could build their students' capacity for scientific imagination and creativity in the undergraduate courses. How could they make it explicit in their teaching? What is the difference between imagination in science and other disciplines?

Now it is time to conclude the workshop. I ask the lecturers to each share what they have got out of our discussion, what they might take and use, and what questions they still have, going around our semi-circle.

Responses are varied: for some it has challenged them to think differently and question what they were doing, others feel they still have lots of questions, some are still undecided about what they could do in their own practice, some feel it is a bit too hard, and one says he is unconvinced.

Then what happens next is interesting. One lecturer says that this is the first time in such a peer group that she had felt that everyone's opinions were valued, whether they fit into the majority view or not – just sitting in a semi-circle, rather in rows, made an enormous difference and changed the nature of the conversation. "It is much more personal. I feel I actually got to know people. I like the fact that we were given the opportunity to say what we think about it. That we don't have to agree." She continues to say that it is interesting to leave a meeting knowing that everyone was taking something different from it, or still had concerns – usually the majority made a decision - then the others either left feeling unheard, or pretended to consent while going off and sticking to their own agenda. "This is a lot more honest."

Her comments then spur a conversation about the processes I used in the workshop to support an open dialogue about teaching practice – the lecturers discuss what they each value about the actual process and how they might like to use aspects of it in other meetings.

Sometimes the simplest things – like sitting so that we face each other, including everyone in the group, giving people turns - make a big difference to the sort of conversation that results. But was there more to it than that?

From a spiral dynamic point of view (Beck and Cowan 1996), was I creating dialogue within a *green meme* postmodern culture (aiming for deep understanding of issues and each other, care, acknowledging all perspectives, allowing for plurality of outcomes, looking for shared meaning and consensus, challenging marginalizing structures), while the usual agenda based meetings were situated within an *orange meme culture* (majority view, goal and outcomes orientated, debate or devil's advocacy, structured for efficiency)?

Interlude 2: Creativity and Imagination in Science

How important is it that we explicitly teach imagination and creativity in science? How can we help students become scientific innovators?

What activities might stimulate creativity and innovation? Are there different types or levels of creativity?

Carlisle Bergquist (2005) has synthesized the research into creativity by saying that we can consider it as four stages (left hand column in table below). In the right hand column I have suggested possible pedagogies or tools which might assist in developing creativity.

Stages of Creativity	Pedagogies and Tools for stimulating creativity
Necessity – a natural learning process of the child – they are not aware they are doing it and it occurs as a natural part of the **make-meaning** process…. Creating new understandings – often as a response to dealing with difference or anomalies.	o Looking for patterns and connections o Dealing with difference, paradox and anomalies, disconfirming evidence o Using a range of experiences from different dimensions of being (imagination, visual, kinesthetic, rational, role play) with connections as well as dissonances (Bateson's interactivity of learning technique)
Analytical – self aware and conscious of the process of creativity. Students are actively and consciously creating products, understandings. Creativity can be developed by processes, ways of thinking and seeing, and metacognitive tools.	o Challenges to solve, designs o Using heuristic devices like De Bono's Scamper, 6 Hats, PMI o Setting up role plays o Using humour, imagination and speculation o Visualizations (thought experiments, putting self into situation) o Co-creative discourse
Synthesizing-innovation – individual opens up to the process and allows.	o Living the problem o Incubation time o Meditation o Complexity o Passionate attunement
Connection with larger reality – transformed consciousness	o Meditation o Personal growth

Fig 9.17

Interlude 3: Why is it so difficult to create critical thinking and discourse in first year university physics classes?

1999. I am standing at the back of a first year science lab of Applied Physics. There are about 32 students, one lecturer running the lab, one assistant and two others from our project observing along with me. The students are doing an electricity lab – series and parallel circuits and the lecturer has just explained the first experiment. I watch and listen as the students struggle to make sense of their diagrams, instructions and lab equipment asking each other procedural level questions "Where does that go?", "How do we connect that?", "What does this do?". There are hands up around the room and I listen in as the observers from around the wall get drawn in, giving a helping hand.

I listen to what the observer/lecturers say and do as they help the students. One observer, when asked about how the circuit goes together, just puts it together for the group. Another explains what he is doing as he does it. "You put this here, connect this, and then you can turn it on." The students are quiet watching.

Why are we here observing? We are supposed to be looking at ways of modifying the course to help students develop critical thinking and to engage in scientific discourse. I am here to listen into student-student and student-lecturer conversation and feed this back to the lecturers so we can diagnose what is happening. I have heard lecturers engaged in iterative and rigorous conversations about their own science amongst their peers, so they themselves are competent in critical thinking and scientific discourse. They have the intention of engaging in more dialogue with the students, yet it is not happening. Why not?

The scientific discourse in the room currently seems very low level and doesn't come close to my indicators for effective scientific and inclusive dialogue. I wonder why it is so different to my own students who in a similar situation would be discussing issues with the procedures, or circuit principles or the nature of electricity. Why isn't this occurring here? Is it the lecturers, the students, the environment, the expectations, the lack of questions to probe understanding? I have heard these students discussing before – they can do it – but it was as result of a carefully planned open ended question. Do they need something problematic and intriguing to catch their interest?

We move onto the next experiment which involves a parallel circuit and there are more hands up than before seeking assistance. Why can't the students work out how to construct the circuit for themselves?

All the lecturers/observers are busy and one group of students see me against the wall. They call me over and ask for some help. I am not supposed to be doing this but I can see the other lecturers are run off their feet with questions.

"I just don't get it," says a student with frustration.
"So how are you thinking about this? What are you seeing when you look at the circuit diagram?" I ask, without thinking and as result start a conversation. I discover that one student doesn't really get the idea of the circuit diagram. So here am I constructing her understanding… asking her to think how the diagram corresponds to the physical components… asking her how she imagines an electron might move around the circuit. And I soon discover that she has the notion that an electron will move around a circuit even when the switch is off. She explains how when the switch is opened, the electron continues to move around to where the switch is, then finds it can't get across and then the current stops. I ask her where she got this idea from and she explains to me about a role play she did in Year 10 of being an electron.

I unpack this further and in doing so discover I have an audience of five other students who all start asking me questions about electricity, how electrons move, what happens when they reach the parallel part of the circuit, why an electron might choose one path over another. Each tells me about their own prior learning experiences in electricity and we end up having a very interesting discussion coming up with the problematic nature of trying to model what is going on in a circuit by thinking of it as moving electrons. They are intrigued about the deeper issues of electricity and wish to understand the hidden meaning of circuit diagrams.

I look up and realize that the lecturer running the session is waiting to go onto the next experiment and we are too noisy. Oops.

I step back against the wall again and ponder what just happened. Was it the question I asked the girl *"How are you thinking about this?"* which was the key? Why didn't the other lecturers in the room question the students more deeply about their understanding? Didn't they see that the difficulty with setting up the equipment was a possible indicator of issues with understanding the concepts?

After the lab I talk to one of the observers (a post grad student) who had gone in and 'properly' set up students' circuits. I told him my experiences with the students I had talked to… how some found it quite difficult working out how to translate from the diagram to a real circuit and how they were interested in how the circuit operated in terms of what happened to the electrons. He looked at me quite surprised. He said it never occurred to him to question why the students were having difficulty putting the circuits together, that if you show them enough times they get the hang of it. That that was the way he learnt how to do circuits.

We then ended up discussing how we made sense of different types of circuit diagrams. I confessed to him that as soon as a circuit has a capacitor, inductor or diode in it that I just can't imagine how it might work. He says "Why should you? I would never try to work out what is happening… you just learn what certain types of circuits do."

I wonder then why do I need to have a conceptual understanding of what is going on? Do I expect more than what is feasible? Is it because I am a female and need to have a more connected understanding? But this seems to be what the students are wanting as well, even the boys I spoke to.

I then go and talk to the lecturer in charge, letting him know that a number of his students have major 'misconceptions' about electricity. We begin to discuss these and then get into a nitty gritty discussion of how electricity really works. The conversation lasts for over an hour and involves lots of diagrams, examples and thought experiments. I am thinking that perhaps this conversation will be very helpful for the lecturer in orienting him towards the problematic nature of electricity so that he can then teach it in a more inquiring way.

But he throws his hands up in the air and admits defeat "I have never questioned electricity before, just used the equations to work it out. It made perfect sense to me that way. Now I really don't know what to think. Sue, you have confused me and I don't like it. I would need to talk to someone who really understood electricity before I would feel even comfortable talking about these things with the students."

I now wonder what habits of mind the physics lecturers in our action research project have about 'physics knowledge'. All of them have told me about the tentative nature of their own research, saying that current science is contingent and based on continual revision and iteration. Yet in contrast, some are quite adamant that the foundational knowledge of physics is pretty certain. I wonder then whether they have an attitude about this 'old' knowledge

(which makes up the undergraduate courses) which makes it difficult to bring a sense of inquiry into it. How much have they leapfrogged from this knowledge into their own research, how much of their use of it has been habit, how much is unquestioned repetition of how they were taught it? How much of this certainty is due to the fact that they think of it in terms of internally consistent mathematical equations rather than concepts? How do they think of physics and how distant is this from how their students think?

What might it mean to conceive such knowledge in new ways and bring a speculative eye to it?

I also wonder how much these attitudes about physics knowledge then sets up an environment where lecturers value their 'authority to know' as the currency of student respect for them. So being speculative or uncertain about concepts might challenge this perceived respect. Setting up more inquiry based discourse might therefore mean trying on new roles which can be a vulnerable process.

I find myself trying to diagnose the lecturers as if they have an illness. What might be the specific barriers to helping each of them see into students' minds and engage in successful discourse with them? How can they reconceptualise the physics they are wanting to teach?

Yes, I begin to realize, that seeking to improve the quality and opportunity for scientific discourse in university science is problematic; not a simple matter of creating an intention, nor developing pedagogical strategies. It is also dependent on each lecturer's habits of mind each of which seem to be creating different barriers. And these are much more difficult to shift despite a keenness by the participants to embrace inquiry based teaching.

I wonder what habits of mind I am developing in this process which also gives me blind spots. What assumptions am I making about students' learning and lecturer abilities as a result of buying into my models too much? Am I bringing enough of a speculative eye to what I think I am perceiving? How important is scientific discourse really? What paradigms and values underpin my own assumptions about what science should be like?

Am I valuing too much the *green* meme over other memes? What might integral scientific discourse be like?

Interlude 4 : Sue talks to Travis about group work and Travis writes in his journal

1999. It is the beginning of the year. Travis is one of seven boys I have this year from a boys' only high school, most of whom seem oblivious to the needs of others in the class. In class discussions Travis will dominate over others who might have their hands up, jumping in, following on his own track despite my efforts to share the conversation around and open it up. He tends to jump on people who are tentative. One girl has already talked to me about how it is impossible to have a good conversation in their small group; Travis is intimidating, gets locked into his own opinions and won't consider those of other people and certainly doesn't help others to articulate their ideas.

I decide to run a session for the class where we look at the different stages of dialogue and practice them. I assign the seven boys as leaders of their groups asking them to be facilitators of discussion… how to help others articulate their ideas… to ensure that criticism isn't brought in too early… to aim for opening up possibilities and understanding.

Travis thinks it is a waste of time and doesn't really participate in the way I have designed. I decide to talk to him after the class. How can I help him see that other people have a lot to offer and that when we help others explain and understand it also helps our own learning…. thus when we aim to ensure the understanding of the whole group we end up with a better outcome for everyone. Will this sell it to him, I wonder?

Travis's journal entry

Well I had a talk with you on Friday, Sue, and quite frankly you are wrong. If you think someone, anyone enters a classroom to sacrifice his/her learning in order to help others, then you are off with the fairies again. No-one enters a classroom aiming to get 5 points and 20 for his mates.

You tell me that I talk too much, so what? That's the way I learn. You say I ask too many questions, since when was a question a bad question? Sue, you need to realize any question is a good question. You say I am interrogating the shy students, that's not my problem, that's their

problem, I can't help it they aren't strong people, they need to come out of their shells and not through the sacrifice of some other student's learning.

You've given me plenty of 'suggestions', well here are a few for you, Sue: get out of this tree hugging hippy bullshit and teach physics, it's quite clear your method is not working. If you think it is working by majority rules, well that's not the way a classroom should be run. EVERYONE should be happy, not 30%, 40% or 99%, EVERYONE. Everyone in that classroom would have done Maths Stage 2, or is co-studying it. We've all got good heads on our shoulders. Can you teach it as a maths lesson, or maths based lesson? It's got to be better than this!!! IT IS UP TO YOU TO MAKE US HAPPY.

I don't particularly like being a guinea pig for your 'mind boggling' bullshit and I could name at least 3 others who hate your teaching methods also Sue. I'm not saying this to hack into you, I'm saying this because I am worried about my learning, and about others who are just as much pissed off as I am.

You shouldn't be talking to me asking for quietness, you should be talking to others asking for loudness!

Yours pissed off, Travis.

Epistemological Pause

July 2006

A few confessions…

I have come back to this chapter now, after reworking Parts 2 and 3, and putting in my art work and now something really hits me. Has an underlying issue of mine been the feminising of science as well as the spiritualising of it?

Yes, you will notice that all my art work uses the female form; some in a non-gendered way, representing the spirit in all of us, but some pieces actually reflect critical feminist perspectives. I have only been articulating these perspectives in the last few years, yet this journey of integrating the feminine within myself began in 1997. Perhaps this was a counter-response to the male dominated field I was in or perhaps it is part of my transformation to more post-modernist perspectives arising out of my engagement with my research.

So has this emerging feminine awareness informed my teaching experimentation? In my search for integral and holistic perspectives am I valuing more the feminine aspects than the masculine? Does this alienate the boys in my class? What approaches are appropriate for their development? Or perhaps I am trying to counter-balance the masculine tendency of the physical sciences?

And what is this 'masculine tendency'? Is it a way of thinking, doing and being? Is *the masculine* in the physical sciences more associated with modernist, propositional, objective thinking whereas *the feminine* seems to draw more from post-modernist perspectives of relativism, subjectivity, complexity and care? What might post-modernist masculine perspectives look like and feel like? What might a balanced feminine and masculine science look like?

As I strive for integral perspectives I feel the tension between my well developed modernist self and my post-modern self. In my writing it is so easy for me to fall back into propositional ways of talking; particularly in thinking about something that happened long ago in the past – it is too easy to assign cause and effect and make judgements about what students have learnt and gained… something which in assessing students I am still required to do.

My headspace in the past was a mixture of certainty and doubt as I developed my living educational theories - putting them to the test, feeling I had understood something and then being perturbed and needing to change my own frame of references. What do I remember about the past? The moments of certainty? The situations where my thinking was perturbed? I found in writing this chapter initially I tuned more into the periods of certainty than doubt and this gave my writing a very modernist tone.

So now in writing from an auto-ethnographical perspective I need to bring in a post-modern awareness – looking deeper into things, expecting complexity and multiple possibilities, expecting rich layers. I need to fill myself with doubt, rather than certainty about what I think I have learnt from the past. It therefore helps to use anecdotes which are problematic and open themselves to multiple interpretations rather than only those which serve as exemplars or confirming evidence.

I find writing in dialogue is helpful sometimes in moving me from a modernist headspace to a postmodernist one. Dialogue enables my contradictory voices to play out in non-linear ways and I can begin to see the greater complexity. As part of the iterative process of writing this chapter I wrote one section as a dialogue which I subsequently replaced with a monologue, which leapfrogged in unpacking layers of meaning.

So in this chapter there are examples of both modernist and postmodernist writing headspaces. I have decided to leave these grating/clashing modes of writing deliberately because this is a key chapter in which I am struggling to find my way into a more post-modern science. And that process is problematic as I find myself drawn back into ways of modernist thinking. So my writing reflects that tension in the past as well as my tensions now in thinking about science and transformation of others.

But as someone searching for an integral solution I see that modernism and postmodernism each have a role to play. I do not think I have found an integral solution in this chapter, rather I have created a tension that might enable us to live our way into a solution.

As I write this chapter I see how much my own learning and ways of explaining my learning are based on *women's ways of knowing* – needing to explain processes rather than just endpoints; helping the reader get inside my headspaces and heart spaces, creating a narrative sense of self. Is the choice of my research methodology based on my gender? And how might someone of another gender read and respond to my approach?

In Integral Theory there are five key aspects – types, states, development lines, levels, quadrants. Types include gender, personality types and learning styles. So gender is an important component of the Integral map… and one now that I have to make explicit and acknowledge.

Yes, my gender is shaping my perceptions of what I see.

Before, I prided myself on my non-gendered approach to the world. HA!

Disclosure:

Crouching Cat – Hidden Leopard

My name is Jane.

Perhaps you think you know me.

In the 1930's I swung on long vines from tree to tree, clinging rapturously to that hero of the jungle, Tarzan.

But I cling to no man no more. And the jungle has changed. It is now glossy boardroom tables and the cut-throat world of corporate finance. You know, the places where decisions are made that shape the world.

You thought I was a pussycat, but I am a leopard to your lion.

Unlike you, I don't go for the jugular and climb to the top over dead bodies. I *seem* to play by your rules, but in fact I am trying to change them. Do you notice how limiting your rules are? How only certain outcomes are possible?

To you I might be chasing butterflies, getting no where. But in fact, in my very act of searching for new ways, the way you see the world transforms.

I am a change agent. The joker in the pack.

See my smile. And smile with me.

Chapter 10

The Ethical Classroom - 1997 – 2004

Questions:

What does it mean to develop ethics in science?

What role does science have in developing student's moral development line?

What does it mean to have a code of ethics as a scientist?

"Every act has *potential* moral significance, because it is, through its consequences, part of a larger whole of behaviour."
John Dewey

Introduction

So far, the incorporation of Holistic Education principles in my teaching has led to extending my pedagogies to improve student learning, seeing my students as complex multi-dimensional beings with different learning needs, helping them experience the wonder of the universe in a connective way, empowering them to think for themselves and work together, and enabling them to bring in their own questions and passions. Along the way I have seen students develop, flourish and transform. But this has been ancillary to my main role as a subject teacher which is to help my students experience and understand physics, albeit with soul.

Enter Travis, the boy from the last chapter, who puts his own learning not just before others, but at their expense. What is my role here? Am I responsible for his ethical development? What values am I bringing when I make the judgement that he *needs* ethical development? His lack of care for others is a big concern to me and I am worried about what sort of engineer he might make. His lack of ethical maturity is obvious. But, what about behaviours and attitudes of other students that are less obvious or less offensive? What have I been blind to in the past? How do I see ethics and my role in creating an ethical classroom? What does it mean to be an ethical person and what might an ethical classroom look like?

How could Holistic Education help me in this? The development of an ethical self, who is able to act wisely, integrating heart and mind, is central to the principles of Holistic Education as well as most spiritual and indigenous traditions.

For Rudolf Steiner, an aim of education is to develop an individual who has 'ethical freedom' – this does not mean a licence to do anything; rather it is someone who is self-aware, understanding the constraints and influences which shape their thinking, feeling and acting. It is about developing such an understanding of self in the world that when one acts, one acts with insight and wisdom (Childs 1996). It is someone who is on a path to self-realization and freedom.

So is this an ethics which comes from intellectual understanding? If so, how can I help my students gain a better intellectual understanding of what they do as ethical beings and are my efforts in developing meta-cognition in thinking useful in building ethical understanding?

But wait, Steiner also says that such ethical behaviour has to be grounded on development of the emotions (care) and an aesthetic appreciation (sense of beauty) which fosters a deeply held sense of respect, so judgement comes from both heart and mind. How does one foster that care? Is it natural, flowing from a loving heart? Can it be learnt? How does one foster an aesthetic sense? Am I helping my students gain respect for nature and all life through encouraging an enchantment and deep connection with the world? (Chapter 6) Could I be doing more?

Greg Cajete (1994) , Indigenous Holistic Educator, describes the importance of the *highest thought* in Indian traditions:

> The indigenous ideal of living the 'good life' in Indian traditions is at times referred to by Indian people as 'striving to think the highest thought'. This metaphor refers to the framework of a sophisticated epistemology of community based ecological education. This is an epistemology in which the community and its mythically authenticated traditions support a way of life and quality of thinking which embodies an ecologically-informed consciousness.
>
> Thinking the highest thought means thinking of one's self, one's community, and one's environment richly. This thinking in the highest, most respectful and compassionate way, systemically influences the actions of both individuals and the community. It is a way to perpetuate 'a good life', a respectful and spiritual life, a wholesome life. Thus the community becomes the centre for teaching and a context for learning how to live ecologically. *(pg 46)*

How is ethics in science seen? Does it aspire to helping students gain *ethical freedom* or the *highest thought*? Is it grounded in care and respect? Is it grounded in values which are ecologically based, spiritually based or community based? Is science value free?

Hmmmph. I am a teacher of Year 12 Physics, not a provider of a whole school program to develop an ethical self! I have a syllabus to cover with perhaps a little room for some discussion on some ethical issues in physics. Physics is about objectivity, not emotions! Surely. But now I am faced with some incidents in my classes – physics, journalism and maths which now challenge me to rethink my notion of ethics and my responsibility as a teacher. Come with me as I am faced with one dilemma after another. Perhaps through this journey we might begin to see some of the issues for teachers in trying to develop an ethical classroom.

Case 1: Why does a chicken walk around when its head is chopped off?

Warning this holds a scene which may disturb some readers

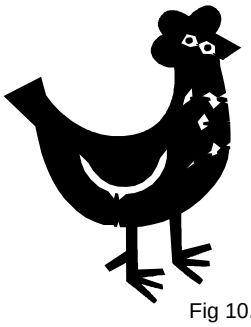


Fig 10.1

1998. *It is the fourth week of physics and my students are giving group presentations where they take a practical situation of their choice and analyse it from a forces point of view, particularly showing how Newton's Third Law might apply (for every action there is an equal and opposite reaction.)*

Danni and Ryan are up the front of the class explaining why a chicken will still move around once its head has been chopped off. They draw on the board a diagram of a chicken and explain the two nervous systems and how each one applies a particular force on the chicken. They draw the vectors and explain how the autonomous nervous system is still in operation for a little while after the head is cut off, which is why the chicken continues to move. I am interested in the way they have brought in ideas from biology, but I am sceptical about their modelling of the forces.

Then they turn on a video and before I have time to react we all see film footage of a Ryan grabbing a live chicken in a field, putting it on a chopping block, chopping its head off with an axe, and then the chicken walking around, a fountain of blood cascading from its neck. Danni and Ryan are giving commentary on the forces acting on the chicken. I am frozen, breath in. So is the rest of the class. Eyes wide, hand moving to mouth. Shock. Laughs uncertainly. Shakes head. Stunned.

My students have just killed a chicken in order to do a scientific experiment.

I am hearing words like "gross", "yuk" and a bit of laughter around the room.

"Uh," I say, "um… you just killed a chicken… um… what about the ethics of doing science?"
"Oh," says, Ryan blithely, "We were having it for Sunday dinner anyway."
Yes, he and Danni, it is revealed, both live on farms and killing chickens is a natural part of life and the order of nature.
"Even so, is that ok? Is it ***ethical as scientists*** *to kill animals for an experiment?" I ask the class. "Is anyone else concerned?"*

Scott (who is into philosophy in a big way) says in an authoritative manner "Well, to consider whether their actions are ethical or not we would need to consider their intentions. We eat chickens for food and have no compunction about killing them. So if their intention was to eat the chicken anyway, and the experiment caused no more pain than the chicken would normally experience then what they did is not unethical."

Students are nodding. No one seems prepared to question Scott's judgement. I still feel uncomfortable, but haven't quite worked out what to do or say next. Should I be looking at the ethical issues of animal testing in general, discussing when is animal testing OK and when isn't it, drawing out the issues more? Should I be asking whether we should have a code of ethics and a process of review in our classroom to approve scientific experiments that students wish to conduct? I have never had to worry about this before as the only things that students normally conduct experiments on are inanimate objects.

Scott might have given a logical justification for killing the chicken, but what about the ethics of showing a scene like that without giving any warning to the audience? Where was Ryan and Danni's concern for us? What about giving us some warning first, giving some option for not watching if it was going to cause distress? How are the other students coping with this? Are they shocked or distressed?

But it is all taken out of my hands. Andrew asks Ryan and Danni if they can show the video again as he would like to now analyse it further. "I don't think your explanation of forces really covered the full motion of the chicken." he said. "Why was it going around in a circle? What other things could cause that?"

And we are away on a discussion of chicken anatomy and vectors with the ethics long forgotten.

How are you feeling after hearing this story? Were you surprised, shocked, disturbed? Was my warning sufficient?

How would you have responded if you were the teacher of this class? How could you have used this opportunity to explore the ethics of the situation? What does this situation tell about the ethics of my students or myself? What might be the responsibility of the teacher to perturb students' ethical positions and help them develop ethical thinking, awareness, and action? How important might be discussions around issues like these in helping students develop their own values and standards?

Let us explore this a little deeper. (Can we discuss ethics without understanding the players, their intentions and culture? Noddings (1984) would suggest that women need to understand the real situation before exploring issues in ethics because they are bringing both *natural care* and an *ethic of care* to the situation. To do that it needs to be personal and particular. In contrast men are more able to deal with abstractions and hypotheticals, applying principles to situations in which they do not need to know all the nitty gritty.)

Meet Ryan and Danni. These are two students who are very caring, friendly and helpful. You met Ryan in Chapter 4 on Spirituality – he went up to his friend and praised him for being his friend. They are both keen to become veterinarians, saving and caring for the lives of animals. Normally they would be concerned about the effect of their actions on others. But in this instance it never occurred to them that killing a chicken for a science experiment might be problematic – if anything it value-added it's otherwise pre-determined death as Sunday dinner. It didn't occur to them that city students might not be used to seeing a chicken killed. For them it was part of the daily life of living on a farm. Their care for animals is in the context of understanding that they are working animals – providing income and food – you care for them well when they are alive and give them a quick humane death.

So perhaps a key to help Danni and Ryan develop their ethical selves was not necessarily to challenge their notions about the role of animals in life or science, but to increase their locus of awareness about the impact of their actions on others. To realize that they were coming from one culture and that they need to project themselves into other people's worlds and predict what might be their experience. If someone in the class had been obviously distressed, I believe that both Danni and Ryan would have been totally surprised. They would be very sorry. It would have been wonderful feedback for them…. Perturbing their view that their perspective was the only one… and being a salutary lesson on needing to predict other perspectives.

However, they got very mixed messages. When we are shocked we react differently. So while some students were concerned (months later, Tiffany wrote in her journal that she still wondered about the chicken) this concern didn't really get across to Ryan and Danni who were very much in their performing roles as presenters. If I had been on the ball and actually seen this as an issue and opportunity for Danni's and Ryan's ethical growth I would have made more of the audience's reactions and later debriefed the presenters… helping them to see the issues.

Why didn't I? Because back then my view of ethics in science was having a philosophic discussion, like Scott, about the pros and cons of ethical actions. Even though I was concerned about connecting my students to the big ideas in physics, I hadn't actually applied any thinking to the notion of what it might mean to deeply connect my students to ethical issues and the issue of being an ethical person. Although I believed I was an ethical person, I had not made explicit to myself what that meant nor how I had become one, nor the fact that my ethics might be culturally dependent and part of a spectrum of ethical development which continued to develop. I did not see my role as a physics teacher as assisting in the development of students' moral development lines, rather I saw ethical discussions as something we do to make physics more interesting and "girl friendly".

For me, ethics in science constituted discussing issues like *Should we be funding research into space when people are starving in the world? What is the responsibility of mobile phone companies when research indicates mobile phones have some effects on the body?* Yes these are questions we can stand back from… weigh up different sides… sometimes make judgements, sometimes recognize it isn't black and white, but grey … sometimes realize that we need to find compromises to live the tensions. Sometimes realize that we can not find a position where we all agree. Useful discussions, but we are disembodied from them. Once the ethical dilemma is resolved in a satisfactory way we can get back to work. Have we been changed by thinking about such issues?

Andrew is another very caring person. He goes out of his way to help others in the class, taking time to explain things they don't understand. Yet, the ethical considerations of chicken killing just washed over him. Can we have compartmentalisation in our ethics and ethical behaviour? Can we care about people and not about animals, the environment or ecology? Is there a *locus of care*, a *proximity of care*, of only caring about *beings like us*?

Scott, the whole class knows, is on another planet. The philosophy planet. If he has an idea or believes in something then he will push it, often talking over the top of people, not maliciously, but just unaware that that is what he is doing. His authoritative manner often shuts down conversations unless he is debating with someone as mentally agile as Andrew, in which case they enjoy the cut and thrust of intellectual debate. Scott seems to be in a mental world where his experience is mediated through that. He denies that feelings should enter into ethical considerations – it is about logic, determining principles and through that weighing up the relative merit of positions. He would deny absolutes, but never-the-less delivers them in his judgements.

Here is someone who has developed his intellect, and an intellectual awareness of ethics, yet something is obviously missing…. a connection to and awareness of those around him and practice of his ethical principles in his relationships with others. If you were his teacher what might you consider doing? How might you challenge him to realize that ethics also includes the feelings within, and that it is worthwhile to listen to that sense of inner discomfort and act from the heart? That ethics is more than just philosophic discussions but also practice. How could you help him tune in more to the *interpersonal field* as opposed to the *intellectual field*?

And what assumptions am I bringing here in even asking these questions?

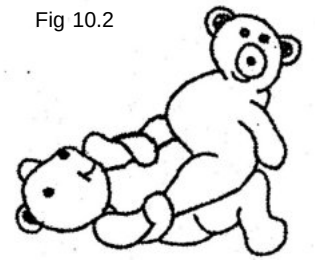
Now if Travis (from the last chapter) had been in this class, giving this presentation, then what would he do? We could assume that he would not be concerned if students in the class were affected by the presentation – *"they need to be stronger"*. Based on his past actions in class I might predict that he would have worked out an argument for why it was OK to kill the chicken which he would use to justify it and if anyone challenged him, he would then avoid further conversation, avoid being perturbed, in order to protect his ego. Yes, that is a bit harsh… I am making my own judgements here, I know. His sense and practice of ethics is less mature than the other students; he seems to be at a more ego-centric, black and white stage. How might you help Travis in developing consideration for others, being more flexible and open to feedback and seeing the shades of grey?

How could you create an ethical science classroom which started where each student was at and helped them flourish and develop their ethical selves? Does this content directed science classroom provide sufficient opportunity? What are the other possibilities?

Case 2: Kama Sutra Bears

1997. *Journalism class, end of first term. This is a class run along an enterprise curriculum framework where students work in teams on publications of their choice – learning is just-in-time and often just-too-late. While this type of class was pretty standard in the innovative College I worked in from 1990-1995, the current college I am in is much more traditional and hasn't really got much experience in how to think about and deal with this sort of learning.*

Fig 10.2



One group has just published their first magazine which includes a humorous article of cartoon bears in Kama Sutra positions. The article gives explicit instructions on what to do, and safety considerations like needing to stretch muscles first and ensure props are strong enough. It causes some complaints, mainly from the Christian group who say they are offended. My students react by saying, "Well they are not representative of our readers", "We didn't force them to read it", "Students see sex stuff in the magazines they read anyway, what's the big deal?", "We have the right to put in things which we think are important."

My students can not see nor appreciate the perspectives of other people, nor allow that other people might have different perspectives to them. They are not prepared to take responsibility for what they have done. Journalism to them is not about audience, it is about the opportunity for them to have a voice.

This is my second year of teaching journalism but the first time we have got any complaints and I am finding my way into thinking how to deal with it. We have an ethical code, based on the code of journalists but it doesn't really cover this situation. And now teachers in the school are debating it – Art and English teachers are defending the right for free press and conservative teachers are slamming the journalism class, saying their magazine will affect the school image. The principal is very unhappy and gives me a bit of an earful (understatement) while I am in the library with some of my students. They get to hear it and also to hear me sticking up for them and suggesting some solutions depending on different scenarios.

I suggest to him that this is a practical enterprise class, engaged in authentic learning where we create real products. Thus things the students do are going to impact on the community

around them. That if we use the feedback from the community then this provides wonderful opportunity for learning. While the mistake might have been 'just-too-late' for some of the readers, the learning is 'better late than never'! So we have to see ethical development as something that comes out of these opportunities, not something that students might have beforehand. "So what are we?" I ask him rhetorically "A place of learning? The issue is how to minimize the harm to the college image while such learning is happening."
"Well I don't want to see this happening again." And he glares at me.
I sigh. "Well it is going to – despite any controls I put on it, things will happen that we cannot predict. What it has shown me is that we need to have a whole school policy on how to deal with such issues – that the school recognises that it is OK for students to make mistakes, but they will get the feedback, and have to show that they are taking it seriously and coming up with solutions."
"Hmmm. So what do I do about the people who have complained to me?"
"Well ask them to visit our class and talk to the students or to write a letter that we can respond to – that is how complaints are dealt with in the broadcasting industry."

> "The person who really thinks learns quite as much from his failures as from his successes."
>
> "To learn from experience" is to make a backward and forward connection between what we do to things and what we enjoy or suffer from things in consequence. Under such conditions, doing becomes a trying; an experiment with the world to find out what it is like; the undergoing becomes instruction--discovery of the connection of things."
>
> John Dewey

The principal still wasn't happy (which was probably justified when later in the year things did blow up in our faces.) However, this was a turning point for the large group of my students who were present. Hearing me take responsibility (copping the consequences of their actions) and negotiate tactics changed their perspective. Many students who had been very aggressive towards and dismissive of the complaints now changed their tack completely – looking for ways we could be more responsible towards the readers, the school and advertisers. How would an advertiser feel being associated with sex images? They devised a warning system for the front cover of their magazines and a complaint procedure. But one boy (manager of LOKI magazine with writers outside the class), who was not party to this process, bypassed all the checks I had negotiated with him for his satirical magazine and managed to create a major controversy in the school, causing me lots of strife with management.

I believe that feedback is crucial to the process of taking ethical responsibility. However, unless your field of view changes, feedback by itself will not necessarily perturb currently

held beliefs. It is being able to understand and care for the perspectives of others, or experiencing broader perspectives which enable us to read and respond to feedback in different ways.

A key thing going for journalism was that the very nature of creating a product which interacts with others puts students into situations where they get feedback and have to make ethical decisions. In contrast, students in my physics class, except for the chicken incident and their relationships with each other, were not provided feedback from the wider community on their *doing* of science. Is it important for science students to also have such authentic experiences? Or do we see science education as something that is done within the closed doors of a classroom?

Meanwhile, I wondered what could I take from the journalism incident to structure activities which could help promote ethical awareness and responsibility which could act as a half way point between authentic experience and abstract discussions. Dewey (1966) believes that imagining the perspectives of others is important in developing the ethical self. It is through the imagination we can step inside someone else's experience and see the impact of what we do. We can play out scenarios and see the consequences.

Case 3: Perspectives and hypotheticals

1998 Journalism. *We are watching a current affairs program. I have just handed out cards with the name of a character on it… different stakeholders who would be involved or interested in the news story we are watching. I have asked students to watch the program from the eyes of the character that they have been given. To imagine who the character is, their likes, dislikes, what they do and what they believe. To get inside their character.*

The students now give their opinions about the program based on the perspective of their character. They are intrigued to hear how the different 'characters' respond to the program as well as to the other characters. The students are relaxed because they are not having to justify their personal positions nor defend their own personal character. They are testing out the impact that different views or positions have on others. They are learning to unpack what is behind a character's view – the hidden values - without feeling that they are being personally exposed. How well do they think they represented the character's view?

I now ask the students to respond as themselves. How are these responses different to the different views expressed by the various characters and what personal values are they bringing?

This activity proves very successful and I find I use this method frequently throughout the year in discussion of media issues. I also value-add it, designing an iterative hypothetical role play where students are given a bit of information, state opinions (from their role as well as their own) and make decisions, then are given more information which causes them to rethink their positions and make new decisions. It challenges students to think about a media issue in a very complex way and deeply challenge their underpinning values.

It enables them to change their positions, rather than defend them and become entrenched in them, which might result through a debate format. I ask them to map how their opinions changed and what were key things that caused this. Students reflect not just on the issue itself but also on their own process of defining what they value. We are developing meta-cognition skills in how we apply and develop values, and how they might be open to change.

What impact did these type of exercises have on the students? It resulted in considerable ability for self-reflection as evidenced by their end of year journal entries – an honesty about self, and self in relationship to others. An understanding of how they and their values had changed. Many commented on how their inter-personal skills developed and how much they began to appreciate and respect diversity in others – understanding others' perspectives and not judging so quickly.

How was this different to the *dialogical classroom* in my physics class where I was encouraging students to bring in more feminine aspects to their discourse? I think it was different – in physics students were engaged in a hermeneutic process of coming to shared meanings, while in journalism they were more imagining themselves as the 'other' and then involved in creating shared meaning through such experience. It was much deeper than the role plays that my physics students were doing when they took on roles of scientists to experience the development of the physics ideas. In journalism they were taking on roles to get inside the way a person saw the world, what they valued and how they might make meaning of a situation.

Did this imagining of others' perspectives develop the ethical self as Dewey would suggest? I believe so. I certainly didn't have to worry about incidents like the previous year in journalism where we disturbed the whole school with our offensive publications – students

took responsibility for what they were doing, developing a code of ethics, putting them into practice in their publications and in their dealings with each other and the wider community. And did I circumvent potential useful learning by preparing students 'just-in-time'? It actually raised the bar and enabled far more subtle learning to develop, an example of which I give below.

Did the students value the process used? It was interesting that when I set up a group project at the end of the year, where students had to facilitate a class discussion of a media issue, three out of four groups included the 'perspective' card system to promote discussion. It was clear that they valued this approach.

One student reflects on how she has changed as a result of the course:

> This is a big question, hey, "how I have changed as a person." Well here goes. This year has been a year where I've been trying to discover who I really am. And you know what? I don't think you ever quite know who you really are. I believe that through life you begin to develop your character and inner qualities but I don't reckon I'll wake up one morning and say "hey, today I know who I am." Nah, it's not going to happen.
>
> It's been really great to look around the classroom and to be surrounded by such a diverse group of people. Every person in the class likes to be treated differently, spoken to differently, finds humour in different things, wears different types of clothes, hangs out in different social clusters. Some of my greatest inter-relational skills have been developed in this class. I think I learnt how to be patient too. And to respect others for their beliefs and in turn I've seen them respect me. It's been nice for once to be able to be happy and act myself within a classroom situation. There is a real sense of freedom and liberation in that.

Case 4: Challenging homophobics

1998 journalism. *Meet Tyler. He has got quite angry about a group of homophobics in the school who are making the lives of gays very difficult. He has decided to write an article about it for the student magazine. "I want to write something which will make them change their behaviour. Like, stop doing this, it isn't right!" he says to me with passion.*
"Would homophobics read an article like that? Would you read something that says don't be who you are?*" I ask mildly.*
"No, you are right." He says, thoughtfully. "They wouldn't even look at something like that. What do I do?"
"Perhaps you could write something which might help them understand a bit more what it is like being gay – what the issues are, how it feels to be victimised? Seeing a gay as a real

person. That is what they are doing with rehabilitating criminals – getting them to face those they have hurt and listening to their stories."
"So I could interview some gay people and find out what it is like being gay and the issues that they have to face?" he says galvanised again.

So Tyler goes off and interviews Rodney Croom, a gay activist, and several gay students and teachers in the school, getting their histories and experiences. He then comes to me and says how these stories were quite sad in some cases and made him angry in others.
"Surely if homophobics saw these stories, they would see the other side and act differently?" he says. "But the problem Sue, is that one of the things that came out of my interviews was that these people do not want people to be sorry for them… they are not victims. If I use their stories to try to create some empathy in the readers, then I am not really being considerate of the needs of my interviewees. I am just using their stories for my own ends."
"Tyler, that is very insightful of you. It hadn't occurred to me. What could you do? How could you use what you know now about the issues with being gay to construct a story – it could be fictional - that might affect those you want to perturb while at the same time not portraying gays as victims?"
"Maybe I could write a hypothetical… perhaps I could get the reader to put themselves in a situation of a gay person. Maybe they could wake up one morning and realize that everyone around them has a different sexual orientation to them and are looking at them as if they are the deviant ones!"
And this is what he did for the student magazine. We are not sure if it was read by any homophobics, or whether it had any effect.

But what about the effect of this process on Tyler? This whole process was a very complex ethical issue requiring him to develop considerable awareness and tactfulness. He had put himself into 'moral proximity' with his interviewees. Their issue became his issue. He had to balance his needs as journalist and activist with their needs. He had projected himself a little into the 'life world' of homophobics, but could have done more perhaps in understanding where their issues might stem from and what might effect change. He was yet to move into mastery of reading culture and being able to work with it but was making attempts to do so. He certainly valued the hypothetical form as one which has the power to change perspectives.

Tyler was also juggling with ethical issues far removed from those of *right* versus *wrong*. His were issues of *right* versus *right* (see fig 10.3). **Loyalty** to the gay group while at the same time wishing to tell the **truth**. **Justice** for gays versus **compassion** of their needs. His

way of solving it was finding his way into post-modern versions of truth representation – impressionistic writing using standards of verisimilitude.

His wrestling with the issue was a revelation to me about the potential for ethical development in our teaching. He read the situation with far more depth and insight than I had. I certainly hadn't thought it through when he first wished to write an article about gays. And even saying "I hadn't thought it through" indicates my habitual response to ethics.

Four ways of classifying 'right versus right' ethical dilemmas are:

1. **Truth vs Loyalty** - this is about being honest while keeping one's promises. Truth tends to be about accurately reporting the fact. Loyalty is about feelings of allegiance to a friend, a group, or a set of ideas.
2. **Individual vs Community** - this is about placing the interests of the individual against those of the larger community.
3. **Short Term vs Long Term** - this is about requirements of the present against the need for a safe and secure future.
4. **Justice vs Mercy** - this is about the conflict between fairness and equal treatment on the one hand and compassion and understanding of special circumstances on the other.

http://www.hent.org/world/rss/files/ethics/ethics_dilemmas.htm retrieved 13/6/2006

Fig 10.3

At the beginning of the year in journalism I did a guided visualization where students went deep into themselves, looking at what they wanted to explore about themselves. Tyler had an emotional experience which surprised him and said to me that it made him realize how much he had suppressed his emotions… how much he tended to experience things with his mind. He decided his goal for journalism was to explore his emotions… to look at bringing them into his writing and integrate them more into who he was. Well he certainly achieved an integration of mind and emotion during the course of this year. His ethics were grounded on both clarity of mind and connection with his own emotions and those of others. He was developing both an *ethic of care* (based on developing values and principles) and *natural care*.

Meta-cognitive tools for unpacking ethical thinking

The students in my classes were coming from a spectrum of ethical development and culture. For those moving into the *self-authoring* mind perspectival stage, they had the capacity to see and question the underlying rules of things. This was particularly true of most of my physics students where we were unpacking and playing with the rules of science. What are the rules of ethics? What might it mean to unpack them and to play with them? What questions might be useful for students at this stage?

- Can you see the different ethical *principles* or *rules* that have underpinned our discussion?

- How might you apply these general principles to this new case? How appropriate might that be and what are the dangers of applying such principles as hard and fast rules?

- Can we discuss this in another way or from another perspective? Instead of thinking about this using *ethical principles*, could we come at it from the *caring perspective*? What might we decide based on that?

Three types of Ethical Thinking:

- **Ends-based thinking** - deciding to do whatever provides the greatest good for the greatest number. This is known as the principle of **utilitarianism**. It relies on being able to predict the consequences of different actions.
- **Rule-based thinking** - deciding what to do based on a rule that you believe should be a general principle that is always followed. Rule-based thinking acknowledges that you can never really know all the consequences of your actions and that it is better to stick to one's principles.
- **Care-based thinking** - deciding what to do based on the idea that this is what we would want others to do to you. This is known as the principle of **reversibility** and is at the center of most religious teachings.

Fig 10.4

- How much are the principles or perspectives we have come up with based on our own values, habits, customs, worldviews or culture? What might be other responses from other cultures or worldviews?

- Is this issue a *'right versus wrong'* one or *'right versus right'* and how much is our own standpoint defining that?

- How has this been useful in helping you come up with your own values, standards, principles and processes? What processes have you found useful for the continual evolving of your ethical self? (Imagination, looking at consequences, seeing through other people's eyes, looking for new perspectives, coming up with personal codes and revising them, putting into practice and looking for feedback, listening to intuition, practicing compassion…?) How have you seen yourself changing? How comfortable do you feel about the process

Would these questions have helped move Scott from his rational mind perspective of the world or entrenched him in it? Would they have helped Travis? What are the limitations of a purely rational approach to the development of ethics?

What would I say to Scott now about the chicken killing incident? Perhaps it might be this...

> *"On one hand I find your arguments quite convincing. But on the other I am still feeling very uncomfortable about the whole chicken killing incident. So I feel a tension between my gut response and an intellectual response. Is that immature of me… should I be dealing with such an issue in an intellectual way…. Or is it also legitimate to listen to other ways of knowing? I am concerned that by intellectualising it I might be ignoring some important aspects. I think I need to explore these inner signals more and understand where they are coming from. Perhaps we need to put ourselves into 'moral proximity' of issues so we can experience this inner voice for ourselves….when we look at things from a distance, or abstractly it is very easy to apply rational principles and arguments. Perhaps it is too easy to eat chicken when you are not doing the killing."*

Perhaps my role as teacher should be to live the ethical tensions myself – rather than resolving them – make these lived tensions transparent to my students, investing the tensions with my angst and authenticity… helping my students to realize that such dilemmas are not easy and that it is alright to live with these tensions. Perhaps then this encourages students to develop a dialogical voice, rather than a monological one.

Bringing in the development stages

What might be appropriate approaches for students at earlier stages of moral and perspectival development?

2004. Meet my maths class. Most of these students are considered 'students at risk' because of behavioural issues. They are coming from very different home cultures to my physics students and have developed behaviours that help them to survive in that world.

In this maths class I had one boy arrested by the police for stealing a car, another interviewed by police for stealing a balance (to weigh drugs), one boy suspended 13 times from his previous school for behaviour issues, a number of students with lesser offences and a number of students who would come to class stoned and late.

I soon realized that the barriers to my students in finding employment were not just their poor level of numeracy and literacy but in fact their ethical behaviours; their complete disregard for rules or for those not in their immediate friendship group and their offensive

opinions like "All Chinese should be sterilised." Having just read Kegan (1982) I thought that many were at Kohlberg's **Individualism and Exchange** stage where their actions are not done because they are the 'right' thing to do, but rather because of the benefits they accrue to self. How could I perturb them to the next level?

How do I build up ethical awareness in such a group? I really don't know, I am not an ethical expert. But I don't want to be someone who just *manages* behaviours, I would like to be able to help *liberate* my students from the prison of their behaviours.

Case 5: "It's my money and I won't pay tax!"

Perhaps this is an opportunity…. We are looking at filling in tax forms and my students say to me that they shouldn't have to pay tax… "It only goes to the pollies anyway." "I earned it, I deserve to have it."

