Science and Mathematics Education Centre

Transforming Saudi Mathematics Education Culture: An Arts-Based Critical Auto-Ethnographic Inquiry

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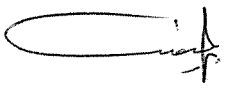
Declaration

This thesis contains no material which has been accepted for the 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 person except where due acknowledgement has been made.

Signature: 

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ABSTRACT

Pre-service mathematics teachers in Saudi Arabia learn about innovative (student-centred) teaching approaches during their undergraduate study with the aim of improving their professional teaching practice when they enter the educational field as teachers. However, I have found that many of them were not practising what they have learned. It seems that they practise only the conventional (teacher-centred) approach to teaching and learning in their mathematics classrooms.

To investigate this issue, I designed an arts-based critical auto/ethnographic methodology with which to engage myself deeply in critical reflexivity about my previous experiences of teaching and learning to understand them deeply and critically. This methodology draws on four major paradigms: Interpretivism (how the world is), Criticalism (how the world should be), Postmodernism (how the world could be) and Integralism (how the world can be seen as 'holism'). I conducted semi-structured interviews with six of my fellow Saudi pre-service colleagues who are now mathematics teachers. This research needs to be regulated and judged by alternative epistemological standards.

I investigated how I discern the culture of the mathematics classroom, how I understand my role as a teacher and students' roles as learners, what are my beliefs towards teaching and learning mathematics, and my previous learning experiences in the culture of mathematics education. Also, I examined the extent to which objectivist epistemology, including the objectivist nature of mathematics, inhibits or hampers me from transforming the culture of the mathematics classroom.

In this inquiry, I found that during pre-service teacher education, my research participants and I held only a traditional conception of teaching and learning, and an objectivist epistemology and absolutist image of the nature of mathematics. Also, I found that our previous (traditional) learning experiences with long-established conceptions of teaching and learning, and our objectivist epistemology, play a central role in shaping our current professional teaching practice. And more importantly, I found that we were largely unaware of them. Today, these issues continue to govern our everyday teaching performance in the mathematics classroom. Lack of conscious awareness of them has contributed to us thinking and acting automatically in accordance with the traditional commonplace culture of mathematics education.

As a consequence of this research, I propose that future mathematics teachers in Saudi Arabia may need to be involved in 'transformative learning'. They would be (i) encouraged to engage in metaphorical thinking about their own beliefs towards teaching practices and learning processes; (ii) empowered to think reflectively and critically about their own previous learning experiences; and (iii) stimulated to be involved in open and critical discourse about their own epistemology and their understanding about the nature of mathematics. By doing so, this might help them to become aware of what governs their current professional teaching practice, to question those assumptions in relation to what they learn about innovative teaching methods, and to envision an alternative or transformative culture for mathematics classrooms in Saudi Arabia. Their envisioning needs to be guided by what they learn about innovative teaching approaches as well as by adopting a critical constructivist epistemology as a way of knowing rather than a prescriptive method of teaching. This epistemology opens a variety of possibilities for looking at key aspects – the nature of mathematics, the ideology of teaching and learning, and personal epistemologies – which impact their professional teaching practice.

ACKNOWLEDGEMENT

I thank Allah (SWT) for the opportunity and ability to complete this work. His favours on me are countless and unlimited.

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A very special recognition and deep love go to the love of my life, my wonderful wife, Ahlam, and my beautiful daughters, for their love, patience, and sacrifice. Babe, I am very thankful for your patience and your sincere love. I will be with you forever. Raneem and Sadeem, I love you so much, your daddy will spend much time with you now.

DEDICATION

I dedicate this doctoral thesis to:

My parents, Marzukh Alsulami and Mastoor Alsulami, who taught me, guided me and supported me all my life. May Allah be merciful to them and let them dwell in Paradise,

My wife, Ahlam, may Allah reward her for her enormous assistance,

My daughters, Rannem and Sadeem, may Allah bless them with faith and success.

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LIST OF ACRONYMS

DCTM: Department of Curriculum and Teaching Methods.

SMEC: Science and Mathematics Education Centre.

MTM: Methods of Teaching Mathematics.

CLA: Collaborative learning approach.

PBUH: Peace be upon him; Muslims use these words after mentioning the Prophet Muhammad.

SWT: Subhanahu Wa Ta'ala; it is an Islamic Arabic phrase that Muslims use after saying Allah and it means ‘Glorified and Exalted is He’.

TIMSS: Trends in International Mathematics and Science Study.

NCTM: National Council of Teachers of Mathematics.

TERG: Transformative educational research group.

CHAPTER 1

MY JOURNEY TO THIS RESEARCH

INTRODUCTION

This introductory chapter provides an overview of my thesis. My aim is to clarify when the idea of this research began and how the notion of this study was constructed. I present the starting point of this research, the development of its ideas and the emergence of its questions and structure. First of all, the idea of this inquiry was not simply constructed by itself nor was it built by an automaton. It was created and constructed by *Me* as an inquirer, learner and researcher. However, who is *Me*? Or, who is the inquirer? Who is constructing this study? I present some information about *Me* – that I believe is important and necessary for a better contextual understanding of my inquiry – including my professional context and my journey to my research problem. At the end of this chapter, I give an outline of the chapters of this thesis.

PROFESSIONAL CONTEXT

I am a Saudi Arabian Muslim man who graduated with excellent grades with first class honours from Jeddah Teacher's College in July 2004 when the College was affiliated to the Ministry of Education. By the way, the College's name has been changed since 2009 to the Faculty of Education after it was annexed to the King Adulaziz University under the umbrella of the Ministry of Higher Education as a result of administrative reform. My subject was Mathematics Education. In August 2004 – a month after graduation – I was employed as a mathematics teacher in primary public schools (see Chapter 7).

Ten months later - June 2005 - I was appointed to Jeddah Teachers' College to be a mathematics teacher educator in the Department of Curriculum and Teaching Methods (DCTM). This department deals with students who are in the final year of the College. Students at this level are named pre-service teachers, prospective

teachers, student teachers, or future teachers. I use these terms interchangeably during this study. Due to a lack of mathematics educators in this department and due to a large number of students, I - despite being a new graduate - was commissioned to observe student teachers who were practising in primary schools. After a year of working at the College, I received a scholarship from the Ministry of Education to do a Master of Science (Mathematics Education) degree at the Science and Mathematics Education Centre (SMEC), Curtin University in Australia. Having finished my Master's Degree, I applied to extend my scholarship for a Doctoral degree in Mathematics Education at SMEC under the supervision of Associate Professor Peter Taylor.

FACULTY CONTEXT

In the Teachers' College, mathematics students are predisposed to be mathematics teachers for primary schools. One of the very important units for mathematics teacher educators at DCTM is Methods of Teaching Mathematics (MTM). As a mathematics teacher educator I am required to teach pre-service mathematics teachers this unit when I return to my country after fulfilling the requirements for the award of the degree of Doctor of Philosophy from Curtin University, and I am required to supervise them when they are under training.

During this unit, prospective mathematics teachers learn several innovative methods of teaching mathematics to use in their teaching practice, such as Collaborative Learning, Discussion and Dialogue, Inductive Way and Problem Solving. This unit has been designed to improve mathematics education in Saudi Arabia (see Chapter 5). Therefore, mathematics teacher educators at DCTM are very keen to teach future teachers innovative student-centred approaches in the hope of fulfilling the Ministry of Education's goals of improving education, in general, and mathematics education, in particular.

PROBLEM CONTEXT: My journey to this inquiry

It is not easy determining when and how this inquiry began. Of course, the formal notion of this inquiry has been constructed by me, as you will notice, as the process of the development of my candidacy proposal. However, the notion of this inquiry in its formal sense – for sure – did not come from scratch or suddenly. By reflecting deeply on my previous learning experiences I found that the notion of this inquiry has a prior heritage. Understanding prior heritage helps me to articulate the history of my research inquiry, to understand its background, and to know how the idea of this research came about. It allows me as well to trace the development of this inquiry, noticing its complexity and emergent nature.