I wonder how I can challenge their views. How can I make it personal so that they own it? I go home and mull over options. I imagine the responses of my students and how I might respond to these. I play out scenarios in my head and ask myself what assumptions and values I am bringing. How can I turn off my value judgements so I don't put my students off? How can I enter into their world? What is it? I begin to evolve an approach that I think might challenge their views.

*I go into the next lesson and give each student a card with **yes** or **no** on it and say that when I ask a question I don't want them to talk (because they usually talk on top of each other and don't listen) but to hold up the card.*

"Do you think you should have to pay taxes?" I ask.

Kohlberg Stages of Moral Development

- **Stage 1 – Obedience and punishment** – do it because it is the rule and will get punished otherwise
- **Stage 2 - Individualism and exchange –** Do it because it gives me an advantage – I'll scratch your back, if you scratch mine
- **Stage 3 – Good interpersonal relationships** – Do it because it is the good thing to do - love, empathy, trust, concern
- **Stage 4 – Maintaining the social order** – do it because the laws are there to ensure society functions.
- **Stage 5 - Social contract and Individual rights –** questions underpinning values and laws of society and may work democratically to change to more just laws
- **Stage 6 – Universal** (Kohlberg subsequently dropped off this stage as he saw little evidence of it)

Gilligan's Stages of Caring

1. *caring for self*
2. *caring for others* – often sacrificial
3. *including themselves into their caring*.
4. *universal and abstract care*.

Fig 10.5

One person says 'Yes' (Because otherwise you go to jail – follow the rule or get punished*) and the rest 'no'. I ask each one to justify their answer which I write on the board. I then say "How about this… what would you do? Yes or no?"*

> *Your best friend knows you are going into town and asks you if you would mind buying the latest CD for her. She gives you $30 which is the price. But when you buy it, it is on sale for $25. Do you tell her that and give her back the change?*

All but three students vote to hand the money back. I now ask them to give reasons for their decision and write them all up on the board.. One boy explains that he would keep the money – because he had made the effort to walk into town and deserved it (care only for self).
Another says "What my friend doesn't know won't hurt him."(If I can get away with it I can do it.)
One girl says "What happens if he found out? You would lose his trust and he would dump you as a friend." And most in the class agree. (A contract approach to making decisions – I get what I want, if I give you what you want, but shows greater imagination about consequences of actions.)
Another person says "Not giving it back would be cheating." (Which is applying a rule of right and wrong.)
Another said "It's your friend! You don't do that to your friends!" (A sense of care for others even if it is only their immediate group.)

I then asked the group to vote again and all but one boy now vote to hand the money back.

I then look at where the money from taxes goes – 50% into social security and we quickly work out that $30,000 of that is paid to my students in youth allowances each year. They are very surprised.
"Yes" I now say hamming it up, "look how much in taxes I am paying each year and it is all going to ***you****! Why should I do that? What are you doing with it? It is to help you come to school and learn, but are you?* ***You*** *are wasting* ***my*** *money. Why can't I keep it and use it for a holiday?"*
Their eyes are wide open, they are sitting straight up and I have their attention. This is an immediate threat to their well being.
"You can't do that," says one, "it wouldn't be fair to us."
"We need the money," says one girl "I wouldn't survive."

"But do you deserve it?" I ask. "Why is it fair that you ***get*** *money but I have to* ***give*** *it? I have worked hard for my money."*
They look at me glum as if I am about to take their money away.
"So when you are earning, will you pay your tax so other people like you can be helped?" I ask. (The golden rule of ethics: Do unto others as you would have them do unto you)
"I hadn't thought about it like that…" says one.
*"Most of you said you wouldn't cheat your friend. When you don't pay taxes is that cheating?" I ask. "****Who*** *are you really cheating?"*
Someone says "So not paying taxes is cheating people like us."
Another says "I never thought of not paying taxes as cheating."
"Do you have one rule for your friends and another rule for strangers?" I ask. "Do you want to take a vote? How many would be prepared to pay taxes when they start earning?"

All but one votes for paying taxes, which is a complete turn around from when I asked that question at the beginning of the class.

What am I doing? Am I using diabolical manipulation? Am I mirroring back to them their own reasoning so they can see the limitations of it? Why can't I model for them appropriate behaviour and values? (And what are these anyway?) Am I helping them out of the "I'll scratch your back if you scratch mine" stage into the next, or just reaffirming to them that that is how it works? Am I developing a sense of *"We do things because it is right, or because we care, or because rules are there to help make society work"?* For those that already cared for themselves or their immediate friends was I increasing their locus of care to include strangers?

Was their change in ethical stance for this particular context transferable to other contexts? Had they learnt any new processes or principles which they could apply? Had this changed their inner self and their own values?

At the time I was feeling good, because it was a good lesson – they were all engaged, most ended up believing that it was important to pay their taxes. I had skilfully used a range of pedagogies and theories to orchestrate this outcome. And yet….

Had I really looked deep enough into what lay behind their attitudes? Yes, let me look deeper. What do I believe I see? Perhaps at a fundamental level there was a lack of trust… because everyone or everything ultimately in their lives seemed to have let them down. Is this where their 'us' versus 'them' mentality comes from? So perhaps building ethical

capacity needs to come from somewhere deeper… building trust and belief in other people, developing a sense of care … and how to be discerning with their trust so that they could be in control of that process.

It seemed that many of my students had unrealistic expectations of others, which set up reaffirming experiences of failure and betrayal. By my encouraging the students to take on enterprise projects they were continually having to ask other people around the school for help. Rather than rushing in unprepared, I encouraged them to project themselves into that other person's world and to see what they were governed by. The students then had to imagine how that person might respond to their requests, work out the objections and then come up with solutions. So rather than blaming others for not meeting their needs, they could take control. And with a number of successes came a lot more confidence and also a trust in their own abilities and a process. For some this was a real turn around… they seemed less defensive, expecting the worse to happen. Rather, they began to be more open to other people, understanding that that not everyone is out to get them, but just limited in what they can do by their circumstances. And this change in behaviour, motivation and attitude was remarked upon by their teachers.

One boy said at the end of the year "I have really changed. I learnt it was important to be fair to everyone. I learnt that you have to stick with a problem and sort it out – you have to take responsibility. Yeah. And you feel better if you do the right thing." Another boy gave a teacher he had harassed in first term a box of chocolates.

However, there were some who were struggling to take on this new role in the turmoil of their home lives, often falling back to old habits. It took continual support and reinforcement. Perhaps they had glimpsed who they could become. Would it be enough? What might an education system look like that incorporates home and community in integrated learning?

Now am I just bringing and imposing my own middle class values to my teaching of these students who are coming from a very different home culture to mine? Will these new values help them survive in *their* world? Will they help them to survive and grow in ours; helping them to move out of the 'generational' or 'situational poverty' circumstances that most find themselves in?

Personally I found that seeing ethics as more than a set of principles and processes – to seeing it as a spectrum of development and coming from deeper issues of self - gave me considerable power in thinking about why students were saying what they were saying. I

realized that I needed to start where they were at and that it was unfair for me to expect particular ethical behaviours when they had yet to move to the corresponding development stage. Consequently, I could be quite strategic in thinking about what sort of dilemmas and experiences could perturb their status quo. How can I use the spectrum of ethical development within a class to provide mirrors and perturbation for each other?

So for students who might be on the lower end of the ethical and perspectival spectrum I found that it was important to negotiate agreed rules, name their behaviours, encourage projection into other people's viewpoints, help students understand the rules behind inter-relational behaviours and give them opportunities to meet ethical dilemmas which affected them personally. It was important to ensure students got feedback from their actions and had help in unpacking that feedback so they could to use it to develop new actions. In the case of students who were pathologically blocked in their development it was important to address their fundamental issues.

For students at the *self authoring* perspectival level, I found that to continue to challenge their ethical thinking I needed to move beyond *right* versus *wrong* dilemmas to more sophisticated ones of *right* versus *right*, encourage them to unpack the principles and processes behind ethical judgements, and to question the notion that ethics is about principles in the first place. I needed to model for them someone who was aspiring to be ethically mindful, walking delicately through minefields and being transparent about their process … ethics isn't a stance - it is a work in progress.

The enterprise framework gave me time and opportunity to do this. In these classes I felt that the student was at the centre of learning. It was about *their* development and empowering them to be in the world. And issues of ethics naturally emerged in this environment.

What was at the centre of my physics class? While I was concerned with the development of my students, it was development which served the understanding of physics, helping students become empowered as scientists and thinkers. The demands of covering content meant I didn't have the luxury to stop and run a lesson on ethics. But should this have been part of my agenda? Should ethical behaviour be an explicit science criterion?

So rather than marking an essay on how well a student has debated the pros and cons of an ethical issue, should we be requiring *demonstration* of an ethical self – through interactions with others, integrity in the doing of science, in coming up with own codes of practice, applying them and reflecting on them? A classroom which is a community of scientists could

be much more than students in dialogue about science – they could be communities of ethical practice where care flourishes and where we value that explicitly.

Can you care too much?

When dealing with student ethical thinking I guess the stuff that stands out and demands attention is when students demonstrate lack of care for others. But for many girls in my classes their issue was caring too much – they were in Gilligan's stage of *caring for others* where there is a danger of sacrificing self. They were affected by proximity, urgency and emotional need. So if a friend had had a row with a boyfriend and needed emotional support then that would be their highest priority – forget coming to class, or commitments they might have made to their class group.

Now some used this as an excuse to be absent, or thrived on the drama of it, or loved to be needed. Some may have developed unhealthy co-dependency. Others were genuinely concerned, emotionally affected and were incapable of working because of that concern. And sometimes they were dealing with very complex and serious problems – for example, friends who were depressed or suicidal.

We value caring people in our society so should one say to a young teenage girl, "Look, this work in your class is more important than helping your friend?" How in fact can we help them develop discernment in determining priority of self needs and others' needs? Of applying perhaps some principles or judgements in determining how and when they might care? Of recognising their own emotional need to help and being able to manage that? Of being able to distinguish between urgency and importance? Of understanding the difference between sacrificing self, becoming a martyr, being exploited, co-dependency and a need to serve? How to recognize when they might be moving into one of these and to know how to act accordingly? How to find compromises which meet their own needs, needs of the person who is demanding their attention and other people who are relying on them? How to ask for help so that they are not the prime carer?

Yes, how well am I doing this? Does this discernment come with better critical thinking skills and development of ethical principles? Or is this need to care compartmentalised away from rational thinking, coming straight from the heart? What would you do?

What I have learnt about the process?

That using real situations that the students are facing or have brought up themselves is often more effective than abstract dilemmas. To be open to these sort of opportunities, but not to necessarily feel I have to immediately respond to them as it is difficult doing something well off the cuff. That it is better to take time to reflect on the issues, to question my own values and assumptions and to ask what moral judgements I am bringing to a situation before I leap in and to realize that whatever I do, I am taking a stance. To carefully design an activity which links to the ethical and cognitive stage of the students using connective pedagogies. To allow time for iterativity and student reflection and growth. To celebrate the outcomes. To build up authentic relationships with the students so we trust each another enough to go deep into our own feelings and values. To encourage students to increase their locus of awareness, develop their imaginations and practice taking on the perspectives of others. To set up situations where students need to work closely with each other encouraging moral proximity, fostering opportunity to care for each other.

How am I bringing spirituality into this?

Part of bringing in spirituality to my concept of ethics is developing my own sense of care I have for my students, which in the case of my maths class takes a bit of practice. I have found helpful various courses and books on relationships and control dramas and most importantly various meditation techniques. One is a form of the Buddhist *Loving Kindness* meditation… where you bring students into your awareness and see them with love and compassion. When I do this I spiral upwards in view, seeing their behaviours as distinct from them, seeing their issues, then seeing their deep needs, seeing their energy and blockages, and then seeing them as beings of light. I begin to develop a sense of compassion and non-judgment where I can be with them in class without all this thinking and categorisation getting in the way.

So on one hand while my rational responses to them are based on my judging their development and their capacities, on the other hand this frees me to not expect beyond that of which they are capable and enables a form of rational non-judgment. (A very fine balance and not always achievable … yes, another ethical tension for me to walk!) This is different to the moments of pure connection where both student and myself feel we are seeing each other. In such a moment no judgement is present because the relationship is operating in a different place. And at moments like this students see themselves in a new way – not through

my judgement, nor expectations, but they see for themselves that inner light of self…. Or so I seem to sense.

Yet my own values and expectations of myself are always present and some students will be judging themselves against that. So it is important that I also have a 'highest thought' for my own ethical behaviour. And despite my best intentions, judgments and values will always come in the way in relationships.

My meditation practice is also important in building my capacity for mindfulness so when I am presented with 'challenging moments' with students I can slow down time – I can recognize my first response (which might be defensive), let that go and allow a more wise response to form. While this is successful for most of my classes, for my maths class the pressures of their behaviours often trigger my first response which is never helpful.

If this inner practice is so useful for me in my own practice as an ethical being, then why am I not encouraging my students to take up such practice? I have put ethics on the agenda of my maths class but I am only really assisting them developing their ethical being through certain intelligences. In my physics class I was concerned about balancing students' predilection for ethics of the mind, with an ethics of the heart. But what about soul? Soul is the *capacity to be*. Wise action might be *mind + heart*. But when soul is in the picture there is another element which goes beyond such judgements of 'wise' or not.

Terry Pratchett (2005) suggests that there are 3 levels of thought:

> **1st thought** – which is gut response, intuition – it could be trustworthy, or clouded by defence mechanisms
>
> **2nd thought** – what other people might say, justifications, layers of critical thinking and unpacking, second guessing, mental gymnastics
>
> **3rd thought** – when the universe thinks through you.

Yes, '3rd thought' is very Tao-like. The principle of wu-wei. When we are aligned and connected with the universe then we are acting in harmony. (1st thought = 3rd thought). We do what is 'right' for the now and we don't second guess. Now people can experience this state momentarily (as a peak experience) or be in a state of being where this is normal – and we would probably call these people sages or masters.

So ethical development for students might be more than helping students develop values, ethical thinking and discerning care – it might also include developing the capacity for 3rd

thought moments, and being able to recognize the difference between 1st thought and 3rd thought. It is infusing experience with spirit and fostering deep connection.

To help me unpack some of the issues of developing student ethical capacity I have been using Western development models and ethical thinking paradigms. Now let's revisit Greg Cajete (1994) where he offers an indigenous ethical development model which is based on a holarchy, rather than going through hierarchical stages – as one matures, one gains higher stages which include earlier ones, and one moves back and forth.

5 ways of thinking – steps towards thinking the 'highest thought'

1. **First type of thinking** – Orientation to one's place – starting at one's home, then moving in ever widening circles to the village, surroundings – an ecological awareness. This is the ground on which the other types of thinking develop.

2. **Second type of thinking** – Consciously understanding the nature of one's relationships to people, plants, animals, natural elements and phenomena. Self knowing based on senses and emotions and developing the ability to hear the spirit moving in the world around.

3. **Third type of thinking** – Reflective, contemplation, speaking and acting. To think things through, make wise choices, to speak responsibly for purpose and effect, and to act decisively and to produce something which is useful and has spirit.

4. **Fourth type of thinking** – Wisdom – complex state of knowing founded on accumulated experience – usually seen in elders.

5. **Fifth type of thinking** – Beyond wisdom to knowing the spirit directly with all one's senses – multi-sensory consciousness associated with mystic and spiritual leaders – visionary experiences that anyone can experience. This is the place where spiritual ecology develops, the centre place of thought, the place of deepest respect and sacredness, the place of the highest thought.

Yes, in my consideration of ethics where is the sense of the sacred? Where is the deep foundational sense of place and understanding of ecology? Where is the deep understanding into the nature of things? What is missing in our Western education system?

My ethical issues seem so disconnected from the natural world – freedom of the press, role of media, animal testing in science, paying taxes. Has the very structure of Western society - classes, schools, isolated family units, day-care, urbanisation - disconnected students from the foundations of being on which ethics naturally develops? Or do we need a spiritual ecology model for the urban world?

There is something so holistic about what Greg Cajete writes – so complete and whole – so spiritual. It seems my own efforts to incorporate Holistic principles in the teaching of ethics are piecemeal – not infused with a grand vision. But this is not a vision I can have alone. I am talking here about a vision that might infuse a whole culture of education.

And what is the role of science, which has the capacity to help students connect with nature, with self and with each other, which can help them to think reflectively and act with wise purpose? Could this have a part in such a vision?

Perhaps for very young children at the *pre-conventional stage*, science has a role in helping to encourage a sense of place in nature, and being able to act respectfully within that place – observe, cultivate, mark the rhythms of nature, harvest, protect. Science here is not about *experimenting* but about *caretaking*. Once begun as a young child this can become a thread throughout one's life. Nel Smit (n.d) has introduced the concept of 'My Patch' in Tasmanian schools which enables students to care-take a small patch of land, preferably natural bush…. It becomes a place of reflection and connecting with nature as well as observing the minute changes that might occur around a tree or a rock.

This sense of place is one of many that students would develop – home, family, social contacts, traditions.

When students start to learn scientific facts and begin scientific inquiry processes at primary school it would be important that this is balanced with a deep connection and sense of awe and wonder in not just their immediate patch of nature but also the universe which is opening up to them. As students feel connection they come to care. So enchanting students with the universe is not just about engaging them or enhancing understanding of concepts it is about activating their souls, becoming a crucial foundation of ethical development.

A key aspect of their learning about the world would be about the relationships of everything to each other and they would be able to place themselves within this web of relationships. They would be able to project themselves into the perspectives of plants, animals,

phenomena and people as well as tuning into them in a more contemplative space. Their scientific objective inquiry would then be done on a foundation of deep respect for the world. Thus the whole world would be in *moral proximity*, in their locus of awareness as they make decisions about how to undergo inquiry.

They would also see themselves in a community of scientists which brings with it responsibility to each other and to those for whom they might be doing science.

As they get older then connection, care, and responsibility become the foundation for rich, creative thinking about the nature of things. Scientific objective thinking is valuable in developing aspects of the mind and when married with other inquiry processes enables a new clarity of thinking. And so the process of development continues as heart, mind and soul are integrated in wise action in the world.

Can the world survive a humanity which does not aspire to the *highest thought*?

Gaia

I am water, I am earth, I am life.

My body is your body.

See though my eyes
And see yourself…
Gaia, wondrous being.

My heart sings when I breathe
Because I breathe your breath;
Your air, your oceans, your forests.

I am you and you are me.
One, together.

Interlude 1: An extract from a student's physics journal

I don't know how much I learnt about electro-magnetism during the debate (*Are your mobile phones killing you?).* What I am learning is how corrupt society is. For example, one article left out information that didn't support their hypothesis. I mean, how corrupt is that? Conspiracies are probably more present than we think, and that too is very scary. I don't think it will turn me away from science though.

Society is also back-stabbing. That's another thing I learnt. People saying "you're not right", "that's wrong" and other things, just because they don't agree with it, or they know it is right but they don't want to accept that this other person is right. It made me realize how wrong things are, even at my work where there are so many different conflicts it isn't funny, and I can't wait until I get out and join the reserve. I'm not saying that this is a bad thing learning this stuff, it's actually very good so I can get out before I start acting like these people.

Tiffany

Interlude 2 – Hypothetical Ethical Dilemma for a researcher

What does it mean to have a code of ethics as a scientist and where do you learn that code of ethics?

You are a researcher within an organization. You have just been called into the office of your boss. He says that the director of the division has a special task for you. He would like you to write a report on a particular subject of research. Your boss hands you a piece of paper. "The director has come up with these conclusions," he says, "and would like you to write a research document which supports those conclusions."

What are you thinking or feeling as he asks you this? What do you say to him?

Let us listen in to a conversation – it is between the boss and his subordinate. It goes something like this…

The subordinate says, "You are joking aren't you? You can't come up with the conclusions before you have done the study!"
"Well the director knows this topic very well and knows that these conclusions are correct… you are just filling in the background."
"I can't do that." The subordinate says, shaking her head. "It is wrong. It is unethical. It is unscientific."
"Well I don't care about that. You have to do it."
"Would *you* do it?" the subordinate asks flabbergasted. "How could anyone trust what you researched again? You would lose all credibility. Surely you can't expect me to put my whole reputation on the line."
"OK, how about doing it, but don't put your name to it."
"This is diabolical…. Now you would put the department's credibility on the line!"
"Look, no one will find out. Anyway, it isn't that much… we already know that these conclusions are sound… it is not like they are lies."
"But even so, the process of research could come up with other factors or possibilities. You are asking me to deliberately ignore anything that doesn't fit into this picture. What happens if it is important and people make decisions where they don't see the whole picture? What happens down the track? You just have to look at the other disasters that the department is dealing with."
"I don't care about that… I am following the orders of the director and you need to as well or you can say goodbye to this job."

"Are you coercing me? This is unbelievable. Why don't you stand up to him and let him know it is unethical research and could lead to poor decision making."
"I am not going to do that. It really isn't a big issue."
"Ugh! Well all I can say is that you have the moral backbone of a worm if you can't see that this is wrong!"

What would you say to the boss? What would you say to the subordinate? What concerns do you have about this issue? How might you have handled it if you were either the boss or the subordinate?

Now this isn't complex ethics. It is right versus wrong isn't it? At least the subordinate felt that it was right versus wrong, but the boss did not appear to have a conflict. What moral culture was he coming from? Did he have a moral blind spot or was he more realistic/pragmatic? Was he acting to save his job – what effected him personally was more important to what might eventually affect other people down the track? Did he not have a code of ethics about doing research? Did he have a lack of imagination in thinking through the consequences of what he was asking? It wasn't as if he was asking his subordinate to do something he wouldn't do himself, was it? Or was he just more enculturated into the nebulous grey areas of organizational ethics.

And what about the subordinate? Did she have an explicated or unexplicated code of ethics as a researcher? Within her defence is the notion of scientific integrity - representing the facts, searching for the whole picture, not having an agenda up front, being open to where the research takes one, prepared to follow up those things that might not fit governing theories. Yet even this code is a naïve belief that the truth can be found. Despite post-modern critiques of science, is it important to still have a code of ethics as a scientist?

Would you have done this report if:

a. You were told you would be sacked if you didn't?
b. You were given a million dollars?
c. It would help move forward a project that could have benefits to others?
d. You were told that by doing it you would save millions of starving people in Africa?

Now let's say that person (the subordinate) was me, many years ago - how might I have handled that situation differently, from my 2006 standpoint? Perhaps I would have seen this as an opportunity to reflect on my own values and assumptions – to question them and look

at them in a bigger context. I may not have thrown them out but I would be more aware of what assumptions and worldviews underpinned my feelings and understandings. In the process of review I would likely have developed my ethical self further. However, I still cannot imagine a situation where I would have agreed to write such a report.

I would also have sought to understand better the moral culture of the different players in this saga and the ways in which they were embedded in the culture of the organisation. I would have made an effort to make explicit to them the ethical games that were being played. I might have encouraged the players involved to be more reflective and imaginative about the impact of what they were asking. I would have encouraged them to explore other options. I would have aimed to challenge the underlying culture in a way that was more subtle. I would have been less black and white and more a player myself. Perhaps. And it may not have made any difference.

Perhaps there is something very useful about experiencing outrage and giving people direct feedback of this outrage. Standing back and facilitating others in unpacking the situation is an act of distance. How can we do both?

How can we help our students develop a code of ethics as a scientist or researcher and realize its evolving nature? How can we prepare them for the ethical situations that they might be faced with when working as researchers? How can we help them see these as opportunities for continuing development of the ethical self, rather than cataclysms or non-events? How can we help them be culturally astute?

And why is this important? Because of the status of science and the status given to what scientists say. Because there are scientists in the world who develop blind spots (are selective in what they see and report on) and whose word is still trusted. Because there are players in the world who are operating at different parts of the ethical spectrum and it helps to identify and understand their machinations if you are required to operate in their world.

Interlude 3: Ethical code of conduct for Physicists

Guidelines for Professional Conduct
American Physical Society

(Adopted by Council - 3 November 1991)

The Constitution of the American Physical Society states that the objective of the Society shall be the advancement and diffusion of the knowledge of physics. It is the purpose of this statement to advance that objective by presenting ethical guidelines for Society members.

Each physicist is a citizen of the community of science. Each shares responsibility for the welfare of this community. Science is best advanced when there is mutual trust, based upon honest behavior, throughout the community. Acts of deception, or any other acts that deliberately compromise the advancement of science, are therefore unacceptable. Honesty must be regarded as the cornerstone of ethics in science.

The following are the minimal standards of ethical behavior relating to several critical aspects of the physics profession.

Research Results

The results of research should be recorded and maintained in a form that allows analysis and review. Research data should be immediately available to scientific collaborators. Following publication, the data should be retained for a reasonable period in order to be available promptly and completely to responsible scientists. Exceptions may be appropriate in certain circumstances in order to preserve privacy to assure patent protection or for similar reasons.

Fabrication of data or selective reporting of data with the intent to mislead or deceive is an egregious departure from the expected norms of scientific conduct, as is the theft of data or research results from others.

Publication and Authorship Practices

Authorship should be limited to those who have made a significant contribution to the concept, design, execution and interpretation of the research study. All those who have made significant contributions should be offered the opportunity to be listed as authors. Other individuals who have contributed to the study should be acknowledged, but not identified as authors. The sources of financial support for the project should be disclosed.

Plagiarism constitutes unethical scientific behavior and is never acceptable. Proper acknowledgement of the work of others used in a research project must always be given. Further, it is the obligation of each author to provide prompt retractions of corrections of errors in published works.

Peer Review

Peer review provides advice concerning research proposals, the publication of research results and career advancement of colleagues. It is an essential component of the scientific process.

Peer review can serve its intended function only if the members of the scientific community

are prepared to provide thorough, fair and objective evaluations based on requisite expertise. Although peer review can be difficult and time-consuming, scientists have an obligation to participate in the process.

Privileged information or ideas that are obtained through peer review must be kept confidential and not used for competitive gain.

Reviewers should disclose conflicts of interest resulting from direct competitive, collaborative, or other relationships with any of the authors, and avoid cases in which such conflicts preclude an objective evaluation.

Conflict of Interest

There are many professional activities of physicists that have the potential for a conflict of interest. Any professional relationship or action that may result in a conflict of interest must be fully disclosed. When objectivity and effectiveness cannot be maintained, the activity should be avoided or discontinued.

It should be recognized that honest error is an integral part of the scientific enterprise. It is not unethical to be wrong, provided that errors are promptly acknowledged and corrected when they are detected. Professional integrity in the formulation, conduct, and reporting of physics activities reflects not only on the reputations of individual physicists and their organizations, but also on the image and credibility of the physics profession as perceived by scientific colleagues, government and the public. It is important that the tradition of ethical behavior be carefully maintained and transmitted with enthusiasm to future generations.

Physicists have an individual and a collective responsibility to ensure that there is no compromise with these guidelines.

http://www.iit.edu/departments/csep/codes/coe/aphysic-b.html Retrieved 19/5/2006

Fig 10.6

What code of ethics for scientists might take in the concerns of postmodernists of the problem of representing ‘truth’, or might include critical theory perspectives?

What code of ethics might include a deep respect for the natural world?

Chapter 11

The enabling classroom – 1997 - 1999

Questions:

What are the power relationships between student and teacher?

How might these be interpreted from a Holistic paradigm?

What does it mean to empower students?

What are the curriculum metaphors which shape the culture and constraints of education?

What might be a holistic or integral curriculum metaphor?

1997 - An encounter outside the library

Sue's Story

I was heading towards the library when I bumped into Lauren on her way out. She said hello to me. Another teacher was also going in at the same time and he looked at me and said is "Lauren also your student? I didn't realize she was doing physics." "Yes," I say looking at Lauren, "she is wanting to get into medicine so has a bit of work to do to get high enough marks before the end of the year." I grimace as I say it as I don't know what has come over me. This teacher, one of the leading male authorities in the school always makes me feel uncomfortable and I lose my sense of tact.

I am totally surprised when after he leaves Lauren bursts into tears.

Lauren's story

When Sue said to me that I needed to work hard to get into medicine, everything just came up to the surface. My exam results had been really worrying me. I had been away after the exams on an expedition trip and when I got back Sue threw my exam paper on the desk, saying she was really disappointed in me. I only got B's. I just couldn't bear Sue's disappointment. I couldn't believe that she would treat me like that.

I guess I have made Sue a bit of a role model… I really admire what she is doing, trying to improve education… she has done so many different things with her life… a real inspiration. I felt really close to her, she is usually so friendly. When I asked her to send me a postcard when she went to America she did. I felt really special.

Sue's story

When Lauren explained to me why she was crying I felt totally astonished. My hand flew to my mouth, my eyes opened and my heart stopped. The poor girl. This was totally out of left field. I must have seemed like such a bitch. It seemed she had totally misconstrued my actions. I remember giving her back her exam paper in the middle of a busy class, dropping it in front of her as I usually do when I hand back assignments. I remember saying to her wryly that she was likely to be disappointed in the results as she was hoping to get all A's to get into medicine, but not to worry because she still had time if she could work really hard. And then I walked away to the next student.

I now explained this to Lauren saying I was really sorry about the misunderstanding and the fact that she had spent so long stewing over it. I gave her a big hug and said "No, no… I am not disappointed in you at all… you are such a wonderful person… I was just really concerned that you might not be able to meet your dream. I really should have spent more time with you to discuss it rather than just giving your exam back to you and running."

Lauren's story

I gave Sue a really big hug. I was so relieved. I think I was relieved more about the fact that she hadn't disappointed me. That she was a really nice person and that it was a misunderstanding. It is funny about how much I cared about that. If one of my other teachers had done the same to me I would have just expected it, but not Sue. I guess I had developed very high expectations of her… I saw her as a friend. And friends don't do that to each other.

Why have I put this story in at this point? What did it mean to me at the time? What did it cause me to think and to do? Yes, let me get into my 1997 head…

I have been heading along very nicely, thankyou, on my exploration of pedagogy, learning and science. So far, when stuff happens it makes me think about how students learn, what they are thinking, how they come to know and how I am knowing. I have all my models and concept maps in my journals to prove how well I am progressing in explicating the learning process.

Yes, I am in my head. And living in my head like this I am interpreting everything from an epistemological consideration. Yet, I believe that I am coming to know my students. I am a mind reader, they say. I know what they are thinking… well what they are thinking about physics anyway. Some tell me I am the only teacher who really knows them, asking me for advice, writing their references. They appreciate the efforts I am making in coming to understand them.

But do I really understand them? Do I really know them? Do I really see Lauren, deep into the heart of her? Did I just say *deep into the heart of her*?

Heart.

What does it mean to see with one's heart?

Yes, yes, I really do care for my students. I am concerned for their wellbeing, helping them discover their sense of purpose and reach their potential, helping them in self understanding. I pay close attention to how my students' feel as a result of this new pedagogy I am challenging them with. I know for some I am taking them out of their comfort zones. I am aware that when faced with a complex task they might feel confused and overwhelmed and I encourage them to name these feelings. When they share these with each other it seems tasks are now more manageable because everyone is in the same boat.

I encourage them to be open and honest about my teaching and the effectiveness of the learning activities. They all know that I am doing a PhD, looking at improving my teaching, and they are eager to help in giving me feedback because, like me, they believe that the system needs to be improved. I have been training myself to accept their feedback; the good,

the bad and the ugly. The first time someone gave me a real critique of a lesson I felt my stomach clench and I had to remember to breathe. I had to force myself to listen passively; not to justify or to defend. I have got good at it I think. I now seem to move outside of myself… see it more as a witness, depersonalised it. It is like me and the student are watching a movie as critics and having a conversation about it. When I am in this mode it is easy to tease things out with the student… *What were you thinking or feeling during this bit?, What would you have done here? Why did I do it this way, good question!*… and so on.

I have created a certain sense of equality in my class as a result of this – we each can comment on and critique the learning that is happening in this class. There is the sense that I am a student as much as they are, but perhaps my subject matter is a little different… the subject of learning as well as physics. They comment that in my classes they are treated like adults rather than children – I see them as real people.

And even this process of student feedback has helped me to be in my students' shoes for a while, helping me to understand how they might be feeling when a teacher criticises them - all in the name of improving performance. How can I do this without being inappropriately judgmental, patronising, personal? How can I be insightful, helpful, inspiring, honouring their own aims and expression of self? What is the difference between feedback which diminishes and that which empowers?

Yes, I have done very well in separating my pedagogy from me. I am not my pedagogy. I am still a good teacher despite stuffing up a lesson. But this episode with Lauren is not critiquing my pedagogy… it is about me, Sue, the human being. When I asked for feedback, I was really putting up boundaries as to what that feedback could be about. But why didn't Lauren give me feedback earlier about how I acted? I felt my students could be really open and honest with me, yet obviously the expectations and complexity of relationships restrain what we feel comfortable being explicit and open about. The very classroom power structures – of teacher and student, the implicit contracts, the course structure, syllabus and assessment - create constraints in those relationships. I am still the teacher and there are certain lines in the sand as a result of this.

Have I been guilty of false pride? Pride in my relationships with students, pride in the openness that we have, pride in my knowledge of them?

Sue, where is your heart?

Yet, I truly believe that relationships are our biggest teacher. They have been for me… causing me to grow as a person and grow in compassion and understanding. I see spiritual practice as something that aims at inner illumination and connection ***and*** also acts in building capacity for mindfulness and compassion in relationships. Relationships are the proving ground and in many ways I see relationships as the main game of life. Why have I got caught up so much in this knowledge game?

What really is insight? It is more than thinking very hard about something, more than a paradigm shift (another way of thinking), more than clarity, more than seeing underlying cultural patterns that might shape us. Perhaps it is a shedding of those things that constrain us from pure being. Is it a shedding of *too much thinking*? Too much analysing, psycho-analysing, development level matching, multi-purpose planning, cultural analysis?

When I let this go, who am I now? What does it mean to *be* in relationship, to *be in my heart*?

But critical thinking and reflection seem so important in letting go. A stage. One needs to explicate and then one can shed. Perhaps then there is integration. What am I shedding here? My pride? What am I gaining? Humility?

What is my state of being? More open to seeing? More open to just *being with*? What does it mean to be with you now Lauren? No analysing, fixing or trying to come to know how you tick. What is this place of pure being? Has my 'care' transformed to love?

> "We need to forget our pedagogy as we open the door to our classes and just be in the presence of our students."
>
> Parker Palmer

How can I integrate these parts of me…. Head, heart, soul?

How can I integrate in my teaching the need for *thinking, intention, modelling* and *analysis* with *the need for pure moments of being*?

How can I do this within the context of *my role as teacher* (with accompanying constraints and obligations) along with *my need to express myself as one human being to another?*

And where is the line now, over which a teacher should not step, in building relationships with students? Am I falling into the trap of caring too much – of putting myself too much in moral proximity with my students? If Holistic Education is about a *pedagogy of love* (Nava

2001) then I need to learn how to love ethically and healthily, developing in myself a capacity for clear mind and warm heart.

And in this effort to build caring relationships with students I have moved the bar in terms of my own ethical behaviour. Because now, it seems they expect far more of me; they are looking for role models, for someone who has awareness and deeper understanding of their issues and their deeper selves. Lauren and other students have standards that they apply in judging their teachers and this is often established by the role that the teacher has – based on the power sharing in the relationship. But now I have created a situation where the teacher/student lines are blurred; both in the context of who has the power in enabling the learning as well as moving from 'distant authority figure' into a mentor and friend role. Yes, we don't expect the standards we might apply to a friend to apply to a figure writing up on the board in front of the class who we see five hours a week.

So now there is a tension between all the multiple roles I am taking as a teacher, some of which are quite contradictory. Walking this tension is both a problem for me and my students and we are working our way through exploring new territory.

Is this a rite of passage for my students? Where they are moving into the adult world of *self authoring mind*, finding a sense of equality, discovering their own power, moving from expecting 'authority figures' to be perfect to valuing the process of looking deeper into behaviours and coming to know and understand another.

Is this a rite of passage for me? Perhaps, it is about discovering a new inner honesty and reflectivity and finding a way of being *appropriately* transparent to my students about my own dilemmas and learning. I show my vulnerability, I am authentic. I am not just a teacher of *knowledge, processes and skills*, where there is an implicit contract between teacher and student – I am also a fellow human being on a journey.

Mezirow (2000) might nod wisely and say that what is happening here is

Some Teaching Metaphors I am dancing between

Leader
Constructor
Developer
Improviser
Initiator
Perturber
Inspirer
Catalyst
Intriguer
Surpriser
Motivator
Mirror
Revealer
Occasioner
Entertainer
Comedian
Facilitator
Collaborator
Conspirer
Helper
Manager
Organizer
Director
Mentor
Coach
Nurturer
Carer
Listener
Trainer
Disciplinarian
Negotiator
Mediator
Lecturer
Emancipator
Empowerer
Role Model
Healer
Friend
Advisor
Learner
Anticipator
Follower
Mother
Significant other
Wonderer
Optimist
Judge
Supporter
Human Being

Fig 11.1

transformative learning:

> Adult educators create protected learning environments in which the conditions of social democracy necessary for transformative learning are fostered. This involves blocking out power relationships engendered in the structure of communication, including those traditionally existing between teachers and learners.

Easier said than done.

Can I be too open and transparent and what might this create?

In 1998 after reading a paper which described a teacher's tactful response to a student's English journal and the resultant inspiring journey, I looked very carefully at how I was responding to my journalism students' journals. I explained to my journalism students the gist of the paper and asked them what they thought of my responses to their journals. That I was concerned I might be too patronising or criticising rather than helpful, welcome and sensitive to their needs to go on their own journey. What might it feel like to welcome a teacher's responses?

They were all very surprised with my question but the verdict was that they were very happy with my responses… unlike many of their experiences of writing journals, where teachers did criticise; they actually looked forward to reading my insights and suggestions. One girl said sincerely "But Sue, we really appreciate you asking us and finding out about how we feel about this. No teacher has ever done that before… asked me how I feel about the way they comment on our work. Thank you!" It was an important lesson for me and one that I took on board in establishing the "I wonder" journal in my Physics class as well as the comments I would scrawl across students' work. Note to self: check what students value in feedback and realize it is different for everyone. Put yourself in their shoes and ask *How might you feel if someone wrote this or said this to you?*

1999 – Travis. You read his journal entry in Chapter 9 on The Dialogical Classroom. His entry was only possible because we had a classroom climate where it was okay for him to talk openly about his frustrations with his learning. When I read his journal entry, I was initially horrified. It might be easy to dismiss it as the rantings of a very immature and selfish boy. Yet there were elements of truth there in what he said about my classes and his passion revealed some of his needs. Yes, there was much he had misunderstood.

It made me realize how much goes on with our students that we just don't know about and how much they often bottle up. And how important it is to continually check for meaning, to allow for think time, to allow students to talk about their learning, especially when such a course as physics is jam-packed-full, with little room for manoeuvre or for student involvement in determining that learning. I had opened the door for him to express his concerns – and that he was upset was clear by his writing - but in doing so did I make myself too much of a doormat? How much consideration should he have shown to me?

Since then I had a Maths student, Shannon, explode after I provided some structure to a topic her group had chosen to do, saying to me "why did you have to ruin this topic by making it so hard – it was something I really wanted to do!!" Her energy blast hit me and I was utterly astonished, just standing still and accepting it. I said very sincerely how sorry I was. She stormed away but later calmed down and apologised to me, saying that she realized she only had to do a small part of what I had put in the group's folder and that it was okay.

I asked her whether she was normally this frustrated in her other classes and whether she tells her teachers this. "Yes, I do get frustrated but I can't tell them that. I just have to sit and put up with it. I feel I can tell you… you are my favourite teacher. Maths has been the only subject I feel I have had control in which I guess is why I got so upset when I thought you had ruined this topic for me. But don't worry, I am planning to leave school as soon as I get a job."

Yes, Shannon I can see why you are frustrated and part of that is from the mixed messages I gave you – on one hand allowing you to choose the topic the class was to explore – alcohol and teenage binge drinking – but on the other hand shaping how you might explore that – through surveys – and then linking it to maths sheets to build up skills in this area. I seemed to promise you autonomy but didn't really sit with you and help you build you own pathway through this experience. Ooops, was my head too in the place of asking *how can I link this experience to maths learning?* I explain my dilemmas to Shannon and how she has made me really question whether I could have done this in another way. She is pleased with my openness. "Next year, just explain to your students what you have explained to me."

In all these cases – Lauren, Travis, Shannon, my journalism students – a key is an ongoing dialogue – a conversation in which we are finding our way. I am not sure of myself at all because this is unfamiliar territory so there is a lot of tentativeness. Sometimes I am thinking carefully and acting strategically, and other times I just show my true reactions – a 'use of self' - in honest and authentic ways, even though they might not be the most 'strategic'. In

really listening to my students and trying to step into their shoes and their perspectives it perturbs my own understandings of my role as teacher.

However, it seems that my authenticity, this willingness to change my views and explicate my dilemmas and changes, enables a deepening of relationships with my students. Some of those relationships which are problematic – create misunderstandings and issues – can end up being the deepest and more caring because of this rocky journey that we have been through. It is interesting that in being more open and equitable I experience more raw emotions from my students than I have ever done before. And I am really concerned at what has been bottled up and what I am seeing and hearing.

Some of my students begin to tell me stories about diminishing experiences they have had throughout their school lives – not just my maths students, but also some of my physics and quite a few of my journalism students who have felt marginalised in different ways. Perhaps my physics students just have a greater resiliency because of more supportive family lives which is why they can be more academically successful. Yet, in my 1998 Physics class I have 3 students taking anti-depressants that I know of, and one with bulimia.

Year 11/12 is a tentative time for these students – most are moving into or through *self-authoring* stage – determining their own set of values, purposes, choosing who they want to be and do, deciding their future careers, looking for greater control and autonomy in their personal lives – and most struggle to find appropriate voice and appropriate control. So while I am looking for appropriate transparency and balance in handing over control, I need to allow them the space to find out how to use these new freedoms and help them in making sense of their experience of doing so.

Perhaps there is an equity in the disequilibrium we each feel? But I also long for some stability, and when I find it, might this entrench me in new disempowering ways with my students?

Unpeeling the layers – a deconstructing of self and structures

During 1997 and 1998 I experienced for myself within the school system some of my most disempowering experiences in my life... not just one, but one after the other. I am a goose trapped in a bottle and I am just beginning to see its shape, but yet have no idea how to get out.

My movement from an *action research cycle* of Kemmis and McTaggart (1982) to the *action inquiry model* of Torbert (1991) was synchronous with these various upheavals. Torbert requires one to adopt a 'critical subjectivity' where one reflects not just on the issue (the object) but rather on oneself and the underpinning assumptions that one might be bringing (the subject).

Torbert's *Action Logics* model is based on a hierarchy of different management styles which he ascertained through studying business leaders. Inherent in his model is the notion that when you are thinking from one perspective you can only interpret your situation within those conceptual frameworks. By engaging in a process of self-reflection and questioning of underpinning assumptions, values and habitual ways of thinking, you are able to move to a higher level of perspective enabling you to manipulate that which you were immersed in and could not see. (You will notice that his ideas are very similar to the field of Adult Transformational Learning (Mezirow 2000) as well as Kegan (1982). Although his study was based on management practices, his model was the basis for Cook-Greuter's (2002) research, which Patricia Gordon (personal communication, July 6 2005 and forthcoming paper) used to develop the *perspectival stages* which I have been referring to throughout my writing.)

So during this time I am engaged in a deep questioning of myself – my spirituality, femininity, underpinning teaching metaphors, where my notions of pedagogy and purposes for education have come from, what do I really value, how I interact with others, my management practices, my notions of science. From an integral perspective I am in the process of reflecting on and transforming many different development lines *all at once* which puts a lot of stress on the *body-mind-soul-spirit* system. It was a vulnerable navel gazing process which went through various iterations as the sources of my 'disorienting dilemmas' kept coming. As a result of this reflective process I realized that many things I did were just habits rather than well articulated intentions. Some aspects of myself were constrained and needed to be liberated, others involved a disintegration and re-integration. I had to re-invent myself – find out what I really did believe and who I wanted to be.

One of a series of quick pictures I drew at the time to represent how I felt

Fig 11.2

For me this was a painful process of unpeeling many different layers of my professional and personal self, going deep into

the very heart of me. It was scary and I felt rootless for a while, even more vulnerable and open to the views of others. It was a time of great tentativeness, trying on new roles, and trying to find a place which I could call home. It is interesting that at the time someone asked me what I could least do without and I said 'my home'. I thought then I meant my house, but I think now it was a metaphor – a need to find that stability – my inner sense of self – my *spiritual home*. Yes, I was someone buffeted in a wind not of my making; trying to find through spiritual practice and through teaching practice some grounding.

The very process of reflection changed me and now when I looked around I could see deeper into the issues at hand and see the spectrum of management structures and ways people operated which perpetuated certain types of response to the issues. Torbert's *Action Logics* now made sense to me and were a powerful model in helping me to be a more effective manager and feel more in control of myself, rather than a victim of circumstances.

Can my emergent understandings help me also to be a better teacher? I now believed that it was important to fully articulate my intentions and the various purposes for my teaching approaches and activities. In making my pedagogy transparent to myself I could be a master at designing activities which were rich opportunities for learning. For example, I created activities which could simultaneously get across concepts of physics using various intelligences, while enchanting the students, supporting their passions, developing certain capacities and encouraging critical reflection on their personal beliefs and the nature of science. Yes, and there are also steak knives with that! I became a master (or was it a magician?) of juggling different intentions, creating rich learning experiences as well as allowing for emergence. Yes, come into my magical classroom where I can integrate constructivist, meaningful, questioning, significant, dialogical, ecological and ethical learning.

But am I *enabling* my students?

Yes, as I am experiencing powerlessness, I wonder whether my students are also experiencing this and I begin to pay closer attention to what I am doing in my classes. I start reading feminist discourses which alert me that there are more to issues than people coming from different perspectives or cognitive frameworks. There are inherent power structures in every aspect of education, from teacher/student relationships, learning theories and curriculum structures. These are generally unquestioned because they are so deeply part of the fabric of our education and social system. Yes, thank you Lauren for helping me to see my habitual assumptions about teacher/student relationships.

So how might I be perpetuating power inequalities in the teaching of physics?

I have tried to put in place empowering structures for students where the **assessment processes** are transparent, where we negotiate meaning and students are empowered to believe what they want to believe. By introducing **meta-cognition** I have tried to help the students unpack what lies behind many of the rules and cultures within science, sometimes encouraging them to come up with their own personal schemas or procedures while at other times providing them with heuristic devices to aid in their reflection. Do these heuristic devices shape the emerging insights and how could I give the students more ownership and choice in these?

I have tried to help the students understand their own **learning styles** and be more in control of their own learning, yet I am the one that ultimately plans the activities and orchestrates the learning in the classroom. In doing so I engage in little explicit negotiation with my students, rather it is based on their feedback or my observations of what I think they need and my own understanding of learning theories. I am the creator using their information, rather than *we create* learning activities together. The exception is when different groups run activities for the class, but this is still a task I have set them.

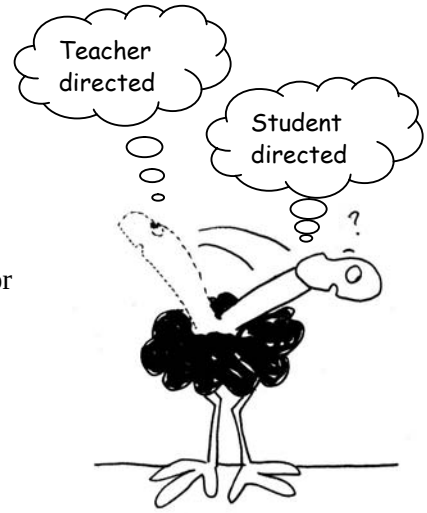


Fig 11.3

The more I try to be transparent about underpinning structures of learning or science, the more I realize that there are even more structures which act as constraints… and sometimes in the very act of making something transparent I might be putting in place disempowering structures.

For example, in getting students to mark their **mid-year exam** exactly as the examiners will at the end of the year gives them very valuable insight into the process which enables them to be more strategic and in control when they come to do their final exam. However, students may feel quite stressed about the thought of marking exams - others seeing their work, not feeling competent enough and afraid their marks might suffer if someone as 'incompetent' as them might mark their exam. So imposing such an activity without giving students opportunity to discuss their concerns and negotiate is as disempowering as the empowering experience I am aiming to create.

And then there is the whole question about the **nature of the exam** itself. It helps to determine student understanding in a paradigm which values 'right knowledge' and 'right procedures'. Students who are operating at *self authoring mind* used to coming up with rich, complex understandings of real situations are being tested using a *socialized mind* assessment device. Some educators might argue that the exam acts as a goal and a focus, yet this statement assumes we value learning where students achieve goals rather than have experiences which foster self-growth and understanding.

A key function of the exam is to act as a moderating tool for teachers; a way of checking their standards as well as ideas about physics. The exam establishes the content to be covered and the minimum depth required, ensuring students acquire foundational knowledge considered important to further education courses. Can teacher moderation of standards and content be done in another way? Is some knowledge more foundational than others? Should I be asking not how to help my students be better at doing the exam, but rather whose needs are being met by the exam?

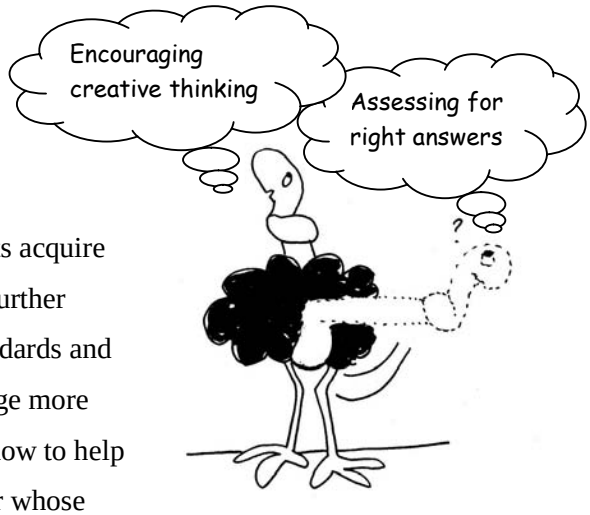


Fig 11.4

What is the role of the **criteria and standards** for the course? On one level they help students make explicit what it is assessors value in science (or other disciplines), enabling them to be more strategic in their learning, being more in control of their performances and outcomes. But when the standards are overly complex, poorly articulated or with no clear sense of development they serve to mystify and alienate students rather than demystify and empower.

They can be a means for assessment *of* learning (summative assessment), assessment *for* learning (help teacher diagnose and plan appropriate learning experiences) and assessment *as* learning (students learn as they assess themselves and each other). The very act of self-assessment can also build self-capacity in terms of self-reflectivity, self-awareness, discernment, confidence in self and their ability to judge and to create own standards.

But assessment can be quite artificial - it can give students a false sense of what it means to complete a task. For example, my journalist students for the first time in their school lives had to iteratively work on their writing to get it to sufficient standard for publication, rather

than just being happy with a C or B before moving onto the next task. Yes, it was tedious, but all said they learnt a lot from having to produce something for real.

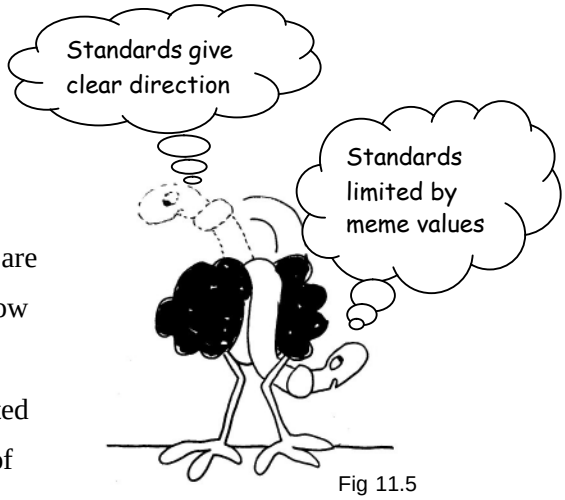


Fig 11.5

At another level, the criteria contain a whole lot of assumptions about the nature of the discipline which could be open to challenge. For example, in science syllabi, we could question what constitutes scientific inquiry, validity, integrity. Embedded in the standards are implicit values. For example, we value people who show the following characteristics: discernment, autonomy, breadth, depth, initiative (which are primarily interpreted from the pragmatic, enterprise *orange cultural meme* of Spiral Dynamics (Beck and Cowan 1996). And then there is the very notion that there are standards to be reached and that these can be simply summarised in 10 criteria (which is the case for every single 150 hour subject offered by the **T**asmania **C**ertificate of **E**ducation.)

How can I balance the need for the students to know explicitly what the teacher is looking for in 'good quality work' with the space to allow for emergence? How do I renegotiate the definition of what constitutes "good quality work" or even ask whether it is the work that is the important thing? How do I balance the need for students to renegotiate based on new aims and a new sense of self, with the need to validate where they have already come from? How can I value the breadth of learning which comes out of my classes but which is not valued through the criteria? For example, where is the criterion that recognizes transformative experiences and can this even be measured by standards?

I am really searching for democracy, not just in the way I interact with my students, but in the underlying structures of syllabi and assessment protocols.

Then there is the **content of the course** which is based around key ideas in physics. This subject is about coming to know a discipline and a discipline's approach to investigating the cosmos. You could say the big guiding question for this course is *what can physics tell us about the universe?* This is a very artificial question and quite different from courses which might be based around real research issues such as *climate change* which require multi-disciplinary approaches. Does this give students misconceptions about the nature of research – that it simply follows along topic lines? Yet, the course itself provides a rich context for exploring far more than the universe.

What is the value of ‘learning’ a discipline? For me, part of that is learning how the discipline fits within other epistemological approaches - but this is not required by the syllabi, just something extra which I put in, taking time away from covering the examinable content.

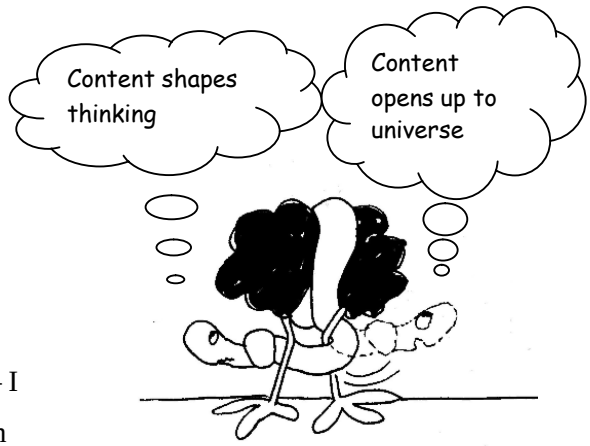


Fig 11.6

I feel quite constrained by the *amount* of content – I would like for students to experience a longer term investigation of their choice where it doesn’t matter what “content” they learn from it – it is the process they go through in an autonomous inquiry. I would like to explore a multi-disciplinary issue or problem so students can see how to appropriately integrate together various epistemologies (I do this to a small extent with the issue *Is your mobile phone killing you?)*. I have tried to contextualise the raw ideas of physics (e.g. circular motion can be contextualised by satellite motion and space flight, sound waves by the physics of music) asking key questions that motivate the need to explore each topic, yet I am concerned that my thinking is trapped within these artificial topic boundaries. I have become more clever and creative in making them meaningful and significant, without really questioning the value of doing so.

I am also still concerned that the very delivery of the physics course is based on the **Newtonian paradigm** of building knowledge bit-by-bit. Although I have tried to play with more holographic approaches in exploring topics, there is still much which is sequential in what I do. The very need to cover set ideas forces me into a narrow approach, assisted by my own need for logic and coherence. I wonder whether if the content was less defined what interesting routes and ways of thinking we might find as we explore questions or issues.

So what might it mean to see science education from a completely different point of view? What is foundational knowledge? What are the benefits of discipline knowledge? How can we find balanced ways of providing multiple experiences of science? What assumptions about science are we inadvertently giving our students as a result of the structure and pedagogies of science courses? How might we be empowering students as learners, scientists and global citizens through these courses?

It also concerns me that these academic students are learning all their subjects in a particular way – based on acquiring knowledge, processes and skills. They are not experiencing the

sort of learning my journalism students are – learning through action – learning to be **active citizens and agents** for change. Can a sense of agency just come through understanding and challenging your own belief systems?

But all this is still thinking from a very pragmatic place centred around the belief that it is important to teach students particular things - whether they are content, skills or attitudes of mind. What is education really for? I am really confused now. Isn't education for the whole person? And what does that mean? **Where is spirit in all this?** When we forget spirit are we suppressing the healthy development of the child? Is ignoring spirit one of the most disempowering things we can do?

Fig 11.7

During the period of 1997 to 1999 I was trying very hard to come up with an understanding of what education is for and what it might mean to educate for the whole person, including the spiritual aspects. Initially I saw spirit as something that added enhancement to students' experiences. For example, I used Egan's (1986) development model *(mythic, romantic, philosophic, ironic)* to plan activities which could stimulate deeper aspects of self.

When I discovered the development models of Steiner (Childs 1996) for the first time I found a coherent system which explains development of the child through spiritual development…. Yes, and it made me very worried. If this model is correct – that our subtle energy and spiritual bodies incarnate into the physical body in successive layers every seven years or so - then education which understands the implication of this and can assist it would be critical. To not do so might set up stress in the growing child. Particular Steiner education philosophies - such as not requiring students to move into abstract thinking or make judgements too soon, instead building aesthetics and heart are based on avoiding stress to the developing *spirit-soul-mind-body* system.

It seemed to me that Steiner is perhaps revealing development stages of the *spirit-soul-mind-body* system, whereas Egan is looking at *soul-mind*, and Piaget at the *mind -body* level.

What is my role then in helping to develop integrated *spirit-soul-mind-body*? What might it mean to help students heal that which has been poorly integrated and assist in further healthy integration? What damage might I be doing? And how do I reconcile this role with one of

teaching science? Yes, my head is going to explode! I have too many dilemmas at too many different levels or dimensions.

Can looking at Curriculum Metaphors help me understand my dilemmas?

Now let me move from my 1997/1998 self into my 2006 self, who has become a student of integral theory and curriculum metaphors. It seems that many of my dilemmas are a result of competing curriculum metaphors, some of which have been described by Schubert (1998). I summarize them below.

(Note: I have located these curriculum metaphors primarily within a specific meme in the spiral dynamic spectrum for the purpose of illustrating perhaps their cultural origins and intent - which is a little simplistic – in reality each metaphor could be situated across a spectrum of cultural memes according to the context under which they are operating.)

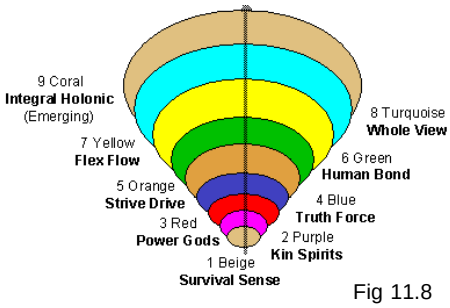


Fig 11.8

Curriculum Metaphor	Description	Intent	Criticism
Curriculum as Discrete Tasks and Concepts	The curriculum is seen as a set of tasks to be mastered and is derived from training programs in business, industry and the military.	'Apprenticeship' with an adult to gain certain knowledge and skills.	Does not prepare the learner for a changing world. Suited to technical training rather than conceptual understanding.
Curriculum as Content or Subject Matter	This metaphor portrays a traditional image of curriculum that stretches back to Pythagoras and Plato. This curriculum is one which receives contents from traditional academic disciplines and transmits them to the learner.	Curriculum development centres largely on subjects, contents, timetables and booklists. Needs may be defined in terms of preparation for university, commerce or general study.	Does not account for cognitive development, creative expression, and personal growth. Nor for planned and un-planned activities that are a major part of students' experiences at school.
Curriculum as Cultural Reproduction	The curriculum metaphor is concerned with the notion of transmission of cultural knowledge and values from one generation to another.	To prepare the youth for the culture of a certain community, state and country.	Helps maintain the status quo by transmitting middle class culture rather than that of the oppressed. Does not help develop critical thinking.

Curriculum as a Program of Planned Activities	Student learning is regarded as a planned program which is directed and executed by schools. It includes written documents – teacher guides, lesson plans, scope and sequence chart, and curriculum implementation packages.	Curriculum development centres largely on planning activities that are considered desirable for students.	Emphasizes outward appearance rather than inner development. It values outcomes and neglects the learning process and personal meaning.
Curriculum as Intended Learning Outcomes	Curriculum is a process of goal setting and drawing pathways to those goals. The outcomes are expressed in general terms like *"understanding the value of…"*. Today most curriculum frameworks have incorporated this image.	The curriculum is explicit and defensible. Teachers and students can determine their learning activities according to their needs and locale.	Draws attention away from unintended outcomes relating to school culture and the hidden curriculum.
Curriculum as Experience	This image of curriculum, following John Dewey, emphasizes experience rather than sets of activities. Learners select a learning experience according to its significance in their life.	With this notion of curriculum, the learners have a key role in curriculum process. Experiences are created as learners reflect on the learning process.	Students' involvement in planning and selecting the learning experiences is very idealistic - they may not be able to decide which is of significance and which is not. How do you implement this in a large school?
Curriculum as Agenda for Social Reconstructi on	This view of the curriculum holds that schools should provide an agenda of knowledge and values that guides students to improve society and the cultural institutions, beliefs and activities that support it.	To improve society – either by teaching desirable changes or by equipping students with critical thinking skills.	Even if schools were influential enough to effect change do educators have the mandate to direct change?
Curriculum as "Currere"	The curriculum is the interpretation of the learner's lived experiences – the learner comes to understand their past, how it drives the present and how it directs the future of their personal and professional life. Individuals come to a greater understanding of themselves, others, and the world about them.	Freedom from unwarranted convention, ideology and labelling. To mutually fashion new directions for oneself, others and the world.	Self-understanding is a parental responsibility. The search for self-knowledge requires professional therapists.

Fig 11.9

As soon as I put Holistic Education at the centre of my teaching practice I am moving into curriculum metaphors which differ from those under which the Tasmanian system is operating. I am trying to balance the authoritative *blue meme* (*Curriculum as content* or *subject matter* or as *cultural reproduction*) with the pragmatic goal oriented *orange meme*

(*curriculum as a set of planned activities* or *intended learning outcomes*) with the democratic pluralistic *green meme* (*curriculum as 'currere'* or *experience* or *an agenda for social reconstruction*). I am searching desperately for an integral solution.

Where does education for the whole person - the spiritual interconnected self - come into these metaphors of Schubert? Is it an extra dimension to each one? A new metaphor? Is it in the space in between? Is it possible to twirl around, incorporating multiple metaphors or are some mutually exclusive? Is it possible to only be consistent to Holistic Education ideals only if I am within a school dedicated to following these, rather than trying to create a holistic space within the mainstream system?

What might be a Holistic curriculum metaphor?

Scott Forbes (2003) conducted a study of some schools in the US who called themselves *Holistic* or *Democratic*, finding that many are consistent with educational theories of Bernstein and Rousseau. He summarizes key aspect of these 'Holistic Schools' as follows.

1. **All students are inherently competent** – students posses inherent learning processes, motivation and latent wisdom – no deficits, only differences.

2. **The student is active and creative in the construction of a valid world of meaning and practice** – heuristic process, arising from students' questions and readiness (not enforced content), meaning needs to be discovered by each person, group meaning, tolerance/accommodation, constructing convergent meaning through dialogue, *forming* of ideas (seeing connections) rather than *holding* ideas - leading to insight.

3. **Finding meaning can't be regulated** – children do not need to be shaped by older, more knowing adults into forms the adult feels are right. The child's meaning structures do not need to be shaped. Self regulation is both a means and an end. While outside regulation can help, to rely on it is counter-developmental.

4. **There is a critical, sceptical view of hierarchical relations.** The teacher's function shouldn't go beyond facilitation, accommodation and context management. Adult role is to support the individual learning process of students and not to determine them. Facilitate experiences which may help student to know oneself better at the end, but the content of that knowledge can't be known or regulated. Teacher

attributes are: understanding students, their needs, correct pedagogic process, relationships and importance of their own development. Teachers are active and creative in construction of valid meaning and practice. Students have a role in hiring and firing teachers.

5. **Shift in time to the present.** The 'now' is perceived as when the connections at the heart of meaning are made, and need to be remade, if something is to remain meaningful. Remembered connections are not as powerful.

6. ***Being* precedes *doing*** – what a person 'is' is more important that what a person 'does'. Education should be primarily about developing a student's being. The problem with *becoming* is that it focuses on the future, what one hopes to be, rather than the present – what is.

7. **Everyone who is actively engaged in the learning process must be learning** – reciprocity in adults and learners.

I believe that what Forbes is describing here are schools whose centre of gravity is primarily within a *green* cultural meme. From Schubert's point of view this might be best described by the metaphor of '*Curriculum as experience*'. These schools represent just one sector of Holistic Education – one which is often criticised. Unlike models by Miller (1996), Nava (2001), Nakagawi (2000) and Steiner (see Childs 1996), they do not appear to have well articulated spiritual pedagogies. The notion of student choice in learning is in direct contrast to Steiner philosophy for young children, where he believes that requiring students to make judgements or choices too early damages the healthy development of the individual.

So why do I introduce this? Because it provides an example of how some schools have tried to move from the *orange meme* into the *green meme*. Even though these small schools usually contain a spectrum of ages, the principles might be particularly relevant for Year 11/12 students who are moving from *socialized mind* to *self-authoring mind*. It also enables me with the benefit of hindsight (because the book was not written while I was teaching physics) to explicate some of my tensions.

I see that I too believe that **students are inherently competent and have latent wisdom**, yet in physics I am delivering set content with carefully constructed activities to create certain opportunities for thinking and understanding. However, I do try to excite students'

curiosity and bring in their own questions, enabling a certain freedom for student construction of meaning.

I wonder then what it might mean to enable freedom for science students to pursue what they want to pursue, and whether they have the skills or sense of self to do this because of our socialising curriculum. What structures in colleges of 1000 students could enable this or is it only possible in small intimate schools? And how does a freedom to pursue what you want provide pre-requisites for further education? Is it possible to balance some opportunities for freedom with more structured approaches?

***Australian Maths and Science School* in Adelaide**

- Enables Year 10 and 11 students to learn most of their discipline knowledge (English, Social Sciences and Science) through science projects they are doing which are linked to scientific research at Flinders University.
- Students are aware of their own learning styles and have help in mapping their progress and achievements throughout their journey.
- They then move into traditional Year 12 where they are able to get properly accredited against the State education system.

Fig 11.10

Yet in teaching journalism I have been able to immerse myself in the *curriculum as experience* metaphor (albeit students assessed at the end of the day against criteria and standards.) Students learn through *doing*. I give my students the power and freedom to pursue a group magazine of their choice, to follow their passions, express their voice and learn how to become effective agents in changing and creating their world (*curriculum as an agenda for social reconstruction?)* I provide some structure and cohesion, some 'just-in-time' learning activities, some 'just-too-late' debriefing and I *occasion* opportunities to challenge thinking and perspectives.

I also encourage deep reflection of their learning experience – asking them to reflect on how they and their thinking are changing over time (*curriculum as currere*). While I have taught my physics students how to think, how to apply critical lenses and understand paradigms – a mental emancipation, my journalism students have also been empowered through *doing* and *reflecting* - engaged in a journey of self-awareness, discovering their self-power - perhaps a holistic empowerment of self.

But I haven't stimulated in my journalism students a sense of curiosity nor a sense of awe in the universe in the way I could with my physics students. It seems that my physics students have journeyed outwards into the cosmos and my journalism students inward into self. Perhaps there is room for both experiences in a student's overall course in College.

Back to Forbe's list. I now wonder whether I have an **agenda about shaping or forming students** according to the different development models and value systems to which I

subscribe or whether understanding these development models enables me to be a more effective *facilitator*. Is just being a facilitator a little simplistic? Are there more roles? What teacher roles are consistent with Holistic Educational principles, which are contradictory and is it important to be consistent? Is democracy taken too far in these models? Is democracy important for students as they approach the adulthood transformative learning of Mezirow, but might it be less appropriate at earlier stages?

I wonder what an **accreditation process** might look like that can help employers easily understand and value the *being* of the whole person who they might consider employing. And from that what might our curriculum frameworks and assessment models look like which support *being* as well as *doing*? Where would *standards* fit here? Yes, how does the notion of *being* have meaning in the context of our pragmatic, material world?

I wonder about conversations that might take place in colleges about the **relationships between teachers and students** and what it might mean to enable true **democracy** in these relationships. How might teachers and students have to reconceptualise themselves? What might it mean for different teachers to operate from different memes of ethical tactfulness? What new types of ethical tactfulness might we have to practice as we move in *memes* and what processes can help build these self-capacities? Where is the time for all this?

What sort of culture in colleges would support **teachers as vulnerable learners**? How can teachers be encouraged to take risks, make mistakes and learn from them in the same way that an experiential curriculum allows students to do so?

What about **democracy** in questioning the **underlying power structures** in the processes and pedagogies that we bring to teaching/learning? For example, my interest in making physics more 'girl friendly' moved from an *orange meme* approach where I tried to make it more relevant to girls (personal contexts, ethical and social issues) to developing discourse structures that could enable them to be part of a physics conversation – moving to the *plural mind* critical theory approach of the *green meme*. But what other pedagogies might I be using which haven't moved to a more pluralistic approach? Does it matter?

I wonder about opportunities for enabling students to *be* in the **present moment**. How can I help students be active constructors of meaning and experience? Where might spiritual practice assist in fostering greater mindfulness and presence? Perhaps here there is a reflexivity between *being* and *doing*… not one <u>or</u> the other… but a partnership which also includes *reflecting*.

How does the course enable students to learn things which are not simply useful for a distant future but also for the immediate present? How much of the physics course is foundational knowledge or building blocks for later? Have I made it directly relevant to my students' questions and lives *now?* What might it mean to do this better? What present moment capacities might the course be building?

Oh dear, I want to move forward in meme cultures but the weight of the current system and its deeply embedded interconnections with the greater social community seems to be insurmountable. Perhaps the answer is not moving to a *green meme* model of schooling but an *integral model* which enables aspects of all parts of the spiral? Can we transcend and include? Is it possible to find partial truths which can happily co-exist from the different memes? Or is it also possible to run a system with inherent tensions? Perhaps allowing these tensions to be part of the system rather than trying to solve them is the force which drives continued evolution?

What is the current culture of the Tasmanian education system?

When the Tasmanian Certificate of Education was introduced in Tasmania in 1992, I believe there was a movement in the underpinning curriculum metaphors from primarily operating in the *blue meme* to operating in the *orange meme*, which was the predominant culture of society at the time – *being enterprising*. A key to this was bringing in concepts of *criteria* and *standards* which opened the box on teaching approaches, valuing far more than had been valued before, making assessment transparent, enabling conversations about subjects and pedagogies between teachers in ways that had not been possible before. However, it did this still within the overall structure of subjects and content.

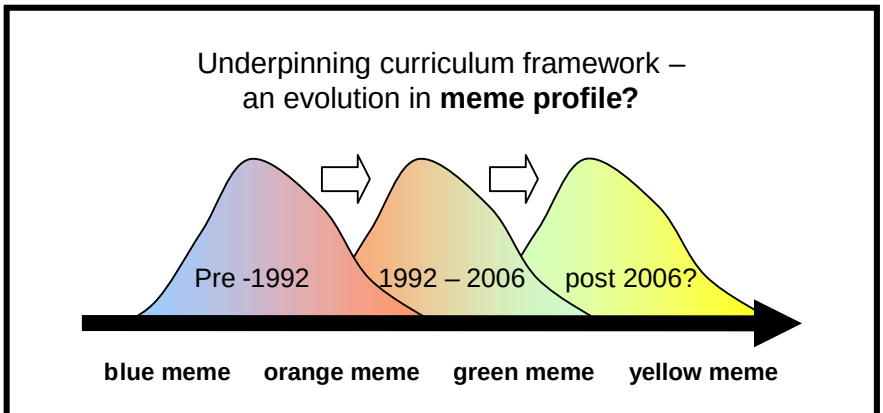


Fig 11.11

I don't think that such a transition could have been possible if the predominant culture of society still rested primarily within the *blue meme* (as is the case for many Asian countries who might have difficulty with implementing such a curriculum structure). It would not have been possible without key curriculum leaders operating from the *green meme* (consultancy, democracy in implementation).

It was a *transformative* curriculum framework in that it fostered transformation of the way many teachers and schools operated. It also paved the way for teachers to explore the more experiential *green meme* oriented curriculum metaphors through the teaching of enterprise or project based subjects where students engaged in an experience of their choice, being assessed against generic criteria (key competencies).

Curriculum 1970 - 80's	**Curriculum 1990's**
▪ Preparation for University & work ▪ Subjects at Level III (good students) → Level II → Level I (poor students) ▪ Examinations and normative assessment ▪ Subjects for less able students watered down versions of pre-tertiary subjects ▪ Learning factual knowledge and discipline skills considered important pre-requisites for university learning	▪ Preparation for University, work, life. ▪ Changing cliental for non-pre-tertiary subjects as students required to stay at school longer ▪ Wide range of subjects designed for different abilities and mixed abilities ▪ Criterion Based Assessment (A,B,C) - based on achieving set standards transparent to the students. ▪ Learning generic skills and processes valued by business *(initiative, emotional intelligence, thinking, responsibility, teams)* ▪ Vocational Subjects and Assessment of Competency (✓) ▪ ICT revolution ▪ Many students doing part-time work
Pedagogies 1970 - 80's	**Pedagogies 1990's**
▪ Chalk and talk ▪ Sequential learning ▪ Desks in rows	▪ Chalk and talk ▪ Sequential learning ▪ Collaborative learning ▪ Problem based learning ▪ Enterprise, Project and Community based learning ▪ Just in time learning ▪ Flexible delivery, ICT ▪ Learning styles and Multiple Intelligences
Teaching metaphors 1970 - 80's	**Teaching Metaphors 1990's**
Teacher as instructor, director	Teacher as instructor, director, facilitator, trainer, emancipator, mentor

Curriculum Metaphors 1970 - 80's	Curriculum Metaphors 1990's
▪ Curriculum as Content or Subject Matter ▪ Curriculum as Cultural Reproduction *Metaphors from Schubert (1998)*	▪ Curriculum as Content or Subject Matter ▪ Curriculum as a Program of Planned Activities ▪ Curriculum as Cultural Reproduction ▪ Curriculum as Experience *(project based learning)* ▪ Curriculum as Discrete Tasks and Concepts *(Competency based learning in Vocational Programs)* Fig 11.12

But now in 2006, 14 years later, many College teachers are finding that this framework is creating limits and tensions – it has created a new 'box'. We have all grown now and many of us, like me, are feeling squashed by that box. We have opened the lid and are looking for new possibilities. Does it have to be a new, bigger box? The challenge now is to create something which is also transformative, but recognizing that the starting point for that transformation has now changed and thus needs to be designed from a new paradigm.

> "We can't solve problems by using the same kind of thinking we used when we created them."
>
> Albert Einstein

Meanwhile, there has been a revolution in K-10 education in the state – the *Essential Learnings* which has moved further away from delivery of 'subjects' to providing more project based, integrative experiences for students alongside the traditional discipline learning. There are now no longer subject or discipline based criteria or individual subject marks – rather generic criteria. So high school students might be assessed on *being literate* or *being numerate* from three different 'subject' teachers giving an amalgamated assessment – a problematic process that teachers and the community are experiencing difficulty coming to terms with.

Some of the generic criteria reflect values from a *green meme* – helping students create a sustainable world and preferred futures, become agents in democracy, encourage critical and reflective thinking. What do these mean? In some schools, some teachers are having difficulty in creating pedagogies that enable their students to *act* democratically. It

> "A sense of agency implies that one can understand perceptively. Such understanding requires the ability and disposition to become critically reflective of one's own assumptions as well as those of others. Engage fully and freely in discourse to validate one's beliefs, and actively take reflective action to implement them."
>
> Mezirow (2000)

requires not just different teaching approaches but different attitudes about the role of teacher, students and content. Perhaps, if a teacher has been working in an autocratic school then they might have had limited experiences of acting democratically themselves and find it difficult to explicate what it might mean to teach it.

Can many of the current tensions in the system be explained as a dislocation between the meme profiles of students, teachers, management of schools and school structures, and the underlying curriculum framework? So a manager of *behaviour management* in a college could be operating from predominantly a *blue meme* (control, rules, consequences) while struggling with a new curriculum which aims to enable student freedom and democracy – *green meme* – while working with students who are just moving from *socialized mind* to *self-authoring mind* and who are wanting to experience control and self-expression but whose development line profiles are at different stages (possibly including a poorly developed ethical line).

So the feeling of unease that people have with aspects of the system could be a result of such unexplicated conflicts in both personal and cultural values. And those people might feel marginalized because their values are now considered inappropriate, no matter how deeply and sincerely held.

University meme cultures in teaching physics

In 1999 and 2000 I was coordinator of a collaborative action research project at a university working with five physics lecturers to improve the first year physics courses. (I describe this project in more detail in Appendix 3.) When I commenced the project, I was quite naïve about the issues of transformation; believing initially that it was a simple matter of assisting the lecturers in developing greater understandings of student learning and adopting more effective teaching pedagogies. I thought by doing this I could help shift teaching practice from a paradigm of *physics as a body of knowledge* to *physics as a process of inquiry.*

As you have read in the previous chapters, there were complex reasons particular to each participant – their habits, beliefs about science, sense of self - which made adoption of different pedagogies problematic, despite their own intentions to change their practice. Given the individual nature of transformation is it possible to stand back and see larger patterns?

The first step of the physics project was the initial unpacking of what it meant to be a scientist and the nature of scientific inquiry; discovering it was more complex and richer than we had first thought. This gave us clear goals as to the sort of thinking/inquiring environment we would like to create for the students. But in trying to create such environments we gained conflicting feedback from the students and were faced with seeming failures. We were presented again and again with 'disorienting dilemmas' which we tried to understand – looking for explanatory theories, trying something else and seeking more feedback.

We were engaged in successive layers of meta-cognition as we needed to look deeper into ourselves… what were the underpinning beliefs and ways of thinking we had about our teaching and about science? Who were we as scientists? How did we think? How is that different to how our students think? How do different people learn? And we needed to create amongst ourselves a meta-language and new style of collaborative inquiring discourse in order to express and explore these deeper questions. Each person ended up coming up with their own learning theories and ways of delivering inquiry based pedagogies, and each took from the project something valuable about the collaborative process we used.

Can we interpret this journey from a spiral dynamic point of view? Perhaps the physics lecturers were initially *operating as scientists* in a culture primarily defined by the **orange meme** (innovation, autonomy, inquiry) while *teaching science* within a culture defined by the **blue meme** (authoritative knowledge)? Was the *way of inquiring into their teaching* (through a process of collaborative reflexive inquiry) helping them to operate in a culture of the **green meme** in *thinking about teaching* (plurality, multiple-perspectives, concern for the needs of others)? As a result of this **green meme** meta-cognition, could they begin to articulate and explore what it might mean to create a *science teaching culture* situated in the **orange meme** level?

Cook-Greuter (personal communication, 2005) suggests that we teach at a level lower to the one we are operating at. By making explicit what we do and why we are doing it, we develop the ability to move to the next perspectival level and thus be

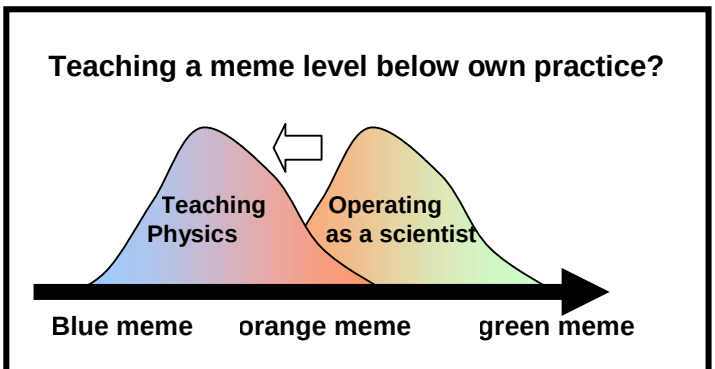


Fig 11.13

able to teach at the level at which were previously operating.

As the lecturers were involved in unpeeling the layers of their teaching practice, I was also challenged to unpeel the layers of my own practice as 'educational expert' and leader. Because although I was teaching my own physics students from orange and green meme perspectives, when I was teaching the teachers – trying to make transparent what I do as a teacher – I found myself falling back to more trivial constructivist and 'Sue, the authority' practices (blue and orange memes). The project forced me to move in perspectival level when it came to understanding the transformation of others.

One result of the project was a better understanding of the learning culture of the students and their expectations. It seemed that student exposure to learning in their first year university courses was primarily through a *blue meme* culture – sitting passively in lectures and tutorials, focused on acquiring the information needed to pass the tests and exams. When the physics lecturers tried to change the learning/teaching culture in their physics courses to a more thinking, participatory *orange meme* culture they found that about half the students embraced this process but the other half did not like it, primarily because it was counter to their other experiences of learning at university. From our interviews it seemed that these students had an expectation that university learning should be based around acquiring content understanding.

Student Concerns

- Too many different approaches – don't know where I stand.
- Which bits are being assessed? What do I need to learn?
- I expect to learn information to help me with the tests.
- I don't want to have to think in lectures – I just want to take down the notes.
- We don't have to do this in our other courses.
- When we are asked to look deeply into something in a lecture it takes time away from getting the content of the course.

Fig 11.14

How can we change a deeply embedded culture of learning? Where do students expectations of learning come from? What expectations and experiences are they bringing from their College and high school experiences and how quickly do they "fit" into the culture of their teaching institution?

An integral framework for curriculum

So now if we look at the **whole education system** from kindergarten to university we might see several different memes operating as students move from primary school (k-6) to high school (7-10) to college (11-12) to university.

Should we have a consistent set of memes across the whole education system? What happens if a student moves from a *green meme* in high school to an *orange meme* in college and then to a *blue meme* at university? Is this counter-evolutionary?

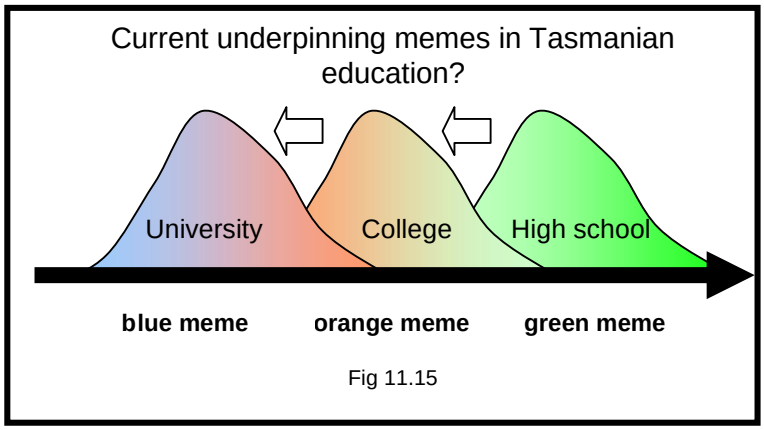


Fig 11.15

Should our educational meme culture be *evolving* to match our students' own development? What might a whole science system look like that takes that into account? (This is what I explore in Chapter 12.)

Could we envision the whole system from an integral perspective? And how might we move to it? What sort of transformative curriculum frameworks would need to be in place to allow teachers to start where they are at and take their own journeys?

Perhaps, an integral framework would take into account the various curriculum metaphors and their cultural location. It would examine practice and ask what aspects of that practice express the positive aspects of a particular meme culture and what aspects detract? How might we then artfully marry the ways of operating in the different meme cultures? How could our processes help flourish and transform all people involved in the system – students, teachers, managers, community?

Perhaps an integral framework might also look at competing notions of curriculum metaphors and ask what purpose of education do these assume? What aspects could we integrate? It might do a quadrant analysis and see which aspects of **I**, **WE**, **IT**, **ITS** are being covered and what might be missing.

An integral framework would aim to be transformative in that it demands of teachers a critical reflection of what they do… by encouraging self-reflection and transparency it stimulates movement in perspectival or meme levels. So it wouldn't only *accommodate* various meme cultures, teaching styles and underpinning metaphors; it would require teachers to engage in dialogue about where they intend to situate themselves and why. It

thus aims to lead teachers into a more integral perspective of what they are doing, though their practice might still be situated in particular memes.

But an integral curriculum framework would also aim to balance the system needs with the individual needs, recognizing and honoring each teacher and their own need to be a master of their journey. It would recognize that each teacher also says something about the system – we are all indicators of the system and it is important to understand what these indicators are telling us. Yes, what might I be telling about the system?

The role of Integral teachers

If education starts with the *whole person* then what might be the role of a teacher operating under such an integral framework?

Gordon (forthcoming) has suggested that we can map the roles of teachers based on the quadrants, using Wilber's 8 indigenous perspectives as referents. Underpinning her development of such roles is the notion that the key purpose of education is to assist in the Integral development of the student. So, if we consider the student as having - **I** - interior states of being, **IT** - body and the subtle bodies, **WE** - cultural situatedness, **ITS** - inter-relationships - then the role of the teacher is to help each of these aspects of self to *flourish* (inner perspective) as well as to *be perturbed* into the next stage (outer perspective). For each quadrant there are different teacher roles or metaphors that can describe this perturbing and flourishing function.

	Metaphors and roles of the Integral Educator
I **Interior Subjective** **(upper left)**	**INSIDE: THE GARDNER:** facilitating the inner flourishing of students: developing fallow, healthy line, state, and quadrant potentials; introducing the learner to life-enhancing knowledge, insights, frameworks, "stories," and metaphors; helping the learner to extend these and current line abilities across AQAL domains; helping the learner to incorporate the partial truths of split-off lower levels and exclude the limitations of these levels; and creating a climate of psychological safety. **OUTSIDE: THE ALCHEMIST:** drawing forth the inner evolution of students into new levels, especially, eliciting higher stages of the cognitive, perspective-taking line; preparing the ground for the transformation of lines; and moving lagging lines and type up to the level of the learner's current cognitive development.

IT **Exterior Objective** **(upper right)**	**INSIDE: THE HEALTH ALLY:** supporting, encouraging, or directly enabling the health and healing of the various levels of the learner's body, including the brain. **OUTSIDE: THE COACH:** stimulating the learner's stretching to optimum bodily functioning and the next stage of body and brain development.
WE **Interior Inter - Subjective** **(lower left)**	**INSIDE: THE INITIATOR:** initiating learners into their culture(s)' unique, interior ways of inhabiting AQAL world spaces and honoring the life-enhancing aspects of these. **OUTSIDE: THE LIBERATOR:** releasing students from exclusive identification with their culture(s)' unique, interior ways of inhabiting AQAL world spaces by helping learners transcend the limitations of these perspectives.
ITS **Exterior Inter- Objective** **(lower right)**	**INSIDE: THE CITIZEN:** reproducing the unique, exterior ways the learner's society (e.g., societal institutions, systems, and roles) inhabits world spaces; helping learners to embody life-enhancing societal aspects. **OUTSIDE: THE ACTIVIST:** freeing students from reproducing the life-diminishing aspects of their society's unique, exterior ways of inhabiting world spaces by empowering learners to transcend the limitations of these in embodied ways. *Note: AQAL means All quadrants, all levels*

Fig 11.16

These provide very powerful metaphors for teaching; opening up rich possibilities, where teachers may realize that they tend to take on certain roles more than others, and that as integral practitioners they also need to examine, try out and develop all roles in their practice.

Underpinning these roles are some key assumptions about the purpose of education, some of which might seem to be competing, particularly when not expressed from the perspective of *integral mind*. For example, two conflicting curriculum metaphors *curriculum as cultural reproduction* and *curriculum as an agenda for social reconstruction*, can be united in this model – one representing the *inner - flourishing* aspects of education and the other the *outer-transformative* aspects across the **WE** and **ITS** quadrants. Similarly *curriculum as experience* and *curriculum as 'currere'* also could be seen to represent the inner and outer aspects across all the quadrants.

Gordon's roles for teachers resonates with me, partly because I was engaged in rich discussions with her in explicating these roles in 2005. Those passionate discussions were an opportunity for me to tease out my own sense of what it meant to be a holistic teacher and to contextualise the roles I was taking within a system culture which may not have supported them. I began to realize that I was, in fact, covering all of the roles of an *Integral Teacher* – my need to empower my students was providing the *outer* element, and my need to enhance the meaning of their experiences with spirit was coming from the expression of the *inner*. I also find her language very beautiful and inspiring, particularly the notion of *life-enhancing* and *life-diminishing* aspects (though is this demarcation subject to judgement?)

Does mapping teacher roles on the quadrants help me? I think so. It helps me understand why I respond to some students in some ways, and others differently. Some students might have issues coming from the **I,** whereas others benefit from help in the **IT** quadrant or the **WE**. Appropriate action on my part requires me tuning into what is happening and working in the area that is needed. The model also helps me to see that all my subjects (Journalism, Physics and Maths) enabled me to take on all roles. So although in 1999 I was feeling suppressed by the limitations of the system, I was still able to dance between these various roles. But perhaps a curriculum framework coming from an integral perspective may have enabled me to be more effective in the way I could express these roles?

The model also helps me see the enormous demands on being an 'integral teacher' and the importance for self nourishment. It makes me realize how much I don't know in supporting the development of the whole person. It is so much easier thinking that your role as a teacher is simply to get subject ideas across!

And where do subjects and curriculum fit here? There is no role saying *instructor of information*. That is because these roles are based primarily on the objective of integral development of the 'whole person'. It is one holon. Asking questions such as *How might I teach physics?* or *How might I design an integral curriculum framework?* would create a different diagram because they are coming from different holon levels.

No, I don't have all the answers. I have only just started flagging the questions.

So where does this take us in terms of transforming science education?

Where do we want to go and what are the issues? What are the implications for teacher transformation and system transformation? What has the description of my journey, my dilemmas and my efforts to create transformation with my colleagues helped in revealing about the barriers to transformation?

I am not suggesting that the 'wonderful world of physics' that I have created is something that should be the vision for science education… but rather the journey I have been on and the issues that have arisen might stimulate thinking, insight and dialogue about where we wish to go from here. What can we learn from my journey through the different classrooms - constructivist, meaningful, questioning, significant, dialogical, ethical and enabling classrooms? What might be missing that should be part of the dialogue? How might the very structure of how I have organized this journey limit our view?

How has the structuring I have done using Integral Theory (outer perspectives) and the going deep into my experience with Holistic Education (inner perspectives) helped in revealing a possible grand narrative for science education?

Where am I now?

Where am I now? Where have my numerous attempts of deconstruction of self left me? Who am I?

In unpeeling the layers of the onion one might expect to lay the person bare. As I peel away, the more I understand what might have shaped and formed me. The more I lay bare the implicit assumptions, values and worldviews, the more I see my interconnectivity and entanglement with the greater world in which I live and how my very thoughts and actions are constrained by the culture of that world.

Yes, I can go even deeper into unpeeling the layers at a mental level but would I then just be riding down a relativistic spiral? At some point I need to stop and be grounded and recognise something important. Yes, I am entangled in the world and perhaps to find this individual whom I call 'myself' I could continue to deconstruct all of this. But when I look from another perspective, I see myself not as a separate consciousness, but something far greater.

Yes, rather than disappearing I am in fact expanding – as these interconnections shape me, they are also the home of my consciousness. Perhaps I need to embrace my entanglement.

As I look deep into the heart of myself, I discover the heart of something far greater than me. I am the world and its culture. And perhaps if I look deeper still I might expand further?

Perhaps as we move up the perspectival levels we are moving from *amorphous belonging*… to *individuation* … to *integration* …. to *pure actualized being*. I am beginning to integrate and perhaps in doing so I am finding my '*true home*'.

Let me engage my spiritual eye. What do I see? I am you. You are me. You tell my story and I tell yours. When I remember this it engenders a sense of compassion and love, humility, a willingness to be surprised, and non-judgement. What might be possible for us together in this place?

Perhaps, as some people say, the point of education is just to remember.

Beyond the Tao

Interlude 1:

A poem written in a time of angst… ethical tactfulness for a green meme? The dilemma of teacher vulnerability?

The child, age 5.
Full of innocence.
A shining face,
A longing infused with optimism.
Hopeful,
Expectant of everything good,
Everything worthwhile.
Life is a joy,
An unfolding,
An adventure.

He is yet to experience the boxes;
The separation of people, of knowledge,
Of feelings.

Life is an ambiguous, amorphous whole
Interpenetrated with light.

Experiences are to be experienced,
Not to be judged, or assessed.
Possibilities are open doorways,
Not yet burdens of unfulfilled potential.

The child smiles,
And imagination flows uninhibited.
Logic doesn't get in the way of a good story.
Surprising tangents play at the edge of consciousness,
Challenging the adult to re-enter the wonderful childlike world of surprises,
Of unfinished sentences.

But when they come to me at age 16, disillusionment has dulled the shining faces. Yet they still dare to shine. Hopefulness and longing are now cloaked by cynicism, bravado.

Why is misbehaviour such an issue for so much of our education system? An indication of the dashed hopes and the shallow worldview indoctrinated through a soulless, impersonal education production system?

Yet even at 16, after 12 years of this mind-numbing process there are still glimmers of possibilities of hopefulness on the faces of these students whose optimism has taken many harsh blows. And to reach them, to gently blow on that dying spark and see it flame and grow and consume, to see the passion and the longing transmuted into fulfilling participation and joyful questioning - what a privilege for the teacher!

These young people show incredible resiliency in their learning journey. I am humbled. I am a terrified wreck masquerading confidence in my service to others. Yet my own spark is so easily diminished, so fragile. In being with these young people I am nurtured; my self-worth and my feelings of being someone who can make a difference grow. As I nurture them, I am nurtured.