The prior heritage of this inquiry came from my learning experiences in pre-service mathematics teacher education, then from my teaching experience as a primary mathematics teacher. So, this inquiry – not surprisingly – was based mainly on my own professional experiences in mathematics education in Saudi Arabia. The ultimate goal of this inquiry was to transform the academic culture of mathematics education in Saudi Arabia, and my educational experiences in the mathematics classroom played a core role in interpreting, criticising and visualising transformative mathematics education for this purpose.

As a pupil/student in Saudi general schools, it was very obvious to me that the negative impression of mathematics as a school subject was widespread amongst Saudi students. A lot my friends regarded mathematics as a hateful and meaningless subject. Some students may even sometimes hate their mathematics teacher just because he teaches mathematics (see Chapter 7). For me, however, I liked mathematics. At that time, I did not know why I liked it but due to this research I could say that I probably was one of the 'elite' students (Aikenhead, 2000) or 'potential' mathematicians (Costa, 1995) who like mathematics for its own sake and who are predisposed to understand mathematics deeply from a mathematics point of view. I used to help my friends in doing their homework. It seemed to me that they got the idea more easily when I explained it to them. Was it maybe because of the kids' language we used?

After I graduated from high school, I applied to several institutions to continue my study. Although the Teachers' College was the last option on my list, I accepted its

offer and disregarded other offers such as the one that I received from the Faculty of Engineering. As Muslims we say it is 'a destiny'.

During my undergraduate study I learned several methods of teaching. All the teaching methods were absolutely new to me. I had not seen alternative ways of teaching during my previous learning experiences, only the traditional teacher-centred approach. So, I thought that what I learned could help me as a mathematics teacher to change students' negative impression toward the mathematics classroom.

However, when, as a pre-service mathematics teacher, I was sent to a primary school for practical training, I noticed that most of my colleagues were not interested in applying what we had learned at the College. They were just focusing on what they had to teach without any concern for how they had to teach. Most of them were embracing a traditional teacher-centred approach to teaching content.

After I graduated from the Teachers' College, I was appointed as a mathematics teacher in primary education. As a novice mathematics teacher, I was encouraged to attend and observe the teaching of experienced mathematics teachers. And likewise, I found the same situation occurring. I found them preferring the conventional teacher-centred method of teaching, ignoring any adaptation of alternative teaching approaches. For me, as a new and enthusiastic teacher, I aimed and endeavoured to do something different. I tried to make a mathematical laboratory by collecting several educational tools that might facilitate mathematics teachers in their teaching. I also attempted to change the atmosphere of the mathematics classroom by using alternative teaching approaches (see Chapter 7).

Ten months later … there was a position (Demonstrator/teacher educator) in the Teachers' College in Mathematics Education. I entered the competition with others who also applied for the same position. I successfully passed all the exams and the interviews, and subsequently I was nominated for this position and was appointed as a mathematics teacher educator. During that time, I observed many mathematics pre-service teachers undertaking practical training in primary schools. Again, I noticed the same traditional teaching practice happening. I observed them following the 'common sense' approach to teaching and ignoring my encouragement to adopt alternative teaching approaches. This made the issue become bigger in my mind.

Therefore, I became very interested to the extent that I wanted to explore 'the secret' behind this matter. Why do future mathematics teachers not practise what they have learned? Are they not well enough qualified? Do they not understand fully such teaching strategies? Do they encounter any major difficulties or obstacles that prevent or hinder them from practising alternative pedagogies? Are they not encouraged enough? Are they not persuaded by those methods? Do they not have enough skills? Is the unit not well enough organized? I asked myself: why is this situation - of neglecting what has been learned - common among pre-service mathematics teachers? Why are they just performing the same passive way of teaching in every class and every day?!! There must be some reason!!!

FIRST BEND: MY MASTER DEGREE

The system in the Teachers' College in Saudi Arabia for demonstrators is to look for an offer to do your Master's or Doctoral degree in your field. So, I applied for a scholarship to do my Master's degree in Mathematics Education at SMEC. My thought when I came to SMEC was to learn more new teaching methods that I could teach to my pre-service teachers when I returned to my country. Later, after I started my Master's study, I found a big gap between my earlier thoughts and what I was learning at SMEC.

In my Master's project, I was asked to think about a research problem. For me, it was like... "Yea... This is the opportunity to inquire about why mathematics teachers in Saudi Arabia do not use what they have learned about teaching methods? Why do they use only the traditional teaching?"

In particular, I was interested in utilising a collaborative learning approach (CLA) to teaching in the mathematics classroom to change students' pessimistic views towards mathematics. So, I wanted to search for what might be the major obstacles that mathematics teachers encounter when they consider utilising CLA. By using narrative inquiry as my research methodology, I went into my own experiences with CLA to describe the place of this approach in my mathematics classroom, and I found that miscontrolling the classroom, lack of time management and classroom

noise were some of the major obstacles that I encountered while I was attempting to apply CLA (Alsulami, 2009).

These might also be the major obstacles encountered by other mathematics teachers in Saudi Arabia, and perhaps they are what hamper those who are willing to implement CLA. However, what about those who have never thought about practising alternative techniques of teaching, neither collaborative learning nor any other? What about those who are not willing to change (improve?) their teaching pedagogies? What about those who still adhere to the methods of memorisation and indoctrination? So, the question might not be what obstacles do future mathematics teachers encounter or that hinder them, but why do they not transform their pedagogies? Why do they not employ what has been learned in their college teaching? Why do they embrace merely the traditional teacher-centred strategies for every topic and every class? Consequently, I decided to inquire further about this in my future study.

SECOND BEND: MY PHD DEGREE

After I had finished my Doctoral application, I went to Peter's (my supervisor's) office. I knocked on his door and entered. I told him my interest and we had a conversation. Our conversation was about what I had done and what I now wanted to do. I told him that I wanted to continue in the same area to find out the reasons that may hinder Saudi mathematics teachers from practising what they have learned, and that my Master's project had focused mainly on the obstacles encountered by me as an innovative mathematics teacher interested in employing 'collaborative learning'.

In the early stage of conducting this PhD research, Peter encouraged me to study his Doctoral-level Constructivism Unit. Having completed that preparation study I formulated a more sophisticated perspective on this issue. I thought that *Saudi pre-service mathematics teachers do not need to learn several methods of teaching inasmuch as they need to be more engaged in discussion about their own epistemologies of teaching practice.* Epistemology is concerned with what we can know about reality and how we can know it (Willis, 2007). I began to think that one of the main reasons for neglecting to apply innovative methods is not so much that

pre-service teachers might encounter obstacles which might hold them back, but perhaps it is due to their objectivist epistemology that governs how they conceive of knowledge and what knowledge is. Is knowledge, from their viewpoint, something objective or subjective? Is it something hard, fixed and tangible or unique, constructed and individually experienced?

Moreover, a related reason concerns questions of how future mathematics teachers perceive and conceive of the culture of the mathematics classroom. What do they think are their roles in the classroom as teachers and their students' roles as learners? And why do they conceive of their roles in such a way? Also, what do teaching and learning mean to them? Or what are their beliefs and conceptions towards teaching and learning? What do they think are the goals of education? These questions were my main concerns and this was how the idea of this research was initially constructed.

To conduct my research, I designed a critical auto-ethnography (later I added 'Arts-based') as my research methodology. As this methodology holds an alternative epistemological position, I was able to reflect critically upon my own previous learning and teaching experiences (see Chapter 2). This research methodology turned the focus to be primarily on me, rather than on others. So, I came to ask myself the same questions that I had raised about Saudi future mathematics teachers. I changed the subject to be 'I' instead of 'they'. I turned my focus to be on my own professional practices; focusing on my own learning experience as a pre-service teacher (see Chapter 5), on my beliefs towards teaching and learning, including my role as a teacher and my students' role as learners in the mathematics classroom (see Chapter 6), and on my own teaching experience as a mathematics teacher (see Chapter 7), investigating them by asking these questions:

1- How do I perceive my undergraduate learning experiences; particularly, my experience in learning innovative teaching approaches? To what extent did it enable me to or hamper me from envisaging the classroom culture from a constructivist perspective?
2- What are my beliefs towards teaching and learning? How did I envision my role as a mathematics teacher and the role of my students as learners? What were the consequences of my beliefs in shaping my professional practice?