What a state! The dependant teacher. Is this unhealthy or is this indeed the universal principle of flow, of reciprocity? At every level of my role as a teacher there seems to be such interdependency. Unhealthy? No! Authentic relationships swirling into different patterns and roles. If our relationships didn't have this interdependency would they in fact be relationships or just lumps of wood lying next to each other? We both have to catch fire in order to produce a good flame. Can the teacher then stand back, be detached, a conductor, unaffected by the music being produced?

Perhaps it is the fact that issues of my soul are being lived through my teaching experience that brings the depth of relationship that gives permission for students to open their souls. Instead of participating with only the public self they go deeper and bring their hearts and minds fully into experience with their learning and each other. We are open, honest, authentic and whole together. Can I expect them to be so without me doing the same? My angst, my quests, my joys, my enigmas, my excitement *are* me. I let my soul shine forth in my face and alight theirs, allowing them to experience wholeness, hopefulness and the innocence of new found wonder in the world.

Sue (2000)

Interlude 2: Some students' thoughts about empowerment

- a contrast between subjects based in different curriculum metaphors

On the inside front cover of Triffany's physics notebook:

> No one can make you feel inferior without your consent.
>
> Eleanor Roosevelt

Physics Students (1997 - end of year questionnaire) – to what extent and how has the delivery and content of this physics course empowered you as a human being?

Giving me the knowledge and processes to help understand the world of phenomena better.

Confidence to deal with washing machines! Understanding how things work.

Seeing science as a tool that you might use under some circumstances.

Spiritually I have been given more ideas with which to form my own beliefs and to contemplate life.

There has been no other learning that I have been so empowered by. I cannot believe that I have been able to gain so much personally and yet still be able to pass the exam.

To be able to think for myself and trust my own processes of thinking.

It is not so much the course content but the skills learnt that have impacted me – things like visualization, goal setting etc have now become part of my everyday life.

Journalism Students (1998 - end of year reflection for final assessment) – how has your notion of empowerment changed over the course of the year?

For me, being confident in who I am and what I live for is followed by a sense of direction and empowerment. There are different sources of empowerment for everyone. Bad stuff is going to happen to us and it is how we deal with it and overcome it that will determine to what extent it affects us. The more empowered you are the more likely you will pick yourself up and continually live in hope for a better day.

I think for me, at the start of the year, that empowerment basically meant honouring the right to free speech and being able to follow your own truths while everybody realizes that you have a right to do so. Now, I have also realized that by empowering yourself you are given the power to influence others through your own example. I think that influencing others is a power I have really developed over the last 18 months, because now more than ever I am willing to accept my own personality (good and bad) and become more self-aware. I would not have been able to embrace my own individuality without the freedom to do as I like – the freedom you have given us in this class.

At first I thought that empowerment was a feeling of nirvana, euphoria, absolute bliss. That being empowered meant being happy with one's self. I now think that empowerment is the ability to make others feel this way.

During the year my confidence and self-esteem has been on the increase. Now I feel I could just about do anything if I put my mind to it! Especially with journalism. I came into the class thinking "Am I doing the right thing?", and now it is like "What the hell! I will give anything a go!". So empowerment means a lot more to me now.

I think empowerment has changed for me. At the beginning of the year I wrote a poem about empowerment and since then I have become more like the person I wanted to be. Although this has been the case, it is not through achieving my goals, rather it is in learning about myself … that I am a stronger person in controlling myself than I am in controlling others.

I think empowerment is the urge to enable yourself to grow, to push yourself to learn, letting yourself learn more, wanting to learn.

Interlude 3: How to transform others…

Part 1 – a perspective from Spiral Dynamics

Spiral Dynamics suggests there are two ways for people to facilitate the transformation of others…

1. Someone (usually a person that is 'leading edge'), who has been through the process and is slightly ahead on the spiral, helps to draw others from one cultural perspective to the next and in the process continues to move themselves.
2. Someone (a spiral master), who can see the whole spiral and can go in at any point, takes on the perspective and the culture of those wishing to move and tunes into what is needed to stimulate and sustain movement.

Part 2 – a reflection on my role as coordinator of a university physics project to improve student learning – assisting transformation.

In my own teaching practice prior to 1999 I had found in myself a deep care and understanding of my students – a compassionate non-judging. I felt close to them, concerned about their needs and wanting to be an advocate for those needs. It concerned me that their capacity for soul expression was not being activated in their other subjects and in some cases diminished. So I might often get quite frustrated with my colleagues' practice in my own school environment, wanting to act as a change agent, stirring things up and challenging current practice

Being involved in the collaborative action research project with the university physics lecturers caused me to question this inconsistency in myself – how can I have humanity with one group and not another?

When I started the university physics project it was very easy to stereotype the lecturers. I had read a study by Taylor (1997) of university teaching of science and maths in the USA. He created two impressionist stories – **Dr Stern** – a conglomerate of male lecturers he had observed and interviewed (who taught traditionally, distanced themselves from students and expected the real learning to happen outside the lecture theatre) and **Mary** – a conglomerate of female lecturers (who was very caring towards her students, building relationships, although she still taught in a traditional way).

When I think of all that is that is wrong with university teaching of science I think of Dr Stern. I know many of my science colleagues also remember their experience of the first few years of university in this way – you are only treated as a person once you get to third year or honors. Yes, some of the lecturers could have been Dr Stern, but were they really? Underneath they were very caring and warm people, concerned that the students enjoy and be excited by physics and experience learning success. It was very easy for me to make value judgments and I had to stop myself, and make an effort to come to know them, their thinking processes, their aspirations. To look behind what they might be doing and saying for the deeper reasons.

In a sense they represented to me an 'otherness'. I could identify with the story of Mary – my classes were built on the notion of relationships and care. Now I had to identify with the other perspective, rather than rejecting it. This was a little tough. I was often frustrated when well planned activities for lectures or labs ended up being pedagogical disasters. I wondered what on earth had happened and why.

So, for example, a really good idea for group work in a lecture might only partly work because the lecturer hadn't fully explained the process of the group work and had minimal information on the cards he handed out. Yes, the students told me how confused they were in the interviews afterwards and how long it took them to actually work out what they had to do. So now I listen closer to his instructions and explanations of physics ideas and I begin to realize that he often skips steps. Why?

Then one day I am sitting quietly in an office when he and a postgrad student come in and start using the whiteboard, writing up furiously lots of equations, talking a foreign language. They are fully engaged in this shorthand language and I have no clue as to what as been said. It shows me a completely new side – a highly competent thinker and researcher, totally at ease in his own milieu – a vast contrast to the way he seems in lectures – which comes across as a little incompetent.

So, I now watch the lecturer as he explains ideas one-to-one in a tutorial with a first year student and then I have worked it out. He is just too clever to teach this course. His first language seems to be mathematics and that is how he thinks – he does not need English explanations to tie the maths together. In order to speak to students he has to translate his language into one that they understand.

OK, so now I have a theory of why he finds it difficult to construct others' understanding, I talk to him about it and tell him that I think he is too clever. He laughs, pleased. "Perhaps," I say "You need to see yourself as a *translator*, rather than explaining what you know yourself in your own physics language, you need to understand the students' physics language and thinking which is very different." This seems to be a useful metaphor. So now we look at some of his notes and assignment solutions and I pretend to be a student asking him to explain the ideas to me. We practice until he gets the hang of adding 5 more steps to each of his one, and remembering to put in the English and the concepts. I try to give him the perspective of a student, explaining what understandings they are bringing. Perhaps we are both translators.

He now has to be vigilant in his lectures and tutes, checking with students that he doesn't go too far too fast. It works until he gets asked a question in a lecture which causes him to talk as he is thinking. He totally loses the students because he is now talking at his level of reasoning not theirs. Yes, it is a long process of improvement. But he feels empowered. Now he can begin to see why things don't work, despite his creative planning and well articulated intentions for a lesson. He has been frustrated too, and annoyed with his incompetence. Why didn't I realize this and show him some compassion?

When I am observing his lectures now, I am doing so with much more understanding. I can see when he goes off into his own mental world and realize that this is a big habit pattern for him to change. I can forgive him for confusing the students. We can roll our eyes together at the end of the lecture and laugh about it as he says to me "I know! I did it again… I realized it though, and stopped, and that was a good thing!"

Perhaps assisting in the transformation of others requires a deep level of insight where one enters their world, being with them, laughing about imperfections as one tries to move towards new ways of being.

Ying/yang -
in coming to know the
'other' I discover in
myself my deep
humanity

Interlude 4: Homework for curriculum planners

Task: Discuss the implications for Tasmanian College education of the preceding chapters.

You may wish to address the following questions:

1. What does it mean to put the whole person at the forefront of the educational agenda?

2. What are the implications for education using disciplines? How might they be made more explicit? What might it mean to extend students within a discipline? What role does each discipline have in assisting in the development of the whole person? What are the limitations of teaching around disciplines and what other approaches may be possible? What might integrative experiences look like within and across disciplines?

3. How can we connect to students' passions? What might it mean to make subjects or experiences more soulful and deeply engaging for students?

4. How might we enable transformative learning of both teachers and students in the education system? What sort of school structures and curriculum frameworks would support this? What are the issues when people are experiencing transformation and how can we support a healthy process?

5. How do we accommodate the range of teachers' worldviews, beliefs and values? What value might we be placing on different worldviews? If we value continued evolution of the system then what values might this be in conflict with?

6. What does it mean to bring in integral perspectives to considering the education of the child, developing curriculum frameworks, teacher professional learning, and school management structures?

7. What are the true capabilities of our students and are we enabling them to flourish and to grow in the current system?

8. What are the limitations of our current assessment system? What limitations might occur because of exams, standards? How do we value all that the student learns or becomes?

9. What does it mean to transcend *teaching for understanding*? Where might we move to? Teaching for innovation, meaning, wisdom, self-realization?

10. Should we be specifically helping to develop soul capabilities as much as we are aiming to develop mental ones? What might this mean? Spiritual practice, developing warm heart, ethical practice? Employing integrative models of human development?

11. What is the role of the teacher in all this? How might we value the process of teacher transformation? How might we value the moving into news ways of ethical tactfulness?

12. What are the underlying assumptions in these questions and are the questions worth asking?

Assessment:

You can present your response to the questions in any way you like… e.g. as a reflective essay, a conversation between different perspectives, a dance, an art installation, a role play….

In your work I am looking for evidence that you have engaged with the text, making an effort to come to know it, relating it to your own experiences and issues. I am looking for reflectivity and self-awareness. I am also keen to see how you might use this as a jumping board for evolving new possibilities and questions and how it may act as a stimulator in your own flourishing and transformation.

Self-Assessment: To what extent (and why) has the text:

- Touched you or spoken to you?
- Perturbed, challenged, annoyed you?
- Surprised, intrigued or inspired you?
- Changed you?

What have you found most valuable in this process? What are the implications for your own way of being in the world? Do you feel your own journey has been supported and what suggestions might you have?

Please contact me to discuss further how you might like to respond and any concerns you might have : sue.stack@bigpond.com

Epistemological Reflection

The problem with models

When engaged in a process of deconstruction there is always the sense that one can be a lot more thorough and vigilant … in fact it is a never ending process.

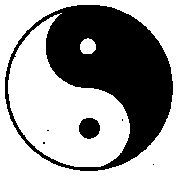
In using spiral dynamics as an analytical tool for deconstructing the curriculum I am using a model which could be criticised, particularly in the way it labels, and its simple principle of evolution of culture. It perhaps oversimplifies the complexity of interactions and the complexity of cultures, but at the same time its contingent insights might enable actions which we can test for effectiveness (though whose version of effectiveness might we be using?)

There are many studies which look at inclusive practices and barriers for students in education – looking at issues of gender, race, indigenous culture, poverty, ability/disability, etc. I have stayed clear of these debates deliberately, choosing to focus on a bigger picture viewpoint – paradigms and cultural memes - though I recognize that these are important aspects in any conversation about an enabling classroom.

I am wary that I am bringing a 'Western cultural' way of thinking to science and curriculum which is quite different to how other nations might experience curriculum. When I first started looking into Holistic Education I thought we needed to do a major overhaul of what we had, and come up with a new vision entirely, incorporating as well as a spiritual paradigm other cultural paradigms (after all Australia is No 2. on the list of multi-cultural societies in the world). But my own efforts in trying to transform the system made me realize that I had two choices – go invent my own school, or work within the current system and be part of a collective journey.

So while colleges are in the process of re-visioning themselves now, it is more in the model of transcend and include. We don't throw out what we have and start from scratch, rather we try to move to more spacious and inclusive views. The problem with this is that our very Western cultural way of learning may be in conflict with other cultures' ways of knowing and being; a case in point being Australia's own indigenous population. So this is an area that concerns me. Thus, although in Chapter 12 I try to come up with an Integral model for science and look at how it might move in perspectival levels, I am wary that I have not taken into account other cultural perspectives. For a truly inclusive model we would need to do this and I hope what I have done will stimulate others to look for possibilities.

My other concern is that my own journey has been one of building deep relationships with others – yet here I am developing an impersonal system model. This is the ethical dilemma, I guess, related to the **greater good** versus **the individual**. How can you have an integral solution? My thought is that Integral Theory provides us with the systemic view - the map of the territory, while Holism provides us with the individual perspective – the experience of the territory itself. We need both in a yin/yang relationship where they interact in a dynamic relationship, each including aspects of the other.



The problem with coverage

I started in my action research with a limited set of literature assisting me as I tried to make meaning of my experiences. As I have moved years later into this reflective writing stage it is clear to me how my experiences interconnect with so many different fields of research, some of which I am just beginning to touch on. My process has opened me up to new fields of knowledge and new

questions which would take a lifetime to research and make meaning of. I am beginning to see what it is I might not know and what might be useful to know. We can only be ready when we are ready. There are books on my shelves partly read waiting for me to have grown enough to understand their significance.

So I am mindful that what I am presenting here is just a partial exploration. Rather than trying to include everything, I have focussed on exploring the contribution that holistic and integral perspectives can make to the debate, trying to create enough depth to get a sense of possibilities and enough breadth to see the shape of the whole environment. I hope that readers coming from other areas will not feel slighted by my oversight, but rather look for ways that our different approaches can interact.

The problem with explicating one's stance

Having gone through several deconstructions of self, both mentally as well as spiritually, I am aware of all that I have left unsaid about my own underpinning values and assumptions, and deconstructive processes, and how these might have shaped the approach I have taken and the meaning I am making. I have done a lot of self-reflective autobiographical writing at different stages over the last 10 years which has helped my own evolutionary process, but much of it is too personal to include. I leave it to the reader to read between the lines and spot my assumptions, neuroses, and strengths. Hopefully with some compassion. Even when I think I understand myself, I discover from what unfolds from my writing, attitudes of mind which previously I have left unexplicated and can now perhaps see them for what they are. But it keeps changing and there is always more to see.

In Chapter 10, *The Ethical Classroom*, I deliberately write with a more authoritative/constructivist tone coming from a value position, thus setting

myself up for the fall in the following chapter, *The Enabling Classroom*. The field of Ethics and values is problematic, as many researchers have found, and one which it seems easier to ignore rather than take a stance.

I have taken a stance and I guess that it is this one; we need to include ethics and values in our teaching. Perhaps we can get around the notion of imposing our values onto others by helping them see the underlying structures that form value systems, so they can dance with freedom in the construction of their own values. But until students have reached the appropriate levels of perspective to do this I think we have no choice but to help their development in context of a set of values that can enable them to reach such perspectives with as healthy a *body-mind-soul-spirit* system as possible.

The problem with making conclusions and using anecdotes

Another problematic aspect of my 'writing as inquiry' is the use of anecdotes. This can be problematic as I have a scientific tendency to want to *conclude* and *generalize* (which is okay if you have many data points). I have to be vigilant with myself to bring a speculative voice rather than a concluding voice. The anecdote does not have this function – it acts as a whole – complete in itself with multiple and rich meaning. When I interpret an anecdote I am applying certain lenses – another person can gain other meanings. A good story/anecdote is like art in that interpretation is open to the reader, enabling multiple meanings. Although my anecdotes include other people they are very much from my point of view and the others involved might remember the situations differently and certainly take away different meanings. I am wary of ascribing to them motivations or feelings they may not have had which is in conflict with the writing of impressionistic stories.

There have been key anecdotes/experiences, some which have lain dormant in my consciousness for years, others which are present, well remembered, which acted as key moments or turning points for me. As I am writing they are surfacing with a sense of urgency and immediacy. A hidden voice waiting to be expressed. Often I write them down and wonder where they are going to lead. Why this story? How is it important? I am letting my subconscious do the work for me in selection, then interpretation begins to emerge.

How I made meaning of them back when they happened is quite different to how I am making meaning of them as I am writing here. As I write I am beginning to see nuances that I hadn't seen before… the anecdote has matured like a rich wine… and it reveals more of myself to me. They definitely become 'teaching stories' similar to the fables of old, with the audience being me…. I hope that they are more generalizable in that they have relevancy for the reader as well.

Behind each of these anecdotes are screeds of student data – video and audio recordings and interviews. These have largely remained invisible in my writing because I am writing more about *my* journey – and that journey occurred because of my assimilation of the data at the time which created praxis. So there is a tension between an agenda where I want to say "This is what my students are capable of and can't we provide an education system that enables this!!!! Ra ra ra! " and needing to substantiate my claims for their learning or for the meaning I am making of their learning.

So sometimes I am mixing purposes and this can be confusing, trying to meet too many competing needs, and possibly losing academic rigor in the process. I think what I am doing is just too big too fit one neat package of epistemology. And in getting involved in anecdotes and meaning, I tend to want to explore that meaning further and possibly lose sight of the bigger picture.

The problem with using the *eye of the mind*

It concerns me that as soon as one moves into interpretation, particularly in examining the cultural influences and underpinning values, that one is identifying with the world of ideas and concepts rather than the spiritual dimension. In Chapter 10 on *The Ethical Classroom* I looked at the notion of 1st thought, 2nd thoughts and 3rd thought. '2nd thoughts' well and truly explain what I have been doing in the latter part of the chapter on *The Enabling Classroom*. In the earlier part of this chapter, however, I included some 3rd thoughts (allowing the universe to speak through me) where I began to see my issue with Lauren as one of soul connection with another.

When I am writing in 3rd thought mode my upper chakras (above the crown) are wide open and I am going deeper and deeper into spiritual insight (Wilber's **I** quadrant – 1st person perspective.) It is a deconstruction if you like, but in a different dimension. I likened it to a shedding. It is a shedding of judgement which opens to seeing things *as they are*. When I deconstruct using a model I am firmly in the act of judging and analysing. (I am conducting a 3rd person analysis of the **WE** and **ITS** quadrant).

The two approaches give very different perspectives and emphases. While the mental process can be coherent, logical, and generalizable, the spiritual one is specific insight associated with *one* relationship, in the *now* and is often paradigm breaking and can therefore seem 'nonsensical' to someone standing in a different paradigm. It is not an 'absolute truth' but a transient truth that acts to move me from where I am now, to another place. Another person meditating on the same issues will get different insights which speak to them. This is because meditation is not so much about revealing the truth of *another* but the truth of *ourselves* and our *I/thou* relationship.

How can one integrate both perspectives or ways of being?

For me, for now, I would like to let go of the models and just be. I know they are just constructs and when I am in my spiritual, heartfelt sense of being they annoy the hell out of me. However, in my overwhelming world of working in a multi-meme culture education system they give me a bit of control…. A way of dealing with complexity. But perhaps if I found a 'Pooh-like' spiritual space in which to operate as a teacher I would be transcending the need to be in control and the need for perfection. Now these spiritual spaces are not alien to me and for periods of time in my past teaching I have lived in them for a while. All the extraneous "stuff" recedes and I am in the moment, in the now, expressing my soul in the presence of another and as a result sending ripples out into the world. Both myself and the world changes … just as much perhaps as through words, models and logic.

In 2005 I was sometimes in this spiritual space while writing my thesis and it was interesting how self-reflective and insightful it was. It had meaning to me. It spurred lots of threads and inter-connections… there were many aspects to pursue. I was pulling in a huge amount of creative and spiritual energy which enabled me to see in new ways, developing new models and perspectives about science and education. But primarily this process of 'seeing' was very healing for me:

- helping me to see how high my expectations were of myself as a teacher and particularly as a holistic teacher,
- helping me to see my students in new ways (particularly the difficult ones) - with greater compassion, learning to love them and see that inner light within them and thus help me see it in myself.
- forgiving myself for my perceived failures.

However, as an academic work, it was not coherent, it lacked epistemological focus. And why should it have those? Is spirit logical and consistent?

But now I am deliberately writing for an audience… I have an agenda, an end point to get to (which arose from the creative process of 2005). However, the very process of rewriting in a coherent way has enabled me new insights… perhaps a flourishing of aspects of self, a deepening of understanding, a greater sense of meaning and significance… a going back to earlier stages of development and cultural paradigms and integrating them so they rest more at ease within the whole of me. So searching for coherence has some benefits.

The issue of wholeness

I started my story by saying that the driving force for my own evolution was the conflict between science and spirituality and the need to reconcile my differences in the third space of the science classroom. I was searching for wholeness. That journey towards wholeness might be characterised by sub-stages – a search for truth, a search for meaning, a search for purpose, a search for coherence and equity, and a search for integration.

Wholeness is an interesting principle. Hesse (2000) in his story of Siddharta sees wholeness as inclusion of all – the good and the bad, the joy and the suffering, the perfect and the imperfect. It is an *embracing* and *acceptance* of all. In which case I have always been whole, I just haven't brought it into my realization. So have I come full circle or perhaps full spiral? I guess my sense of wholeness is one similar to the expanding balls. I was whole before (a smaller ball) and I am still whole now (the expanded ball) with infinitely bigger balls still possible. Perhaps as I expand I also encourage those around me to expand as well, and they encourage and stimulate me?

Has the very nature of this inquiry been consistent with the principles of wholeness? From the point of view of Wilber I have tried to engage the *eye of the senses*, *eye of the mind* and *eye of the spirit* – all dimensions of being – and in doing so have honed these eyes so that they are now capable of seeing more.

I have journeyed around the quadrants – looking into the **IT**, **ITS**, **WE** and **I** spaces. I have moved up and down the perspectival levels, as different stages of writing caused me to move into different cognitive frameworks – whether using psychic mind, integral mind, systemic mind, plural mind or self-authoring mind. Sometimes I have become trapped in a perspectival level bringing only those lenses to what I was seeing. Meditation, or being with my classes, playing with a young niece, or working with clay had a way of pulling me out. In revisiting these different perspectival levels I was able to flourish them further and integrate aspects within myself.

How have I incorporated Henderson and Kesson's (2004) holographic model for educational inquiry? This inquiry is based around seven modes or voices and when in interplay together perhaps wholeness results. How successfully have I used these different voices:

Techne – *inquiry into one's craft – action research – how to do something.*

This was my key inquiry mode during 1990 to 1999 where I used action research to

Seven Ways of Knowing

Techne – *craft reflection* – how do we do it?
Poesis – *soulful attunement of the creative process* – what is whole and beautiful in what we do?
Praxis – *critical inquiry* – what are the underlying power structures? Whose needs are being served?
Dialogos – *multi-perspectival inquiry* – different voices, enabling dialogue.
Phronesis – *practical, deliberate wisdom* - unpacking the reasons behind things.
Polis – *public moral inquiry* - what are the underpinning values and ethics?
Theoria – *contemplative wisdom* – what is the purpose of education, what does it mean to vision?

Henderson and Kesson (2004)
Fig 11.17

explore the teaching of physics and journalism. I have extended this inquiry mode by using Torbert's (1991) *Action Inquiry* model where one is aware of the value system and the assumptions you are making as you inquire. *Techne* is a very pragmatic mode of inquiry where one is interested in how to improve one's craft and is focussed on those immediate tools which support this venture… which can explain some of my tunnel vision when engaged in it.

Poesis –*How can we bring in a sense of beauty (love, passion, receptiveness, soulfulness, fulfilment) to what we do? Does it create a sense of profound order, harmony or wellbeing for the participants? How does it enable depth and meaning and movement from perceived parts to imaginative whole? How does it foster perceptiveness, imagination, creativity and intuitive self?*

The question of wholeness was the driving question for my own journey… How to perceive my subject as a whole, how to perceive my students from a holistic perspective, how to be holistic and soulful in my expression of self as a teacher and as a researcher.

In trying to include a spiritual paradigm in my teaching of physics I was essentially asking how I could make my teaching more soulful, creative, aesthetic, connective, fulfilling. How could I be more fully present with my students and help them to be present?

I was concerned about what it meant to care for my students and foster a caring classroom, emphasising 'warm heart' as much as 'clear mind'. These are questions which stem from the questions *What does it mean to educate for flourishing?* and *How is our notion of flourishing limited by the paradigm we are in?* What is missing perhaps from this inquiry mode is the developmental, evolutionary notion of soul expression.

Praxis – *critical inquiry – what are the explicit and implicit power relationships between teacher and student? What are the underpinning curriculum metaphors and who do they serve? What purpose does our assessment serve and what does it value? How are we valuing what students are gaining?*

I have used spiral dynamics and curriculum metaphors to explore the underpinning values inherent in the Tasmanian Education system which is only a very partial critical theory analysis. I use them to explore whether some of the tensions I have experienced in my teaching can be explained by implicit structures in our curriculum frameworks. To be in a space which is mindful of all the implicit structures and issues can inadvertently put up a barrier between present moment experience and another, so I believe this needs to be used with caution.

Dialogous – *gaining other perspectives – voices of the students, parents, colleagues, wider community, scientists.*

A key to my study of exploring what it meant to be a holistic teacher was gaining student feedback; finding out about their perspectives about what I was trialling, as well as coming to know and see them and their culture. In seeking this it was important for me to develop a way of being that was open to criticism and was non-judgmental, thus enabling my students to express themselves fully and reflectively.

However, now in the writing of the study I have moved to mono-voice (mine). I am crafting an argument which uses their carefully selected stories and voices and contextualises them in such ways that they might not agree or even understand my interpretations.

In my writing I have used dialogue to explore different perspectives, and some of the dialogues between my curriculum planners are often based on real conversations I have had with colleagues, but even so the viewpoints expressed should not be seen as representative of other viewpoints in Tasmanian education.

So this *written* study does not really represent a true *dialogos* inquiry where a group of people representing different viewpoints come together to tease out meaning based on a group understanding. But perhaps it is more consistent with *open space technology* – where people come together, sharing their stories and perspectives. This affects each person in a unique way. They then leave without necessarily coming to any consensus or solutions but with a desire to integrate the new understandings within their own contexts.

Phronesis – *deliberate collaborative inquiry. Exploring deeper – suspending initial judgement in order to understand the reasons behind actions and perceptions. Changing one's perceptions, finding courses of action based on strengthened awareness, embodied wise judgement.*

In being part of a collaborative action research project at a university of physics department (see Appendix 3 for details) I was able to benefit from the group process which enabled mediation of my thinking and ideas. In being able to be a fly on the wall in another institution enabled me to gain another perspective; I could see my own actions with more distance and clarity, questioning long-time habits, assumptions and values.

The inquiry process forced our group to look deeply into the reasons behind what we do as teachers and scientists, and to deeply unpack the

students' learning experiences and their needs. It forced me to look for the deeper reasons behind barriers to transforming teaching practice. As a result all of us were taken on a transformative journey leading to change in perceptions about students, each other and the teaching process.

Did it foster greater wisdom or moral awareness? Certainly it was important for me in developing greater empathy for my colleagues, despite our differences in paradigms and in helping me to understand that we need to support everyone, no matter how ill-fitting they might be within the current or projected system. That the process of curriculum reform can act to marginalise some as it empowers others.

Polis – *ethical issues. How are my values in conflict with the students? How much do I disclose? Where do they intersect and how can we pull together disparate values?*

My spiral dynamic and integral analysis has been an effort to understand values as a result of different cultural memes as well as developmental needs. In looking for an Integral solution I am trying to find a system which might facilitate expression of the whole system as it needs to be expressed. Yet that is an analytical approach and can act to create barriers with another.

The key to my own journey has been one of finding appropriate ways of being with my students – balancing authenticity and vulnerability with my duty of care as a teacher… building self-capacity with meditation and mindful practice. Realizing perhaps that ethical tactfulness is something that evolves while at the same time being contextual.

Theoria – *what is the purpose of education? What is the world we want to create? How can we vision together?*

The question of the purpose of education has been a problematic one for me with many conflicting possibilities which I have struggled to explicate, understand and integrate throughout my study. I am doing this through processes of deconstructing, storying, imagining, visioning and meditating. As my capacity grows, so do the possibilities I can see and the more aware I am of how I might be limiting my own vision.

I am not too sure whether I am satisfied that I have found a sense of ease with this question or have found my way into a vision – rather that for now I accept the tensions. But I hope that my continuing to ask this question, and my struggles with it through my work, assists others envisioning a future for the world, for education and for science.

What is missing with these modes of inquiry?

I believe that there needs to be another mode or dimension to inquiry which goes beyond concepts and questions… which embraces the spiritual dimension… sits quietly in the infinite now. Otherwise these inquiry modes are *wholistic* rather than *holistic*.

Ok. So taking my own advice I have just done a little meditation. This is the insight that has emerged, for what its worth…

We need to be careful of following a set of questions (from different perspectives) and thinking that this constitutes a multi-mode inquiry. Rather, as we adopt an inquiry mode we need to live in that space. It means moving into the intent and full experience of the mode and then allowing one's own questions

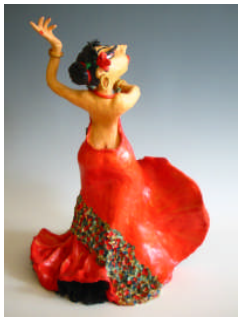
and seeking to emerge. The more unfamiliar we are with the mode the more practice we need in accessing its state of being and mindfulness. The space will actually change and evolve as we use it along with our own growth. The entry into a mode might require very different stimulation.

It is interesting that when I was engaged in writing Chapter 10 - *The Ethical Classroom* I was dealing with ethical issues in my current journalism class requiring me to be very mindful of my own values and agenda in helping students explore theirs. In contrast, in writing Chapter 6 - *The Meaningful Classroom* I was expressing my own creativity and bounciness with inspiring and imaginative sculptural forms. Where am I now as I bring an epistemological eye to what I am doing?

Perhaps inadvertently I have been involved in a holistic inquiry – where I have experienced different spaces to see different views – but what might it mean for these to truly integrate into a whole (including the spiritual dimension)? Perhaps the integration lies in the living and being of the person involved in the inquiry. It is seen, not in my writing, nor thinking, but in the person I am today, this moment.

Sitting, still in my bathrobe (even though it is noon – too engaged with my thoughts to spare time to get dressed), wet hair from the shower, typing away, with a little smile on my face as I realize how incongruous it all is. Time to go and live! Time to express my fullness of being!

Ok. Yes. Let me go put the clothes in the dryer.



The Grande Passion

Part 3

Integrating science and soul

(creating a grand narrative)

Chapter 12

Steps towards an Integral Science

Questions:

What is science now and what can it be?

Can science evolve? Can it assist in the evolution of world consciousness?

What attributes might an integral scientist have?

How might we integrate soul and science in education?

Introduction

This is my culminating chapter where, with a great sleight of hand, I attempt to draw upon the experiences of my own journey in trying to integrate science and soul in *my teaching*, in order to try and integrate science and soul on a grand scale…. Possibly creating a model which can inform science educators globally. Yes, these are my tentative steps towards creating a grand narrative. This grand narrative has been recently birthed, yet to grow up into a fully fledged theory. It is problematic. I hope though that it can be the basis of good dialogue and that the problems become a spur for greater creativity and insight.

In this chapter I summarize my experiences which I have richly tried to describe in Part 2, using many tables or maps. This has the benefit of providing schemas to enable us to perhaps see the shape of the environment, but leaves behind the richness and the meaning of that environment. So this chapter needs to be seen in the context of Part 1 and Part 2.

What is science?

Some definitions courtesy of Google:

- The pursuit of knowledge and understanding, from the Latin term *scientia*, which means 'knowledge'
- Science is from the Latin root *scire*, to know. The earliest origin of the word is related to cutting or splitting apart. Knowing is, in a sense, the art of being able to separate ideas from each other.
- A particular branch of scientific knowledge; ‘the science of genetics’

- Skill: ability to produce solutions in some problem domain; "the skill of a well-trained boxer"; "the sweet science of pugilism"
- Science is a process for evaluating empirical knowledge (the scientific method), a global community of scholars, and the organized body of knowledge gained by this process and carried by this community (and others). Natural sciences study nature; social sciences study human beings and society.
- A method of learning about the physical universe by applying the principles of the scientific method, which includes making empirical observations, proposing hypotheses to explain those observations, and testing those hypotheses in valid and reliable ways; also refers to the organized body of knowledge that results from scientific study
- A branch of knowledge based on objectivity and involving observation and experimentation.
- Studies that normally encompass courses based on a knowledge of facts, phenomena, laws, and proximate cause are designated Science (e.g. Biology, Chemistry, Computer Science, Geography, Geology, Mathematics, Nutrition, and Physics).
- Those branches of study relating to the phenomena of the physical universe and its laws, a connected body of demonstrated truths with observed facts systematically classified under general laws; the study of relative, modified Principles which can be proven through physical measurements and through physical senses.

What do you think of these definitions? What do they reveal about the beliefs of the authors?

What definition of science would you write?

What does a scientist do?

When I was a scientist in a paper mill I didn't really ask myself what science really was. I just went and did whatever was necessary to do to achieve my inquiry goals, using all the skills at my disposal to understand and improve the complex multi-variate system which was a paper machine. Perhaps it is helpful to share with you what I was doing… is this typical of scientific activity?

I would do those things you might consider science – pouring over drafting documents, designing experiments, determining effective measurement protocols, taking measurements, writing computer programs to analyse data, sitting for hours at my Fourier analyser to discern patterns in the masses of data, looking up literature, coming up with connections and theories, testing these, discussing with members of my multi-disciplinary team (chemist, mechanical engineer, process engineer and myself as physicist) to get feedback on my thinking and gain other perspectives before I would write a technical report of my findings.

Then there are those activities that you might not consider science… chatting with people around the mill, getting inside the machine and experiencing for myself as much as I could as it hurtled along at 790m/s, hanging around the machine shop watching the guys grind the rolls, crawling over dismantled gear boxes, doodling, drawing cartoons of the dilemmas we were facing and writing poetry when I was really stuck with a problem, allowing for incubation time.

And that was just the 'inquiry process' used to gain knowledge about the system. Then there was how we reported 'this science knowledge' to the stakeholders at the mill and the process of implementation of the science - engineering solutions or issues, operator training issues, time frames, costings, weighing up options, impact on machine downtime, impact on market and on the environment. To be an effective part of these dialogues I had to move outside my 'scientist hat' and learn production, engineering and economic language. I also found that the science didn't speak for itself; I not only had to be an effective communicator and marketer of the science but also a player in the games between the different departments, learning how to get everyone on-side, giving them ownership in the process, and undertaking considerable negotiation to get some of my ambitious experiments done.

I began to realize that science was not value neutral – the science questions I asked were influenced by the needs of the stakeholders and budget constraints. I was doing a pragmatic science.

And just being a scientist in a large mill situation, asking questions of the people around me, had another impact as well. After asking a machine operator about why they might change a particular variable on the machine and what they observed as a result, they began to be scientists themselves. Previously a lot of their interaction with the machine controls were like a kid playing a complex interactive computer game – they had learnt ways to make the system work through trial and error, without working out the underpinning rules. And here I was interested in understanding the *why*, respecting their experience and 'know-how', and interested in what they were doing. So the operators started questioning their habitual actions, looking for causes and effects (which is hard in a multi-variate system), coming to me with deductions which I could then test with more rigor.

The act of me doing science rippled beyond my own scientific activity, creating a community of people thinking scientifically. Perhaps the system I was studying was more than *paper-machine* it was *man + machine* and in order to understand that you need to build goodwill so people can let you into their heads and actions.

So where does the line of being a scientist start and stop? For me doing science wasn't just about getting knowledge, it was about being an agent of change with that knowledge, and then being able to scientifically test the impact of the agency.

And then there is the notion of the scientist in a global community of scientists, sharing knowledge, giving feedback, presenting formally for peer review, adding to global understanding. Yes, I was involved in this as well and even though much paper science is done within private business rather than at public research institutions, there is still an openness in sharing information, new insights and successful solutions. Without this global community and open communication channels it would not be possible to make the advances that have occurred in the technology and operation of paper mills. And the formal papers are only a small part of this communication. There is a 'science club' whose aim is to share knowledge for the common good, to ensure quality of the knowledge and the scientific activity, to be open to question and be prepared to change in the face of competing evidence (within the scientific paradigm).

So what are the activities of scientists?

There is the **empirical** aspect of it – getting data of the physical world. There is the scientific method which is considered a cycle or rule that one might use in getting the physical data. (Observe, question, hypothesise, design experiment, test, analyse, conclude, compare). There is the **process** the scientist might go through in their whole inquiry, including discourse, imagination, exploring alternatives, incubation, intuition and insight.

There is the **community of scientists** who through the last 350 years have set the rules for how discoveries get accepted to the body of scientific knowledge, have established notions of scientific integrity, and enabled a global discourse of scientific ideas. And then there is this growing body of knowledge, some of which has endured for hundreds of years while other aspects are changing and are under challenge.

And this is just the science of the physical world… there is science of people, societies, culture, spiritual matters; each coming with their own research methodologies, perspectives, habits of mind and notions of what constitutes rigor. Between some of these different approaches there is conflict while the relationships between others have enabled creation of new transdisciplinary approaches.

But wait that is not all. We have the **critiques of science**. While some naïve scientists believe that gaining physical data means they are gaining *the truth* and that it constitutes proof, philosophers would argue that isn't possible. Post-structuralists might argue that language and concepts are products of our own minds and create a lens that we interpret what we see. Critical Theorists would critique the power of science, the colonization by science of indigenous cultures and how it has influenced the way we think in the world today. Feminist critique might challenge the reductionist view that it has. Ethicists would question the use science is put to. And so on.

And then there is the notion of scientists as **agents** in the world, requiring knowledge of cultural conditions which affect that agency, as well as understanding the impacts of their acts of agency, being able to take on perspectives of others and work in multi-disciplinary circumstances.

So the activity of science is actually quite a complex multi-layered one. And the empirical aspect of it is actually one small part. (see Fig 12.1 over page.)

Science education

So what does it mean to teach science to students from very young children to university training? What is the difference between the *professional activity* of science and what science may have to offer from an educational point of view?

Could science education be a key player in **developing the child**? Helping to develop the rational mind through scientific thinking and inquiry processes (building clarity), tuning into the child's deep need to discover the world, empowering students with knowledge to help them operate in the world today, connecting them deeply to nature and the cosmos (stimulating their souls, developing aesthetic appreciation, respect and natural care, sense of place and being a foundation for ethical development), perturbing them to new development stages?

The activity of science

Where does science happen in Wilber's quadrants?

Cognition Imagination Aesthetics Insight Values	Empirical method Know-how
Discourse Cultural conventions Science Paradigm	Systems Fit, Ethical implications

AGENCY?

Scientific Community
How does inquiry get accepted as knowledge?
Why and how do disciplines get structured and what are conventions for forming knowledge and inquiry processes?
What is the cultural interactivity of science?

Cognition Imagination Aesthetics Insight Values	Empirical method Know-how
Discourse	Systems Fit

Scientific Inquiry Process
Contextual experiments within larger inquiry process
Come to understandings, build theories
Collaborative

	Empirical method

Scientific Method
Hypothesize, design, test, analyse, compare

Physical World

Critiques of science

Critical Theory – power relations, colonization of science thinking in the way the world thinks
Cultural Theory
Ethical uses?

Philosophy of Science
Objectivity? Bias, quantum universe, mental constructs of reality
Deduction vs induction?
Falsifiability vs Confirmability?
Ethical processes?
Science and society relationships?

Validity of method
Accuracy
Appropriateness

Fig 12.1

What about science education for encouraging students to be scientists… both in the layman sense (community scientists like landcare, wildcare activities) as well as being a professional scientist?

Attributes of **layman science** would include developing inquiry processes, ethical awareness and stance, agency and connection to the natural world which would lead to passionate commitment or engagement.

Students on a **professional science** pathway would need to gain the skills to operate as scientists – not just foundational knowledge and inquiry skills, but also understanding the community of practice in which they will be operating, developing integrity, purpose and passion, becoming critically and ethically aware and being able to operate with agency in complex cultures and multi-disciplinary environments.

But is this **Integral Science**? Or just being more explicit about what is already out there?

For me science is a complex cultural activity and it makes sense that science education should include practical understanding of this culture by enabling students to be scientific ethical agents experiencing the feedback from their communities thus gaining insight into the complexity of relationships. Perhaps this could attract those high school girls back to science, for whom their interpersonal world is their prime concern. But is this really science then?

Can science grow up?

Science Circus - 1997

Welcome to my science circus elective. It is a small group of students from Year 11/12 science courses who are interested in developing some presentations and activities for primary school students. They are brainstorming on the board what they could do….

It is interesting listening to them. They are totally focused on what topics of science they think might appeal to young students. They are talking about how they could develop some key concepts in each of these topics. They are asking themselves what might be good props they

could use to develop the ideas. What might be weird enough and interesting enough to appeal to primary students?

I decide to intervene. “It is interesting that you have been thinking in terms of knowledge that you want to get across. Is this how you think of science?”

They stop in their tracks and ask me what else science could be. “A process of coming to know something… an investigation?” I suggest.
“Oh, yeah, the scientific method,” says one. “Get them to do an experiment?”
“Oh yeah,” says another, “Good idea, what might be a good experiment to do?”
“We would need to give them instructions to follow,” said another.
“Umm,” I say, “I was thinking more about how you could get the students thinking for themselves… going on their own journey of discovery, the way scientists do.”
“Umm, Sue, what exactly do scientists do?”

And it was a mystery for them. Most of them had very little experience of the inquiry aspects of science in their previous courses; they saw science as *knowledge to be learnt*, *experiments to follow* and *procedures and equipment to be mastered.*
One girl mused, “I remember in primary school being given a problem to solve from a crime scene… we had to use forensic techniques to solve a problem. It was great fun.”
“How come science isn’t like that now?” one boy asked.

So we ended up having a very interesting conversation about what science is. They totally changed their tack and decided to try and get across the notion that scientists are real people, and could be you or me, it is the scientific *thinking* you brought to what you do that makes you a scientist, not what you *know,* nor whether you had complex technology to conduct experiments. They decided to present an interactive skit which used a witch to show the difference between an ad hoc investigation (for the elixir of youth) versus what a scientific one should be. They then planned to give the students a problem to solve in which they could apply their newly gained knowledge of good scientific thinking.

We worked on this over the next few weeks; we even went to a Dr Karl show for young primary school students to see how science presentations were done. My students were horrified that the whole performance was a series of one weird fact after another. The primary kids were rapt,

hands up, wanting to say what they knew. “This isn’t what science is,” said Melissa, “no wonder we have got this view of science if this is what we are exposed to!” Yet, the primary students were full of curiosity, wanting to know more, breathing out in amazement at some of Dr Karl’s’ interesting stories or demonstrations.

Well my students could have challenged / value-added those perceptions about science by going around the city with their own version of what science was, but we ended up changing tack because the group were so interested in wanting to explore what science was and how it fitted in with other ways of seeing the world. Our *science circus* became *philosophy of science*. We ended up having amazing conversations about the meaning of life as well as exploring critiques of science. The students felt a whole new world had been opened up to them.

This experience was an important one for me in trying to ask myself what science really is, and being able to critique the way we teachers perceived our role in teaching it. Students are wonderful mirrors if you give them the chance and they revealed to me that although I thought I was doing a good job in helping them understand this physics I was teaching I wasn’t really creating a true reflection in my classes of what science really looks like as community of practice. Were my own students *being* scientists or rather learning *about* science? Doing experiments that helped you understand the content or confirm other people’s theories wasn’t really what real science was about, was it?

Also, instead of philosophy of science as an add-on in an elective, I realized that it should have a place in my teaching of physics. When I started looking at the course with this in mind I realized that particular topics lent themselves to some of the big philosophy of science issues. I could ask in electrostatics as we were determining the charge of the electron *“How do we really know an electron exists? Has anyone seen one?”* Students begin to realize that all the experiments are just seeing the *effect* of the electron, not actually seeing it *directly.*

Through this they challenge their own prior assumptions and how we come to know and create knowledge. They become intrigued in the historical development of an idea and who did it and why. They discover that social contexts have as much influence in acceptance of ideas as does the virtue of the idea. We discover when we explore the topic *Light*, that the wave theory of light was actually discovered one hundred years before it was accepted as knowledge, because it conflicted with Newton’s version. So knowledge doesn’t appear out of nowhere, it is politically

constructed. When I tell the students that the current text book's version of quantum theory is flawed, they are initially appalled as text books are seen as unquestioned sources of truth. And then they move on and become critical and discerning thinkers.

Yet, in mid 2005, I was observing a third year university chemistry class and interviewing students. One said to me the best way to teach chemistry was in lecture format where knowledge could be handed out, *"Because these formulas are cast in stone, they don't change, there is nothing to discuss, you just need to learn them."*

Creating experiences for students where they *be* scientists is a key concern of the Tasmanian Essential Learnings curriculum for K-10. This is a thinking curriculum where students are engaged in inquiry processes that enable them to both experience a process of *coming to know* (inquiry) as well as developing or constructing *knowledge*. Thus science is seen as both verb and noun.

What does it mean to *be* a scientist at different development stages and what type of knowledge is being developed? My physics students were keen to discover not just knowledge of the physical world, but also the critique of how that knowledge was developed from a philosophical point of view. They could challenge the objective view that science appears to have. They are at the level of the *self authoring* mind.

Perspectival Levels

Pre-conventional:
- Fluid Mind
- Unsocialized mind

Conventional:
- Socialised mind
- Self-authoring mind

Post-conventional:
- Pluralistic mind
- Systemic mind
- Integral Mind

Transpersonal:
- Psychic mind
- Subtle mind
- Causal mind

But if you are a young child exploring your world, you are just beginning to experience objectivity and dis-identifying yourself from your complex interactions with the world. Experiences which ask you to look for empirical evidence of your assertions according to some disciplined rules is helpful in teasing out what is real and what is magical and thus useful in helping children to attain the next perspective view.

So young primary children at the concrete stage moving from *unsocialized mind* to *socialized mind* are going to need a different sort of science to students moving from *socialized mind* to *self-authoring mind* who are now able to deal with abstract concepts and can see the scientific method itself as something to investigate. The younger students have enormous curiosity in the

world and want to collect lots of quick intriguing facts as well as *be* scientists in exploring their world.

There is a real concern now at Year 11/12 level and at the university that the way we currently teach science is not going to engage those students coming through the Essential Learnings K-10 thinking curriculum. These students will be used to experiencing science in a much broader way than what we currently do; they will have started to experience science at the *self-authoring mind* level and are now looking to develop themselves further. Our prime concern until now has been disseminating a body of knowledge and developing rigor in the use of standard experimental procedures - which is really still at the *socialized mind* level. Our challenge is to re-vision what science courses look like for these students so that we can assist both their growth as well as help them master our current wisdom and yes, perhaps they could even add to it.

Can our concept of what science is grow as well? Not only might there be ways of thinking about science teaching suitable for different development levels of our students, but also science itself could be different at the different stages. Each stage of science might be suitable then for different contexts or fields of inquiry. As in spiral dynamics, could the integral scientist be able to tune into the necessary level appropriate for the job at hand?

The difficulty is when we don't realize the options; when we get stuck into thinking science is just at the *socialized mind* or the *self-authoring* one, or when our own personal growth might be limited because we identify so much with one of the levels because our job requires us to adopt that perspective. The key to development up the stages is dis-identification with the lower one. At the stage you are at, it owns you, rather than you owning it. (Kegan 1982)

Do you remember my student Scott, our overly rational philosopher in the Chapter 2 on Integral Theory? He is at the *self-authoring mind* level. He manipulates with ease ideas, theories and critiques of theories. But he does this from the *eye of the mind*. He sees the rational mind as a tool which will help explain the whole of reality, even while philosophically he questions whether there is one to begin with.

Scott is questioning his beliefs, but even this questioning is shaped by the epistemological methodology he using. So moving into the *plural mind* is more than just challenging your belief structures; it is an ability to engage with other ways of knowing and being. Can science courses

help in this or is this where student's experiences in art, literature or drama can help? Can art, literature and drama be part of the science learning experience? Can they be developed as tools for a scientist's toolkit?

How has my teaching helped in entrenching Scott? Or perhaps he needs to experience the necessary flourishing at a level before moving on? What is my role in his development? What tools might help them? What has physics got that speaks to where he is at and where he might become? What is the difference between all those tools I can use in the teaching of physics and this tool which is physics?

As teachers are we identifying too much with one stage as well identifying with what our role is? How can we dis-identify? Does the act of reflection, of teasing out *who you are, why you are* help? Is self-realization something that happens only to a fully enlightened being, or is self-realization the ongoing process of realizing self *now* and thus enabling dis-identification from what has been owning us, so we can own it and continue in our healthy development as human beings?

What type of self-realization practices might be suitable at the different stages? What might meta-cognition look like for the different stages? We tend to associate meta-cognition with just thinking and reflecting on our own thinking processes. Yet it is clear that as one moves up the stages, one can begin to reflect on:

1. **Socialized mind –** how am I thinking about that?
2. **Self authoring mind** - the rules which shape our thinking (e.g. through philosophy of science),
3. **Plural Mind** - the language which shapes our thinking (cultural embeddedness)
4. **Systemic Mind** - the self-stages which shape our thinking.

In my work with university science lecturers (see Appendix 3), I was assisting them in making explicit their scientific and thinking processes and helping them to unpack the hidden rules of science activity. As a result of this they were able to re-conceptualise their roles as teachers – and begin to teach more congruently with what they were actually doing as practicing scientists. Most were operating as scientists at the *self-authoring level* (even though they might be

operating at higher levels in other aspects of their lives) but teaching science at the *conventional level*, just in the same way that my physics students in the science circus were planning to teach primary school students. It seems we teach at the level below that which we have made explicit.

At each level we need heuristic devices that can help us make what we do explicit. So the inquiry model for primary school students operating at the *socialized mind level* is extremely valuable for them in realizing that scientific inquiry has different facets which need to be moved through with rigor. (see Fig 12.2) Different types of thinking can be easily demarcated – *lets' put on the science hat (getting evidence) or the imagination hat, or the history hat.*

The scientific inquiry model which I developed for my physics students (and which was used successfully by physics lecturers) was valuable for those wishing to explicate scientific inquiry at the *self-authoring mind level*. (see Fig 12.3) At this stage students can move with discernment between different ways of thinking and focus realizing that they are all part of the process of inquiring as a scientist.

An inquiry model suitable for the *plural mind level* might be Wilber's 8 indigenous epistemologies. (see fig 12.4)

In the same way, we could consider what **discourse** might look like for the different levels and what suitable heuristic devices might be useful. My

Scientific Inquiry process
– socialized mind

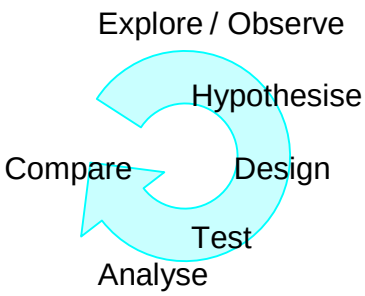


Fig 12.2

Scientific Inquiry Process
– Self-authoring Mind

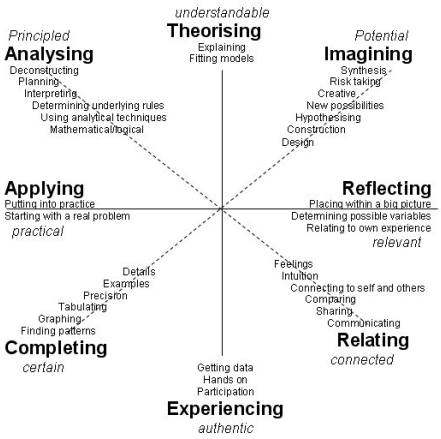


Fig 12.3

Integral Inquiry epistemologies
- plural mind

I Phenomenology Structuralism	**IT** Autopoesis Empiricism
WE Hermeneutics Cultural anthropology	**ITS** Social autopoesis Functionalism

Fig 12.4

‘critical thinking’ model for discourse (see Chapter 9) is appropriate for the *self-authoring level*, but the trivial consructivists’ concept challenge model is more appropriate for students operating at the *socialized mind level* as they are not yet ready to challenge their belief structures.

My need to have students write their lab books from *their personal point of view* was me mixing up a *plural mind* postmodernist approach with a *self-authoring* science approach. I was trying too hard to put my own plural mind understanding of science into practice, rather than realizing that I first needed to develop students’ reporting skills at the *self-authoring* level. So it is okay for me to write this thesis in a personalized, culturally reflective manner, because I have already mastered scientific and economic reporting – I can break the rules knowingly at a post-conventional level. Which is very different to someone breaking the rules at a pre-conventional level.

By being aware of the different stages of science I am able to understand my own dichotomies – particularly the physics versus spirituality one. I can see that spirituality can *infuse* my teaching of physics at the *self-authoring level* (through sense of wonder, deep meaning, existential questioning), but at the *plural mind* and *integral level* it becomes an *equal partner* in inquiring into the Kosmos.

Mapping science on the perspectival stages

I am now going to introduce a table (see Fig 12.5) based on the perspectival levels where I map what science might be like at each stage, detailing the different facets of science which I have explored briefly above, and in much more detail in the previous chapters. It is a work in progress.

The basic structure of the table is an amalgamation of the work of Kegan (1982), Wilber (2000b) and Cook-Greuter (2002) put into an integrative framework by Gordon (personal communication, July 6, 2005 and forthcoming paper). I have only recently used this as an organizing structure – previously I was using the cognitive development model of Egan (1986). I have found this new structure to be much more powerful because of its logical sequencing – the notion that the next stage can now manipulate what was amorphous to the previous stage. It also differentiates the upper stages better than Egan’s model. However, I have used my

understanding of Egan to help me assign certain science experiences to different stages as he has some very useful insights about how teaching techniques should change for the different stages.

I have used my own experiences in science education to tease out what science might look like at the lower stages but have relied heavily on the descriptions that Cook-Greuter uses at the higher stages in her research on *Leadership Development Action Logics* to speculate on what science at the higher stages might look like. Like me, Cook-Greuter (personal communication 2005) has found in her research that leaders teach at a stage lower than the one they operate at.

The perspectival stages relate to personal development stages (**I**) rather than the spiral dynamic cultural memes (**WE**). I have used perspectival stages deliberately to show how science can be linked to the development stage of the individual, so in planning science education from kindergarten to university we can marry it to the evolving individual. I have color coded the stages to show how they link with the spiral dynamic levels because we can also think of these as cultural memes in which people (who might be at other perspectival levels) operate.

I am offering this schema as a heuristic device which educators or scientists can use to help reflect on their practice. Some of the aspects may be better placed in different stages and may be debatable. It is a work in progress. Please bring a critical eye to it. How useful is it for you? What further testing would you like to see?

How well do you think the premise holds that science can grow in the perspectives? And what might be the possibilities for science as its practitioners move towards the *integral mind?* What are the implications for what we teach in our schools, universities and science education training?

Fig 12.5

Possible Stages of Science and Scientific Thinking	
Pre-conventional ***1st person perspective*** *Immersed in perceptions and impulses.*	**Fluid Mind** The world is magical. Subjective experience. Self is the prime cause.
1st person expanded *Treats perceptions and impulses as objects to manipulate and reflect on, making it possible to create categories embedded in its own point of view.* **Egocentric, magic, pre-operational**	**Unsocialized mind** Naïve science based on personal experience. Keen to understand and make sense of the world. Acts upon objects to see what happens and makes deductions based on what they see. Sees connections between things. But might assign cause and effect incorrectly… *"Bees make honey so we can eat it."* Sense of wonder and awe in reality… things being what they are. Connects with nature (immediate environment) by being in nature, observing, doing, caretaking, cultivating, telling stories, imagining themselves taking on animal and plant forms. Sense of place and being present. This connection is a foundation for development of the ethical and caring self.
Conventional ***2nd person perspective*** *Treats categories as objects to manipulate and reflect upon, making it possible to internalize society's rules and values.* **Socio-centric, mythic, concrete operations** **Looking for knowledge**	**Socialized mind** A key aim of developing scientific thinking here is to develop objectivity. The self is becoming separated from the world and the world becomes an object which can be manipulated by rules. There is a danger in becoming too objective and distant – needs to be balanced with connective experiences of the world as well. o Science is procedural, empirical (look for evidence in physical world) o Simple inquiry cycle ***(Observe, explore, hypothesize, design, test, analyse, explain, compare)*** o **Rigor** is in the meticulousness of carrying out the procedures; the accuracy and precision, the trustworthiness of the data and the deductions. o Students are keen to **find the truth** and believe there is one. Keen to find out how things work and why. o Developing **procedural skills**, following rules o Reflection on processes and trustworthiness o **Precise language** rather than fuzziness, debate, follows discourse rules

(trivial constructivism)	o **Presentations** in 3rd person objective voice according to a set standard. o Look at **patterns** and how to categorize o Look at exploring the nature of **simple relationships** and discerning cause and effect, learning to control variables o Mapping **webs of relationships** and seeing self in context with others and the world o Looking at **feedback** and simple system dynamics o **Sense of wonder** in the patterns, connections, symmetry of nature. o **Sense of connection** to the web of life, the earth, the universe – sense of place and responsibility. o Keen to understand the **nitty gritty** - building conventional scientific knowledge – *collecting* facts and explanations. Likes to go deep into something and become an expert knower. Is curious and finds the world fascinating. o Explores **the weird**, the amazing, the extreme in order to find what is normal. o **Creativity** expressed in designing experiments, making models, discovering patterns for themselves, telling stories, imagining what is possible, creatively explaining their own understandings of conventional science. **Nature of science:** o Helps us come to know how the world works and to solve problems o It has heroic scientists with inventions which change people's lives. We need to be aware of consequences of our actions and follow up. o Science theories are being developed and refined and sometimes changed. o Science has ethical dilemmas which can be debated. o What makes science different to other ways of inquiring into the world?
3rd person perspective *Treats rules as objects to reflect upon, making it possible to create its own ideology and identity.* **World-centric, rational, formal operations** **Looking for understanding** (social constructivism)	**Self Authoring mind** Now that the student has learnt objective procedures they can be more critical of the methods used and more involved in developing own inquiry pathways. They can incorporate other ways of knowing. o Expanded **scientific inquiry** process which goes beyond the experimental method (includes discourse, peer review, abstraction (ideas and tools), problem solving, modeling, intuition, connecting to bigger wholes, searching for alternatives, playing with ideas, imagination.) o **Expanded notion of rigor** to include breadth, depth, connectedness, usefulness of inquiry etc. (It is not enough for the procedures to be rigorous, they need to be appropriate - can now select with discernment from a scientific toolkit of processes.) o Interested in *how* particular explanations have been derived – want to **construct own understandings** rather than accept others.

	o Questioning own prior knowledge and being discerning in what theories they now choose to believe – **critical thinkers**, now more critical of the notion that there is 'one truth'. o Want to link their big **existential questions** into their inquiry and for the inquiry to be relevant to them. o Can see **linking ideas** within and across scientific disciplines. o Sets up their own **synthesizing meaning frameworks** for their knowledge based on generalizing principles which connect disparate knowledge. These frameworks are in a state of perturbation and flow. o Keen to **discover root causes and reasons**, and explore consequences through time. o Can explore **complex multivariate systems** by modeling and breaking down into causal relationships o Copes with **paradox** by treating as *either/or*, seeking to find a better scientific theory which removes it, or ignores by compartmentalizing. o Develops **mastery within their discipline** – of procedures and knowledge. o Works **collaboratively** with others across science disciplines but may have problems in co-operative inquiry which goes outside science, disdaining the non-rational / empirical. o Can set up effective **discourse** (from a toolkit of possibilities) and understand how discourse protocols can shape outcomes o **Self reflective thinkers** – able to look at self thinking and self processes. o Uses **science to improve the world** – add to knowledge or to fix problems. o **Scientific integrity** based on being true to the science and the scientific method. o **Creativity** expressed in new insights, creative and novel ways to explain what is happening, developing both physical and abstract models or products, finding new solutions. o **Presentation** style in 3rd person but now tailored for the audience (scientific paper, log book, technical report) o **Sense of wonder** in the elegance of formula, the symmetry of theories. o **Sense of connection** to life, nature, the earth or the universe *in time* (past, present, future). **Nature of Science:** o Reflects on the nature and history of science; how science theories are developed (complexly and collaboratively), their tentativeness, the role of scientific thinking and its limitations, scientific revolutions and paradigms, the nature of scientific proof. o Explores how science has impacted on society and how society has influenced science. o Has a code of ethics as a scientist and is able to understand the ethical rules, processes and values which are used in making ethical judgments in science. o Believes that science can solve the problems of the world and that the laws of the universe can be figured out in time.

	o Explores the edges of science – what is real science, pseudo-science. Becomes an intellectual skeptic. May bring a scientific/rational eye to their whole life if firmly entrenched in the scientific paradigm.
Post – Conventional ***4th person perspective*** *Treats its own ideology and identity as an object to reflect upon, making it possible to respect diversity* **World-centric, pluralistic, postmodern, post-formal operations** **Looking for meaning** (Critical and radical constructivism)	**Pluralistic mind** Students are able to see the perspective of science as one of **many paradigms** or cultural worldviews. They can critique its privileged status and understand how it has shaped the way the world now thinks and how they have been conditioned. They understand how our **situatedness in culture** affects our 'objectivity' – our worldviews and language influence the way we construct theories, design experiments, test, interpret and assign validity status. Students now put themselves back into their inquiry (1st person reflections), realizing that they need to make transparent what they are bringing to it. They value the subjective experience as well as the objective. Students are able to see the **relativity** of scientific theories and perspectives. They are interested now in the context they were derived and the intentions and beliefs of the scientists. They are interested in how the theories have meaning and significance in the world, as much as wanting to understand them. They may now believe that nothing can be true and everything is relative and that it is up to the individual to **choose what to believe**. They can treat scientific theories as metaphors. They are likely to broaden their scientific disciplinary skills with inquiry skills based on **other ways of knowing**. They are now interested in broadening their focus from *science of the physical* world to *science + people's experience of the physical world*. (e.g. science education, deep ecology.) They may be interested in more personal and intimate qualitative research methodologies like lived experience, hermeneutics, phenomenology, case studies, co-operative inquiry. They can engage in **multi-disciplinary inquiry** (which goes outside of science) by being open to other perspectives on reality and other ways of coming to know the world. Being able to maintain rigor across discipline perspectives might mean ensuring every perspective has an equal voice… even though this may not be appropriate. **Discourse** moves from verbal communication to holistic communication – including kinesthetic, drama, artistic. The artistic perspective is seen as a way of helping challenge perceptions and create new perspectives. **Paradox** is not an issue because everything is relative – *and/both* can exist without any problem. They can tolerate ambiguity and uncertainty. They can tolerate conflicting disciplinary perspectives by enabling the different voices to speak rather than reconciling them. They are able to engage in dialectical reasoning.

	They are less interested in past causes and future effects as they are with the **immediate present** and how that might unfold. More interested in the process, relationships and non-linear influences. Systems are seen as complex interactivity (rather than specific cause and effect relationships). Prefer holistic compared to linear logic. They can see themselves having many **different identities** – old scientific self, subjective self and can have problems integrating these. They are becoming introspective, going deep into their own experience. Values pluralities. **Ethical understanding** is much more relative and culturally dependent.
4th person perspective expanded *Treats pluralities and contradictions, both inner and outer as objects to reflect upon, making it possible to organize pluralities* **World-centric, holistic, general systems thinker, post-formal operations** **Looking for structure**	**Systemic mind** Scientists can extract the essence of theories to determine **big ideas and themes** which they are able to manipulate and integrate into new meta-understandings and frameworks, developing original perceptions of the world. They can see parallel themes across disciplines, contexts and time. Scientists can perceive systemic patterns or long term trends. They understand that science is done in a **cultural context which creates reflexivity**. Using science to fix problems is naïve without understanding the cultural resistances to change. Science alone cannot fix problems. Systems are *scientific + cultural*. Scientists do more than just find solutions; they become strategic agents in working within cultures to transform attitudes. In order to do this well they might study organizational and cultural dynamics. Scientists have a general systems view of reality, and can comprehend **multiple interconnected systems of relationships** and processes. They see gaining and reading feedback as crucial part of their work and lives. Scientists deal with contradictions or **paradox** from different knowledge perspectives by seeing them as partial truths which can be integrated in grander meta-system models (e.g. Integral Theory, System Dynamics). They can develop transdisciplinary inquiry which uses research methods across many disciplines appropriately in an integrated way. Scientists tend to **think outside the box** as they give free reign to dreams, fantasy and imagination… no longer feeling the need to be constrained by logic…. Thus gaining insight. Values authenticity. Truth can be approximated – complex arguments carry more weight than simple ones. Engaged in self appraisal and committed to own and other's growth.

5th person perspective *Reflects upon systems as objects, making it possible to correlate and organize them into meta-frameworks.* **World-centric, holarchial, integral, vision-logic** **Looking for true self, true reality**	**Integral mind** People working at this level are considered very **fluid and flexible** and can take on roles from any of the earlier perspectival stages with ease, choosing the perspective appropriate for the job at hand. They have finely tuned **interpersonal skills** and insight into other's complex and dynamic personalities. They can move into the perspectives of earlier stages to assist others, giving transformational feedback. They may work briefly in organizations, catalyzing sustained transformation. They can be very useful in helping to bring together people from different perspectival stages and helping bridge the conflicts of perspective. At a personal level these people are now **wary of the excessive map** making of the human experience that the systemic mind has been making. They realize that the map is not the territory. They realize that the pursuit of objective self-identification and rational, objective explanations of the universe are futile – artifacts of our need to make permanent and material that which is in flux and immaterial. However they understand that this need to objectify and make meaning is an essential part of the development process for humankind and respect the scientific process for others, if not themselves. They hope to **unearth the limits of the rational mind**, and to unlearn their automatic, conditioned responses based on memory and cultural reinforcement. They may view the rational mind as a shackle. They now have access to intuition, feelings, dreams, archetypes and other transpersonal states and are able to experience flow states leading to a direct mode of being.
Mystical Levels **6*th person perspective*** Theocentric, unitive, transcends and includes all of the above. **Being**	**Psychic Mind, Subtle mind, Causal no-mind, Witness** **Able to see all experience**, including the rational, as phenomena of being, valuing all states of being. Less interested in the seeking as in the being, focussed in the now. Realize that understanding is an illusion. Comprehend things in a visionary and holistic way in addition to apprehending them through the rational mind.

A word of caution. Where do the theories of Steiner sit where he has an integrated *spirit-soul-mind-body* system of human development? Here I am just focusing on the development of this thing called science which needs to be done in harmony with the development needs of the whole child. Science can support the flourishing and transformation of several development lines and development of others can support student's experience of science. It should be reflexive and balanced. Science is one of many contexts for a child's growth.

Where are other cultures situated in this story? What about their ways of knowing and inquiring into the world which might take their young children on a completely different journey to Western children? How could these perspectives be integrated on such a map?

Integrating soul and science in education

The previous table of *science through the perspectival levels* enables us to see that the further up the stages one goes, the more soul aspects are integrated, until one is well into the transpersonal stages of *fully integrated being*. But can soul be a part of science at every stage? Is soul in science more than the WOW factor – **W**onder **O**f the **W**orld? In Chapter 10 I suggested, based on the work by Cajete (1994), that science education has a role to play in providing young children with a sense of place in nature which is foundational for further development of ethical and soul capacities. But is there more to soul in science than this?

How was soul present in my physics classes? Perhaps it enhanced students' experiences; stimulating curiosity, existential questioning, passion and creativity; creating a quality of attention, mindfulness and reflection; deepening relationships and sense of natural care and ethics; supporting transformation; connecting to nature and self; encouraging deep meaning and experiences; and providing a place where students could be and express their whole selves.

It provided the motivation and the nurturing environment for students to explore what it meant to be scientists; assisting in better thinking and inquiry, higher participation and collaboration, greater discernment, autonomy and initiative.

It seemed to me that students went on an inquiry journey which had many similar experiences to a spiritual journey.

Spiritual Journey	**Science Journey**
Inspired by a deep need to find truth, meaning, purpose, wholeness or place in the universe	Inspired by a need to understand the universe
Contemplation / reflection / insight – going deep into self and experience	Imagination / reflection / meaning / insight – going deep into nature and phenomena
Service / ethical practice / vocation / wise action / mindfulness	Caring / developing ethical practice / looking for vocation / attention

Inquiry – discernment / deep questioning / integral	Inquiry – self aware, critical thinking, inquiry processes
Turning points /consciousness transformation / awakening / experience of a dimension beyond self	Turning points / transformation of perspective
Deep relationships	Dialogical and caring community
Sense of place / being at home in the universe	Sense of place in nature and cosmos
Self expression / creativity	Expression of own questions and ideas / creative meaning making

Fig 12.6

Perhaps there is a reflexivity between building soul capacity and building science 'thinking' capacity? As we assist students on their science journey we also plant the seeds for a greater personal one. As we nurture students with soul in our classes we enable them to explore themselves as well as the discipline knowledge and processes.

There has been a lot of work globally in recent years about developing curriculum to encourage thinking. The Tasmanian K-10 *Essential Learnings* is centered around thinking, inquiry and *Teaching for Understanding*. This is already having an impact on how various Tasmanian high schools are reconceptualising their science curriculum, which will in turn have implications for the delivery of science in year 11/12 colleges and universities.

Harpez (2003) has suggested that one can think about the **Thinking Curriculum** in three ways:

1. Giving students **thinking tools** (e.g. De Bono)

2. Development of **thinking dispositions** (e.g. Costa and Kallick's (2000) *Habits of Mind*, and Perkin's *Thinking Dispositions*) which build attitudes and capacity for creative and effective thinking.

3. **Teaching for Understanding** pedagogies (e.g. Project Zero at Harvard University) which use generative questions for student-centred inquiry, carefully planned to deliver understandings valued by the teacher or the course.

Perhaps, in my physics class I was building *Habits of Mind* without necessarily intending to? Costa and Kallick's *Habits of Mind* are based on what creative and effective thinkers and enterprising people do. These qualities could be interpreted from a purely pragmatic point of

view or could go deeper, based on the sort of spiritual qualities that Grof (1993) describes. Below I have correlated the *Habits of Mind* with the *Qualities of Spiritual Maturity*, showing how soul might be a deeper expression of mind. As we aim to build capacities for *thinking*, can we also build capacity for *soul*? (See Appendix 2 for fuller descriptions of each category.)

Qualities of Spiritual Maturity (Grof 1993)	**Habits of Mind** (Costa and Kallick 2000)
Faith, trust, and inner security	Persisting
Physical, emotional, mental and spiritual clarity	Thinking and communicating with clarity and precision
Serenity	Managing impulsivity
Living in the present moment	Gathering data through all senses
Love, compassion and service	Listening with understanding and empathy
Expressing the creative soul *(my addition)*	Creating, imagining, innovating
Personal freedom	Thinking flexibly
A sense of wonder, mystery, and reverence	Responding with wonderment and awe
Honesty and authenticity	Thinking about thinking (meta-cognition)
Responsibility and discipline	Taking responsible risks
Connection with the earth, nature and everyday life	Striving for accuracy
Hope, happiness, joy, and humour	Finding humour
A sense of purpose and place in space and time	Questioning and posing problems
Tolerance and patience	Thinking inter-dependently
Wisdom and understanding	Applying past knowledge to new situations
Gratitude, humility and willingness	Remaining open to continuous learning

Fig 12.7

So in thinking about a science curriculum and science education it might help us to think about *science thinking* or the *science mind* as nested within *soul* (see Fig 12.8). Soul is pervasive and ever present… not something considered as a small aspect of a curriculum. So what might be the aspects of scientific curriculum based on *thinking*? Perhaps in addition to *thinking pedagogies,*

thinking tools and *thinking dispositions* we could also consider *ways of knowing*, *cognitive development* and *curriculum metaphors.* What might their corresponding *soul* aspects be?

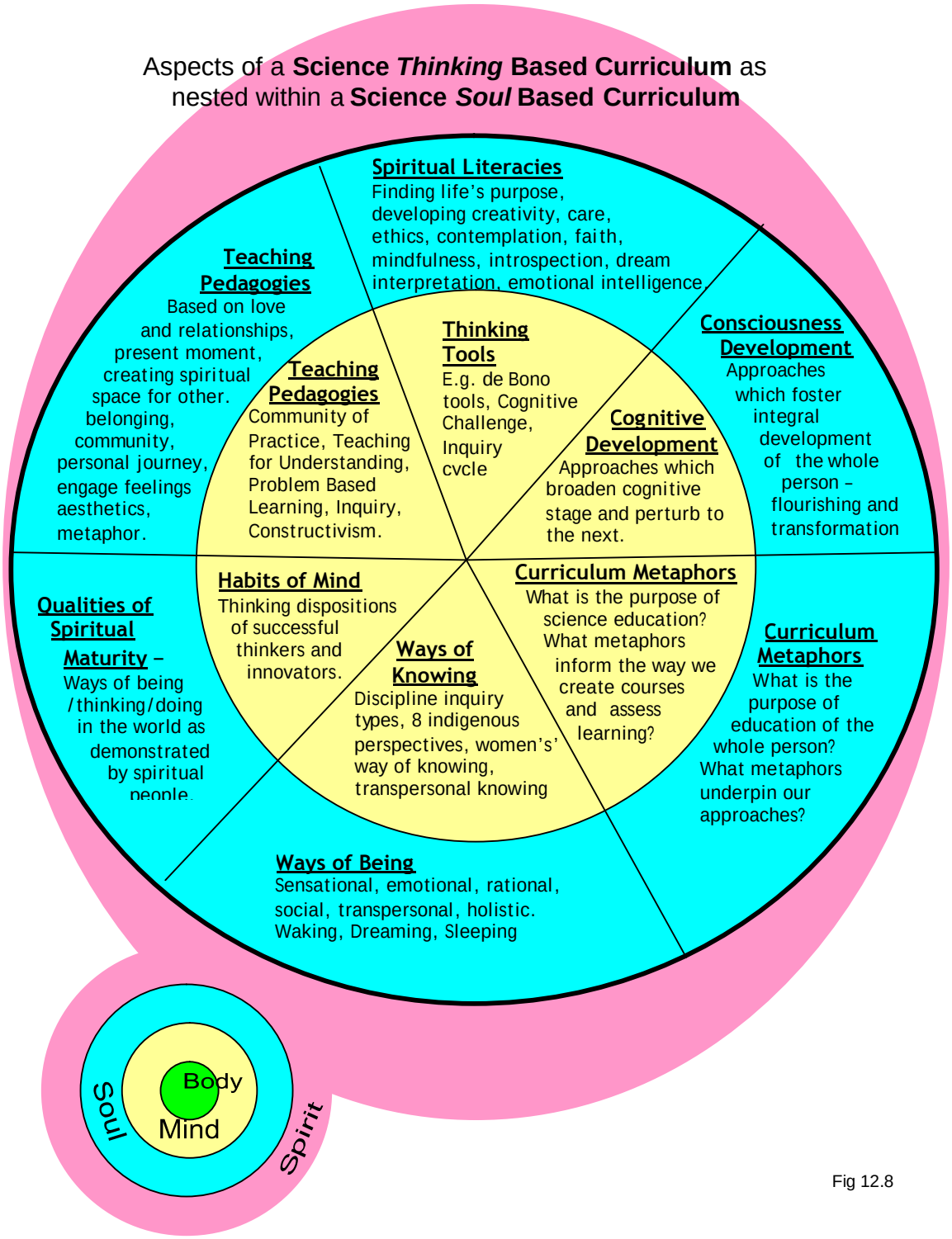


Fig 12.8

So perhaps a rich science curriculum can draw on *mind* and *soul*, helping students to integrate these in action. So science creates a context which enables development of the whole person and soul supports the development of the scientific self. However, where this becomes problematic is when the curriculum metaphors that support science learning are in conflict with curriculum metaphors which support development of the whole person. How does one resolve this? Moving to a different way of thinking about science? And what is the role of the teacher in all this?

What is science looking at?

For science and soul to be truly integrated we would need to ask *what is science now looking at?* Is it still in the realm of **IT** and **ITS** or can we allow for an integral science which looks at the world of **I** and **WE**. Do we need to provide demarcations for social science and natural sciences?

And what about the spiritual dimension? Can science look at the causal and subtle states as well as the gross? For example, study of subtle **IT** might take us into alternative medicine – acupuncture, vibrational medicine or yoga. Study of the subtle **ITS** might help us explore biodynamics – the interaction of cosmic energies in soil and plant systems. Study of subtle **WE** might take us into Jung's collective unconscious or Sheldrake's Morphogenic Fields.

And is science limited to the *eye of the senses* and the *eye of mind*, or can it also use the *eye of the spirit*. What might it mean to use these with discernment and integration?

What paradigms are we in when we conduct science or teach science? How does our view constrain what we might consider as a context for science research?

What might it mean to be an integral scientist?

In the Chapter 11 I included Gordon's (forthcoming) recommendation for what an *Integral Teacher* could be like which was based on Wilber's 8 indigenous epistemologies. Using a similar approach I have asked what an *integral scientist* might look like based on Wilber's quadrants.

I Holistic Being	**IT** Master of Discipline
WE Perspective Taker	**ITS** Systems Thinker

Fig 12.9

1. **Scientist as a Holistic Being** – being aware of personal development lines; feelings, intentions, values, ways of thinking, cultural and perspectival limitations of own thinking. Reflecting on own being and becoming. Aware of soul and the sense of purpose and meaning that they bring to their vocation. Based on a deep sense of the inner self and connection to life and others.

2. **Scientist as a Master of Discipline** – aware of the tools that the discipline has – empirical methods, inquiry processes, intimacy with that they are trying to know, critical discourse, process of knowledge consensus, innovation to commercialization, ethical appropriateness of research methods. Understands critiques of the epistemology of their discipline and the cultural situatedness of the discipline. Aware of the limits of their own knowledge and skills; questioning their claims to know. Based on a passion to discover the wonder and mysteries of the world and a commitment to assist in world understanding, quality of life or evolution.

3. **Scientist as Perspective Taker** – able to understand and inhabit the perspectives of others in their field, other discipline approaches and those affected by the science or the issues that they are investigating. Able to understand cultural perspectives and the obstacles to change. Can use other perspectives as lenses for their own research thus questioning its usefulness, ethical dimensions, meaning and appropriateness for the whole. Based on meaningful and compassionate relationships with others and a deep need to be of service.

4. **Scientist as Systems Thinker** – able to zoom into different holon levels and understand the impacts of what they do at each layer. Recognizes their interactivity within the whole. Able to map the cultural, political and social systems as well as scientific systems and to question their research as to its impact, effectiveness and sustainability. Based on an openness and sensitivity to the feedback that the system provides them.

A tentative summary…

What might we think of when we think of *integral science*?

- ***who* it is that is doing the science** - bringing our whole selves to our engagement with science, and the action of being scientists - integrating heart, mind and soul – becoming an integral scientist.
- ***stages of science* -** different stages of science suit people at different perspective levels or cultural memes.
- **science *as transformation*** - the act of doing science fosters development and transformation of the human being who is in process of doing it, particularly in the stages from *impulsive mind* to *socialized mind* to *self-authoring mind.* Science is one thread of human development.
- **science *thinking* nested within *soul* –** soul qualities support effective science practice, and science provides a context for developing soul capacities.
- ***what* we look at in science** - not just physical (gross) world but also looking at subtle and causal states
- ***how* we do science – scientific epistemologies** - the research tools and methodologies – broadening these to cover all epistemologies and all dimensions of being.
- ***what context is it in***? – understanding the interactivity, cultural embeddedness, paradigms, limitations, power relationships, system effects and ethical dimensions.
- ***why* are we doing science?** – personal understanding and growth, connecting with nature, inquiring into the universe, advancing the world, consciousness evolution, service to others, development of an ethical and wise self?
- ***how do we teach science?*** – Science thinking nested within soul - pedagogies, curriculum metaphors, habits of mind/being, ways of knowing and being, literacies and tools for thinking and soul, consciousness development, role of teacher.

Conclude 1: The problem with transforming science?

2005. I am sitting in a packed auditorium at the CSIRO Marine Laboratories in Hobart. It is an informal lunchtime seminar where one scientist, Dr Jaci Brown, is giving a talk about her role of *Scientist in Residence* at a local girls high school for six weeks. Her specialty is climate change modeling and so she worked with teachers at the school to create learning activities for Year 7 classes through to grade 10 classes on the topic of climate change.

Jaci is describing how she introduced ideas of climate change to Year 7 Maths classes using graphs and system feedback diagrams and how difficult it was for students to grasp the concepts. She used lots of analogies and tried to bring it back to students' personal experience. She explains how she introduces one graph to the class: "Here is a pie chart which shows how much of each gas we produce. All of these affect climate change…See this piece of the pie chart – these are hydrocarbons - these are the gasses in your hairsprays and deodorants…. By just switching brands to a pump action you can help to reduce these emissions in the atmosphere." She tells us that many of the girls were shocked asking *"Why weren't we told about climate change?"*

Now who is in the audience at this seminar? Leading climate change scientists, the Australian Senator for climate change, representatives from the Greens who have put together educational packages for schools on climate change and sustainability, and some teachers.

The scientists in the audience are shocked that the students hadn't even heard of climate change. "Surely everyone knows?" one says. Someone then responds saying that because of the way that the media represents it, the science seems uncertain. "But we are about 95% certain… the case for it is mounting up… the only thing we don't know is to what extent the climate will change," exclaims another scientist in response.

The Senator says that the problem is that the media is giving equal air time to both sides, rather than giving more weight to the science. "Scientists from oil companies come on and say there isn't a problem, but no-one from the public side of science gets up and puts the alternative case. We need our public scientists to be more public!"
"But I can't do that," says one of the scientists, "I would lose my integrity as a scientist … I have to be seen as impartial… I cannot be associated with a cause."

Jaci suggests that a big step forward in educating the public would be scientists going into schools or doing what she is now engaged in – preparing learning activities on climate change for teachers to use across Tasmania. There is agreement among the scientists of the importance of public education as these are people who are very concerned about the impact of climate change on the earth and would like to see public behaviours changing to more sustainable living. One scientist says "Perhaps then people would know enough to vote for a government who is prepared to sign the Kyoto protocol." (Australia is one of a few Western countries who has yet to sign.) Another says "And start living more sustainably themselves."

The Greens representative says that it isn't just about getting information out there… that information alone will not change behaviour… there needs to be ways of ensuring students can engage in sustainable change. "It is more than just teaching students the ideas of climate change… we need ways to change the culture of how they operate in the world."

I suggest that perhaps a Year 7 student trying to understand system changes at a global level also needs to experience systems at a more local level … where they could gain feedback and see the consequences of their actions and be able to modify them. A global system doesn't give them feedback so it is a bit like a blackhole. But we don't just have to stick to science systems … we could look at cultural. So a student could suggest to their Mum to buy a new type of hairspray and then see what helps her sustain that or hinders that and devises ways to overcome obstacles. Or the students in a school could sign a declaration for non-hydrocarbon hairsprays and if they can stick to this for one year then there are rewards or celebrations…. getting positive reinforcement for their actions.

Then the senator says that even knowing about climate change and having an incentive to change isn't enough. That she has just been to the Pacific Conference for climate change where Pacific Islanders have ample evidence of how sea levels are rising and have had to deal with increased incidences of extreme weather. "But they are not doing anything about it because they are coming from a fundamental Christian point of view…. They see it as the second coming and are saying … bring it on! What do you do when the worldview of a group doesn't even accept the need to change?"

There is a stunned silence. “So I went to key Christian leaders in Australia and told them what was happening and asked them what their role was in challenging this viewpoint,” she continued.

If I could read the mind of everyone there I would have heard “This is a big issue…. Bigger than we think. What do we do now?”

I start to think that we have really moved away from a scientific issue into one of culture – how do you understand the cultures of others, how they come to know, why they might change their positions? Could we understand this problem better if we brought a **spiral dynamic** lens to the situation? For example, Esbjorn-Hargens (2005) has looked at likely responses to a program to increase recycling based on the cultural meme someone is operating at… so someone in the **blue** meme might do it because they are told to, someone in the **red** meme would not do it and rebel, someone in the **orange** meme would do it because it made good commercial or scientific sense and someone in the **green** meme might do it because they care. So understanding the various memes within our society helps us to design appropriate strategies to educate and transform behaviour.

And would it help to understand which cultural perspectives the different players might be coming from in this seminar? Would it be beneficial to analyse the processes we are using in looking at the issues and the perspectives we are bringing?

What cultural perspectives did the participants have? So are the climate scientists operating within an **orange** meme in their practice *as scientists*, but fall into a **blue** meme way of operating in their ways of thinking of *how* to educate others and bring about change? (It will be OK if we just tell them.) Is the Senator operating in the **green** meme as a change agent, understanding pluralities and looking for ways of activating others? Are the scientists operating within a **green** meme in terms of their private concern for the planet and their desire to make a bigger impact on public opinion, yet feel that they have to play a role within a well defined science culture in order to retain their status as scientists?

What might be a systemic approach (**yellow** meme) in looking at this issue, I wonder? Are we perhaps seeing the glimmerings of it just in this interactivity between different cultural memes and perspectives in this seminar? (And each person might be bringing multiple-perspectives in

tension.) Would it be useful to name what is going on here so people could see how their defined (and non-defined) roles are an important part of the whole, rather than feeling their positions are too far removed from each other? Would a spiral dynamic or integral map help in understanding where all approaches to this issue might fit, how they might be needed and what might be missing? So perhaps spiral dynamics could become a useful heuristic tool in helping explore complex issues which involve both culture and science.

How might someone operating at the *integral mind* (**Turquoise** meme) perspective work with this group or with this issue? Perhaps they might use individual strengths, look for weaknesses, search for other 'experts' to fill gaps and find ways of creating the glue between all participants that could yield emergent understandings and sustainable ongoing actions. Perhaps they might be open to synchronicity and serendipity; to understanding perhaps there is more to this issue than solving it… the very process of coming together to solve something like this is in fact an opportunity for global transformation and evolution in consciousness. They might look beyond the strategic into a place of visioning… and look to engage others in a process that can speak deep within their souls … enabling the space for flourishing or transformation.

So what is the role of a 'real scientist' in all this? How can scientists reconcile a need to maintain their integrity as scientists with their need to be a global citizen? Should scientists have the skills to make their science accessible and knowable by the public as well as with their usual audience of the scientific community? Should they be able to see the cultural obstacles to people using their information and plan around that? At what point do they move from being scientists to being advocates or agents of change… or is that best left to the cultural experts, or the politicians?

Should scientists be seeing science as a continuum of perspectives, realizing that they can choose where they locate themselves for particular studies or issues? Should we be encouraging science graduates to see themselves as growing not just in mastery of discipline but also mastery of perspectival and cultural levels?

But the story doesn't end there.

The courses that Jaci designed in collaboration with teachers from a high school were converted into learning sequences available to all high schools in Tasmania. Immediately after they became

public, the climate change topic for Year 10 science students was highly criticized by one science department within the university. They believed that the topic of climate change was far too complex for a high school student to understand. They would much rather the teachers focused on teaching the students 'real science', providing proper foundations for undergraduate science courses which would then be the basis for any proper science research on climate change. Which meme are these departments coming from?

Underlying their concern are some key assumptions about the role of high school science programs and what they are for. But how many students actually progress to do university science from Year 10? No more than 10%. So what is the role of high school science? If this is the last time a student does science in their education then what would you like them to leave with? Partial knowledge which are building blocks for non-realized future studies? Understanding the complexity of global issues, helping them to be informed, responsible global citizens? Building moral awareness and capacity? Building a desire to know more about the world and their role in it, no matter what career path they take? (These are the new *green meme* criteria underpinning the *Essential Learning* curriculum for K-10.)

Is it possible to build some foundations *for later* studies while creating some meaningful learning *for now?* Perhaps this requires us to perceive new metaphors for science knowledge – not merely the Newtonian building blocks but perhaps as well more holographic or integral notions of knowledge construction.

And what about the CSIRO scientists' role in promoting awareness of climate change? Just two months after this seminar the government expressly forbade any scientists in the division to speak directly with the public, and some of the scientists who had made predictions based on the number of people likely to be dislocated from the Pacific as a result of sea level rise were gagged; they were told that they were not to discuss anything related to 'policy' and to stick to 'science' (Cohen 2006). Yes, the Australian government has a clear idea of the demarcation between science and policy. To change science in Australia then requires much more than changing science education… it requires changing the very culture of how science is perceived, used and valued within the fabric of our society.

Conclude 2: The possibilities of transforming science

2000. I am at the beach with my four and a half year old nephew, Glen. It is something we have been doing together every couple of weeks.

Today we have been walking along, looking at the sand squiggles from buried seashells and picking up interesting treasures. Glen suddenly looks at me and says "How come that sand over there (points to the dry sand) is different to that sand there (points to the wet sand.)"
"Hmmm," I say, giving me time to think. What does he mean? Hasn't he realized that that sand there is wet and that one over there is dry? I decide not to pre-empt him and to find out what he is thinking. "Why do you think they might be different?" I ask in as neutral way as possible.
"Well," he says, "I was thinking that this (points to the dry sand) might be salt from the sea."
"Interesting idea," I say, "how might you test that?"
He looks at me blankly.
"Could you taste it and see if it tasted like salt?" I ask.
"Yes!" says Glen eyes lit up, and he carefully tastes a bit. Then he shakes his head and says that it doesn't taste like salt. "I don't know why it is different then," he says a little despondently.

I point to the waves coming in and ask him if he thinks that they might have anything to do with it. He looks for a while and decides to get some water and put it on the dry sand.
"I am trying to see if it turns into that sand (points to the wet sand)." he says.
The dry sand looks wet but certainly hasn't changed to the muddy texture and yellowish tinge of the wet sand. He shakes his head and says that water doesn't do it.
"Do you think you put on enough water?" I ask.

He thinks about it and picks up some of the dry sand and carries it below the waterline. He plonks his little pile on the wet sand in the path of a wave. When the wave passes there is no pile of sand remaining. "Where has my sand gone!" he squeals. "It has disappeared."

He acts quite shocked. I say that perhaps there wasn't enough sand and as it got wet it might have flattened out. He looks at me for a while then goes and gets a large mound of dry sand, putting it in front of a wave. It gets wet and doesn't disappear. It looks exactly like the muddy wet sand. Glen is really excited, hopping around. "It is the same sand!" he says. "The only difference is whether it is wet or not."

Phew, I think. I am exhausted. That was amazing. I was so glad I hadn't just told him the answer right away. It was really interesting being privy to his thinking. I thought about how much I took for granted about the world, and how much is so incredibly new to him. How excited he gets about the littlest thing. How can I help him retain that sense of curiosity and intrigue?

So we continue to walk along the beach, still exploring, searching for treasures. But there is more to life than science I think.

So I say to Glen, "You know we have spent our whole time at the beach being scientists, experimenting with sand, looking at what makes those squiggly lines in the sand. Maybe for a change we should be something different."
"Like what?"
"What about being artists?"
"What do artists do?"
"Well artists look at the world in a different way….how things look – how beautiful they are – the patterns… does that make sense… they look at the scenery, the sky."
"Ok."
So Glen looks at the sky and the waves and the beach. After a while he says. "You know the clouds make very interesting patterns. And look here in the water. The sky is in the water."
Wow, I think.

"Do you want to try something different again?" I ask. "Let us try being monks."
"What do monks do?"
"Well they are interested in experiencing the world fully, they breathe deeply, smell the air – can you feel it as you breathe in – the tanginess, the salty smell? They listen carefully to all the sounds being very quiet. Can you hear the waves, the birds, the cars? They look at the waves and just watch them rolling in…. can you see the rhythm of the waves? They walk slowly and feel the sand on their feet and the earth underneath them."
Glen is doing all this and then suddenly he twirls around.
"What are you doing?" I ask him smiling away.
"I can't help it, I feel so good."

He stops twirling and says "Can we play our imaginary game now. I would like to call the sea serpent…. *Sea serpent, sea serpent, come to us, we are your friends and I promise to care for you.*" (This is an invocation he had invented on a previous trip.) "Now," he says, "let me get out my magic box of treasures." He presses the magic button on the top of his finger and his invisible treasure box opens.

"What are you taking out today?" I ask.

"I am not taking anything out," he says, "I am putting something in."

"What are you going to put in?" I ask, thinking maybe he would put in the feather he had found.

"I am putting in the whole world!"

"The whole world! … why are you doing that?"

"Because the whole world is a treasure."

"All the animals and plants and everything?"

"Yes the whole lot. I am putting it in here because someone has to keep it safe."

Conclude 3: Visioning

Sit with me now in this space.

Let us vision together.

Where do you want to go?

Where do I want to go?

Afterword

Owl quietly closed the book. “Hmph,” he said, “I think that something definitely needs to be done.”

The other animals looked at him, nodding.

He huffed and puffed a bit and blew out his chest. “I will be definitely writing a letter to the editor,” he said.

“What will be in it?” squeaked Piglet in anticipation.

“Definitely an F,” said owl.

“Oh.” said Piglet.

“Well I am going to do something too,” said Piglet donning a cape and sword. “I am going to be a warrior fighting for what I value. I am going to change the world.”

“Yes,” said Christopher Robin, “I am going to change the world too, but by being a transformed being living in the world.”

“What does that mean dear?” asked Kanga.