Are they sufficient to practise what I learned about student-centred teaching approaches?

3- How do I perceive my teaching experience as a mathematics teacher? How do I evaluate my attempts at using innovative teaching methods aimed at changing my students' negative perceptions about mathematics?

I engaged in critical self-reflective thinking about these questions using new theoretical lenses that I developed as my research inquiry progressed (see Chapter 4). By turning the focus of the study to be on myself, I came to realise many things about me, my professional learning and teaching practices and my attempts at using alternative teaching methods. In this research, I focused on two stages of my professional practice. The first stage is my learning experience during pre-service teacher education where I learned about innovative teaching approaches of mathematics. The second stage is my teaching experience as a mathematics teacher where I started to teach mathematics in primary schools.

My critical reflection on the first stage made me realise that I had been involved in a learning experience that was insufficient to obtain the expected benefits of innovative teaching methods (see Chapter 5). My critical reflection on the second stage made me realise that I unconsciously followed specific conservative assumptions about teaching and learning. Also, I came to realise that those assumptions (that I was not aware of) played a key role in shaping my professional teaching practice (see Chapter 6). Furthermore, I came to realise that my attempts to practise new teaching methods were limited to the physical environment, and they did not actually provide my students with alternative or meaningful learning experiences (see Chapter 7).

As a consequence of these realisations about my learning and teaching practices, I began asking myself questions such as: Why did I do what I did in such a way? Why did I have this kind of classroom culture? Where did those unware assumptions come from? Why were my ideas of change limited to the classroom routine and did not consider students' learning processes? This led me to think critically about my view of the nature of mathematics and its value in students' lives. Later I came to realise that my previous experiences were governed by an objectivist epistemology (see Chapter 4). Then, I started to think that realising what I was doing was not enough for me if I wanted to make a difference and to change my practice. The aim of this

research was to investigate ways of transforming the classic culture of the mathematics classroom in Saudi schools, especially from a constructivist perspective. So, I thought about what I would need to do when I return home to teaching Saudi mathematics future teachers. According to these thoughts, two research questions emerged.

4- To what extent does an objectivist epistemology and an objectivist image of mathematics hinder me from utilising *properly* what has been learned about innovative student-centred strategies in my teaching?
5- To what extent does engaging myself in 'transformative learning' about my previous learning experiences, my beliefs towards teaching and learning, and my own personal epistemology encourage me to transform the culture of mathematics education in Saudi Arabia?

My realisations would not have happened without immersing deeply and reflecting critically on my past experience and re-envisioning the possibility of my future professional practice. Thanks to my methodology, which I used not only to conduct my research but also as a transformative learning tool to transform how I visualise the culture of the Saudi mathematics classroom.

In this research I endeavoured to build the first step in transforming my vision of the mathematics education culture in my country, aiming to be able to improve and reform the system of mathematics education. Transformative education involves rethinking the classroom culture and provides several new possibilities for teachers to teach and for students to learn. A transformative perspective can be used to deconstruct the repressive culture of the classic classroom which privileges an objectivist epistemology of mathematics teaching and learning and the dominance of an absolutist image of the nature of mathematics.

MY RESEARCH STRUCTURE

In the following table I provide a brief account of each chapter of this thesis.

Chapter	Description
One: My Journey To This Research	Clarifying the idea of my research, its aims and its significance.
Two: What Is My Research Methodology?	Describing my research methodology that I used to conduct this inquiry. I outline the research paradigms that influenced my methodology. Also, I discuss the ethical considerations and the quality standards of this research.
Three: Me, Culture/Religion, Education And Saudi Arabia	Providing the context of Saudi Arabia, its location, the Saudi people and the culture, the education system and an overview of mathematics education in the country.
Four: A Need For Reconceptualisation: Looking Back And Looking Forward	Outlining the educational and sociological theories that became part of my inquiry; particularly, describing my transformation from objectivism to (critical) constructivism and transformative learning theory. I also discuss the three human interests.
Five: During The Pre-service Preparation Period	Critically illustrating my learning experience as a pre-service mathematics teacher, and evaluating its influence on my professional teaching practice. I advocate using 'transformative learning' in preparing future mathematics teaching, proposing an open and critical discourse approach for teacher educators to use.
Six: During My Practical Field	Critically exploring my previous narrow perspective about teaching and learning during my practical field experience,

Teaching/Training Experience	and its consequence for structuring my professional practice, then demonstrating the significance of using metaphor as a tool in elaborating a perspective of teaching and learning as a means of changing my teaching performance.
Seven: Becoming A Mathematics Teacher	Critically illustrating my teaching experience of mathematics, and demonstrating the influence of privileging an objectivist epistemology and pervasive traditional teaching culture upon my initial willingness to change my teaching practice. I advocate introducing constructivist epistemology to future teachers of mathematics in order to elaborate their understanding of the need to transform the culture of the mathematics classroom in Saudi Arabia.
Eight: The Backstage Of Doing My Research	Uncovering what was going on backstage.

CHAPTER 2

WHAT IS MY RESEARCH METHODOLOGY?

INTRODUCTION

This chapter narrates my experience of developing the epistemology of this Arts-based critical auto/ethnographic research inquiry. I have organised the chapter by, firstly, presenting an account of my experience of discussing this type of research with some of my fellow PhD candidate colleagues. Next, I give an overview of four major paradigms that influence my research methodology. Then, I outline and justify the research methodology that I adopted for this study, as being the most appropriate for answering my research questions. This is followed by a discussion of the ethical considerations and quality standards of this research.

WHAT AM I DOING?

It could be any time during my PhD study when I talk to my Saudi colleagues about the methodology of my research. Many times I have been asked questions such as:

Ahmed: "Is what you are doing considered research?"

Ali: "Should it be called research?"

Saud: "Is what you have been doing *really* research?"

These questions imply that what I am doing is not research or that it is not considered as *real* research –from the questioner's point of view, of course. More so, these questions are often asked in a way that suggests scepticism, doubt, and even hostility or taunting. So, it was unhelpful for me to respond directly and simply to these questions with the response "YES, it is. What I have been conducting is definitely considered *real* research".

Unfortunately, others' points of view are judged against the standards set by our points of view; whether we identify those standards or not.

I believe that the best way to answer these questions is by identifying what *I* mean by research. On the one hand, those who asked (or ridiculed) me about my research might not regard it as valid research, because their thinking about and doing research has been shaped in a particular way and from a specific perspective dominated by quantitative social science research paradigm. This perspective is sometimes called 'positivism' (Willis, 2007). So, from their perspectives, if research does not follow their research *epistemology*, it is not considered as valid research. Consequently, if one wants to judge my research, one has to judge it through its own ideologies and lenses. Why I say this is because I do not agree with one type of research which has to fit all manner of diverse research purposes.

“In answer to your questions”, I respond, “I would say that for many researchers their research should be objective, value free and involve looking for absolute truths (or Truths). However, what if I claim that human knowledge cannot be independent of the human mind? What if I do not believe in absolute truth? What if I believe that all truths are "contingent on the describing activities of human beings" (Ellis & Bochner, 2000, p.746)? Does this mean that I cannot conduct a research? In other words, am I unable to conduct research unless I accept an unquestionable Truth that needs to be discovered? I wonder: should I follow only one ideology and opinion in conducting research? Or should I follow what I think is valuable and appropriate for me and my inquiry? Basically and simply, what if I embrace an alternative epistemology?”

Ahmed, Ali and Saud look to each other and offer no responses to my questions.

“But we as Muslims believe in Truth”, Ali says after a while.