“It means I am going to change what happens in my school by being an enthusiastic and caring learner in my school. My teachers will just not know what hit them!”

“Hmmm,” said Rabbit, “I’m not sure about this going off and doing your own thing approach. I really think we need a committee. Hey Tigger, come and be on my committee!”

Tigger was jumping off a large tree stump and was very focussed. He suddenly realized all the animals were looking at him and exclaimed “I think I just felt momentum! I am just going to keep practicing until I get it right!”

Eyeyore started kicking the book with his hoof. “You know it is all a con,” he said. “We started out thinking there was going to be an answer and there are only more and more questions. Where is the answer?”

“Oh dear,” said Kanga, “I think you have missed the point. To come up with ONE answer is reducing everything to Flatland. It is the plurality of questions which keep the tensions alive and enable us to live with depth and humanity.”

“Well how are all those questions going to help you with Roo?” sulked Eyeore.

“Well I think right now I might spend some time with him. Be really present with him and just see what emerges. I am so busy being Mum that I have forgotten to be present in the moment, even with myself. I think that is what I am going to do right now.”

“And what are you going to do Pooh?” asked Christopher Robin, lovingly kicking the prone bear with his foot.
“Uh, what, uh, what?” said Pooh acting as if he had woken from a deep sleep. He looked at all the animals staring at him and yawned. “Did I miss anything?” he asked. “I was just having a very nice dream. It was about all my friends, sitting together having a picnic. There was lots of honey and condensed milk and we all had a very good time.”
“Even me?” squeaked Piglet, who often fell into holes and got mud on his clothes.
“Yes, Piglet, even you” smiled Pooh, patting his friend on the shoulder. “What is a bit of mud now and then when there are elevensives to follow.”

Epilogue

Now at the end of any good story the author has a duty to tie up the threads and leave the reader with a sense of closure, even if the aim of the writing has been for the purpose of opening up. I have tried to tie up the threads of science, but what about my own threads?

Here in this autobiographical study I have invited you to enter deeply into my life world, to engage with my character and invest quite a few hours of your life in following this character's journey. So should there be a happy ending along with a glorious sunset? What happens to me?

Will I continue in science? Well I can't imagine going back into the physics box and teaching it again despite the wonderful experiences I have had with my classes and my love of the subject. Maybe opportunities might open up for me in education of science educators, who knows. I am really unsure of my direction and in the fullness of time it may become clear. Meanwhile, I am preparing for my next art exhibition in April 2007, called *"One day Mrs Higgins woke up and decided to be surprised."* It follows my 2005 exhibition of *"The seduction of Agnes Scornethope."* (see www.users.bigpond.com/rsstack/art)

I am also working with refugees from Africa and have helped in setting up a befriending program as well as assisting in the research and writing of testimonies in helping relatives of refugees to be able to immigrate to Australia. This has been an enormously powerful and moving experience for me, pushing me to new understandings of cultural difference and the implicit barriers in our society that marginalize other ways of knowing, being, and community. I might now use my newly developed ethnography skills to perhaps explore this area further.

Later this year I will be facilitating a ceramic sculpture course for African women (mothers and daughters) which will be linked to a trauma counseling program (many of these women have been raped and tortured.) But meanwhile I am building bridges between their community and ours by dancing with them as they teach their next generation their traditions.

And I am back in a Year 11/12 college, teaching journalism to keep me grounded in teaching reality, yet bouncing against that bottle again as I try to express openly my own holistic being as a teacher. Perhaps I can do something about that bottle in the process – maybe it can grow.

And despite the long days of writing where the fridge has gone empty and my husband has had to be creative in sustaining physical life, we are still a happy couple and will continue to be active in the global community, waving the holistic and integral flag.

And although I still have chronic fatigue, I am getting a lot better. I hope that this process of writing might help me to recover, helping me to name and then dis-identify with those habits of mind which constrain my soul and my health. I certainly stretched too far in this journey of mine – going on a marathon of transformation, rather than shorter excursions with time for integration. My illness has forced me to integrate in multiple ways of being and although I would not wish to experience this process again, I value what I have gained from it.

Perhaps now I am moving to a better understanding of the meaning of balance. But perhaps not. Perhaps I am just as precariously positioned as before, waiting for the next perturbing thing which will create the disequilibrium needed for growth. And perhaps that is part of the process of awakening. Perhaps as I become more

awake I can allow myself to *be* and see in ways that enable harmony and wholeness. But until that time I am still stretching…

Awakening

Appendices

Appendix 1

Explicating the Research Process

Questions:

What has been my research process?
What has informed my research methodology?
What concerns do I have about the research methods and processes?

What am I wanting to know and how can I come to know?

My research has not exactly gone to plan because I have been very ill in the middle of it, which may (or may not) be considered serendipitous. I started out specifically intending to research my teaching practice as a Year 11/12 Physics and Journalism teacher between 1996 and 1999 in order to explore deeply *what it means to move towards being a holistic teacher*. I have now integrated that within a larger context of examining the implications of Holistic and Integral referents for curriculum design and for the conceptualising of science education and science. My research can now be best described as several studies within a bigger study. But in truth there has only been one study – into myself.

I started doing a Doctorate of Science Education in June 1996 with my big question being "*What does it mean to teach holistically? How can I make my classes more meaningful for my students?*" This is something I had been exploring in my classes over the previous years. Taking on a doctorate meant a continuation with the exploration but now with a more rigorous research process and input of educational referents.

My participation in the various sessions of the course exposed me to new ways of conceptualising education – a whole world of theorists, philosophers and critics. I was

introduced to the world of relativism, plurality and postmodernism – a pretty big journey for someone with a science background and a pragmatic approach to teaching. Whereas before I was looking at improving my teaching by experimenting with practical classroom activities and principles, now I was being asked to look at the cultural metaphors that underpinned my assumptions of learning and education.

Holistic education had earlier introduced me to the notion of worldviews but my engagement with it was not at the level of the theorists; rather looking at what other teachers like myself had trialled in their classes and how I could learn from that; modify or value add for my own purpose. From that I might deduce principles which I could transfer to new situations, working with teachers and curriculum design.

So what research approach would suit my research questions and my own way of learning? I was attracted to the 'lived experience' genre of research (Whitehead 1989) based on action research models (Kemmis and McTaggart 1982). I am after all a practical person who needs to experience things for myself to understand something. I found myself exploring in two key ways:

1. **Seeking to find underlying principles** / systems / significant meanings which could inform the generation of classroom practice. This set up a loop - *Theory* to *practice* to *evaluation* to *reflection* to *modifying an understanding of the theory* to....

2. **Trialling different practical strategies** in my classes to seek the emerging themes / principles / meaning and significance. This research loop was *practice* to *evaluation* to *reflection* to *theorizing* to *practice with revised intentionality* to.... This was more aligned to grounded research methodologies where theories emerge from the research.

In seeking to find underlying principles that could guide development of holistic practice I asked the following key questions:

- *What does it mean to be a human being? How do different notions of human beingness articulate into educational models?*
- *What is the purpose of education? How is this affected by notions of human beingness?*
- *How does a human being develop and how is this affected by notions of human beingness?*

This started a journey of reading, embracing a range of viewpoints drawn from literature on **spirituality in the everyday world** (e.g. Brussat 1996, Pearmain 1998, Hanh 1991, Moore 1994, Hubbard 1998, Grof 1993, Capra and Steindl-Rast 1991, Sheldrake and Fox 1996, Wilber 1997), **the new sciences** (e.g. Zukav 1979, Wheatley 1994, Talbot 1992, Prigogine 1997, Peat 1987, Lovelock 1979, Laszlo 1996, Capra 1982, 1988, 1991, 1996), **ecoliteracy** (e.g. Orr 1994, Capra 1993, Knudston and Suziki 1994, Fox 1990, Bateson 1972, Macey 1991), **feminist discourses** (e.g. Belenky et al 1986, Goldberger et al 1996, Noddings 1992), **indigenous education** (Cajete 1994), **Holistic Education practices** (e.g. Miller 1994, 1996, Flake 1993, Palmer 1993) and **development models** (e.g. Brennan 1987, Childs 1996, Egan 1986).

Sometimes I read broadly, just dipping to get a sense of the whole and sometimes I stopped and spent a long time trying to get to terms with a particular standpoint through reflection, dialogue with others and then articulating it into practice and determining outcomes…coming to understand the ideas through experiencing them in action. I read with the lens of a teacher looking for practical ways of incorporating big ideas into her teaching.

Meanwhile, I was also exploring a range of teaching strategies that were individually justified and supported by research and teaching materials - eg. constructivist teaching strategies (Tobin 1993); conceptual change strategies (Duit and Confrey 1996); multiple intelligence strategies - such as conceptual mapping, metaphors, visualisations, and role plays (Gardner 1985, Lazear 1991); whole brain learning strategies (as researched by Julia Atkin); thinking strategies (de Bono 1992); and collaborative learning strategies (Bennett 1991, Gibbs 1994). However, few of these were explained or positioned in relation to my key questions above.

What I discovered was that my two processes became reflexive of the other. Experiencing the teaching strategies enabled me to get at an understanding of the principles I was reading about by having concrete exemplars to make sense of the wave of theorising words. And the principles that I was exploring enabled me to question the strategies from a bigger picture standpoint than originally indicated by the researchers, leading to imbuing the strategies with greater intentionality. There was a coming together, a synergy, that enabled me to creatively model and synthesise many principles together and play with them in practice in my classes in new and richly meaningful ways.

This wasn't real research, I thought, just play. Though play which I journalled and where I interviewed students, gave them questionnaires and asked them to write journals to give me feedback for this play of mine.

The questions I was exploring were:

- what learning experiences are rich and meaningful for my students and my colleagues
- what experiences and ways of thinking can empower students to seek that which is meaningful for them
- what models of thinking (underpinning systems or principles) are useful in giving greater intentionality to everyday teaching strategies in order to create meaningful experiences for students
- ways of assisting other teachers to move from traditional reductionist and disconnected practices into more holistic ones and as a result gaining better understanding of the constraints to such movement.

Then in September 1997 I had a doctorate institute that forced me to look critically at my research process and notions of validity and rigor. How rigorous was I when doing action research? What can I claim to know and why? Is this really the best methodology for me and what can I learn from others? So now the whole world of the social sciences opens up for me… phenomenology, ethno-methodology, personal experience, grounded research, feminist research, seventh moment research, research as writing (as described in Denzin and Lincoln 1994). What can I take from these?

Situating my action research

First of all I am situated within the realm of personal experience research methodologies as described by Candinin and Connelly (1994). The advantage of researching one's own personal experience compared to researching someone else's is that it takes a whole interpretive loop out of the research (Fenstermacher 1992). The downside is that when the researcher and the researched are one and the same it becomes difficult to retain enough detachment and objectivity. The researcher becomes bound by their own ways of knowing and being which creates self-validating research - the knower and the known shape each other. The different types of personal experience methods aim to deal with this problem in different ways.

Phenomenological and grounded research methodologies both interpret lived experience. In both of these, the researcher is trying to interpret with a clean slate, with no theoretical assumptions guiding the interpretation, listening for the emerging themes and theories. Unfortunately, no matter how hard we try, our life experience gets in the way and the interpretations are not theory-free or value-free. In my case, while I wish to draw emergent themes from my lived experience, I am deliberately starting with a theoretical underpinning. While I can use the interpretive procedures suggested by phenomenological researchers such as van Maanen (1990) I am not situated exclusively within that research framework.

The *action inquiry* of Torbert (1991) attempts to address the problem of self-validating research by suggesting a *'critical subjectivity'*. He shows a hierarchy of operation that a researcher can be in - from an impulsive and un-aware position to stages where the researcher becomes aware of the different levels of paradigms that they are working under. (His model was later adapted and further researched by Cook-Greuter (2002) and underpins the perspectival stages that I have been referring to throughout this thesis.) He requires as part of the research that the researcher undergoes a rigorous self-critique and self-examination. By doing this, the epistemological and ontological assumptions of the researcher become explicit and greater honesty and authenticity can be brought to the interpretation. In the process of doing this the researcher herself is transformed to higher stages. Therefore, as part of my research I have adopted an ongoing deep personal reflection that questions the underlying influences and constraints in the way I am thinking and seeing.

What is action inquiry?

I initially adopted an action research process along the lines of Kemmis & McTaggart (1982). This involved a *'plan, action, reflect'* iterative cycle. The action research of Kemmis and McTaggart requires considerable attention to goal setting, planning and following an established process in order to ensure procedural rigour. However, Argrys et al (1985) warns about setting a paradigm for action research, which involves setting goals seeking firm outcomes. The researcher should be aware of what attitudes about their research that they bring to their research (as opposed to theoretical or value positions). An attitude where the researcher shifts from wishing to achieve specific effective *outcomes* to wishing to achieve an effective *process* will open up the research, enabling greater participation of others and new ideas and possibilities to emerge. This means being reflective about how the process is enabling the attainment of valid information, free and informed choice and internal commitment.

Torbert (1991) describes action inquiry as *"knowledge gained in action for action"* or *"consciousness in the midst of action"*. So my research process is actually an iterative spiral of *planning or intent, trial, feedback, reflection, theorising, planning* etc which may be happening as I am *in* action as a teacher (where I am responding *in the moment* to student response and then modifying what I am doing), **or** is being done at separate and distinct times. In order to capture my 'in the now' *inquiry in action* process I am recording through journaling my actual experience and then reflecting on this experience using a phenomenological interpretive approach.

A more staged formal approach to the cycle includes getting student feedback via interviews, journals and questionnaires and then applying interpretive and analysis methods to these 'field texts' as suggested by Connelly & Clandinin (1988). Then, using this information new plans and strategies can be developed for further research, linking to appropriate theoretical frameworks. Previous understandings might be reinforced if the implementation of new activities seem effective, and those that fail perturb to new insights.

As well as having a planned process / cycle I have also tried to keep an open mind, being ready to listen for whatever happens without having specific expectations or intent - providing space for surprises.

I find that action research now becomes a way of life and not something I can switch off. I am constantly examining my experience - whatever I am doing – whether in conversation with friends or playing with my nephews. I find myself almost being *too* reflective, *too* eager to seek meaning and create new actions…. and forgetting just to *be*.

How does one achieve authenticity and trustworthiness in the **action research** process?

The problems with research of this kind and the responsibilities of the researcher are well described by Clandinin & Connelly (1994). Can I claim to know the other? I can't even claim to know myself! My research relies heavily on my interpretation of what is going on around me. I am making assumptions about students and colleagues that are based on conversations, observations, my journal reflections, their journal reflections and interviews with them. I am making them through my own interpretive lens of which I need to be constantly aware.

By using a hermeneutic discourse process over long periods of time I can deepen my understanding and appreciation of my students. I can provide space for their voices and teach myself to listen with care. I find mindful practices help me in being more fully present to their states – seeing their body language, their energy, hearing their voice and listening for what is unsaid. With all these clues I still can not claim to know. I have to be mindful not to bring my history with them to cloud how I see them *this* moment, yet still use this to help me read the clues in order to see beneath the words that they say.

By providing a caring space between us (not just informed by ethical tactfulness, but also the deep loving *natural care* of Noddings (1984)), students can trust me and thus be honest and tentative in reflecting on themselves. In this moment I am not just seeing who they *were* but also how they *are becoming* as this act of self-reflection creates change.

By providing a spiritual space within me I invite them to share their deep being and when I listen in this space perhaps I connect with their souls as well as their voices. This is perhaps the *mind-body* connection that Heshusius and Ballard (1996) suggest are important in interpretive discourse….

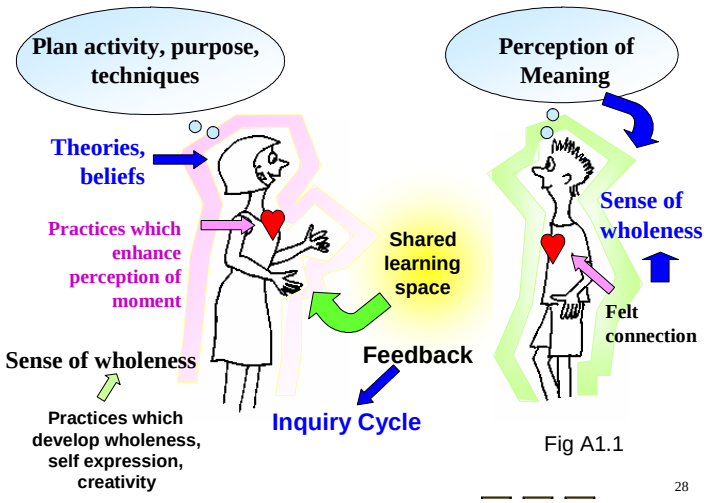


Fig A1.1

embodied discourse. That we go beyond rational knowing and knowing through feelings, into direct modes of knowing. That in this place of *embodied discourse* we can break down the separation between self and other. This is now using *seventh moment* research techniques (Lincoln and Denzin 2000) where we value the sacred.

But do I really know? In this spiritual place I have participated in a *transient moment of being* with this young person. How do I capture it? Their verbal discourse does not illuminate the whole.

I capture it through impressionistic writing (Taylor 2002) of 'field texts' where the narrative tries to capture the whole - the feelings, the student/teacher connection, the body language, dialogue, competing needs and underpinning values. It is so important to capture the *heart* of the words, the underlying humour and the humanity. So now I have captured

lasting images in my journals as well as the memories in my head which are constantly being 're-membered' in context of my new meaning-making structures.

Yet even these stories/texts in my journals can be read and interpreted in a different way according to my need. I find in the process of the action research cycle I look at them from different stances as described by Torbert (1991) – how can I use this to design an effective activity, how can I use this to understand principles of learning, how can I use this to understand systemic relationships, how in reading this and reflecting on it am I changed? And how do these different field texts relate? What are the themes? What is the essence that is being revealed here? Where does the meaning lie? So I am now engaged in a process of hermeneutical phenomenological reflection.

Using **triangulation processes** as described by Denzin (1988) can also assist in the trustworthiness of the research. One aspect of triangulation is ensuring other perspectives are taken. Now there are the different perspectives that I take as a result of the stage of conceptual framework that I am at. But there are the perspectives of others. As well as using my students' voices and texts in my research, I have also used a professional researcher to run a focus group for my 1998 Physics class (see Appendix 6 for her report). I have had other teachers and lecturers in my classrooms giving me feedback.

I have also sought other perspectives on my ideas about learning through running workshops for science teachers and gaining feedback. I was able to test many of my understandings through dialogue with colleagues, my husband and educational discourse groups, enabling me to move to meta-understandings of these ideas I was playing with. Then the test was in the pudding… how well did my ideas lead to better learning, enjoyment and improved outcomes for my students?

There is also triangulation in the instruments used. I used conversations, student work, questionnaires (including the CLES survey – Appendix 8) exam results, student journals and taped and video taped interviews, … as well as my own personal journals which also include 'field texts', poems, concept maps, diary entries, cartoons, fictional stories.

Broadening my research questions

Now, all this exploration into research methodologies had another impact aside from just situating my own research. Authors such as Guba and Lincoln (1994) and Wilber (1998)

really criticised the scientific method. Initially I agreed with them, thinking quantitative research was inappropriate in the human sciences. Then I started questioning what they defined as science. I began to think that their view of science was an impoverished one that had little to do with the way I had done science as a research scientist in a paper mill for three years. This really niggled at me and I started questioning *what is science really?*

- What would a holistic science look like?
- Is science changing and growing - can it include qualitative forms of research and still be science?
- How can we know anything?
- What are students' beliefs about science and where do they come from?
- How can I get students to think critically about the process and nature of science and what are the benefits?

So now I had three strands that started interacting and informing each other – *holistic principles*, *holistic practice* and *research epistemologies*. Soon it was to be joined by a fourth - *communicating* to the reader. For me, all these strands were problematic individually as well as in relation to each other - usually the research method is independent of what it is that one is studying but in my case it became an essential part of *what* I was studying. I spent the next year reading and trialling what it meant to research with rigor, to teach with moral tact, to empower others without manipulating, to help construct a reader's understanding to empower without patronising.

My efforts to make meaning of what I was doing for myself and for a reader, and how to teach in meaningful ways merged with developing ways of helping my journalism students make meaning of their writing for others. All of a sudden in both science and journalism I had found that in my effort to create frameworks and develop epistemological metaphors to inform my understanding I was encouraging my students to do the same. In their modelling of their ways of thinking and knowing the world they stumbled upon intellectual freedom and discernment. For some, they will never be the same; particularly in the way they perceive the world.

I couldn't help it but it seemed that I was caught in a fractal (as opposed to a time warp). Is this what it is like to do holistic research, I wondered? Connectedness; synchronicity; systems within systems; living the question, the answer, the process simultaneously; emergent systemic properties greater than the parts; a relational dynamism; a cosmic joke

full of ironies. And probably the most important in terms of the rigor question, the researcher in turn becomes the researched - an integral part of the research process.

I had found in asking what it meant to *teach* holistically I couldn't separate that from what it meant to *research* holistically or *write* holistically or *think* holistically or even *be* holistically.

And who is this holistic being who *is* me? In 1998 I spent some time remembering and re-contextualising the experiences of my life and my teaching in an effort to critically reflect about the influences which had shaped my way of seeing and being in the world. I was engaged in autobiographical narrative as suggested by Connelly and Clandinin (1988) as a way of exploring my personal practical knowledge. It wasn't for the purpose of publication, but for the purpose of critical self-study. It was a peeling away the onion layers; seeing where my culture and my history had created this person I was now. As I remembered, I re-storied it and drew from my past experiences greater and greater meanings and connections.

It forced me to a new perspective of seeing; in fact I had now developed new conceptual frameworks in which now to interpret my world (as described by Yorks and Marsick (2000)). Again I storied and now my history shifted again. It could be interpreted in another way and connect in new meaningful ways. I now saw myself, not as an independent being, but as someone whose definition was only in her relationships with the world and the story she chose to tell of that. My history (mystory) was in itself a construct. How could I ever ensure rigor now, when even the tools/perspectives I could bring to examine myself were shifting as well as these assumptions, intentions, values and history which were loosely attached to this being called 'Sue'. I am now fully into relativism and I am questioning everything.

Where is the ground that I can stand on and from which I can anchor my research? Can Torbert's notion of *critical subjectivity* help me here? Can I walk the tension of being in this place of continual critical reflection without blowing up? Am I now too overly aware of the dangers of self deception in research (Salner 1999)?

And yes for a while I did blow up and it was not pretty.

I know now I cannot represent reality. I wonder if I can even represent my own experience of reality. Because even that changes now as I move into different perspectival views.

Salner suggests that a solution to the trap of self-deception is the collaborative process where one's meanings get tested by working with others.

In 1999 and 2000 I was coordinator of a collaborative action research project with at a university physics department. It was a co-operative inquiry project with 5 university lecturers looking at improving the learning experience of first year physics students. This provided me with a major test of my own understanding of effective pedagogies in the teaching of science. It challenged me to find inclusive ways of assisting others in exploring new ways of teaching and conceptualizing themselves as teachers.

It honed my interview and observation skills with students and gave me confidence in my ability to understand and represent student voices. This project was carefully researched using various instruments and acted both as triangulation as well as a prompt for my own research, particularly in understanding what it meant to be a *practicing scientist* as opposed to *science teacher* or *science student*.

Perhaps this was an anchor? But I continued to unfold and unpeel and perhaps like a caterpillar needing to push against the cocoon in order to harden its wings this was a process I need to go through before I could move to the next stage. And this stage is the deep emergence and experience of spirit. Oh dear, yet another perspective. But now at least I truly have a lived experience of what the mystical stages are like. I have sat for a while in these places and they have given me perhaps the insight to make meaning of the essence of spirit and how it can be present in what we do. I can now interpret my experiences again with another layer of meaning or realization.

Synthesising through storying

So, now, in 2000 and 2001, I make an effort to capture the questions, the processes, the reflection, the theorising, and the outcomes of these last few years. I draw on all my experiences of the previous few years: my relationship to my classes (journalism, physics, pastoral care), my students and ex-students, my colleagues, my role as mentor for student teachers, my role of running professional development for teachers, my role as coordinator / researcher at the university physics department in *and* my inner life.

I start to write up my thesis as a novel with characters drawn from my experience of science teachers. Each character represents a different development stage as suggested by Torbert

(1991). And so I put them into interaction with each other, playing out through dialogue how the different perspectives interpret and make meaning of my research. It was playful and enabled me to express myself in each of these stages… all of which I had visited in my journey. In this way I incorporated the difference stances without necessarily saying that one was better than another, except for one who still a bit of a dinosaur. I was engaged in a multiple voicing technique as suggested by Gergen and Gergen (2000) which doesn't try to resolve difference through coming to a singular, integrative conclusion, but rather helps to keep pluralities alive to provide deeper meaning.

This storying was an important part of my meaning-making process and helped me to integrate as well as make explicit what good learning and science looks like. I made some major insights about science and the limitations of our current conceptualisation of what science is. I was able to stand back from my entanglement with my own spirituality and extract some essences.

I now revisited the literature on Holistic Education and Spirituality in Education finding a new range of literature had opened up before me. (e.g. Tacey 2000, Nakagawi 2000, Forbes 2003, Nava 2001, Palmer 1998, Krishnamurti 1983, Kessler 2000, Zohar and Marshall 2000, Miller 1996, Gerber 2001, Wilber 2000a, Wright 2000). Whereas before I was reading the available literature from the eyes of a classroom practitioner, looking for practical implications for the classroom, now I was reading with a mind to cohesive theories and understandings – *How can spirituality be at the forefront of curriculum discussions? How can it inform whole program planning? What ways of thinking about whole curriculum structures can support spirituality?* I was more interested in the big picture – extracting essences and themes.

I was also reading with a view to writing about the literature and its implications. So in my reading I had moved from someone trying to *construct their understanding* of the text to the act of *reading-writing* as described by Spivey (1995) which aims to look at what might be cohesive, relevant or usefully disconfirming. And in this process my interpretive lens ensured a certain selectivity.

Moving into an integral perspective

And then I collapsed because I had been trying to do all this with Chronic Fatigue. I took a break from it all – went and enrolled in a Year 12 Art Course alongside students I would

normally teach … and learnt so much from being a student with them. As a developing artist I discovered that the world does look different when perceived through the lens of an artist as opposed to a scientist. I had been able to broaden my perspective of the world from the empirical/critical lens of the *scientist* and the inner lens of the *meditator*, to the lens of the *social scientist* as a result of my doctorate studies … and now to the lens of an *artist*. The art was no diversion but an important element in my understanding of what it might mean to experience the world integrally.

In 2003 and 2004 I started back part-time teaching a maths class for 'students-at-risk' while developing a career as an artist. Maths was the opportunity to try out my understanding of Holistic Education and principles; however it challenged my notions of Holistic Education and I realised I needed a much better structural understanding of human development. Enter Integral Theory.

Ken Wilber had been a key referent for me during my 1996-99 action research process … he had continued to develop his models to the point of what is now called Integral Theory (Wilber 2000a). I had engaged with this model in 2001 before I had collapsed and now I revisited it. I discovered that he had come out of seclusion and was now engaging many sectors of the community and disciplines in conversations in how this could be applied to their practice.

In late 2004 I became a participant in the Integral Theory Educational Theory group who were looking at exploring how Integral Theory could be applied to education. In the group we had people from Steiner and Montessori backgrounds, high schools and universities. I was providing a Holistic Education perspective. Although I was just a small contributor in this group, I have been involved in many long and detailed phone calls and forum conversations which have been so helpful in my teasing out aspects of the theory. As Wilber continued to write and publish online we would take on board his new theories. Representatives of the group had regular meetings with Wilber taking our questions and understandings and checking their interpretation.

This process of dialogue has been essential for me in engaging with Integral Theory at the level where you are not just an isolated person applying it as you wish (which had been the case in my application of other theories such as Egan (1986)), but rather in a very disciplined and rigorous testing of what we are coming to know in a consensual community. There is so much to know and I have only scratched the surface, but I hope that this process of

hermeneutical dialogue has at least helped align my understandings to others in the field of Integral Education.

So now, in 2005, I find that I can move from the messy richness of my whole experience and structure it using Integral Theory. I have moved into another sort of reading – looking for cohesiveness between development stage models, revisiting my earlier influences (spiritual, ecoliteracy, new science, feminism, holistic) and seeing where they might be positioned on Wilber's framework. Not because I want to organize everything and have it in its place, but because I believe that it can help me see beyond the trees to the forest…. which in turn is just a stepping stone to another way of knowing and being in the world. In revisiting I find so much I had missed in my earlier readings. I am able to draw forth key essences and questions as I am involved in the process of trying to understand the inter-relationships and inter-weavings of the different perspectives.

I now begin to explore curriculum metaphors (Doll (1993), Schubert (1988), Davis (2004)) looking at how they might be positioned on integral theory. I see myself moving from the *pluralistic mind* of research – the personal lived experience – now to the *systemic mind* … organising into grand schemas.

And how do I know that these grand schemes are any good?

This understanding I have of whole curriculum and curriculum metaphors is valued by curriculum implementers and designers… I am asked to be a critical friend to a high school implementing new curriculum as well as being a critical friend for the curriculum review process for the revisioning of Year 11/12 curriculum frameworks. This provides a very practical test of all these big ideas and I find that these organizational tools enable me to hone into issues which seem amorphous to the school leaders but make sense when understood from this big picture perspective. My role seems to be asking questions which help people lift into new ways of seeing their current issues.

I find that that the integral model is a powerful lens in helping me personally understand the different ways of experiencing Holistic Education in my quite diverse subjects. It helps me re-story Holistic Education and give it structure and rigor. I can see where different aspects can be related in the spiral dynamic model and therefore why it has been so difficult to easily pin down. I am ready to write.

Writing as Inquiry

2005. So what is my thesis about now? It has morphed as I write it. I am not merely using integral theory as an interpretive lens for my own lived experience, but also using my lived experience as a way of putting flesh on integral theory in the context of education.

I am trying to situate Holistic Education on integral theory and use both as a way of informing our current Year11/12 curriculum review. I am writing about enchanting physics, experiential journalism, dysfunctional maths, creative forums, the problems with science education. I am teasing out what I really mean about spirituality and really mean about science. I am asking who I am and what has informed me. I write, and reflect, move to new spaces and then write with greater insight. I am releasing, interpreting, creating, understanding. It seems that I am trying to capture the last 15 years of my life. Is this a thesis, or is this therapy? Yes, let me lay on the couch for a while.

I notice sometimes I just rant; all my frustrations and suppressed agency surfaces. Other times I write in a way that surprises me with its beauty and insight. There is so much here. I become selective, very selective. I explore further some aspects; try to provide some distance and detachment, some academic rigor. I try to be creative allowing myself to write in different ways that might reveal different aspects of self and the issue. I use the techniques of Bateson (1972) – creating a tapestry, rather than a single thread – using metaphor, dialogue, and monologue to create different spaces where meaning can be made in the space in between. Some writing might cohere with the whole, while other creates a dissonance. Sitting with these and allowing the meaning to emerge over time pushes me to new levels of insight. I am an artist, expressing self on a messy canvas, and I need time to sit back and interpret what I have done.

I am going deep into myself. This writing includes rational states alongside the transpersonal and so my process has also incorporated transpersonal inquiry processes (Braud and Anderson 1998) which value dreams, incubation, meditative insights alongside reflective rigor. So this process of writing is alert to the intuitive nudges I get; the need to go find a book, remember an incident, look for a specific journal entry, phone an ex-student. So my subconscious also becomes a selector of what needs to go in, as well as my rational mind. I open myself to this process, knowing that whatever is selected there will always be bias, and perhaps I can trust the story within to know how to emerge. I am using Wilber's *vision-logic*.

I am trying to balance my writing with the *eye of mind* (interpretation and analysis), *eye of senses* (empirical data and experience) and *eye of the spirit* (meditation).

And this writing is no longer constrained by my thoughts of an audience. I can even let go my earlier attempts in 2000 and start afresh, enabling *this* current me to find a way to tell this complex story. It is me trying to express the multiple dimensions of my reality… to honour the diverse voices within myself and the fractal layers in the education holon.

In the process of this writing emerges some deep understanding about the nature of spirituality and the nature of science and how these can be integrated. I begin to derive perspectival models of development for science education and models to incorporate spirituality as a key part of our curriculum. I am excited and I share these with others and get some positive feedback and some puzzlement.

I have moved from the *action research* of Kenmmit and McTaggert, to the *critical action inquiry* of Torbert, to the deep self-study *heuristic research* of Moustakis (1990) and now in this process of writing I have found a new process… *writing as inquiry* as explored by Richardson (2000) and van Manaan (2003).

Perhaps I am entering into the aims of *seventh moment* research (Lincoln & Denzin (2000)):

> This is interpretative research that refuses to retreat to abstractions and high theory. It is a way of being in the world that avoids jargon and incomprehensible discourse. It celebrates the local, the sacred, the act of constructing meaning. Viewing culture as a complex process of improvisation, it seeks to understand how people enact and construct meaning in their daily lives. It celebrates auto-ethnography, the personal account, "-'mystories', myth and folklore.

Epistemological tensions

I now send this writing to my supervisor, Peter, who gives me a one word response several months later after reading several chapters - "magnificent." He will read the rest soon. I am heartened. But when he gets back to me in March 2006, he has questions for me. What is my epistemological stance that each style of writing is representing? How does one bit connect with another bit? Is there supposed to be a chronological thread or a propositional thread? Where is the coherence? Am I over-claiming in this bit here? How can I make my epistemology a lot more present so the academic reader knows how to judge the quality of the research?

We spend an intense two weeks discussing issues and epistemologies. He suggests that perhaps after all what I have been doing is an *auto-ethnographical study* – enquiring into my own experience in context of the educational and science cultures.

"What!" I think. Not another epistemology! Do I need to start again? I now have a pile of papers to read on auto-ethnography. I find my brain only being able to take so much of the academic explanation of what these methodologies are. I much prefer to learn through the connective knowing of Belenky et al (1986) – through personal stories, getting inside someone's head and seeing what something looks like, smells like, sounds like. By accident, in a google search for something else, I come across a Master's dissertation by Narumol Reungnum (Mon), a student of Peter's. It is an auto-ethnographical exploration of her as a science teacher in a Thai culture.

What she is describing is the conflict between two value systems. It not only gives me an exemplar of an auto-ethnographic study using conversational style writing, but the notion of cultural conflict really resonates with me. Her dilemmas directly speak to me through her story and remind me of my own dialectic - trying to walk the tension between science and spirituality. I remember my novelistic writing attempts of 2000 where my different characters represented different aspects of myself – Dan represented the science self, and Mei, the spiritual self. I had put them in dialogue with each other then, but had forgotten that in my 2005 writing. While the dialectic was implicitly there, I had not really used my conflict as a tension which moved the story forward.

I now speak to Peter, and he says to me, yes, he should have thought of it earlier – that Mon's situation was very similar to mine – that he should have realised that really what I was doing was a cultural study (my spiritual culture was foreign to Western science in a similar way that an Asian or African culture might be.) He gives me a paper (Taylor 2006) in which he describes how the conflict between these two cultures (say, a Western science culture and the person's home culture) creates perturbation and growth, resulting in not just transformation of the person who is trying to resolve the conflict, but also transformation of their understanding and practice of their own culture and of science. And this reconceptualisation can become something that can enrich our collective understanding of science or of the home culture. There is a third space where both cultures are able to grow – value-added by the influence of each other.

I read this and I am going "Yes! Yes!" This really explains well my own journey and now I wonder if I can use this to help me structure things in a new way. I wonder if the explication

of my journey can help grow the science and science education communities' notions of what science education can be? Can I write in a way that might create praxis for science educators? Perhaps they are my audience, whereas before I had thought of Year 11/12 curriculum planners as my audience. Perhaps I can extract this one thread out of the complexity of my 2005 writing about holistic and integral implications for whole curriculum visioning and just focus on the science thread?

How can I represent such a journey? I imagine cartoon heads – science and spirituality – eying each other off at the beginning of my teaching experience and then gradually throughout my study being a lot more interactive and learning from each other.

So perhaps I can put in a chronological thread – my own journey of how my ideas changed and the impact on me. The playing field for this was my physics classroom and I realise that there is a third head here – my pedagogical head. Now this head I had fully explicated in my 2005 writing, reflecting on my key notions of pedagogy and the experiences that shaped them. I now thought perhaps I could use some of this and also make more explicit my science and spirituality heads.

So now I start writing (which is Part 2) of this study, using some of what I had written about my physics experience before but now contextualising it in a story of evolvement and transformation. I began to realise that there were key themes which I could extract and make into major chapters. At the end of each chapter I ask my science, pedagogical and spiritual heads to reflect on where they had come.

But I still liked the Bateson notions of creating both disconfirming and confirming experiences, so to counter the chronological, logical development I decided to use interludes at the end of chapters to create different spaces.

In my epistemological notes at the beginning of Part 2 I go into more detail about the inquiry issues and processes so I won't repeat those here. (For example, my use of lived experience methodologies of Whitehead (1998) (creating 'living educational theory') and the seven inquiry modes of Henderson and Kesson (2004).)

So now as I write this story I am integrating some of the writing from 2005 which is in a different voice and needs to be rewritten into a more speculative voice. I am trying to create impressionistic vignettes which help place the reader more into my experiences. I am wary of my role in interpretation; not just interpreting another's experiences but actually trying to

explain and model them. Am I being too modernistic? Is this modelling helpful beyond helping me to explicate my own thinking? Does it help others or is it too simplistic? Am I being critically self-reflective enough; not just in my interpretation about my past experiences, but in questioning the modes of inquiry I am bringing to interpreting these experiences? Or am I lost in the moment of re-telling my story? What is the academic rigor that I am bringing now?

I am also concerned with the amount of material. Do I need to put it all in? Can I say it with less? Should I be telling my story as it is, or trying to capture key bits as essences? How can I write about others without being denigrating? How can I balance the need to provide a sense of characterization and dramatics (Taylor 2002) for my impressionistic vignettes, with the fact that these characters are easily identified?

I am trying to balance too many academic requirements and epistemologies. In trying to be holistic in my inquiry approaches I worry that I might not be academic enough. Yes, I am perhaps trying too hard to cover all of Wilber's quadrants in my inquiry.

4 Quadrant Integral Theory

Upper Left: **"I"** **Interior-Individual** phenomenology, psychotherapy, meditation, emotional intelligence, personal transformation	**Upper Right**: **"IT"** **Exterior-Individual** empiricism, scientific analysis, quality control, behavioural analysis
Lower Left: **"WE"** **Interior-Collective** hermeneutics, multiculturalism, postmodernism, worldviews, corporate culture, collective values	**Lower Right**: **"ITS"** **Exterior-Collective** systems theory, social systems, communications networks, systems analysis

Fig A1.2

Yet this process of inquiry has moved me to a new place; in writing about this transformational journey that I have being on and interpreting it through integral theory I now feel a lot more balanced – not just in myself, but also in the way I think about integral theory. I realise that some of my 2005 interpretation and analysis was quite simplistic and perhaps now I am able to see things a little more complexly. I am really concerned about the process of even trying to interpret experience through cultural and transformational models of development.

Part of my dilemmas in research are explained by Taylor (2006) in *Contemporary Qualitative Research for Science and Mathematics Educators*. I have been doing this research for a long time and the field of qualitative science research has grown from more practical styles of research closer to experiences of scientists (lived experience, auto-biography, action research) into much more critically self-reflective, post-modern research.

Some of my crisis of academic rigor stem from the reflexivity between my own transformation in perspectives (and particularly a flourishing of plural mind) and the research I was doing. As I grew, the type of research changed, and I changed as a result of the type of research. Denzin and Lincoln (2005) describe a scheme of nine moments of qualitative research. When I look at them I feel to some extent that I have been on that journey perhaps up to the 6th moment. It wasn't that clear at the time – because I was reading research papers that crossed different 'moments'. I was sucked into a particular point of view. I look at the criticisms of each moment and I think "Oh my God, I was and maybe still am guilty of that."

My conflict with spirituality and science has been one where I would like to reject modernism, but I can't because it is so much part of my make up as a scientist. I have been guilty of modernist interpretations all the way through my writing as inquiry – trying to pin down an 'objective truth'. It is a function of my need to have understanding. I can't just be in the world… I need to make sense of it.

Engaging in a spiritual life opens the door to other ways of being. I look at the nine moments and I feel sad that I have succumbed to a modernist need for interpretation. It is interesting that when you look at the perspectival levels that the *integral mind* level rejects excessive model making and

Nine Moments of Qualitative Research

1. Traditional Period (1900 -1950) – in which the heroic, lone field worker romanticises his subject in accordance with social realism, positivism and objectivism.

2. Modernist Phase (or Golden Age of the Social Sciences) (1950 -1970) – researchers as cultural romantics with emancipatory ideals valorize tragic subjects and critique social structures using the language of positivism and post-positivism.

3. Blurred Genres – (1970-1986) – naturalism, post-positivism and constructivism prevail, qualitative researchers become sensitive to the politics and ethics of their world, stop privileging their own interpretative voices, and produce multi-perspectival "thick descriptions" using Arts based genres.

4. Crisis of Representation (1986-1990) – research and writing become a lot more reflexively aware, a new politics of textuality contests the authority of the empirical sciences to represent the world of lived experiences, fieldwork and writing blur, writing as method of inquiry merges

5. Post-modern experimentation Ethnographic Writing (1990-1995) – researchers responding to the ongoing triples crises of representation, legitimation and praxis experiment with different ways of representing the 'other'; a major focus on participatory research and generating theory from small scale problem-solving research in local contexts

6. Post-experimental Inquiry (1995-2000) – researchers focus on novel ways of portraying and politicising lived experience via fictional ethnographies, ethnographic poetry, multi-media texts, visual form, and co-constructed multi-voice representations.

Fig A1.3 (continued over page)

interpretation and is searching for ways of pure being… but when you move onto the transpersonal levels there is an acceptance of all of life and all of experience, including the need for modernistic explanations. And when one looks at the quadrant model in Integral Theory you can see that all approaches are valued. So perhaps these 'moments' are not something we grow out of but which we *transcend* and *include*, finding those partial truths from each aspect which inform the whole, spiralling upwards in ever more spacious views.

Nine Moments of Qualitative Research (cont)

7. methodologically contested present (2000-2004) – a time of debate and struggle born of massive deregulation within qualitative research and of political contestation with conservative regimes (that make claims regarding truth) over what counts as 'valid' research.

8. The immediate future (2005 -) – social sciences emphasises a social justice purpose, the rise of indigenous social science(s); decolonisation of the academy via graduate research and culturally diverse faculty; social scientists transforming their own institutions via "liberation methodology"

9. The fracture future – academic work as political praxis; generation of new ethics, aesthetics and teleologies for a globalised world.

Denzin and Lincoln (2005)

Fig A1.3

So where is my research situated now? Can I proudly stand up and say I am happy with what I have done? Well, I feel it is the best that I can do for now. I may not perhaps have fulfilled all the requirements for academic rigor in any one category – I am perhaps 'blurring the genres' too much, but I have tried to bring a critical self-reflectivity to this process which is not just one based on the *eye of the mind* but also draws on insight from the *eye of the spirit*.

Am I trying to find my way into a 10th moment – could it be *the integral future*? Perhaps this moment is one where integration occurs in the holistic experience of the one doing the research. Perhaps this moment includes and transcends the others and a key to it is the taking of the researcher on a transformational journey that is particular to them and their soul needs. The research method then is appropriate to who the researcher is and needs to grow reflexively with them. If the aim of research is *praxis* (creating change in the world) then to transform the world, transform self.

And with that she rotates her shoulders. Smiles and thinks about a shower. Yes, is that the time? I have to plan my journalism class tomorrow. It is going to start with a visualisation… a deep experience of their sense of place in the world and cosmos and then when they are fully in their quiet inner space I am going to ask the students the following questions. Who are you? What is your deep passion? What do you like to be? What are your questions? What vision do you have for yourself?

And we will see what happens next.

Appendix 2

Comparison of *Habits of Mind* and *Spiritual Qualities*

How well do the spiritual qualities (Grof 1993) correspond to and provide foundational support to the Habits of mind (Costa and Kallick 2000)?

Qualities of Spiritual Maturity	Habits of Mind
Faith, trust, and inner security The ability to live without anxiety or doubt. An inner security free of fear and deprivation.	**Persisting** *Stick to it!* Persevering in task through to completion; remaining focused, comfortable with ambiguity and obstacles. Having faith in one's abilities to find a solution.
Physical, emotional, mental and spiritual clarity Physical clarity has to do with attention to the body's health and real needs. Mental and emotional clarity have to do with awareness, discernment and lucidity. Spiritual clarity has to do with wholeness, simplicity and sensitivity.	**Thinking and communicating with clarity and precision** *Be clear!* Striving for accurate communication in both written and oral form; avoiding over generalizations, distortions and deletions. Aim for clarity, precise language, universal labels and analogies.
Serenity A state of equanimity, inner tranquillity and peacefulness in the face of challenge and change.	**Managing impulsivity** *Take your Time!* Thinking before acting; remaining calm thoughtful and deliberative. Form a vision.
Living in the present moment The ability to live in the present rather escaping to the past or the future. The ability to constantly 'let go'.	**Gathering data through all senses** *Use your natural pathways!* Gathering data through all the sensory pathways--gustatory, olfactory, tactile, kinesthetic, auditory and visual.
Love, compassion and service Love and compassion are often associated with the beginning of a true spiritual life. Love dissolves confusion and fear and elicits kindness, openness and respect. Unless we love and trust ourselves, we cannot love others. Compassion goes beyond a personal form of love to a love of all creation.	**Listening with understanding and empathy** Understand *Others*! Devoting mental energy to another person's thoughts and ideas; holding in abeyance one's own thoughts in order to perceive another's point of view and emotions.

Qualities of Spiritual Maturity	Habits of Mind
Personal freedom Letting go of attachments and living questions and problems into answers and opportunities without drama, escape, or avoidance.	**Thinking flexibly** *Look at it Another Way!* Being able to change perspectives (their own and others, big picture, and particular), generate alternatives, consider options
A sense of wonder, mystery, and reverence A direct experience of the cosmos which is unitive, inclusive, and expansive. A sense of being aware of the profound interconnectedness of all creation.	**Responding with wonderment and awe** *Have fun figuring it out!* Finding the world awesome, mysterious and being intrigued with phenomena and beauty.
Honesty and authenticity No longer lying to ourselves and others about what we are doing and what the consequences are. To live as we really are without delusion about the reality of the past, the present, our selfhood and behaviours.	**Thinking about thinking (metacognition)** *Know your knowing!* Being aware of one's own thoughts, strategies, feelings and actions and their effects on others.
Responsibility and discipline Becoming accountable for ourselves without feeling excessively responsible for others. Dependable and creative completion of our responsibilities and a disciplined approach to personal growth.	**Taking responsible risks** *Venture out!* Being adventuresome; living on the edge of one's competence - using intuition, drawing on past knowledge and meeting new challenges. Taking educated risks based on knowledge.
Connection with the earth, nature and everyday life Even though we may find great inspiration in sacred systems or transcendent experiences, we recognise the sacredness of daily activities, other people, other life forms, inanimate matter, and nature. "It's no good being an angel if you're no earthly use."	**Striving for accuracy** *Check it again!* A desire for exactness, mastery, fidelity and craftsmanship.
Hope, happiness, joy, and humour Hope and happiness are states of well-being and contentment emanating from a deep feeling of inner wealth irrespective of outer events or experiences. Joy and humour spring from a warm heart and a sense of the 'cosmic game'.	**Finding humor** Laugh *a little!* Finding the whimsical, incongruous and unexpected. Being able to laugh at oneself. Being playful with ideas and perceiving situations from original and interesting perspectives.