“Yes you are right”, I respond. “As a Muslim, I do not believe in absolute truth unless it has been mentioned in The Holy Qur’an by Allah or has been revealed to The Prophet Muhammad (PBUH). Imam Malik, a great Muslim scholar, said "everyone’s talk is takeable and rejectable except who is in this grave" (he was pointing to The Prophet’s grave in Medina) (Alsakhawi, No. 815). In The Qur’an, we are commanded to think, meditate and reflect about everything around us including ourselves. Moreover, The Qur’an has given thought to those who believe in something just because they have found their parents following that belief, without

meditating about themselves and the world around them. How come we need to follow the conventional ideas of conducting research just because that way was established many years ago? We might follow that way but, as suggested in The Qur'an, only after careful consideration. From another aspect, my research is not into religious matters or questions. My research is about educational matters and we know better about our life in education, just as The Prophet said to his companions commenting on their cultivating palms, "You know best the affairs of your worldly life" (Ahmed, No. 12086). He (PBUH) also said in another narration, "I am only a human being like you. If I tell you to do something with regard to religion, then follow it, but if I tell you to do something based on personal opinion, then [realise] that I am only human being" (Muslim, No. 2361). So, there is no conflict between what you said about Muslims needing to believe in Truth and what I do".

I wanna see the world through my own eyes ... not thru those of others
I wanna hear voices with my own ears ... not with those of others
I wanna smell a smell with my own nose ... not with that of others
I wanna say a word with my own tongue ... not with that of others
I wanna understand an idea with my own mind ... not with that of others
I wanna do my research my own way which respects my values and beliefs

"Therefore I began asking myself", I continue, "why can I not adopt, foster or cultivate an alternative epistemology of research practice that provides me opportunities and means to transform my professional practice? I need to assert that with the hegemony of using only one perspective (whatever that may be) and without the possibility of choosing and using alternative epistemologies that lead me to embrace alternative paradigms, the hope of development and transformation in Saudi mathematics education might have no place, the prospect of creativity might disappear".

Saud: "Excuse me Naif, I do not want to interrupt you but what are you looking for in your research?"

Ali: "Yea, that's a good question".

WHAT CAN I SAY I AM LOOKING FOR?

"For those who are looking for an objective truth", I reply to Saud and Ali, "my kind of Arts-based critical auto/ethnographic research is not compatible with the epistemology they have chosen to follow. I believe that no one knows the complete truth except Allah. So, this methodology I have chosen does not aim to look for absolute truth. Rather, it allows me to build a new understanding of my learning and teaching experiences and to make meaning out of certain educational aspects of my life lived in the context of an academic mathematics education culture in Saudi Arabia. My aim is to improve that context and my professional practice, and to foster change in Saudi mathematics education by providing transformative professional development. Not surprisingly, the approach provides for non-deterministic outcomes. It provides new contextually plausible and possible understandings.

Ahmed: "Naif!!" *Ahmed closes his eyes and says with head moving*: "What are you talking about? Could you please be specific?"

Saud: "What is your research … I mean, what's your definition of research?"

> *"What you are doing is not research", He says...*
> *"I know your epistemology!! Do you know my epistemology??", I say...*
> *"No, I don't", He says...*
> *"You do not know my research, then", I say…*
> *"What is your research then?", He says...*
> *"This is the right question, detective!!!", I say.*

WHAT IS MY RESEARCH?

"It is easy to rewrite the definition of my type of research", I respond, "based on what is written in books by respected authors. But I am not going to do so. This is not because I am unable or I am not allowed to do so. It is because I tend to deem that there is not a single research definition that can fit all kinds of research purposes and because research definitions have usually been written from the point of view of specific epistemologies, ideologies and perspectives. These research definitions have been seemingly composed by nobody and out of nowhere. They do not necessarily

need to be compatible with mine, and might not help me or you to understand my research. Consequently, I need to define my research based on my own sense of purpose. Hence, I might define my research in the following way".

"My research involves …

- Transformative learning about my own professional practices.
- Engaging myself in critical reflection about my past experiences.
- Examining critically my personal and professional values and beliefs.
- Reconceptualising my own professionalism.
- Committing myself to transform mathematics education culture (by transforming pedagogical practices, the images of teachers' and students' roles, and of mathematics) within my own institution.
- Building contextual understanding and making meaning of my professional practice.
- Engaging myself and others to rethink about some educational aspects.
- Designing a creative research structure.
- Using alternative paradigms, an alternative methodology, alternative epistemologies and alternative quality standards.
- Subjective, not value free, constructive, emergent, contextualized, narrative stories.
- Complex and dynamic investigative processes.
- My not being isolated or static; reflecting on, interacting with and responding to new constructive knowledge".

"The nature of my research is complex, multi-dimensional and non-objective, which factors are characteristics of a *postmodern worldview* because the context of the problem in my inquiry is complex and dynamic. So, it is not simple to provide a clear-cut definition of my research that enables me to say, "This is a clear outline of my research". The points related above are clues for you about what my research might be. My research is what I have been doing".

My story and my life

(This is my story, this is me, Naif)

What is my story? What is my life?
Here is my story; here is my life...
This is my story; this is me, Naif.

My life is a story; my story is my life...
Saying my story; to know my life...
This is my story; this is me, Naif

I wanna say my story; it is my life...
Forgetting my story; losing my life...
This is my story; this is me, Naif.

Do you wanna know about me?
Looking for my story; to know my life...
Ignoring my story; you ignore my life...
This is my story; this is me, Naif.

Ahmed: “Can you give us more details about your research?”

“Sure, I can”, I say smiling. “In my study I make my own experiences, in my various roles as a pre-service mathematics teacher and a mathematics teacher, a "topic of investigation in its own right" (Ellis & Bochner, 2000, p.733). My experiences have not been just as an isolated person; rather they have come from interaction with others who became part of my experience. So, the experiences of others could be involved in this inquiry. Moreover, my experiences and those of others were not isolated from our society; they were embedded and reflected within it. So, features of our society and their influence upon us could also be embedded in this inquiry. Furthermore, I am allowed to refer to our Holy Book (The Qur’an) and our Prophet Mohammad (PBUH) that we are inspired by them to demonstrate and show the deep culture behind our experiences, noting that our social culture in Saudi Arabia is derived from Islamic culture in general. My inquiry provides me with an avenue for doing something meaningful for both myself and the world surrounding me (Ellis & Bochner, 2000)”.

“In this inquiry, I am applying an alternative (non-standard) approach to research, employing unconventional methods of writing and structuring the thesis. Drawing on the Interpretivist (how the world is), Criticalist (how the world should be),

Postmodernist (how the world can be) and Integralist (how the world can blend the various theories) paradigms of research, I create my research methodology which provides multiple methods such as writing as inquiry and reflective writing in order to both conduct and represent my inquiry".

Ahmed: "Paradigm?!!"

Ali: "Now, excuse me a minute!"

Saud: "Calm down Ali. What does Paradigm mean, Naif?"

"**What do I mean by Paradigm?** Well, this is a really good question", I respond, "Because it clarifies the *school of thought* that I am following. A paradigm can be defined as a "comprehensive belief system, worldview, or framework that guides research and practice in a [particular] field" (Wills, 2007, p. 8). So, it is a worldview that guides me as a researcher and learner, and can be identified by its fundamental assumptions of ontology, epistemology and methodology (Guba & Linclon, 1994; Willis, 2007). Ontology and epistemology are two major aspects of metaphysics (a branch of philosophy) and are essential aspects of a paradigm. Ontology is concerned with the nature of reality (or being or existence). It concerns what can exist or what is real. Epistemology is concerned with what we can know about reality and how we can justify our claims to know. Epistemology is about theories of knowledge (Willis, 2007).

Saud: "Ontology and epistemology?!! Can you explain a bit more what these terms mean?"

Ali: "How do they work in your research?"

Naif: "Do not be in a hurry. More details of what I mean by ontology and epistemology in my methodology are discussed in the following section".

INTERPRETIVISM

I use three features of the research paradigm of Interpretivism: (1) new research process, (2) alternative ontology and epistemology, and (3) new understanding of the problem under investigation.

First, Interpretivism allows me to embrace an open-ended research design that allows me to welcome newly emerging research questions, an emergent mode of inquiry and an emergent thesis structure (Taylor, 2008; Taylor et al., 2012). I found Interpretivism appropriate for replacing the hegemony of conventional research that was restricting my thinking and writing in my conducting and constructing the inquiry.

Interpretivism is like a salad...
You have to put something on it to make it better,
Interpretivism is like a farm...
You can cultivate whatever you like,
Interpretivism is like a garden...
It is full of colours,
Interpretivism is yours...
You can construct it as you like,
Interpretivism is like a bird...
It keeps me flying,
Interpretivism is like a sweet...
It can't be bitter
Interpretivism is like going to heaven...
You never want to return back,
Interpretivism is like liberty...
It doesn't like restrictions.

Second, I was troubled by the limitations of the conventional ontological and epistemological aspects of research (Ellis & Bochner, 2000) - such as a materialist ontology in which reality, including thought and feeling, can be explained only in the material or physical world, and empirical epistemology in which I can come to know about the world only through experiments (Willis, 2007). Then I found an appropriate ontology and epistemology in Interpretivism.

An ontological position concerns the nature or essence of the phenomena being studied (Orlikowski & Baroudi, 1991). My way of relating to people is different from considering how I relate to objects of natural science. The differences between objects in the social and natural science are respected in this paradigm (Bryman, 2004) in which people can give their meanings of phenomena, unlike the natural

science objects which cannot. The objective methods of natural sciences do not help me so effectively to understand my educational problems.

My ontology in this methodology is that the current academic culture of mathematics education in Saudi Arabia is not external to me because I grew up within it; it is not imposed upon my consciousness nor is it entirely separate from me. Rather, it is a product of my consciousness. I live within it and within the process of fashioning it (Cohen, Manion & Morrison, 2000). From a constructivist point of view, there is no reality for me other than what I construct in my own mind. Therefore, my apprehension of reality could be experienced in a different way in the consciousness of another person. Therefore, I could say that the realities seen via this methodology are multiple (Guba & Lincoln, 1994) as they could be highlighted in varied ways. Different ontological positions can lead me to varied stances on the issue (Willis, 2007). Hence, my ontology articulates that the Saudi mathematics education culture is not a single objective reality produced seemingly by no-one and existing 'out there'. I state that from my own professional perspective I get to understand the academic culture of mathematics education in Saudi Arabia based upon a specific context as a result of my cognition of my learning and teaching experiences.

An epistemological position concerns the nature of knowledge and its forms and how it can be acquired (Cohen et al., 2000). It could also concern the nature of the relationship between me as inquirer and what can be known. By the way, ontological and epistemological positions are interconnected in such a way that my view of either of them constrains my view of the other (Guba & Linclon, 1994). So, when I conceive the situation under study as a product of my consciousness, my claim is that the knowledge produced is not an objective claim. Knowledge does not suddenly live in my mind or come from someone else. Knowledge is built in my mind in a long, complex and complicated process of cognition. Therefore, I can say that I construct my knowledge based upon my understanding of my experiences.

My epistemology in this methodology sees knowledge as subjective, personal and based upon one's experience (Cohen et al., 2000). So, the quality and the viability of the research information I produce via this approach do not necessarily produce a slavish correspondence to the "objective reality" "out there" (Kincheloe & Tobin, 2009, p. 524). Consequently, the knowledge claimed by critical auto/ethnography

seems to be softer, more subjective and related to my experiences. From a constructivist point of view, knowledge is not considered universal, it is contextualized. From the same perspective, knowledge is not considered common or standard; it is unique and personally experienced.

Third, the paradigm of Interpretivism encourages me as a researcher to understand and reconstruct a new meaning of the academic culture of mathematics education in Saudi Arabia (Guba & Linclon, 1994) by interpreting and reflecting upon my own learning and teaching experiences within that culture, based on the context of my own and my research participants' thoughts, beliefs, values and associated aspects of the culture. So, my purpose is to generate a new contextual understanding for mathematics education in Saudi Arabia. When I generate my data, I do not want to test an a priori theory; instead I want to construct fresh understanding. In other words, rather than seeking out absolute form of truth in my inquiry, I intend to try to generate new understandings of the context of Saudi mathematics education. Interpretivism allows me to provide substantial descriptive details which are imperative in providing for contextual understanding (Bryman, 2004).

However, it is important to state that my understanding does not claim to have the status of objective truth. Rather, it is tentative and inter-subjective and still open to new interpretation (Guba & Linclon, 1994). My understanding needs to be construed in the light of particular circumstances, of a specific context, of the current situation (in which the situations may be changing, rather than fixed), of my participants' interpretations of their understanding of that academic culture, of the mathematics education context of which my participants and I were part (Cohen et al., 2000).

Interpretivism … freedom to gain … freedom to share
Interpretivism … freedom to reflect … freedom to know
Interpretivism … freedom to imagine … freedom to learn
Interpretivism … freedom from error … freedom to be creative
Interpretivism … freedom from the 'objective' … freedom to be subjective
Interpretivism … I want to be free ... I'll say my view
Interpretivism … end to restriction ... freedom of expression ...
conclusion isn't expected ... Truth is depression...

CRITICALISM

This research paradigm provides me with power that allows me and encourages me to do three things: to deconstruct, reconceptualise and transform the culture of mathematics education in Saudi Arabia.

First, Criticalism provides me with an essential power that helps me to deconstruct the hegemonic ideology of mathematics education in Saudi Arabia which could be the major reason for holding back transformative education in the country. I orient the power of this paradigm towards revealing the assumptions of mathematics education that have been taken for granted. Deconstructing the hegemonic can be attempted through questioning (Cohen, et al., 2000) and criticizing the status quo (Orlikowski & Baroudi, 1991) of Saudi mathematics education, the assumptions of teaching and learning ideologies, the assumptions of the prevailing image of mathematics, and by questioning the aspects of mathematics education that have been taken as unquestionable. To move towards transformative education the hegemonic ideology of mathematics education in Saudi Arabia needs to be scrutinised and re-evaluated.

Second, Criticalism along with Interpretivism allows me to take a further step after deconstruction to create a new vision of mathematics education. It allows me to reconceptualise the academic culture of mathematics education in Saudi Arabia based on alternative assumptions of mathematics education that respect a person's subjective knowledge but without privileging it. This combination of research paradigms enables me to reconceptualise the culture of mathematics education through critical reflection. So, during the process of evaluating the classroom culture critical questions need to be asked to highlight any flaws and to lead me to generate professional praxis (Taylor et al., 2012) for transforming the mathematics education culture.

Third, following deconstructing and reconceptualising, Criticalism allows me to take action and create change (Cohen, et al., 2000; Willis 2007). Criticalism does not provide me only with the power to criticize the current culture of mathematics education in Saudi Arabia but also to look at ways of transforming that culture (Guba & Linclon, 1994). Critical turn is necessary to emancipate (Cohen et al., 2000) myself (my thoughts, beliefs, consciousness, awareness) from the current academic

culture, the artificial boundaries of mathematics education around me into which I have been encultured. Thus, I would seek to rid myself of the hegemonic situation in conventional teaching and learning in mathematics education, and thus have my professional conceptions transformed. This research paradigm has the capacity to empower me to link my research to the ideal of mental emancipation that could free me from viewpoints that control and restrict me to following a specific research perspective that does not fit my own interests (Vinden, 1999). This emancipation seems to be a crucial point in transformation. Without this power, I might find it impossible to think creatively and critically, to understand subjectively and contextually, or to change and be transformed.

POSTMODERNISM

To identify Postmodernism from a literal perspective, I can say that 'post' means 'after'; so Postmodernism means 'after Modernism'. It includes what does not work within Modernism. Postmodernism tends to react against certain principles and practices of established Modernism (Desmond, 2011). However, these statements may not have added anything to Postmodernism's meaning and at the same time do not clarify or identify the essence of Postmodernism. When I say 'after Modernism' it intends to be something which is not compatible with Modernism's ideas. However, what comes after could be more elaborated and on the other hand also could be more conservative or something else about which we have not thought.