Qualities of Spiritual Maturity	16 Habits of Mind
A sense of purpose and place in space and time A sense of the unique and necessary place and personal contribution of each individual being in the world. "Where does my deep gladness meet the world's deep need?"	**Questioning and posing problems** How *do you know?* Having a questioning attitude; knowing what data are needed and developing questioning strategies to produce those data. Finding problems to solve and questions to ask.
Tolerance and patience The ability to embrace self and 'the other' in spite of perceived weakness or difference. To even move beyond tolerance to acceptance and celebration of difference and diversity. Patience means to take events and experiences as they come without complaint or expectation. It also means all things have a natural time and place to be.	**Thinking interdependently** *Work together!* Being able to work in and learn from others in reciprocal situations. . Listening, consensus seeking, giving up an idea to work with someone else's, empathy, compassion, group leadership, knowing how to support group efforts, altruism, open to feedback.
Wisdom and understanding Deep insight, possible at any age, expressed through everyday action.	**Applying past knowledge to new situations** *Use what you Learn!* Accessing prior knowledge; transferring knowledge beyond the situation in which it was learned.
Gratitude, humility and willingness Gratitude is the recognition of the little miracles that occur everyday. Humility is the ability to move beyond arrogance and grandiosity toward an honest acceptance of ourselves with all our perceived limitations and faults.	**Remaining open to continuous learning** Learn *from experiences!* Having humility and pride when admitting we don't know; resisting complacency.
Expressing the creative soul *Creativity is a way of expressing the soul and allowing the energy to flow through us into what we do. It is a celebration and an act of life.* (My entry)	**Creating, imagining, innovating** *Try a different way!* Generating new and novel ideas, fluency, originality, imagine oneself as the object or the situation, explore limits of possibility.

References:

Costa, A and Kallick, B (2000) *Habits of Mind: A Developmental Series.* Alexandria, VA: Association for Supervision and Curriculum Development

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Appendix 3

Transforming the teaching of university first year physics - 1999 - 2000

Questions:

What are the issues in assisting in the transformation of science teaching?
What are the different cultural memes that scientists operate under as scientists and science teachers?
How is the reformer transformed?

Introduction

In this chapter I describe a collaborative research project I was involved with at a university physics department to improve teaching and learning of first year physics courses during 1999 and 2000. I describe university teaching practices and explore the attitudes and habit patterns that act as barriers to successful adoption of new pedagogies, despite the best intentions of the participating lecturers in the project. I suggest that in transforming science education we need to deeply understand the 'who' that is doing the teaching of science – who they are as a scientist, a person, their beliefs about science and learning, their learning styles and temperaments and the culture that they are in.

I then draw on transformational learning theory to analyse several key aspects of the project and how different project processes helped or hindered transformation. Following this, I bring a spiral dynamic lens in trying to understand the big picture patterns that seemed to emerge.

The beginning of a relationship with the university physics department

March 1995. *I am sitting in a small lecture theatre with about 40 first year physics students. We are in tiered rows listening to the lecturer at the front – Dr Brown. It is the first physics lecture of the year – the topic is 3 dimensional unit vectors – the basic building blocks of any spatial physics.*

I am here by accident. I really came to the university to give a workshop to about 10 physics lecturers around some of my ideas about teaching physics, based on five years experience teaching Year 11/12 physical sciences courses at college level. I was invited by a lecturer who I had been working with on various physics syllabus committees. Following the workshop Dr Brown, a participant, said "Why not sit in my lecture and give me some feedback."

So here I am sitting, held in place by this enveloping chair and tray, facing the front. This is the first lecture of the year and I watch at a loss at what Dr Brown is doing. Why, when there is an ocean of possibilities which could excite and stimulate students to be curious explorers of this physical universe is Dr Brown starting with this small dry pebble? Bumbling, as he tries to balance his wooden pointer and his two arms to show the three dimensional co-ordinates.

I start writing. Why can't he see the students are flummoxed, why isn't he asking them questions? Why is he the one in control of the talking – why can't he allow students to talk among themselves to tease out their questions and understandings?

Why, instead of starting with the maths, isn't he starting with an interesting context so that students can see the usefulness of the vector modelling to a real situation?

Why has he answered that student's question in that way, can't he see the underlying question behind it, why isn't he probing deeper? Can't he see the dissatisfaction that the student has with his answer?

Why is he so focussed on ***telling****, rather than helping students to understand? I look at how students are taking notes squinting at the scrawled chalk marks on the board. Is there any time for them here to think about what they are hearing and writing. Is there another way of doing this?*

Why on earth hasn't he had a three dimensional co-ordinate model made so he can pass it around the students so they can see in 3D space how a vector might deconstruct into the unit vectors, rather than this indecipherable hand waving and poorly drawn diagrams?

I am caught now in the minutiae.

But the lecture is over and my four ex-students from my 1994 Year 12 Physics class now rush up to me. They had previously greeted me enthusiastically, wanting to know why I was there. Now they roll their eyes at me "Have I made the right choice?" asks one.
"I thought physics was going to be interesting." says another. "I want to explore the cosmos, to think, to ask the big questions! Where are the questions?"
"Is it going to get any better?" asks another. "I think you have given us unrealistic expectations of what physics can be."

What have I done? Have I let my students down by giving them incorrect expectations? Can I help make it better? I am feeling really cross. Here I have done my best to excite students about physics, encourage them to think, to be curious, to delight in coming to understand something and gain new insights. And as a result here are four students who were ready to go the distance – to get a degree in a physics. And after the first lesson they are having second thoughts.

As I leave the lecture theatre Dr Brown asks me what I thought. He looks down at my notes surprised, I think, at how much I have written. "Do you really want to know?" I ask. He nods as if he is bracing himself.

I can't help myself. It all pours out… my questions and thoughts about his teaching … almost accusingly. It is like a vomit. And he is just standing there straight and silent. I begin to realize what I am doing. Telling. Seeing him as an object to inform, change, rather than a human being. The enemy. I put my hand over my mouth and stop abruptly.

"I am really sorry", I say and I explain about my conversation with my students and how it had made me really cross and I didn't know what came over me. I am really embarrassed.

"You have certainly given me something to think about." He says and we part.

Based on that episode, it would be hard to imagine that I might have a continuing relationship with the university physics department, but over the next few years it grows.

What is my responsibility as a Year 11/12 science teacher towards creating successful experiences for my students in their continuing science pathways? I had never seen it as my issue before – the dry university degree was just something you had to put up with before you could do 'real' physics or science. It was a means to an end. But could it be an end in itself? Could I be active in creating change of how physics was perceived at university level?

Its purpose, the way it was delivered, the way it might engage and challenge students to continue to grow?

Yes, it was time I made it my business and it seemed that despite that tactless episode with Dr Brown that the university physics department was keen to get me back. In 1996 I acted as a critical friend for one lecturer assisting in his implementation of constructivist pedagogies in his classes. That led to workshops which we ran for other lecturers and state science teachers. With the decline in numbers of students taking 'pure' and 'applied physics', the physics department was looking at ways of attracting students and in 1998 the department applied for a federal grant to run a collaborative learning project looking at improving the teaching and learning for first year physics courses. The project began in 1999 and I was invited to be co-ordinator. Five lecturers and two post-graduate students were part of our collaborative action research project.

By then I had gained a few skills and a little wisdom in professional learning and transformation issues, though the project would challenge my understanding and push me to new perspectival levels. I had also developed a strong working relationship with a number of the project participants and certainly no longer perceived them as 'the enemy', although I was just as passionate about the need for change. I also had had two and half years of doing my own action research for my doctorate and had begun to unpack my own attitudes, assumptions and practices in science education.

Dr Brown is a keen supporter of the project and despite my tactlessness he tells me he took quite a bit of what I said in 1995 on board… "Sue, you really made me think!" His first lecture is now an overview of where the course is leading, the research questions that the department is engaged in, including his own questions and dilemmas in his own field of research. He has joined the project, keen to develop a greater understanding of how his students come to understand, what misconceptions they have and how to challenge these, how to encourage a thinking classroom so students gain a deeper understanding of physics ideas.

But what about the big picture? Being better constructors of knowledge is still within a paradigm where physics is seen as knowledge to be acquired…. *Physics as a body of knowledge*. Is there another way of thinking about physics?

How can an under-graduate university physics course take students on a continuing journey of rigor, of thinking, of scientific inquiry, of invention of ideas, of participation in a

dialogical scientific community, helping them to be critical of science while at the same time inducting them into it? How can such a course encourage their own development as human beings and challenge them to explore both self and the universe? How can it develop a sense of *ethical agency* – a passion not just for the pursuit of knowledge and following one's own curiosity - but also in helping the world be a better place? How can it help them experience other perspectives and research modalities so that they are effective participants in multi-disciplinary inquiry?

Yes, I have a vision of what an undergraduate physics course could be about; I can even see structures in my head which might facilitate it – different styles of delivery from more content based to inquiry based to multi-disciplinary problem based projects. Topics which might not just introduce physics ideas but also lend themselves to philosophical critique, or ethical dilemmas. Student run symposiums… the possibilities are endless.

Whoa Sue, reality check! Just because I am co-ordinator of the project doesn't mean I get to impose my vision and my methods on others. When I talk enthusiastically about the possibilities to the participants it is clear it is just too big and too overwhelming a change. Even though the lecturers are doing their own innovative scientific research and are used to facilitating open ended research that their graduate students are undertaking, it seems that they have been enculturated into a way of thinking about undergraduate courses. *There is foundational content we need to get across and the students don't have enough understanding to do their own projects.*

So what can we do? How can we infuse the current structure of the first year physics courses with the goals of the team. And what are these goals and how do we explicate them?

This is the beginning of a transformational journey for all of us. I learnt a lot about the difficulty of helping others to adopt new ways of thinking and practices and how important it is to look deeper for underlying reasons. I realized that often very little outward movement actually requires enormous inward movement in thinking and perspective. I learnt I could not generalise, that everyone was very different and as facilitator I needed to work at an individual level as well as a group level – unpeeling the layers of another's habitual practices and thinking, their deep goals and passions – and unpeeling the relationship of myself with others as I helped them to see themselves.

It was difficult and frustrating and I made quite a few mistakes as I tried to balance my various roles and find an ethically tactful, self-reflexive way of being. It is only now in

reflecting on the experience that I can see how in working as a leader/teacher of others I fell into the same trap as the lecturers had with their students – seeing ourselves as holders of knowledge and constructors of that knowledge – in my case the knowledge was educational theory and pedagogies.

Is it worthwhile telling something of our process and our dilemmas? I think so. Perhaps this physics department is not representative of all physics departments, but perhaps it indicates the difficulty in creating sustainable change. So whereas in Chapter 12 I proposed a new Integral vision for science, this chapter acts as a balance to that… perhaps serving as a cautionary tale for reformists.

So here I am in 1999, in a position of working with others to help take them on a journey, armed with my own experiences, some educational theory, and a little pedagogical leadership experience. Even though I think I have made explicit my assumptions, values and ideas about science and physics education, this project now takes me to a new level – causing me to make sense of my own journey of 10 years of physics teaching. I begin to realize my 'physics teaching head' is a very different headspace to most other teachers. Yes, I am in *'Sue's wonderful world of physics'* and *'Sue's wonderful world of educational understanding'* and through this project I begin to realize how different this world is to others. I realize it isn't a right way of doing things or a wrong way – but just different and that it can add an interesting dimension to any conversation about science teaching.

However, even though I am learning to be more pluralistic in my perspectives, I still have a strong modernistic streak which I am constantly doing battle with… wanting to find the truth, the answers, the strategy. Yes, as the physics lecturers seem to want to find a strategy in their teaching which will help students understand better, I want to find a strategy with working with them that will push them forward.

Action research project to improve teaching and learning of first year physics courses – getting started

It is March 1999 and I have a plan…. We are using ***action research*** as our method of inquiry into the teaching and learning with the first stage involving setting some tentative goals for the project… what do we want to achieve?

Although each of the physics lecturers brings to the project different experiences of teaching and different educational philosophies, they all agree that they want to make the learning experience for the students more enjoyable and meaningful; helping them understand more deeply and stimulating their curiosity in physics and the world. This sounds good but it is problematic and we have to unpack this further. What is it that the students *need* to understand? And what does this mean to each lecturer? Is it about making their content-bound lectures a little more interactive; involving trivial constructivist techniques which help students build up concepts and challenge misunderstandings? Is it about making the lab sessions less instruction based and more open ended? Is it questioning the purpose of lectures, the choice of topics or the very notion of what science teaching is about?

How can I begin a conversation where we look beyond the need to *construct content* into the very heart of how we perceive science teaching? What does it really *mean* to be a scientist? Can we help our students experience what it means to be a scientist? What might this look like and feel like? Yes, I ask the lecturers, what is it like for you as you do science?

I have a model which I have developed which is a map of the territory a scientist might cover as they engage in scientific inquiry. I ask the lecturers to reflect on their own research and map their research journeys around the model.

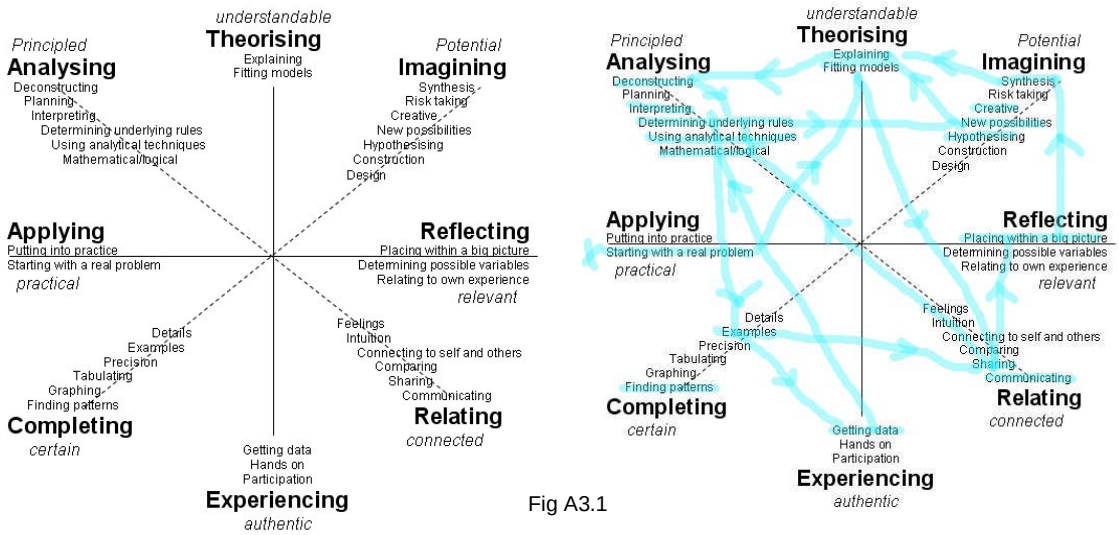

Fig A3.1

In doing this we discover that each of us takes a different journey and has preferred areas where we might spend more time, depending on whether you are a theoretical physicist or one that also engages in experimentation or observation. We do seem to cover the same territory. And quite a bit of this territory, while valued by the scientists themselves, is not something which they might normally consider ‘science inquiry’ and certainly not something

they actively or explicitly encourage in their teaching – for example, processes like intuition, sharing, imagining.

So perhaps 'inquiry' is more an *attitude* rather than a set of *procedures* - where the individual is engaged in personal meaning making, following their curiosity, gaining insights and being creative in development of theories and practices. As part of this inquiry they discerningly use a tool kit of processes and procedures as they aim to come to know. And they are engaged with a greater community which acts as a sounding board, moderator, source of ideas and information - so meaning making moves out of the personal into a collaborative endeavor.

"Being a scientist," says one lecturer, "is a way of life. It is a type of thinking and looking at the world that you bring whether watching TV or doing a research project."
"It is about questioning, discernment, wanting to look deeper, being open to possibilities," muses another.
"But how do we move from how we are teaching now, to creating an environment where students can experience this sense of inquiry?"

This project is primarily looking at improving teaching in first year Applied Physics as well as the pure physics course. The students who are doing Applied Physics are from courses in Agricultural Science, Pharmacy and Surveying as well as from general science courses. We decide to ask these client departments what it is they hope their students will gain as a result of doing the Applied Physics unit.

So some interesting discussions ensue where it seems that while some minimal foundational content is required for some of the client courses, the key concern is that the students experience a 'physics way' of doing things, or a physics style of thinking. What do these departments mean? What is a *physics style of thinking*? Procedural, logical, solving problems, exploring concepts, seeking evidence? How was this different to other types of science thinking? And are the students in the program gaining these skills from the current teaching methods?

So now our project team is teasing out what it means to develop physics thinking and we are wondering how much thinking the students might be doing already. What are they understanding? What questions are they thinking to themselves as they listen to lectures? How are they relating what they are learning about in physics to their main course of study? How do the lab sessions enable inquiry based thinking to occur?

So how do we find this out? We decide to do peer observations of the two lecturers who are currently involved in teaching the two first year courses – Dr Brown (pure physics) and Dan (Applied Physics). I suggest that the observers also interview the students afterwards and discover what they are thinking, but they do not feel comfortable with doing that, so I become the interviewer and thus an intermediary between the students and the lecturers.

Over a couple of weeks of lectures I am observing students, their participation, their body language, their questions and how they might chat to each other when the lecturer is talking, sometimes eavesdropping on what they are saying. I listen to their talk if the lecturer schedules time for think-pair-share. And then afterwards, after each lecture, I pull aside about six students and interview them, asking them how they were thinking during the lecture – were they understanding, what unanswered questions they had, how effective a particular pedagogy might be. I am listening from a context of my own experience as a science teacher and expectations of what effective inquiry and learning might be.

I write these responses up in note form and then provide this feedback to the lecturers at our fortnightly meeting where we all share our observations of the lectures we have been to. (see Appendix 7 for an example of these.) The student responses are problematic and individual. While some students might be following the concepts, others have switched off. Some do not expect to think in a lecture and just sit passively, saying they learn best if they can read over it later. Others might be frustrated because they are still seeking something more – understanding, plausibility, significance or relevance. Some are making connections to their own lives and other courses, but others have compartmentalized what they are learning.

When I probe further as to what the students might have understood from a lecture, I often find 'misconceptions' or students saying, "Oh, now I think about it, I don't really understand it, why does this happen ….?" Often after that they are so keen to understand something that I find that I am reconstructing their understandings. This helps me understand their thinking better which is very useful when I relate to the lecturers what is going on in the students heads and how they are stumbling over particular concepts and why. But I wish the lecturers were experiencing this first hand as I am learning so much about the students as a result of these processes of inquiring into their thinking.

The sort of detailed feedback I am giving to the lecturers is quite new to them. Although they work individually with students in tutorials to help them understand something, most don't seem to have gone into this much depth in understanding their thinking. So the help they are

giving students is more from a teacher perspective, rather than from the student's perspective.

The fact that the student feedback about the lectures is so varied initially seems worrying for some lecturers – they had expected that if they adopted new pedagogies then these will work for all students. But it becomes clear that this is not going to be the case.

Dan throws up his hands "But if it is all based on individual preference how can we plan what to do?" So the need to try and make sense of the variety of data now opens up the door for looking at what educational theory can help explain this and help us plan better. I now introduce the notion of *learning styles* and ask whether we can look at the student responses using this as a lens; seeing that some students are coming from certain preferred learning styles. Some of the lecturers had been quite wary of educational theory and anti the university's own teaching and learning unit, so coming to a point where learning theories are seen as useful seems to be a significant step. But does the notion of learning styles really sink in?

Dan has just given a test and shows me the paper, saying "I just threw in this question to make up the marks – it is just writing the right symbols on the diagram - it is easy. But only 50% of the students got it right! Why didn't they get it? I must have explained this at least three times!"

I grab a piece of chalk and draw a make believe formula on the board with a variety of symbols and ask him if he would be able to understand that. He looks at me horrified and shakes his head "I can't do that now… I would have to take it home and look over it, substitute some numbers in, maybe do some quick graphs in order to get my head around it… I haven't got time for this."
"Hmmm," I say, "So ***me*** *explaining it to you three times wouldn't work?" I give him a cheeky glance, raising my eyebrows. "Perhaps," I continue, "if you feel like that then it is likely that quite a few of your students will feel the same."*
He looks at me thoughtfully "OK, I see where you are going with this… yes I could do a little exercise which helps them get more familiar with this."

With each lecturer now, I am trying to help them reflect not only on what it means to be a scientist but also a learner. I am trying to put them in their students' shoes in as many ways as possible and tease out the differences and similarities between how they and their students think.

Getting more inquiry happening

Dr Brown has started giving questions in the middle of his pure physics lectures for small groups of three to discuss which they then share with the whole group. I have helped him in thinking about designing intriguing questions that might probe student understanding, moving them deeper into applying concepts and discussing their plausibility.

He is quite taken aback at the sort of responses he initially gets which reveal many 'misconceptions'. He wonders whether this has been the case all along in his teaching of physics, but he just hasn't asked the right questions to tease out these issues. He becomes intrigued with constructivist and misconception research and finds a diagnosis tool for the topic of motion. He applies it and is shocked that these students, who have completed Year 12 Physics, have major misconceptions about Newton's laws and momentum. He now asks "Why do they think that? Where have they got their notions from? How can I challenge these views?"

We have conversations where we tease out how students might be constructing understandings and what might be influencing these. He now revises how he constructs his lectures, what examples he uses and what he is aiming to achieve. So rather than just intending to *cover* a topic, he has a need to ensure the students *understand* it. He now asks more questions during the lecture, checking for understanding. And soon the atmosphere of the lectures change. The students seem to have more initiative in interrupting and asking questions and most students now are engaged in coming to understand the concepts in class.

Dr Brown seems energized by the lively discussions and his flexibility has enabled him to adapt on the spot to the students' questions and needs. He seems to enjoy inquiring into the questions that the students raise; gaining skill in opening these up to class discussion, rather than always being the 'expert knower' who gives the answer. When he gives a post diagnosis test on the topic he is delighted to see an improvement in student understanding. Dr Brown seems to have achieved an attitude of inquiry in his pure physics lectures, but this unfortunately hasn't been the case in the Applied Physics lectures.

Dan wants to get more inquiry happening in his lectures as well. His tells me that he wants to ask more questions. So I am sitting here observing a lecture, listening to how he asks questions and the impact on the students.

There are about 60 students scattered in this lecture theatre which could take 200. Dan is down the front giving a talk on optics, using a Power Point presentation which carefully constructs the concepts using well designed diagrams.

Dan has asked a question. "Another application of a prism is…?" I look around at how the students are reacting to this. They are shifting a little in their chairs, some are tilting their heads or looking at their friends, some are leaning forward. They seem to be thinking and now hands are going up from all around the lecture theatre. One student says "a telescope?"
Dan says "No… well yes, but that isn't the one I am after …. So another application of a prism … is ….a …?"
*Another student tries but it isn't the right answer and finally Dan says "Another application of a prism is …. **The eye!**"*

There seems to be a change in energy in the room. It seems colder.

A bit later on Dan asks another question which is also closed. This time students are holding themselves, waiting. Non-committal. One person right at the front puts up their hand.

After the lecture we head over to the morning tea room and as we grab a cup of tea I say "Actually Dan, I noticed that you asked quite a few questions. Did you notice how the students responded?"
Dan tells me that he doesn't really see what is going on because he is so focussed on remembering what he has to say next.
"Are you aware of the difference between open and closed questions?" I ask.
No, he hasn't really thought about it. I explain how the students seemed to shut down when they were expected to come up with the one answer that he was thinking of. Perhaps the issue isn't how many questions you ask but the type of questions… giving students an open question that could have several possibilities, encouraging them to be more speculative, allowing for different approaches, valuing any thinking they are doing… that way students are encouraged to participate. I am warming to my theme.

But Dan is looking horrified. "I can't ask them an open ended question." he says. "I wouldn't know what possibilities were reasonable and what weren't. I would have to work out all the possibilities before I could ask a question like that. I can't think on the spot … I need time to think. I would be totally stressed." He is getting more and more agitated.

Hmmm. "When presented with several possibilities perhaps you could imagine yourself as a scientist then, rather than a teacher… what techniques do you use to decide whether something is plausible… look for justifying theory, test it out, do a thought experiment? How could you ask your students to be scientists with you?"

Dan is not convinced that he can carry it off but he says that he will go away and think about it. A few days later he tells me he has an open ended question that he thinks he might use in the optics lab session the next day. He feels there are two options for his question and that he would ask the students to test these out.

The lab session starts with Dan up the front giving the students instructions on putting together optical benches, lenses and mirrors to see different aspects of optical theory. There is not much discussion between students in their pairs… just practical conversations… "look through this", "place this here", "where has that bit gone to?". There are three other lecturers in the room observing, standing back against the walls.

Dan now asks his open ended question and asks each group to discuss possibilities. There is a lot of discussion and then Dan asks for ideas. There are three main possibilities that students come up with. Dan writes them all up on the board as I have suggested. He is looking very uncomfortable as he writes up the third one. He then asks the students to think how they might test each of these out and to go ahead and work out which one might be the best explanation.

The energy of the room has completely changed… the students are fully engaged, theorising, exploring, testing. The observer lecturers are drawn from the outskirts of the room and start engaging with the students as they are trying to come up with theories… these lecturers are enjoying the dialogue… challenging students to be more analytical as well as speculative. One student, who I have interviewed several times over the last weeks and is getting to know me, grabs me and says "Sue, I have been thinking how this might be relevant to… and I am wondering…" I am really pleased and think that this is now an inquiring classroom.

Dan is still up the front of the lab looking at his next lot of notes, head down. Oops, it is supposed to be him having these sort of conversations, not me.

Dan now calls everyone to attention and asks students to share what they have found out. There is a good discussion and he eliminates all but one possibility from the board and then gives the formal explanation.

After the 3 hour lab session I ask him how he felt his open ended question went. "I was not happy," he says, "When that third possibility came up I panicked. I couldn't think whether it might be true or not. I remembered what you said and I wrote it down on the board, but I really didn't want to put it up there."
"But it was such a success… the students were really engaged in some good scientific thinking. It seemed to be the highlight of the session."
"But I ended up running out of time. It took a lot longer than I thought. Now I have to cover more in the next session."
"Could you cover less content and give yourself time to do something like this?"
"I am going to have to think about it. I really don't feel comfortable with this sort of thing."

How can I help Dan to be more comfortable about this? Practice? Is this just about pedagogy, or does this reflect who Dan is? Can he change who he is, his very nature? Should I be expecting him to? What is the difference between Dr Brown and Dan? Is it learning style? Is it personality? Is it an attitude to science? What sort of scientists are they anyway?

How can we improve scientific discourse?

April, 1999. *It is a month later and Dan is running a lab session now on electricity – series and parallel circuits.*

I am standing at the back of the room along with two other observer lecturers and a lab assistant – a post-grad student. We are continuing to explore how we can encourage critical and inquiry based thinking. We have had several meetings where we have looked at my reports of the type of student discourse in lab sessions. When engaged in following the instruction based experiments the students seem stuck in procedural questions, not moving into other areas of inquiry such as theorising, analysing, hypothesizing, imagining, and connecting. Why not? When Dan gave them the open ended question they did move into much richer scientific discourse. Is it the type of activities which limit their discourse or the way they might be designed? Is it the conversations that they are having with their teachers? The observers are keen to listen into what is happening as well as try to stimulate some scientific discourse.

Dan has just explained the first experiment. I watch and listen as the students struggle to make sense of their diagrams, instructions and lab equipment asking each other procedural

level questions "Where does that go?", "How do we connect that?", "What does this do?". There are hands up around the room and I listen in as the observers from around the wall get drawn in, giving a helping hand.

I listen to what the observer/lecturers say and do as they help the students. The post-grad student, when asked about how the circuit goes together, just puts it together for the group. A lecturer talks another group through his actions: "You put this here, connect this, and then you can turn it on." The students are quiet watching.

I have heard these lecturers engaged in iterative and rigorous conversations about their own science amongst their peers, so they themselves are competent in critical thinking and scientific discourse. They have the intention of engaging in more dialogue with the students, yet it is not happening. Why not?

I wonder why it is so different to my own students who in a similar situation would be discussing issues with the procedures, or circuit principles or the nature of electricity. Why isn't this occurring here? Is it the lecturers, the students, the environment, the expectations, the lack of questions to probe understanding? Do the students need something problematic and intriguing to catch their interest?

We move onto the next experiment which involves a parallel circuit and there are more hands up than before seeking assistance. Why can't the students work out how to construct the circuit for themselves?

All the lecturers/observers are busy and one group of students see me against the wall. They call me over and ask for some help. I am not supposed to be doing this but I can see the other lecturers are run off their feet with questions.

"I just don't get it," says a student with frustration.
"So how are you thinking about this? What are you seeing when you look at the circuit diagram?" I ask, without thinking and as result start a conversation. I discover that one student doesn't really get the idea of the circuit diagram. So here am I constructing her understanding… asking her to think how the diagram corresponds to the physical components… asking her how she imagines an electron might move around the circuit. And I soon discover that she has the notion that an electron will move around a circuit even when the switch is off. She explains how when the switch is opened, the electron continues to move around to where the switch is, then finds it can't get across and then the current stops. I ask

her where she got this idea from and she explains to me about a role play she did in Year 10 of being an electron.

I unpack this further and in doing so discover I have an audience of five other students who all start asking me questions about electricity, how electrons move, what happens when they reach the parallel part of the circuit, why an electron might choose one path over another. Each tells me about their own prior learning experiences in electricity and we end up having a very interesting discussion coming up with the problematic nature of trying to model what is going on in a circuit by thinking of it as moving electrons. They are intrigued about the deeper issues of electricity and wish to understand the hidden meaning of circuit diagrams.

I look up and realize that Dan is waiting to go onto the next experiment and we are too noisy. Oops.

I step back against the wall again and ponder what just happened. Was it the question I asked the girl "How are you thinking about this?" which was the key? Why didn't the other lecturers in the room question the students more deeply about their understanding? Didn't they see that the difficulty with setting up the equipment was a possible indicator of issues with understanding the concepts?

After the lab I talk to the post-grad student who had gone in and 'properly' set up students' circuits. I told him my experiences with the students I had talked to… how some found it quite difficult working out how to translate from the diagram to a real circuit and how they were interested in how the circuit operated in terms of what happened to the electrons. He looked at me quite surprised. He said it never occurred to him to question why the students were having difficulty putting the circuits together, that if you show them enough times they get the hang of it. That that was the way he learnt how to do circuits.

We then ended up discussing how we made sense of different types of circuit diagrams. I confessed to him that as soon as a circuit has a capacitor, inductor or diode in it that I just can't imagine how it might work. He says "Why should you? I would never try to work out what is happening… you just learn what certain types of circuits do."

I wonder then why do I need to have a conceptual understanding of what is going on? Do I expect more than what is feasible? Is it because I am a female and need to have 'connected understanding' as suggested by the research into ***women's ways of knowing*** *(Belenky et al. 1986)? But this seems to be what the students are wanting as well, even the boys I spoke to.*

I then go and talk to Dan, letting him know that a number of his students have major 'misconceptions' about electricity. We begin to discuss these and then get into a nitty gritty discussion of how electricity really works. The conversation lasts for over an hour and involves lots of diagrams, examples and thought experiments. I am thinking that perhaps this conversation will be very helpful for Dan in orienting him towards the problematic nature of electricity so that he can then teach it in a more inquiring way.

But Dan throws his hands up in the air and admits defeat "I have never questioned electricity before, just used the equations to work it out. It made perfect sense to me that way. Now I really don't know what to think. Sue, you have confused me and I don't like it. I would need to talk to someone who really understood electricity before I would feel even comfortable talking about these things with the students."

Following this incident, I begin to wonder what habits of mind each of the physics lecturers have about 'physics knowledge'. We have had conversations about the theories of critical constructivism – the contingency of scientific knowledge and how interpretation is based on paradigms. Most of the lecturers see the tentative nature of their own research, saying that current science is contingent and based on continual revision and iteration. Yet in contrast, some are quite adamant that the foundational knowledge of physics is pretty certain. I wonder then whether they have an attitude about this 'old' knowledge (which makes up the undergraduate courses) which makes it difficult to bring a sense of inquiry into it.

How much have they leapfrogged from this knowledge into their own research, how much of their use of it has been habit, how much is unquestioned repetition of how they were taught it? How much of this certainty is due to the fact that they think of it in terms of internally consistent mathematical equations rather than concepts? How do they think of physics and how distant is this from how their students think? Maybe it just doesn't occur to them to ask students *what they are thinking* because for them it is something that you don't really think about?

What might it mean to conceive such knowledge in new ways and bring a speculative eye to it?

I also wonder how much these attitudes about physics knowledge then sets up an environment where lecturers value their 'authority to know' as the currency of student respect for them. So being speculative or uncertain about concepts might challenge this

perceived respect. Setting up more inquiry based discourse might therefore mean trying on new roles, which can be a vulnerable process.

But is this the issue with Dan, or does it go deeper into who he is as a scientist? He confesses to me that his research is different to the others. He describes himself as data-collector, rather than a theoriser – someone who bunkers down in the research lab. I wonder then whether he has been attracted to the sort of research which matches his temperament and learning style, and whether he is then incapable of the thinking-on-the feet theorising and inquiring that Dr Brown seems to do with ease in his teaching. Who is Dr Brown as a researcher? Someone on the leading edge of his field, a conference speaker, a leader of a research group, a theorist, a manager and more of a people person.

So I now find myself trying to diagnose the lecturers as if they have an illness. What might be the specific barriers to helping each of them see into students' minds and engage in successful discourse with them? How can they reconceptualise the physics they are wanting to teach?

Yes, I begin to realize, that seeking to improve the quality and opportunity for inquiry learning in university science is problematic. Not a simple matter of creating an intention, or developing pedagogical strategies, but it is also dependent on each lecturer's habits of mind and a deeper sense of being each of which seems to be creating different barriers. And these are much more difficult to shift despite a keenness by the participants to embrace inquiry based teaching.

A new phase

May, 1999. *We come to a point in the project which is the nadir. Our fortnightly meeting has ended up being a moan session, despite the successes that Dr Brown has been achieving. Two lecturers now have taken topics in the Applied Physics course and are feeling frustrated because of lack of progress and the mounting contradictory evidence from the students. Jeff has tried to be innovative in his use of constructivist and collaborative pedagogies but the responses from the students are mixed with a lot of suggestions for improvement. He also has evidence from his own questionnaire which he gave the students and is disappointed with what he has read. Part of the issue is that his questions are a bit obtuse, but at least he is asking them, rather than relying on me. Part of the issue is that although he is a great planner and thinker, when he comes to do something it doesn't quite work out, but I have yet to understand why.*

One lecturer says in complete frustration, "What is it that the students want? We are trying our best? We are trying to make it more relevant and inquiring! Why doesn't that work?"
"They are just not used to hard work any more – they expect to be entertained – for us to hand it out to them – when I was at uni I was expected to go home and do the work to understand it."
"They say they want it to be relevant but what does that mean? Most of the stuff you learn at university isn't relevant until you leave and start using it. They expect it to be relevant ***now*** *but perhaps relevance is a luxury."*
"Yes, the undergraduate course is something you get through before you get to the interesting stuff – sitting in lectures taking notes worked for us, why do they need something different?"

Is this what they really thought? I was horrified. I had thought I had done a good job of shifting the lecturers into student perspectives, understanding that today's learners are a different breed with different needs and helping them see more about how they thought. Creating a sympathy and empathy for the students. Did they really mean these comments, or was it a past mindset on its last frustrated fling? How could I challenge this?

"Can you remember anything memorable from your university course?" I ask. They shake their heads. "Well," I say, "I remember in my Honour's year when my High Energy Physics lecturer rushed into the room all flushed and excited to a lesson on quarks, crying out "Wiesenberger has just discovered the Omega boson!!!!!!!!!!""" ('High energy' physics was both the topic we were studying and the state of the lecturer.)

The lecturers look at me, seemingly electrified.
"Really? Wow! I wish that had happened to me, how exciting!!!!"
"Why aren't we doing that?"
"What sort of course would you like to have done in physics?" I ask.

And we end up having a very deep conversation about possibilities, preferences, dreams…
"Why can't we share our excitement and love of physics in how we teach?" muses one lecturer.

So it seems to me now that this nadir has become a key turning point – not just finding motivation but an actual shift in thinking about what it is we are teaching and why. Perhaps

we are moving deeper into unpeeling the layers and as part of the process we need to revisit previous mindsets to try them out before we throw them away for good.

This is a crucial time for us as we are moving into the second stage of the project where we are looking at visioning how the second semester teaching will go in Applied Physics. First semester has been about experimenting with practice within the confines of the established course and through that gaining some insight into student learning and the issues of science teaching. So at this stage we hope to use that understanding to redesign what and how we deliver the course in second semester. We make a quick decision to eliminate one of the five topics to give more time to go a bit more deeply in the remaining four topics and we change their focus. We now have four different lecturers taking each of the four different topics.

Whereas the first semester topics were only tinkered with to make them a little more interactive, three of the lecturers are looking at rethinking and re-orienting what they are doing for second semester. It seems they have left behind the need to cover specific content; rather, they are looking at what student learning a topic might yield beyond specific content ideas… for example, grand themes of science, science history, contingent nature of research, inquiry based thinking, including bringing in their own cutting edge research.

Janice decides to introduce her own research as well as a historic context in the exploration of some key quantum ideas… showing students how science is constructed historically. Dr Tim uses his own research in bio-electricity as a way of asking students to critically reflect on the usefulness of applying electrical models to biological situations. Jeff is interested in using case studies to help the students inquire into concepts of physics to do with heat, particularly giving concrete and connective experiences. Dan decides to keep his current structure, intent and slides from last year and just work on getting more discussion and questioning happening.

We also decide to redesign the second semester lab experiments so that they take students more on a scientific inquiry journey; some experiments requiring a more theoretical approach, others requiring students to creatively design the experiment and to reflect on the effectiveness of their design, others which start with real problems or challenges. The students are required to do four experiments out of a choice of 12 and present one of these as an individual experimental write up, and another as a group presentation to the class. They are given criteria on which they will be assessed.

In making these changes, different lecturers are now bringing in different understandings from educational theories like trivial, social and critical constructivism, learning styles, or women's' ways of knowing. From being anti the educational jargon, the lecturers are now using it with relative ease, though still challenging me if I get into educational abstracts. It seems the contradictory nature of the student feedback and the gap between intention and action has required the lecturers to seek out educational understandings which can support their journey of planning, action and reflection.

Some are demanding educational papers on particular themes, or seeking them themselves, while others are still reliant on me for extracting and dispensing key elements relevant to what they are doing. I seem to have analysed their learning styles and am adjusting my own input based on that. For example, Dan says "Just give me one strategy at a time, not several – it is too confusing. I don't want to know the theory" and I do that, but in our debriefing discussions I bring in some theories to help Dan understand what is going on. So I am trying to move Dan through various modes of inquiry in understanding his teaching and the learning that is occurring.

With all this are we seeing any improvement in teaching? These lecturers are moving out of their comfort zones and experience and to expect them to perform well first time in a new approach is unrealistic. It has certainly been my experience that any new pedagogy I adopt often requires enormous focus the first time which makes you blind to many of the other things that are going on. So a lecturer might organize a great activity which he is trying to remember, but forgetting some of the glue that might make it work. For example, Jeff often loses where he is in lectures so I give him a simple strategy of writing up on the board at the start of the lecture a list of what he is intending to cover. He now refers to this list throughout the lecture and the students can see where he is and what he aims to cover. We refer to it as creating *signposts*. So now he doesn't have to keep the organizational aspects in his head.

The lecturers now are more engaged in getting their own feedback – designing questionnaires and emailing students. Dr Tim asks all his students at the end of each of his lectures to fill in a sheet using my Critical Thinking schema: "What have you understood? Do you think it is plausible? Do you think it is useful? Are you willing to believe it? Why / why not?"

He then uses the answers to infer student understanding and interest and to design the content and style of his following lecture – for example, whether it is providing more background, a deeper case study, more opportunity for student discussion, or a tutorial style

session. This seems to suit Dr Tim's nature and learning style. He seems to be more of a reflective learner – one who likes to stand back, see the bigger picture, gain all perspectives and then consider possible options before deciding to act.

The lecturers still feel uncomfortable asking students for feedback about the sessions face to face, but at least now I feel that they are not totally relying on me as a go-between, though I am still debriefing students after the sessions.

We are beginning to hear increasing quantity and quality of scientific discourse in lectures and in lab sessions and many students seem to be engaged in a *process of inquiry*. But we are still getting contradictory feedback as to the effectiveness of what is being trialled. At the end of the year the students are given CLES surveys (see Appendix 8) and an outside interviewer runs two focus groups which are videoed. When we look at the data from these, the feedback from lecturer questionnaires and my student interviews we begin to see a pattern.

It seems we can class the students in two groups. One group, which has adopted the metaphor of *physics as inquiry*, enjoys the thinking involved, has begun to value the inquiry and thinking skills that they have gained even though they might not value all the content they have had to learn. So the relevance of the physics doesn't just lie in the relevance of the content to their other courses or lives, but rather the relevance of developing a scientific way of thinking. They appreciate the efforts the lecturers have made, and are sympathetic to the fact that they might not have got it right all the time.

Then there is another group who seems to expect that physics should be taught as a *body of knowledge*. Some of the concerns of these students are:

- Too many different approaches – don't know where I stand.
- Which bits are being assessed? What do I need to learn?
- I expect to learn information to help me with the tests.
- I don't want to have to think in lectures – I just want to take down the notes.
- We don't have to do this in our other courses.
- When we are asked to look deeply into something in a lecture it takes time away from getting the content of the course.

We hypothesized that these students became enculturated very quickly into a passive learning culture as a result of the different courses they were exposed to. But why had the

other students adopted the inquiry approach? Was their style of learning more suited to that approach? How could we help the *'physics as a body of knowledge'* students move to a place where they valued inquiry learning?

Perhaps we hadn't made it clear enough to them what we valued? Were the tests giving mixed messages that we still valued *content* over *thinking*? How were we explaining the different approaches we were using and their relevance to the students? It seemed that while the lecturers had gone on a journey from *physics as a body of knowledge* to *physics as inquiry*, they hadn't been explicit with the students about this and taken these students on the same journey. Why not?

In seeing the two discrete groups we also asked ourselves is it possible to have both – *physics as a body of knowledge* **AND** *physics as inquiry*… that each supported the other. How could the lecturers make clear to the students the appropriate dance between them?

And how did the project meet up with my own vision for undergraduate physics courses? It seemed that perhaps we had barely inched along the path that I had envisaged… the lecturers had perhaps opened a door into greater possibilities and different ways of thinking but were still in the process of stepping through, some with more confidence than others. And each saw different things through that doorway, based on their own values and experiences. These were quite different to what I had envisioned at the beginning of the project based on my own context of holistic education.

What had the lecturers gained? A questioning of the nature of physics and the habits and assumptions which they brought to their science teaching? An expectation that they could share their passion for science and science thinking in their teaching? A realization that student perspectives are very different to their own and the need to find out what these are? Skill and ease in engaging in meta-discourse about their own teaching? A confidence in experimenting with their own practice and determining its effectiveness? A greater flexibility and ability to deal with pluralities and contradictions? An awareness and interest in the nature of learning?

These are skills that we might call 'learning how to learn'. It wasn't so much about achieving measurable improvement in student learning outcomes as an inner change of attitude towards what it meant to teach physics… an orientation towards being a learner of one's teaching practice. So the project was more a seed for each lecturer's continued journey. How did the seed grow? That perhaps is another story.

2006 - Reflections on the project and the role of feedback

At the time of doing this project I was coming up with insights about processes which might help or hinder the lecturers in their journey. Over the years these insights have grown and changed, helping me to see within that experience rich sources for further learning about the nature of transformation and the role of transformational leadership.

For example, at the start of the project I felt it would be valuable for the lecturers to be engaged in face-to-face conversations with students about their learning – to be able to see into students' minds, come to know them as well as developing an empathy for them. The process of coming to understand my students was a key aspect of my own journey in improving my teaching and learning practice; causing me to be more self-reflective and critically aware of my underpinning assumptions, helping me to develop new understandings about how we learn. My own philosophy of learning was one where I saw an important part of the learning process as gaining feedback from multiple sources - the system you are in teaches you. Without feedback, what would stimulate growth?

However, very early on in the project, I realized that many of the lecturers were not seeing nor responding to the clues that the students were giving. How could I get lecturers to see and read the feedback that was already present … students' body language response in lectures, the deeper issues in their questions or in their answers to assignments? What did those tell us about their engagement, their understanding and the way they thought?

I was also hoping that the lecturers could start a process of reflexive practice by, for example, simply asking students at the end of a lecture what they have learnt, what worked and what didn't, what they valued and might use.

However, the lecturers did not feel comfortable asking these sort of questions – for some it was hard enough asking a student face-to-face *"Do you understand this?"* I didn't know how to solve this issue at the time, and I didn't want to press it, as I thought it would cause too much stress at the beginning of the project. So I took on the role of gaining student feedback through interviewing students after sessions and then relating this to the lecturers at our meetings or debriefings. Then I wondered whether by me doing this I had taken the opportunity from the lecturers. Perhaps this was a mistake, I worried, given how much I was learning about student thinking and needs as a result of my interviews with students.

But now, I think that it was important that I started the process of gaining feedback, rather than requiring the lecturers to get their own feedback, because getting the feedback was essential to the movement of the project – not just a movement in terms of getting action started, but that the style of questions which I was asking and the subsequent student responses pushed the lecturers into new layers of thinking about science, their teaching and student learning. It also removed a potential source of stress which might have reduced the goodwill that the different participants brought to the project. How to balance the amount of discomfort – enough to stimulate growth, but not too much to close down the effort?

As a result of our discussions about the feedback from students and each other's observations of the sessions, it seemed that most of the lecturers built up a better awareness of what to look for in the visual, physical and verbal clues that the students were giving us during sessions, and over time were able to pull out aspects of a teaching session and unpack it for themselves. This led to them devising their own questions, which they then got me to ask the students. So it seemed that they had begun to bring a scientific eye to our process; inquiring into the business of teaching and learning, albeit at a distance. We got into a rhythm at our meetings of sharing, interpreting, theorizing, clarifying the dilemmas which led to devising new questions for the students.