Postmodernism seems to be controversial in its definition and its features. To the best of my knowledge, there is no single accepted definition of Postmodernism. Postmodernism does not and cannot provide complete answers to questions about its own meaning (St. Pierre, 2000), simply because any attempt to define it, would violate its premise "that no definite terms, boundaries or absolute truths exist" (allaboutphilosophy.org). So, when I attempt to state a clear literal meaning of it, I - at the same time – compromise its very essence as it entirely rejects such objective truth. It refuses classifications and dualistic doctrines (e.g., right or wrong). It respects pluralism. It dissolves restrictive definitions.

However, a proper explanation of how Postmodernism fits my inquiry could be that characterised by Lyotard – as one of its leading theorists – (1984): "incredulity towards metanarratives" (Meynell, 1999), of that which has been taken for granted. In The Holy Book, Allah (SWT) questions those who follow what has been taken for granted without thinking. Allah says:

﴿ وَإِذَا قِيلَ لَهُمُ اتَّبِعُوا مَا أَنزَلَ اللّهُ قَالُواْ بَلْ نَتَّبِعُ مَا أَلْفَيْنَا عَلَيْهِ آبَاءنَا أَوَلَوْ كَانَ آبَاؤُهُمْ لاَ يَعْقِلُونَ شَيْئاً وَلاَ يَهْتَدُونَ ﴾

"When we ask them to follow what the Lord commands, they respond: 'We found our fathers lived by a rule of life and we on their tracks are guided'. What! Even if their fathers did not use their reasoning at all, nor were they truly guided" (Holy Qur'an, 1:170). So, I am not going to say that I found people in a situation and I am going to follow in their tracks. Rather, I say I am going to use my own mind, my reasoning to think of the ways of conducting a research that have been used previously. I am not going to follow others without thinking. I might follow others and might take some things for granted but I need to use my mind, to think, to question, reflect and judge whether it makes sense for me or not.

On the other hand, Postmodernism seems to be a danger if I - as a teacher educator and as a Muslim as well - adopt it in its entirety[1]. It is dangerous because Postmodernism (generally speaking) tends to deconstruct instead of construct. As a teacher educator only deconstructing (including deconstructing my deconstructing) might lead me into a chaotic state of mind that the relevant concepts would not assist me to start doing my research. It would not help me to express meaningfully to my students. It would not assist me to aid my students to construct their own understandings and their knowledge. It might enable me to do so but only at the cost of my being in a constantly sceptical frame of mind. I do not know!!!

So, instead of embracing Postmodernism entirely I use some of its constructive features, or what has been called 'constructive Postmodernism' (Shea, 1998; Schiralli, 1999; Taylor et al., 2012) which would help me to achieve a stable base for

[1] Actually, I cannot adopt it in its entirety. If I were to adopt it in its entirety, I should have to respect its characteristic of being suspicious by being suspicious of its tenets. This is a challenge in Postmodernism. Also, I as a Muslim educator believe in absolute truth about, for example, the existence of God (Allah), although we are supposed to think and reflect about what God has created, not to be suspicious of his existence but to increase our faith.

my inquiry and hence to enhance my possibilities for cumulative and meaningful understanding (Schiralli, 1999).

First, Postmodernism is a set of perspectives used in critical theory (Desmond, 2011). It opens my mind (1) to think critically, and more importantly, freely about what I am doing without having to stick to following obediently a certain line of action, (2) to think carefully about what I have taken for granted in the way of conducting research. It is a new way to understand a new world. Therefore, the ideas of validity and reliability of research have become the subject of my sceptical view of what counts as such in typical and trusted research.

Second, Postmodernism brings to our attention the very important concept of 'representation' (Denzin & Lincoln, 2000) and research based on the Arts (McNiff, 2008; Eisner, 2008). Postmodernism welcomes me to use figurative forms such as pictures, poems and poetry to convey the meanings I want to express (Eisner, 1981, 1997) and to extend our understanding of the Other (Bryman, 2004). It enables me to break the hegemonic role of scientific writing up of research. It allows me to represent my inquiry in a non-conventional way; not tied to using an established scientific style of writing or the third person voice or conventional thesis structure. The reason for writing in an unconventional scientific manner is that I need to write in a way that allows readers to understand and sympathise with my particular version of mathematics education (Denzin, 1997).

Third, Postmodernism encourages me to use powerful new logics, such as metaphorical logic, which facilitate me to capture the complexity of the aspects of teaching and learning by engaging in multi-schema envisioning, and new genres such as the narrative genre that also helps me to richly depict the complexity of my experiences in mathematics education by speaking from my lived storied perspective, foregrounding its contexts, events and people (Taylor et al., 2012). By using both, I aim to be able to make new sense of my experiences in a complex study of mathematics education in Saudi Arabia.

Fourth, Postmodernism respects the diversity of theories, attitudes, ideas, and human experiences (often conflicting) (Polkinghorne, 1992; Desmond, 2011). It does not seek a grand theory about human experience regardless of the context. It involves building fragments of understanding developed in different contexts. Pluralism and

difference are considered to be key aspects of its central principles (Polkinghorne, 1992; Taylor et al., 2012). Postmodernism is about 'philosophical relativity'. Truth, culture, ethics and politics are all relative within Postmodernism. So, "no idea or expression or belief can be more credible than any other because all ideas are equally valid" (Desmond, 2011, p. 154).

Although I have explained these paradigms separately, they are interconnected. I cannot, for example, talk about Postmodernism keeping Interpretivism and Criticalism aside. From an Integral Perspective, each paradigm emerges from (and includes) earlier paradigms (Taylor et al., 2012).

A LETTER ADDRESSED TO POSITIVISM

Dear Positivism,

You were my close friend. Honestly, I only had you. To tell you the truth, I was very patient with your restricted perspective. You did not provide for my needs. You did not even allow me to involve my personal values in the research. I had had enough. You portrayed me and my values as dangerous things.

Sorry Positivism, it is time to leave you and say farewell. I have found other friends. I have found myself by being associated with them. They have provided me the freedom that I was looking for; disciplined freedom. They fit my interest in emancipation. So, I have to leave you here because I know you will not be happy coming with me. You might be good for others, but not for me, sorry.

I have a fond regard for myself, so, I wish to talk a lot about myself ... to tell my stories ... to share my experiences and to narrate something of my school life, in order to understand myself thereby leading me to some form of personal transformation. Will you allow me to do so??!!

I like fun too, so, I wish to have some choice in my way of talking ... in my way of representing my ideas and in my way of writing. My dear Positivism, it is hard to be creative without freedom.

Dear Positivism, I still respect you and I will not forget you. Actually I cannot forget you; you were my first friend and were the only one at the time. But by growing up and becoming able to think for myself, I think I need to have some other friends as well. You are still one of them. I may need you again one day. In fact, I still include you in my research project, but not explicitly. I cannot get completely away from your reductionism. It seems there is no escape from you, my dear.

I tried to write a little poem to you. I am not sure how good it is but I hope you enjoy it. If you have time please read it.

All the best Positivism!

Your friend, Naif.

My poem to you...

Good bye positivism ...
You always take a strong position ...
Of how research should be done ...
Reasons for research to be done ...
How data are to be collected ...
And how to be analysed...

Good bye positivism ...
Let me take up another position ...
Softer than your position ...
That allows me to act positively ...
And allows you to keep your position...

Good bye positivism ...
I'm not meaning that for good ...
We still are excellent friends ...
But we do not have the same mind ...
But we are still friends...

Good bye positivism ...
We both do research ...
In the field of education ...

Our focuses are different ...
As our purposes are different …
As we think differently...

Bye-bye positivism ...
By the way ...
There are others who like you ...
But they have different names ...
You know, you're all the same ...
Say the same ...
Think the same ...
You look different but you are the same..

Good bye positivism ...
Convey my farewell ...
To those who are parallel to you ...
To name a few: ...
Good bye empiricism ...
God bye objectivism ...
Good bye all tough conditions.

Good bye positivism ...
But to be more specific ...
Good bye to your hegemony ...
Only your hegemony ...
You are still around by virtue of your genes ...
We cannot remove them ...
But retain positively ...
Being thoughtful ... Seeing mindful☺...

INTEGRALISM

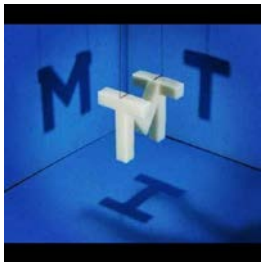
There are five men who met at a home. The old man - whose name is Positivism - is sitting on the biggest black sofa in the living room. He is very rigid in his thoughts. He entertains no other categories than right or wrong, white or black, light or dark,

love or hate. He has ruled the home for a long time. The second man whose name is Interpretivism becomes unhappy with this repressive situation. So, he attempts to do good positivist thinking with less rigorous procedures than his mate. However, the old man, Positivism, does not like that and he starts resisting the second man's thoughts. Therefore, the second man starts deconstructing this repressive situation by providing several alternative ways of thinking. One of his claims is that human experiences are not fixed quantities. There is no right or wrong in understanding the concepts of others. However, the old man has pervasive power due to the hegemony he has enjoyed for such a long period; so he does not simply allow the second man to get away with deconstructing his hegemony.

While they are fighting to win, another man enters the home; his name is Criticalism. He seems to be nearer in sympathy to the second man, supporting him to deconstruct the throne of the old man. "It is time for justice", Criticalism shouts. While they are fighting, suddenly, a very handsome man whose name is Postmodernism enters the home. He does not like harsh ideologies. "Why do you guys not go to another room where it may be easier to reach agreement?", Postmodernism suggests. He takes them into another fascinating room which has many different colours (new ways of thinking). "What is wrong with you guys?", Postmodernism asks. "Each of you has his own perspective. It is good to have such multiple perspectives around in our home".

While this complex situation of fighting and transforming is occurring, there is a knock on door ... They go quiet ... The door opens ... A very young and polite guy enters and greets all of them ... No one talks ... They just look at him ... He smiles and says, "I have been listening to all of you when I was at the door. I should have to remind you that you are brothers ... You are sons of one father ... You are the children of 'educational research'. Having said that, every one of you has his own way of thinking, which is great for each of you. The important thing is that we all need each other. All of you are involving yourselves in telling stories, even you (he indicates Positivism), but the difference is that each of you has his own distinctive way of telling stories about the world you live in. We do not only have different perspectives but also complement each other. We might not be here if it was not for you (Positivism). And you also (Positivism) might need one or two of us to build deep understanding of the world we live in. How about you think about the fact that each

of you has a window to see the world as it is? You might each see the same world but each of you has his angle to see from. And we can talk to each other about how we each view the world in order to make up a composite picture. I would also like to tell you that I am also your brother. Despite my young age, I want to say that my father asked me to take all of you under my umbrella ... So, I am glad to include all of you". "Who are you?", they ask. He says: "I am Integralism".



The above fictional story illustrates my understanding of Integralism. Integralism tends to combine apparently different perspectives (or even seemingly contradictory or conflicted) to co-exist together in a balanced relationship. Integralism is about developing the ability to conceptualise everything as a whole. Integralism is a 'vision-logic' that transcends rational thought and involves a great deal of meditation for non-dualistic (non-polarised) awareness. Integralism is a 'vision-logic' that "supports an integrated personality" . . . when 'vision-logic' "is the basis of actual interior transformation" (Wilber, 2011, p. 287). It is a conceptually inclusive mode of reasoning (Taylor, 2014) that stimulates integration among a variety of realisations, and evokes the relationships between one's sense of past, present and future, self and other, particular and general, and instance and type.

Integralism allows me to combine Interpretivism, Criticalism and Postmodernism in order to construct this Arts-based critical auto/ethnographic inquiry. Three different epistemologies are included in an integral point of view. Integralism is a comprehensive perspective that gives different epistemologies the same status. For this research – which is not restricted to only one worldview – I take several elements from different worldviews to produce and generate "my own methodology", which – for me – fits the aims of my research. The reason for not following only one paradigm is that I do not believe that Saudi educational reality is unitary. It does not make sense to me that we all should perceive of reality from a single point of view. We do not see reality exactly the same way. There are multiple perceptions of Saudi educational reality. So, to perceive of reality, I need to employ multiple perspectives which can be combined by adopting the idea of multi-paradigmatic research design space (Taylor, 2008; Taylor et al., 2012) that provides me with what I need to construct my hybrid research methodology. In my research I

need to interpret an event, criticize an idea, adopt uncommon representations and envision alternative cultures. I need an inclusive perspective that allows me to envisage an inclusive mathematics education culture.

Integralism is really what I feel I need in the culture of mathematics education in Saudi Arabia. I thank Postmodernism for promoting a plurality of views and treating these views with the same status. However, Integralism moves one more step by not only accepting the variety of views but by bringing the different views to co-exist AND to cooperate together to build a more inclusive view, and more so, to argue that a view cannot be completely understood unless the opposite point of view is considered. A student-centred teaching approach, for example, needs to be understood in relation to a teacher-centred approach. Both approaches need to work together to provide a more comprehensive approach to Saudi mathematics education. Metaphorically speaking, I would say that ideas, views or perspectives are colours. Each colour, red, blue, green… has its own quality and is the favourite for some people. Bringing the colours together constitutes the rainbow. And a rainbow seems to be what Saudi mathematics education culture needs.

Culturally speaking, people tend to vary in their views and it is likely that they always will. Allah said:

﴿ وَلَوْ شَاءَ رَبُّكَ لَجَعَلَ النَّاسَ أُمَّةً وَاحِدَةً وَلا يَزَالُونَ مُخْتَلِفِينَ ﴾

"And if your Lord had willed, He could have made mankind one community; but they will not cease to differ" (The Qur'an, 11:118). The best way to transcend the differences could be by accepting them as they are, as Postmodernism suggests with the view to promoting pluralism. However, to bring unity out of diversity, an inclusive view is required. It is important to say that an inclusive view does not mean that each different view has to give up its own ideologies or principles, but it does mean that (a) each focuses on the similarities more than on the differences, (b) focuses on the moral values more than on specific procedures, (c) focuses on the purposes more than on the methods. The goal is to build a more inclusive view and cooperative vision in the field of Saudi mathematics education rather than to produce a single view.

Without Integralism as an overarching framework, this research might be seen as full of contradictions. For example, I have adopted 'transformative research' and it may *appear* that I reject Positivist research but in fact I do not. Also, I advocate 'transformative education including critical constructivist epistemology and emancipatory interest' and may *appear* to reject traditional educational approaches including those based on objectivist epistemology and technical interest. Well, it is not really that simple. First of all, when I criticise it does not mean that I reject everything. On one hand, my criticism shows the value of what has been criticised (otherwise I would not have been caring about it☺) and on the other hand I only criticise the domination of it. Second, I do not need to give much space in my research to argue for the benefits of Positivist research and traditional education in Saudi mathematics education culture because they are already widespread and have created their own justification. Third, metaphorical thinking helps a lot in my research to go beyond the literal level of thinking (see Chapter 6). My research is an attempt to inject transformative research and transformative education into Saudi mathematics education culture and to integrate it with what is already there. Having said that, what I have being trying to clarify might add more contradictions when objective theory is brought into the discussion. 'A theory of everything' needs to be at hand in which "an integral vision offers considerably more wholeness than the slice-and-dice alternatives" (Wilber, 2000, p. xii).

ARTS-BASED CRITICAL AUTO/ETHNOGRAPHY

My experiences in school life are neither simple nor linear; they are rich and complex in quality. The richness, complexity and the quality of my school life cannot be captured by quantitative tools and methods alone. It entails me – Naif Alsulami; a researcher and learner – to use an alternative form of inquiry to capture them. Drawing on the aforementioned paradigms I construct an arts-based critical auto/ethnographic methodology.

This methodology allows me to focus on myself (auto), Saudi mathematics education culture (ethno) and the inquiry process (graphy) (Reed-Danahay, 1997). Auto/ethnography connects my personality (auto) to Saudi education culture (ethno) and in the process the two concepts may become fused together. It allows me to

breach the conventional separation of myself from my research by making myself the object and the instrument in conducting research (Ellis & Bochner, 2000).