When one lecturer initiated his own student feedback questionnaire after taking his topic two months into the project, I was taken aback. Why didn't he go through me? Hmmph!! Uh oh, I thought, where is that coming from? Isn't the whole point that he build up confidence to do this for himself? I felt like a mother not yet ready to let my child have its independence. So, his questionnaire wasn't exactly well written and the answers he got back showed the confusion of the students, but at least he had a go at framing the questions, and thus getting feedback about his feedback device. Next time he was a lot more effective, independently devising suitable questionnaire questions. As the others took up teaching of the various topics they too got involved in writing their own questionnaires or emailing the students and I realized the importance of allowing each of them to work out an effective process for themselves.

However, most didn't take the next step of moving to face-to face conversations with the students about their learning. How could I have helped them build up skill, confidence and attitudes of mind that would enable them to engage in meta-cognitive talk with their students? Did they need to build up a meta-cognitive language between themselves, practice it before they had enough confidence? Was it their perceived relationships with the students? Could I have used role plays? How could I have helped them unpack this further?

When I reflect on my own journey as a science teacher I realize that I too started slowly in getting student feedback… using questions on the end of their worksheets which asked my students what they had learnt and how they could improve their learning. I built up an ease in asking these questions on paper, giving me time to reflect and unpack them before talking to my students. It gave me a distance, a time to get out of a defensive mode. After such 'training' I could then move into the immediacy of a face-to-face discussion about such things, using an attitude of openness and inquiry.

Yes, I realize, perhaps I was expecting too much. My competence with seeking feedback was based on a long slow process as I was engaged in an action research process where I brought Torbert's (1991) 'critical subjectivity' to my thinking. Perhaps it is a reflexive process that as we gain the skill to ask such questions of students, we see more, we move into different paradigms, and the questions we ask change. In a sense, I was trying to short cut this with the physics lecturers in just one year. I was trying to balance the questions they wanted to ask from their current perspectives along with the questions I felt that they should be asking that would reveal underpinning assumptions and lead them to higher perspectives.

So how might I do this differently? I think if I was to work in such a project again I would be looking at ways of assisting participants to move towards an autonomy in the area of gaining feedback about whatever it is that they are doing. But at the same time I would be ensuring there also was feedback beyond the level of perspective that they might be operating at that could draw them forward in perspective. I would assist in helping them move from single loop inquiry cycles (plan-act-reflect processes which aim to improve craft) to double and triple loop inquiry (critical subjectivity which aims to question underpinning assumptions and values).

I would try to *occasion* opportunities which demonstrate the value of feedback – how useful it is to our learning. I would help the participants understand the problematic nature of feedback; the issues related to each respondent's perspective as well as the paradigms we adopt that shape the questions we ask and the interpretations of the responses. I would see conflicting evidence as a way of creating learning moments; opportunities to question underpinning paradigms and habits of mind. So I would be highlighting these, rather than trying to explain them.

OK, so far that is not much different to what actually happened – but I think now I would be more aware of the process rather than learning on the run, as it were. And I wouldn't just

keep that process to myself. I would try to make transparent the processes of transformation and try to name the issues that are developing. I would possibly make explicit goals about what we want to achieve in terms of self-learning processes as well as the project outcomes … for example, *by the end of the project we want to be comfortable in seeking student feedback for ourselves, developing ways that suit our own learning styles.*

But perhaps I can only see this now because I have moved from educational theories based in a constructivist paradigm to those which are more congruent with a transformational learning paradigm. My questions to my students are now not just *What do you understand?*, or *How are you thinking and learning?*, but also *How are you changing?* The feedback I am seeking has a dual purpose; to inform me but also to help develop self awareness and reflectivity in my students, where they can explore their thinking, learning and self-transformation processes. And I help my students name what is happening to them, seeing the patterns and realizing that their angst is just part of an overall process.

So what is that process?

Mezirow (2000) has detailed some of the characteristics of the process of transformation which I think quite well describes what we experienced in the project. So in the next section I am going to share some of the emergent insights I gained about managing such a project and bring some Transformational Theory analysis to it. As I undergo this process of analysis, I discover that my own understanding of what was going on changes. It is problematic and I am wary of claiming too much or pinning down my contingent understandings. In moving into this analytical mode I am wary of moving to more of a modernist perspective which I ask you to read in counterpoint with my more postmodern descriptions and speculations in the previous sections.

Transformational Learning Theory

When we talk about *transformational learning* it can relate to transformation of **perspectives** and the ways we operate (e.g. Torbert's (2005) **Action Logics** or Gordon's (forthcoming) **perspectival levels)**, transformation of **self** (movement in **ego stages** (e.g. Kegan 1982) or **development lines** (Gardner (1985), Wilber (2000b)) or transformation of the **cultural paradigms** in which we are situated (e.g. Beck and Cowen's **Spiral Dynamics** 1996).

I am going to suggest that as a result of this project transformational learning occurred in the perspectives and cultural paradigms we brought to the thinking about and teaching of science.

A characteristic of movement to the next stage of perspective is that the stage you were in becomes explicit – it is something you can now reflect on and control (Kegan 1982). The Action Logic research (Cook-Greuter personal communication , 2005) suggests that one will tend to teach at the perspective stage lower than what you are operating at yourself.

So how does one move in perspective? It is the reflexive process of examining what you are doing – making it explicit. But there are layers and layers of this… one might just make the outer layers explicit and nothing much will change. It is usually by questioning one's underpinning values and assumptions that enables the paradigm shift that moves you into a new perspective.

Mezirow (2000) has suggested that the transformational journey has different phases which people might experience. When I look at this list I see that much of this occurred during our project.

Disorienting dilemmas

Our **disorienting dilemma** first started with the problem of declining numbers of physics students. Why were they leaving? What was the physics courses lacking? Was it just a change in global careers or was it that we were no longer providing the sort of learning that students wanted? A bit of both it seemed. From the university administration questionnaires given to all students over the previous five years, the physics department had not done

Transformative Theory

Transformations often follow some variation of the following phases:

- A disorientating dilemma – also paradox, enigma, anomaly
- Self examination with feelings of fear, anger, guilt, or shame
- A critical assessment of assumptions
- Recognition that one's discontent and the process of transformation are shared
- Exploration of options for new roles, relationships and actions
- Planning a course of action
- Acquiring knowledge and skills for implementing one's plans
- Provisional trying of new roles
- Building confidence and self-confidence in new roles and relationships
- A re-integration into one's life on the basis of conditions dictated by one's new perspective

The transformative process may also involve:

- Encountering a "missing piece" that provides the integration necessary for a transformative experience
- A revisioning of self in the eyes and responses of similar others
- Making public, primarily for ourselves, the historical dimensions of our dilemma - and confronting it as a difficulty to be worked through.

Mezirow (2000)
Fig A3.2

well in terms of providing effective learning opportunities.

So this was a key impetus to be involved in such a project. And the disorienting dilemmas kept coming; the 'misconceptions' that students were having, the conflicting responses to the new pedagogies, the limitations of the lecturers' current understandings of learning to explain what was going on. It would have been quite easy to try and explain everything, but being in a state of confusion and doubt seemed to be important in moving most of us beyond current perspectives and ways of operating.

I recommend a strategy of making the tensions explicit, keeping them alive and establishing an attitude that it is okay to have such tensions… how do we live our way into solutions or new ways of being where we have transcended the tensions? Now this may require practicing a new mode of thinking where we move from linear thinking into dialectical thinking.

Questioning underpinning assumptions

Questioning underpinning assumptions about what it means to be a scientist and do science was also an important part of the process. This involved making explicit what it is we value and what it is we do. This was one of the first conversations we had as a group and it was something that set the scene for discussions throughout the project – we could always bring issues back to the key question – *What is it we value in science and how does this action we intend help us articulate this?*

Asking this question about assumptions enabled the lecturers to expand their view of what science is and what scientific inquiry is. Making the inquiry process explicit was the first step in thinking about how to bring that into the teaching. The next step, which was making it happen, was far more difficult.

However, I wonder if the lecturers would have been able to articulate this expanded view of science without my help. Because I had already gone through this process and had questioned the prevailing notion of the scientific method, coming up with my own expanded and richer version, I was able to help the lecturers tease out what it was they did. I don't think that by themselves they would have realized that creativity, discourse, community and intuition are as important to scientific inquiry as are procedural and analytical processes.

So I don't think it is enough to question one's underlying paradigms and values without doing so in a context that enables one to see other possibilities… whether it might be talking to someone who has gone before on the perspective journey, or talking to people from other disciplines and learning other ways of seeing. Otherwise, it would be very easy to just stay exactly where you have been.

Collaboration – admitting feelings – shared purpose – meta-discourse

Another key aspect of the project was the **collaborative nature** – the **shared purpose** and sense of ease that each of the participants had with each other and with me, the partial outsider. I was astonished at the first meeting how open each participant was about their **feelings** about the project.

I had used de Bono's 6 hats in starting the project and one of these is the red hat – *How are you feeling about this?* When I first asked this question, one of the participants described how fearful he was – how he had worked very hard over his holidays in creating Power Points of his topics for first semester and just felt overwhelmed at the thought of having to change them. This helped us to unpack a bit more what our aims might be and how we could still experiment within current structures. I emphasized after this how useful it is to listen to feelings because they often lead us into new insights that we might not have if we just bring an analytical eye to something.

6 Hats

Blue hat: what processes are we going to use?
White hat: what information do we have?
Red hat: how do you feel?
Yellow hat: positives
Black hat: negatives and obstacles
Green Hat: possibilities

Fig A3.3

The wonderful thing about de Bono's hats is that it gives a *process language*, one which we used throughout the project… so you might hear a participant say "can we put on the green hat for a while as we look at this?" or "I need to put on the red hat today." So this technique values and honours people's feelings. I also encouraged everyone to invent their own hats and once one of the participants said "Let's put on the 'Sue' hat." I asked what that one was and he said "It's the big picture hat", a comment which helped me see myself a bit better from the participants' eyes. So the hat idea was a very playful tool which gave permission to expose our vulnerability as well as allow for creativity. It also paves the way for **self-examination** and honesty about self to others. It cuts across adversarial thinking to give new perspectives.

I also believe that this technique helped to circumvent embarrassment that the lecturers might have had in allowing their peers observe their sessions. In my experience with teachers, having someone watching what you do is one of the most frightening things… and I admit myself to being self-conscious. So the ease at which the 'guinea pig lecturers' allowed project participants to sit in labs and lectures and then critique them was a testimony to the relationships that they had with each other, and to their movement to an attitude of distancing their own egos from their teaching prowess.

So, a key to acquiring skills to do this project was not just the teaching skills but the meta-cognitive tools that could help us explore and unpack what we were doing in a supportive environment. Further was overcoming the difficulty with the educational jargon. Even though at the beginning of the project I tried to speak in plain English, the participants would look at me and say "What on earth are you talking about?" It wasn't so much the actual language and the jargon but the educational concepts and the perspectival level that I was bringing to my interpretations.

So, although I shared with the participants a physics background, some of the time the educational language that I was using was outside the lecturers' language register thus part of our process was building up a shared language in which we could discuss learning from a meta-level. I deliberately used physics metaphors to explain learning principles which some of the lecturers found very stimulating and others mind-boggling. (e.g. Do we have to build up physics concepts *bit by bit* in a Newtonian way, or can we use the idea of the *hologram* where you can see the whole in each part of the hologram? Or can we use a systems approach where we look at interconnecting ideas?)

It was important to have lots of examples to explain what was meant by the learning theory, and to use again and again as references actual situations that the participants had experienced… "Like that time when…". We were making up our own stories which became part of our mythology and part of our language. So peer observations weren't just about comparing another's practice or looking for particular things; they also became shared experiences which became part of the common language.

It occurs to me that when you do not initially have a reflective or meta-cognitive language then the stories, the myths and the metaphors can bypass the conscious mind and work at other levels. Telling our stories to each other and hearing different interpretations of them can take one to a new level of understanding – able to see one's own experience with new

eyes. Listening to another's stories can enable you to try out your tentative educational theories in applying to their narratives.

However, while I had in my head lots of **living educational theories** (Whitehead 1998) which I was modifying, I hadn't made this explicit to myself at the stage of the project – it is only now in writing my thesis that I can perhaps understand the significance of living educational theories. How it is important to create tentative models that can help you explain; but then expect for these to be perturbed. I think I could have been far more aware of how the lecturers were constructing models of learning and better helped them to understand the significance of this process. I was more trying to construct understandings for them… dishing out theories based on what I thought they needed.

I bumbled around, sometimes making mistakes (e.g. not recognizing when I should have supported one lecturer more in helping him find educational theories as he showed readiness to do so). And sometimes just the serendipity of the moment led to wonderful 'learning moments'. So, it isn't just about being *strategic* in knowing how to assist others, it is also about being aware of the value of a particular situation in assisting learning. A state of mindfulness in myself as facilitator, but also making this process transparent to others… how can we all learn to be more mindful and aware of our significant learning moments?

Over the course of the project our meta-discourse changed. The lecturers had developed an ease in talking about educational issues as well as scientific ones, which was evidenced in how they talked to their colleagues from other disciplines as well as to each other. I believe that a key to this was the regular fortnightly meetings where we had new student data to reflect upon as well as peer observations and the reflections of the 'guinea pig' lecturers. It also helped that our conversations weren't just formal – but happened in corridors, morning tea room, one-to-one debriefings, etc.

One lecturer, in his end of project paper highlighted the role of the collaborative nature of the project, saying how important it was to engage in such discourse about teaching and learning. He really enjoyed it and it was a highlight of the project for him.

Trying on new roles

Trying on **new roles** was also an important aspect of the project, but not one which I understood fully at the time. I knew that many of the lecturers were moving beyond their comfort zones and I was trying to assist in diagnosing barriers and helping build up

appropriate skills or attitudes. One lecturer said to me that, whereas he was happy experimenting with his teaching for the first year Applied Physics course, he wasn't comfortable in doing it with second or third year pure physics students because he was concerned about what they would think of him. At the time I made a throw away remark and shook my head in mock disapproval "That is not like you, Tim." And I didn't stop to think what the reasons might be behind his concern.

I now wonder whether the role that Tim was taking on in the Applied Physics course was quite a different one for him… he was moving from the *expert knower* into someone who was being vulnerable to the students – inquiring with them, and perhaps not coming across confidently in his management of that. Perhaps the respect that his pure physics students had for him was based on his *authority to know*?

Where was the source of respect that my own students had for me? Was it from my competence in inquiring, my flexibility and responsiveness to their learning and my relationships with them as real people? Yet, I still 'knew stuff' and they could rely on me to ensure they would achieve well on the exam. I would hate to teach the physics course without any sort of knowledge at all. Yes, I still was an *expert knower*, even though I might be engaging with my students in the inquiry process.

And in my relationship to the participants of the project I was still *an authority* - of teaching - and this is what lay behind my own comment to Tim… an arrogance stemming from my authority as an educational expert. Hmmmm.

Perhaps in helping Tim extend his pedagogical experimentation to third year physics I should have helped him make explicit to himself his confidence in the science content and processes – to come to a self-realization of his own competence and value – to determine what he did know and didn't, demarcating the boundaries of this 'authority to know'. I should have realized that it is one thing to try on new roles in a supportive environment where you are part of a greater project, with students aware of the project and on-side, and another to experiment by yourself in isolation.

Yes, I should have listened to his concerns rather than looking at him askance and saying "That's not like you." But at the time I saw the notion of *authority* and *respect* in teaching as outmoded concepts based on metaphors of teaching which I assumed came from a traditional teaching culture. I saw myself as a *facilitator* and *occasioner* of learning, rather than an *authority* figure.

In moving from one type of metaphor to another, rather than integrating appropriately I was rejecting my earlier self. This is a typical response, according to Kegan (1982), as we move in ego stages – rejection followed by integration. So, while I was undergoing this process of personal transformation I could not really see and understand all that what was going on with others, valuing their experience and concerns.

In hindsight, I see that I should have helped Tim unpack some of the reasons why he couldn't transfer his newfound teaching approaches and help him to come up with possible strategies. He wasn't yet able to integrate these tentative new roles into his wider sphere.

Democracy in learning

Now Mezirow (2000) suggests that a supportive environment is one where there is a democracy in the management structures… all participants are learners, including the leader. I certainly learnt a lot from the project and this learning was something that I made transparent for the other participants (even though some might not have understood my thinking processes)… there was a sense that we were all learning. Yet, I had a certain authority as the educational expert which still remained. In future I think I would be more vigilant in being self-aware of the power structures and what I might be creating; trying to develop more humility and thus opening myself to learn a lot more from my colleagues.

Making it public

Towards the end of the project three of the participants wrote papers for various conferences around Australia and we all contributed to a website which captured various perspectives of the project (students', mine, lecturers', outside interviewer of focus groups, reference member's analysis). At the time that the lecturers were preparing their papers I was very sick and so they were written without any involvement from me, which in hindsight I believe was an excellent thing.

At the time I was worried whether they would really understand all that we learnt from the project. Would they capture all the insights that were made, particularly some of the big picture analysis that I had done towards the end? Yes, this concern I had about capturing the 'the truth of it all' is really quite laughable. Because it is clear that each of these papers is entirely personal, reflecting each lecturer's own journey, what they valued and what they gained. They all became advocates for change in their discipline – each advocating

something different, wishing to share *their* insights with their community. This is a wonderful result – ownership, multiple perspectives showing the richness and value of the project.

The act of writing such papers enabled them to reflect on what they had learnt and valued and what they would do in future. In making it public it also enabled a celebration of that learning and opportunity for feedback from their broader community of physics colleagues in Australia.

The style of the papers was very different to their normal scientific papers; not just in the very personal nature, but also the speculative frame of mind that valued the journey as much as the results. In standing up in front of their colleagues they felt at ease and were confident in discussing educational issues…. Or so I have discerned from their descriptions of these events.

In hindsight I would encourage all individuals involved in a project like this to make public what they do to a bigger audience than that of the project… to **test** their new understandings in a bigger context of community discourse in addition to the testing ground of pedagogical experimentation.

Note: For the sake of maintaining the anonymity of the participants I have not referenced their papers.

Spiral Dynamics

If I was to analyse the project in terms of **spiral dynamics** (Beck and Cowan 1996) I would say (simplistically) that by the end of the project most of the participants were operating in the *green meme* (plurality of perspectives, reflexive collaborative inquiry, journey as important as the result) in *thinking about and discussing their teaching of science.*

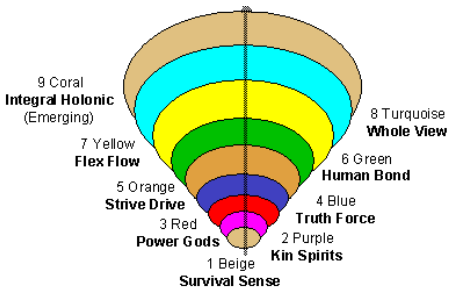

Fig A3.4

At the beginning of the project, I think most were operating *as scientists* in the ***orange meme*** (innovation, autonomy, inquiry, transparent goals and standards), but had not made that explicit – so were teaching in the ***blue meme*** (authoritative knowledge). Through the process of self-reflection and discourse they could make explicit what they were doing as scientists

and thus take the first steps to teaching in the ***orange meme***. (They were also operating within other meme cultures in other aspects of their lives.)

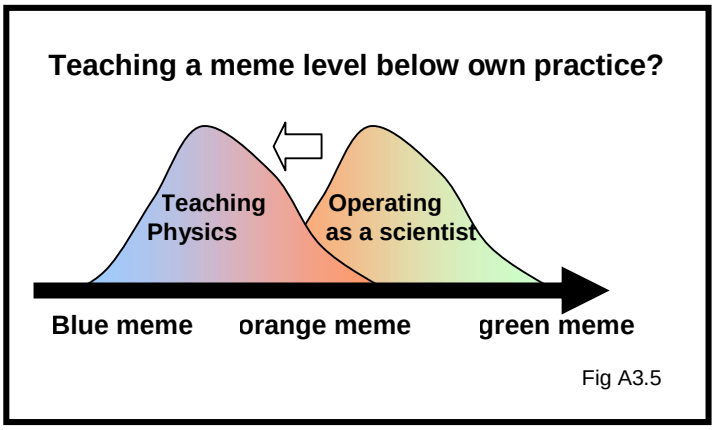

Fig A3.5

However, half the students in this project preferred their teaching to be at the ***blue meme*** level, while the other half preferred operating in the ***orange meme***. What might be their preferences today?

As I discuss in *Chapter 11 – The Enabling Classroom,* understanding the underpinning teaching and learning culture becomes critical when thinking about science education from kindergarten to university. As students develop and move in ego and perspective levels their learning is better supported by being in a teaching/learning culture which aligns itself to their development. In the current Tasmanian education system the adoption of the **Essential Learnings** is giving students science learning experiences across blue, orange and green memes. So, if university science is not to be counter-evolutionary then I believe it is important that it takes students to the next step.

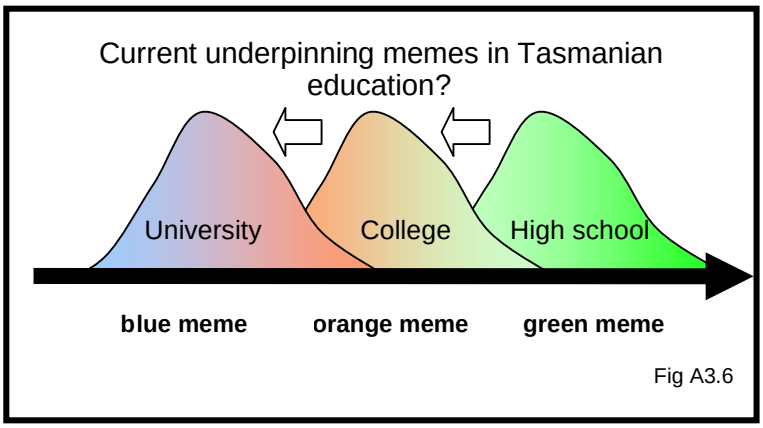

Fig A3.6

This project shows the difficulty in a faculty moving from a traditional *blue meme* dominated teaching culture to a more inquiring *orange meme* culture… but that is only the beginning. What might a *green* or *yellow* (integral) university science learning culture be like? And what transformations might be needed to get there?

I think I was operating in the ***green meme*** in terms of managing the project – trying to be sensitive to the needs of the lecturers and making transparent the processes, yet when it came to 'teaching' the lecturers about educational theories I was working at lower meme levels. In doing this project it assisted me to continue to move in perspective, causing me to get inside the very process of transformation and thus graduate to more integral perspectives which I

am now still easing my way into. I now don't think that there is anything wrong with working at the lower meme levels. However, there is a difference between being stuck in them, unable to think outside the box, versus strategically or attentively entering different meme operating methods because they might be the most effective for the time and place.

Spiral Dynamics suggests two ways for people to facilitate the transformation of others…

1. Someone (usually a person that is 'leading edge'), who has been through the process and is slightly ahead on the spiral, helps to draw others from one cultural perspective to the next and in the process continues to move themselves.

2. Someone (a spiral master), who can see the whole spiral and can go in at any point, takes on the perspective and the culture of those wishing to move and tunes into what is needed to stimulate and sustain movement.

So what was my role in all this? Perhaps, I was someone on the leading edge helping to draw forth others, not always succeeding and sometimes causing opposition and stress. Perhaps now I have a greater perspective to understand why and to act differently. Have I graduated to spiral master? The proof perhaps lies in the pudding and I still have a ways to go.

Post-script - Discovering my humanity

In my own teaching practice prior to 1999 I had found in myself a deep care and understanding of my students – a compassionate non-judging. I felt close to them, concerned about their needs and wanting to be an advocate for those needs. It concerned me that their capacity for soul expression was not being activated in their other subjects. So I might often get quite frustrated with my colleagues' practice in my own school environment.

Being involved in the collaborative project with the university lecturers changed my perspectives about teachers and has perhaps helped me to be more compassionate in my relations with educators.

When I started the project it was very easy to stereotype the lecturers. I had read a study by Taylor (1997) of university teaching of science and maths in the USA. He created two impressionist stories – Dr Stern – a conglomerate of male lecturers he had observed and interviewed (who taught traditionally, distanced themselves from students and expected the real learning to happen outside the lecture theatre) and Mary – a conglomerate of female

lecturers (who was very caring towards her students, building relationships, although she still taught in a traditional way).

When I think of all that is wrong with university teaching of science I think of Dr Stern. I know many of my science colleagues also remember their experience of the first few years of university in this way – you are only treated as a person once you get to third year or honors. Yes, some of the lecturers could have been Dr Stern, but were they really? Underneath they were very caring and warm people, concerned that the students enjoy and be excited by physics and experience learning success. It was very easy for me to make value judgments; I had to stop myself, and make an effort to come to know them, their thinking processes, their aspirations. To look behind what they might be doing and saying for the deeper reasons.

In a sense they represented to me an 'otherness'. I could identify with the story of Mary – my classes were built on the notion of relationships and care. Now I had to identify with the other perspective, rather than rejecting it. This was a little tough. I was often frustrated when well planned activities for lectures or labs ended up being pedagogical disasters. I wondered what on earth had happened and why.

For example, a really good idea for group work in a lecture might only partly work because the lecturer hadn't fully explained the process of the group work enough and had minimal information on the cards he handed out. Yes, the students told me how confused they were in the interviews afterwards and how long it took them to actually work out what they had to do. So now I listen closer to his instructions and explanations of physics ideas and I begin to realize that he often skips steps. Why?

Then one day I am sitting quietly in an office when he and a post grad student come in and start using the whiteboard, writing up furiously lots of equations, talking a foreign language. They are fully engaged in this shorthand language and I have no clue as to what has been said. It shows me a completely new side – a highly competent thinker and researcher, totally at ease in his own milieu – a vast contrast to the way he seems in lectures – which comes across as a little incompetent.

So, I now watch the lecturer as he explains ideas one-to-one in a tutorial to a student and then I have worked it out. He is just too clever to teach this course. His first language seems to be mathematics and that is how he thinks – he does not need English explanations to tie

the maths together. In order to speak to students he has to translate his language into one that they understand.

OK, so now I have a theory of why he finds it difficult to construct others' understanding, I talk to him about it and tell him that I think he is too clever. He laughs, pleased. "Perhaps," I say "You need to see yourself as a *translator*, rather than explaining what you know yourself in your own physics language, you need to understand the students' physics language and thinking which is very different." This seems to be a useful metaphor. So now we look at some of his notes and assignment solutions and I pretend to be a student asking him to explain the ideas to me. We practice until he gets the hang of adding five more steps to each of his one, and remembering to put in the English. I try to give him the perspective of a student, explaining what understandings they are bringing. Perhaps we are both translators.

He now has to be vigilant in his lectures and tutes, checking with students he doesn't go too far too fast. It works until he gets asked a question in a lecture which causes him to talk as he is thinking. He totally loses the students because he is now talking at his level of reasoning not theirs. Yes, it is a long process of improvement. But he feels empowered. Now he can begin to see why things don't work, despite his creative planning and well articulated intentions for a lesson. He has been frustrated too, and annoyed with his incompetence. Why didn't I realize this and show him some compassion?

Barriers to adopting new pedagogies:

Denial of need for them – "my way works OK, just another fad" – help them to see students' perspectives, use their scepticism as part of keeping the process of change manageable

Overwhelmed by what needs to be done – help them make a plan with manageable steps & goals, time for processing

Disconnection – others are engaged but you aren't and feel left out – help them to find their new fit into the group and vision

Feel incompetent as adopt unfamiliar pedagogies – help them to understand that this is part of process, don't go too far too fast, look for reasons.

Dread of going into classes – a combination of the above.

Fig A3.7

When I am observing his lectures now, I am doing so with much more understanding. I can see when he goes off into his own mental world and realize that this is a big habit pattern for him to change. I can forgive him for confusing the students. We can roll our eyes together at the end of the lecture and laugh about it as he says to me "I know! I did it again… I realized it though, and stopped, and that was a good thing!"

Perhaps assisting in the transformation of others requires a deep level of insight where one enters their world, being with them, laughing about imperfections as one tries to move towards new ways of being.

Ying/yang -

In coming to know the 'other

I discover in myself

my deep humanity

Appendix 4

Student consent form

Below is an example of a consent form and a short open ended questionnaire which I gave my 1998 Physics class:

Sue's Doctoral Research 1998 - Can you help?

I am interested in finding out what is important for young people in their education as part of my doctorate thesis. I am working with teachers (Year 11 to uni) to help them improve their courses so that they are more meaningful and relevant to their students.

Your input would really help teachers understand.

Would you be interested in giving us feedback? It is entirely voluntary and you can pull out at any time.

You can:

1. Fill in the **CLES questionnaire** provided, *and/or*
2. write a **reflection** on the physics course based on the questions over page, *and/or*
3. come to a **focus group** to discuss with an interviewer what you really think, *and/or*
4. **tell the teachers** – work with small groups of teachers in a workshop conducted by me for the annual physics/chemistry teachers conference.

All points of view will be appreciated no matter how strange, negative or positive.

Confidentiality/Permission

The information you give may be used in several ways:

1. as statistical data
2. as information which will help me understand and to develop theories of learning
3. as quotes which could be used in educational papers to illustrate a particular point.

In all cases your name will be kept confidential. But it is useful to me to have your name on the questionnaire/reflection responses so that I can compare against other indicators and to check with you your interpretation.

Are you happy for the information you provide to be used in this way? Would you like to limit how it is used?

I give permission for the information to be used in the ways 1 / 2 / 3 (please cross out ones not applicable).

Signed:……..……Name: …… Contact Number:…….

Please return to Sue Stack, 556 Nelson Rd, Mt Nelson, TAS 7007.

Any enquiries contact me at 62248938 or on rstack@trump.net.au

Reflection Questions:

We would value your reflections on the physics course based around the following questions. You can write it in any way which suits you … in point form, as it comes, as a poem or cartoon… you can answer each question separately or the whole thing together:

1. What things or aspects about the physics course did you value and why?
2. What did you dislike? What did you need or want but didn't get? What would you have liked to have seen?
3. How did your beliefs about science change over the course of the year and what caused them to change?
4. Any other reflections that would help us understand what is important for you in your education…

Appendix 5

Comparison of subjects – Maths, Physics, Journalism at a Year 11/12 college

Physics	**Journalism**	**Maths (low level)**
Year 12 Pre-tertiary Elite academic students ***Subject - centred***	*Year 11/12* Mixture of abilities and behaviours ***Student - directed***	*Year 11/12* Considered the problem students in the school ***Student - centred***
Content driven Teacher directed – whole class or group activities Student freedom to construct personal knowledge Negotiation of major presentation topic	**Enterprise learning** – Students produce magazines in teams Negotiation of magazine type to achieve personal goals Training given just in time. Learning through feedback with community Some content – *media appreciation*, role plays, student negotiated presentations Teacher facilitated, student directed	**Mixture of negotiated content and enterprise** Teacher directed and facilitated based on developing programs for student's needs at the time. Negotiation of topics, enterprise, projects, assessment styles, behaviour codes. Individual learning plans. Just in time and just too late learning Learning through feedback with community
External exam *Internal assessment:* tests, essays, presentations, lab reports, some self assessment Students focussed on achieving goals, meeting criteria standards	*Internal assessment:* Journal, portfolio, presentations, self assessment Students self-reflect on criteria and goals as part of assessment	*Internal assessment:* completing tasks, projects, self assessment Initially not interested in criteria and how they are learning – begin to develop discernment and honesty about their performance
Motivation: Motivated, independent, responsible learners, expect homework and to study. Well developed cognitively but some have less developed EI and social skills.	Keen to work on own magazines, want to learn by doing, range of abilities and maturity.	Hate maths, have had poor success with learning, been considered the dummies and as a result have poor learning behaviours.
Openness to learning: Open, willing to take risks, trusting, high integrity.	Open and willing to take risks though some initially have protective barriers.	Closed, barriers up, can't trust, afraid of failure, dishonest with self and others.

Physics	Journalism	Maths
Personal problems: stress, panic attacks, bulimia, depression, glandular fever	Depression, loss of direction, previous disempowerment, mental illness, broken homes, computer chat addiction	Aggression, anger, truancy, school suspensions and trouble with police, stealing, bullying, depression, abuse at home, binge drinking, drugs, alcoholic parents, emotional manipulation, mindless computer game addiction
Goals: Many feel a need to help others or the world in some way as well as meeting personal needs… going into medicine or engineering.	Some have social conscience and journalism is seen as a way of exercising agency in their peer group. For others it is just an expression of self.	Their biggest concern is surviving in their world and being with their immediate group of friends.
Community of scientists	Community of enterprise – publishing house	Community of learners (eventually)
Understanding my world (so later I can do something useful)	***Being creative in my world and being an agent in my world***	***Being in control of my world***

Appendix 6

Physics Students Year 12 Focus Group

Initial Reactions by interviewer Jean Grosse

Introduction

In order to study the perceptions of a particular set of students who had completed Physics in Year 12 in 1998, the class was invited to participate in a focused discussion about their views of physics. Five students attended.

The discussion was focused around the following issues:

- Why do you need a T shirt for a physics class?
- What do you mean when you say on your T-shirt that you 'don't give a rat's arse' ?
- What do you actually do in physics?
- Is it hard to understand?
- How much work does it take to get through?
- Are you allowed to help each other?
- Do you ever get to follow up ideas or questions of your own in physics?
- How important is maths to physics? If you were weaker at maths would you understand the concepts?
- Do you get to experiment with many materials?
- How important are the subject criteria?
- How is the white board used in your physics class?
- What sort of notes do you take?
- What sort of jobs are out there for physics people?
- Who do you talk to when you have a problem with the work or ideas in physics?
- Do your parents know what you do in physics?

Probes were applied to responses as each question was raised (usually of the form of a reiterating 'Why?', "How?" or "In what way?"). The focus group was conducted after the students had sat their final physics examination. It was held in their College at 9.15 am on Wednesday 2nd December and the session was videotaped to allow for later analysis. There were 3 males and 2 females in the group.

Some Initial Reactions:

1. There was a strong collective identity to this group that seemed to centre around their learning of physics. They had enjoyed helping each other and taking responsibility for the achievement of the group. There was a tension between their sense of individual achievement in the subject and the satisfaction of participating in a learning team.

2. For this group, physics was fun and at the same time it had been a really hard and demanding subject. There was tension between the enjoyment of the learning and the rigours of the discipline.

3. Their experience of physics this year had been very different from any previous Science class. Although they all had successfully completed science subjects in previous years, their most common description of those subjects was 'boring' and 'not much fun'. There was tension here between the strategies needed to be successful in a routinised closed exam system and strategies needed to be successful in this 'open-ended' learning system.

4. The team-bonding sessions at the beginning of the year had been unfamiliar to the students and did not seem like 'physics' to them. In retrospect they described those activities as really valuable in changing their views about physics having to be boring. There was tension here between the apparent waste of time on personal development activities and the drive to get on with the serious business of covering all the required criteria in physics. The dilemma they were confronting now was that that apparent wasted time had actually developed their capacity to learn smarter and faster by engaging with their own curiosity in the process.

5. All of these students were surprised at how much time they could take to really grasp a concept and once they did, how much time it saved later. (because they 'really' understood) . Their ownership of their learning was apparent in the way they explained the concepts to the researcher. (and helped each other to do so)

Physics Focus Group - the issue questions and brief response summary

Why do you need a T shirt for a physics class?

To identify them as a group, strong collective identiy , centred around the task of mastering physics as an HSC subject .

What do you mean when you say you don't give a rat's arse?

Symbol of the fun aspect , the capacity of the group to challenge accepted 'certainties'.

What do you actually do in physics?

Have fun, ask questions , raise uncertainties, try to understand and engage with physical concepts, use formulae to test theories., and learn to live with uncertainties .

Is it hard to understand?

There was a common acceptance that the concepts were complex and took hard work to work through. There were many times when the task appeared too hard and it was the help from the group that carried individuals through.

There was also a relief evident that there were some 'things' that you might never be able to fully understand. (eg - what is light ?)

How much work does it take to get through?

The quantity of the work was seen as huge - it was necessary to get through basic concepts before others could be built on those initial ideas. The criteria and syllabus was the driving force here. Not all of the students acknowledged they had put in enough effort - one was expecting to fail yet he spoke of the pleasure he had in learning about physics as part of this class.

Are you allowed to help each other?

Encouraged to do so - it was important to this group that if possible everyone succeeded - there was collective responsibility for achievement. They said they really enjoyed sharing their information and expertise.

Do you ever get to follow up ideas or questions of your own in physics?

In this class there was a strong feeling of ownership of the learning.

How important is maths to physics ? If you were weaker at maths would you understand the concepts?

Consensus that it was important but not critical - they indicated that it was possible to follow up curiosity and grasp concepts of physics without

having really top maths skills , but said the problems would arise when you had to know and use formulae.

Do you get to experiment with many materials?
Several experiments were referred to and mostly described in terms of discovering the concepts through the experimentation.

How important are the subject criteria?
These were seen as important only in terms of accreditation - they had to be completed as a routine and then learned 'by rote' torrecalled at exam time only.

How is the white board used in your physics class?
This was seen as an interactive alternative to the text book, with the advantage that the teacher 'writing up' could be interrupted by queries and puzzles from the class.

What sort of notes do you take?
A taken-for -granted part of the white board work and not referred to as a chore.

What sort of jobs are out there for physics people?
Engineering was the only real suggestion - they saw physics principles being applied in many places but were unaware of any wider market value of physics.

Who do you talk to when you have a problem with the work or ideas in physics?
The collective learning style was evident here - they talked to each other , or to the teacher or let it become a class problem to solve.

Do your parents know what you do in physics?
Parents were kept aware how demanding the course was but not of the content.

J. Grosse , SPIRT Project , Dec 98

Appendix 7

University Action Research Project – Interview data example

The following is an example of my notes taken after interviewing 13 students following a first year Applied Physics lecture during the topic of Atomic Physics. The interviewing of students was part of gaining feedback which could inform planning of future lectures and approaches. These notes served as a stimulus for the action research team to discuss how students are understanding, what they are gaining out of the course and what they are expecting from it. And then to discuss aims for their teaching and possible pedagogies and content likely to engage students better.

Student Feedback - beginning of semester (Atomic Physics)

Questions asked students included:

- *How are you going?*
- *Are you understanding things?*
- *What do you feel about participation/discussion in lectures?*
- *What is your attitude to physics?*
- *What they would like to see to conclude atomic physics.*

1. Girl, completed Physics Year 12, currently studying Pharmacy

- Haven't had much experience with experiments
- Found photoelectric effect confusing - didn't understand why we were doing it
- Found transforming equation practice too easy but other new things too quick, too hard
- Found questions in lectures useful but take time
- Wary of being in a new group
- Good lecturer - words are easy to understand - not too big or scientific
- Good analogies
- Applications good
- Have disliked physics in the past because it is too hard and boring. Hard to understand and too technical.

2. Girl, completed Physics Year 12, Pharmacy

- Photoelectric effect is just revision.
- More interested in applications and the theory to be more in depth.

3. Boy, Completed Physics Year 12, Pharmacy

- Forgotten most of photoelectric effect - the meaning of the formula, what work function relates to.
- Didn't really understand the lecture.

- Would like more notes or a book to refer to.
- Questions were useful.
- Can't see any application to him or course.

4. Girl, Completed Chemistry Year 12, Pharmacy

- Didn't understand photoelectric effect but am following it. Will follow it up in the text book. May have seen in first year Chemistry Course.
- Have done wavelength in Chemistry…. Can use formula but don't understand why.
- Prefer understanding concepts before doing calculations … helps by connecting to other concepts or ideas.
- Found photoelectric diagram hard to understand … needs to be explained… hard to picture.
- Participating in lectures is OK

5. Boy, Completed Physics Year 12, Science

- Understood photoelectric effect from last year but found it difficult to understand this year.

6. Girl, Completed Physical Science Year 11

- Didn't really get photoelectric concepts but doesn't expect to. Can use the formula.
- Not really interesting or relevant so no need to try to understand.

7. Girl + Boy, completed Physics Year 12, Ag Sc

- Both enjoy physics
- Found atomic physics OK because they had done it before but new bits were too fast.
- Could understand atomic energy levels but found laser application too confusing - like to have this gone over again.
- The notes are good - can go over them in own time.
- The analogy (soccer) was good - helped get a sense of what was going on.
- Found the questions in class were a bit out of the blue … so hard to get thoughts together to respond. But would welcome time to interact with a group in class.

8. Girl, completed Physics Year 12, Pharmacy

- Lectures are OK but not doing any thinking in them. Doing this later at home…. Took 1/2 hour to derive a formula at home by self.
- The lectures are not interactive - can't feel that can ask questions.

9. Boy, completed Physics Year 12, Pharmacy

- Basically dislikes physics, finds it boring. Only finds stuff to do with space interesting. The easier it is the less boring.
- Doesn't expect to think in lectures.
- Calculations hard.

10. Girl, completed Physics Year 12, Pharmacy

- Finds it boring (but so is Chemistry) but looking forward to nuclear medicine lecture.
- Don't see why have to do physics for pharmacy, heard it will be dropped… 'what have oscillations got to do with dispensing drugs?'

11. completed Physics Year 12, Ag Sc

- Difficult to know what we are doing experiment for.

- Lecturer hard to understand
- Atomic is boring. It would be less boring if we knew how to apply it … doing it for ourselves… problems.
- Would like examples of exam problems - get to do it in lecture then check answer.
- Would like more interaction to make it more interesting.
- It would make it more interesting if we knew how it is relevant to Ag Science, or medicine or just relevant.

12. completed Physics Year 12

- Need time to practice formula, given worked examples, tute time … don't know which equation to use.
- 'Have to say I am really lethargic in lectures… following but can't really apply things.'

Appendix 8

Constructivist Learning Environment Survey (CLES)

The CLES survey comes in four parts – student *actual* (what is happening in my class) and *preferred* (what I would like to see happening in my class) and teacher *actual* and *preferred.*

The survey over page is an example of a student **actual** survey designed for university classes. *Actual* and *preferred* surveys were given to the first year Applied Physics university students as part of the university physics department action research project which I discuss in Appendix 3. The lectures were also given *actual* and *preferred* surveys. The data was computer analysed, graphed in summary form and then interpreted by Peter Taylor. This analysis was then used alongside qualitative data (interviews, focus groups, video) to help the lecturers in the project reflect on the effectiveness of their teaching, student needs and learning styles as well as the underpinning metaphors that both students and lecturers were assuming.

I used a similar survey with my Physics classes in 1997 and 1998 …. Instead of *lectures* it said *classes* and instead of *lecturer* it said *teacher*. I used this survey alongside more open ended questions which I designed. I used the feedback from the students to reflect on my own teaching, where I would like to be, how I could be more effective and be more explicit to my students.

USCLES survey
What actually happens in this university class

DIRECTIONS

1. **Purpose of the Questionnaire**
This questionnaire asks you to describe important aspects of the university class that you are in right now. There are no right or wrong answers. This is not a test and your answers will not affect your assessment. Your opinion is what is wanted.

2. **How to Answer Each Question**
On the next few pages you will find 36 sentences arranged in 6 clusters. For each sentence, circle only one number corresponding to your answer. For example:

	Almost Always	Often	Some-times	Seldom	Almost Never
In this class . . .					
8 The lecturer asks me questions.	5	4	3	2	1

- If you think the lecturer *almost always* asks you questions, circle the 5.
- If you think the lecturer *almost never* asks you questions, circle the 1.
- Or you can choose the number 2, 3 or 4 if one of these seems like a more accurate answer.

3. **How to Change Your Answer**
If you want to change your answer, cross it out and circle a new number, For example:

8 The lecturer asks me questions.	~~5~~	4	3	2	1

4. **Course Information**
Please provide information in the box below. Please be assured that your answers to this questionnaire will be treated confidentially. If you don't mind us following up your responses through an interview please let us know your name and phone number. Thanks.

a. Title of Course: (pharmacy, science…)	b. Previous physics experience:
c. Your Name: (optional) Phone number:	d. Your Sex: male /female

5. **Completing the Questionnaire**
Now turn the page and please give an answer for every question.

Relevance of Learning	Almost Always	Often	Some-times	Seldom	Almost Never
In this class . . .					
1 I learn about the world outside of university.	5	4	3	2	1
2 My learning focuses on issues that interest me.	5	4	3	2	1
3 What I learn is related to my future life.	5	4	3	2	1
In this class . . .					
4 I learn how to solve real-life problems.	5	4	3	2	1
5 I learn interesting things about real life.	5	4	3	2	1
6 What I learn connects well with what I know already.	5	4	3	2	1
Reflective Thinking	Almost Always	Often	Some-times	Seldom	Almost Never
In this class . . .					
7 I think carefully about <u>how</u> I learn.	5	4	3	2	1
8 I think critically about my own ideas.	5	4	3	2	1
9 I learn to be sceptical.	5	4	3	2	1
In this class . . .					
10 I learn how to become a better learner.	5	4	3	2	1
11 I think critically about my understanding.	5	4	3	2	1
12 I learn to suspend disbelief in new ideas.	5	4	3	2	1
Negotiation	Almost Always	Often	Some-times	Seldom	Almost Never
In this class . . .					
13 I get the chance to talk to other students.	5	4	3	2	1
14 I discuss my experiences with other students.	5	4	3	2	1
15 I explain my ideas to other students.	5	4	3	2	1
In this class . . .					
16 I ask other students to explain their ideas.	5	4	3	2	1
17 Other students ask me to explain my ideas.	5	4	3	2	1
18 Other students explain their ideas to me.	5	4	3	2	1
	Almost Always	Often	Some-times	Seldom	Almost Never

Leadership	Almost Always	Often	Some-times	Seldom	Almost Never
In this class . . .					
19 The lecturer talks enthusiastically about her/his subject.	5	4	3	2	1
20 The lecturer holds the students' attention.	5	4	3	2	1
21 The lecturer is a good leader.	5	4	3	2	1
In this class . . .					
22 The lecturer knows everything that goes on.	5	4	3	2	1
23 The lecturer acts confidently.	5	4	3	2	1
24 The lecturer explains things clearly	5	4	3	2	1

Empathy	Almost Always	Often	Some-times	Seldom	Almost Never
In this class . . .					
25 The lecturer trusts the students.	5	4	3	2	1
26 If students don't agree with the lecturer they can talk about it.	5	4	3	2	1
27 The lecturer is willing to explain things again.	5	4	3	2	1
In this class . . .					
28 If the students have something to say, the lecturer will listen.	5	4	3	2	1
29 The lecturer realises when students don't understand.	5	4	3	2	1
30 The lecturer is patient.	5	4	3	2	1

Support	Almost Always	Often	Some-times	Seldom	Almost Never
In this class . . .					
31 The lecturer helps students with their work.	5	4	3	2	1
32 The lecturer is friendly.	5	4	3	2	1
33 The lecturer is someone students can depend on.	5	4	3	2	1
In this class . . .					
34 It is alright to tell the lecturer when we do not understand.	5	4	3	2	1
35 The lecturer takes a personal interest in us.	5	4	3	2	1
36 It is a pleasant place to be.	5	4	3	2	1
	Almost Always	Often	Some-times	Seldom	Almost Never

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