Critical auto-ethnography, however, seems to be sometimes a loose term. It can be used with a somewhat different application in varied research situations. There are some commonly used terms that provide a sense of the range of methodologies associated with autoethnography (Ellis & Bochner, 2000). Critical auto-ethnography can be used, for example, as a narrative inquiry. Critical auto-ethnographers are not like objectivists. They are very flexible in functioning in accordance with several terms of inquiries. I found that Taylor's definition is appropriate for me. Taylor (2010) said: "Critical auto/ethnography is situated at the nexus of ethnography, writing as inquiry, arts-based research, narrative inquiry, evocative autoethnography, anthropological poetics, philosophical inquiry, critical hermeneutics and practitioner inquiry" (p. 7). So, critical auto/ethnography can be understood as non-positivist research.

Critical auto/ethnography provides me with an approach to immerse myself deeply in the moments of my academic as well as personal life, to understand them closely and critically. It makes my life and experiences in school the focus of the research (Reed-Danahay, 1997). Thus, you will find that this inquiry is neither written in the third person nor follows the conventional writing in using a passive voice as if it was written from 'nowhere by nobody'. Rather, you will notice during this inquiry my own voice, my personal narrative and my stories and my first person voice as I write about my learning experiences as a prospective teacher and a mathematics teacher.

My experiences are not static; they are changing and evolving. They are unique and should be studied in their contexts; they are not fully generalizable (Cohen et al., 2000). Therefore, you will notice also that I am emphasizing significant details and necessary accessories surrounding my experiences with mathematics education. They are very important and crucial in the contextual understanding (Bryman, 2004) of what I am trying to express. (Do you think conventional research can achieve this contextual understanding? This is why I embrace this research – kindly reminder☺). I need to achieve this kind of understanding for myself because of the challenge of the complexity of my educational inquiry. It goes without saying that my aim is to

explain the complexity of my experiences through verbal description rather than deal in hypotheses with numerical value.

This transformative approach to educational research requests me to be the one who is generating the data through stories, gathering information and evidence relating to my research topic, presenting my past and present personal experiences and those of the participants in an actual college setting and to discuss the meaning of those stories and experiences (Creswell, 2008) by reflecting critically upon them in order to construct a deep understanding about them. In this type of research I see myself as a self-ethnographer as I am sharing my stories with others in mathematics classrooms. My subjectivity and personal accountability are dynamic in this approach.

What makes this approach to knowledge production legitimate is that it is inspired by the Holy Quran. In the Qur'an, there is a chapter (28) by the name of Al-Qasas (Narratives/Stories). The entire chapter (12) Yusuf (Joseph) has been devoted to the story of Yusuf (Joseph), Yaqub (Jacob), Zulaikha and the brothers. In the beginning of the chapter, Allah (SWT) says:

﴿ نَحْنُ نَقُصُّ عَلَيْكَ أَحْسَنَ الْقَصَصِ بِمَا أَوْحَيْنَا إِلَيْكَ هَذَا الْقُرْآنَ ﴾

"We narrate to you, O Prophet, the most excellent of the narratives by (means of) what We have revealed to you in this Qur'an". (Holy Qur'an, 12:3). In the concluding verse of this chapter, Allah (SWT) says:

﴿ لَقَدْ كَانَ فِي قَصَصِهِمْ عِبْرَةٌ لِأُوْلِي الأَلْبَابِ مَا كَانَ حَدِيثًا يُفْتَرَى وَلَكِنْ تَصْدِيقَ الَّذِي بَيْنَ يَدَيْهِ وَتَفْصِيلَ كُلِّ شَيْءٍ وَهُدًى وَرَحْمَةً لِقَوْمٍ يُؤْمِنُونَ ﴾

"In their histories there is certainly a lesson for men of understanding. It is not a narrative which could be falsified, but a verification of what is before it and a distinct explanation of all things and a guide and a mercy to a people who believe". (Holy Qur'an, 12:111). In several places in the Qur'an Allah (SWT), after telling a story, says "that they may reflect", "perhaps they may understand". These features are characteristics of transformative learning which lie at the heart of transformative educational research.

My aim in using this innovative research is to both understand and portray my and others' lived experiences which demonstrate subjectivity and personal accountability and which I employ as 'direct testimony' to justify my own inquiry (Ellis & Bochner, 2000). My goal in telling my experiences is not to portray the facts of what happened to me precisely, rather, my purpose is to convey the meaning for me of my lived experiences in mathematics education. I am telling stories to engage the reader to enter and feel part of my experiences. I am writing in a way to stimulate the reader to feel and think about my experiences and about his/her experiences in relation to mine. I want the reader to experience my experiences as I lived them (Ellis & Bochner, 2000).

The situation of mathematics education in Saudi Arabia perhaps needs to be examined and studied through the eyes of the research participants as well (Cohen et al., 2000). So, I have conducted semi-structured interviews with six Saudi pre-service mathematics teachers attending Jeddah Teachers' College in Saudi Arabia. I prefer to call these personal conversations rather than interviews. 'Interview' would mean that I asked questions which the interviewee answered. However, in my conversation with my participants I was not merely looking for answers. Rather, I wanted to hear their stories and their experiences in Saudi mathematics education. My participants and I become "part of the ongoing narrative record" (Connelly & Clandinin, 1990, p. 5). This does not mean I did not ask specific questions. I invited and encouraged them, first, to tell their stories, and then I took the responsibility for interpreting the meaning of their talk (Chase, 2003), as well as for raising some questions about their stories. Steinar Kvale (1996) defines qualitative research interviews as "attempts to understand the world from the subjects' point of view, to unfold the meaning of peoples' experiences, to uncover their lived world prior to scientific explanations" (p. 1).

The interviewees were all male. They were in the final semester of their practical training. I interviewed them in the first semester of the 2010-2011 academic year. The conversations lasted from one hour to an hour and a half. I used an audio-recorder to record the conversations. After finishing the conversations, I transcribed them. I used Arabic language in the conversations. During the conversations, I asked the participants about their experiences when they were studying at college and about their experiences while they were teaching mathematics in schools. I asked them to

describe their work and to explain their own values, beliefs and actions regarding teaching and learning.

MY WRITING…

Critical auto/ethnography considers the act of writing as: a method of inquiry (Taylor, 2010); as a method of generating my data; and, as a way of finding out more about myself and my topic. Writing is a way of getting to know. I inquire at the same time as I am writing (Richadson, 2000).

It is vital writing … Not static at all
Here is my own voice … Not the omniscient one
I'm writing in the first voice … Not the third one.

My voice is made known … Not hidden
I'm an instrument … Not an impediment
I'm "onymous" … Not anonymous.

My research should be read … Not scanned
Its meaning… In the reading
My attention… Turns to writing… Not boring
Never express precisely … Completely
Yet, I keep on going … In my writing.

Writing is expressive … Don't take it for granted
Writing is fun … Not full of grief

Writing is my life … As I write about my life
Writing presents my voice … As I write my experience.

Who you are? … Do you know?
When you write … You may know!!

Writing about myself … To find out about myself
Writing my stories … To see myself.

I write the unknown to be known
I write to know what was unknown
I write to know … what I didn't know.

In my past learning...
I learned to write what I know … But didn't know how to write
I learned to write what I knew … I learned to know before I wrote
I learned to write… But not to really know
My writing was about what I already know

What if I write to know …
Write what I don't know to know …
Write what is unknown to be known.

My writing has different ways … my life different stories.
Writing in different ways … means considering new aspects of my life.

I write about myself … From myself … To understand myself
I wanna make a difference … About my experience

Should it be done academically (objectively)?? … But why??!!
Why not narratively!! … Why not poetically!! … Why not evocatively!! …
Emotionally!! …Strikingly!!
Why not??!!! … So, … Let's do it.

ETHICAL CONSIDERATIONS

During my previous life, I participated in very few 'data collection' processes. I remember when a teacher educator distributed his research questionnaire to us as pre-service teachers. He asked us to fill in a questionnaire that was going to help him in his research. Even though we did what he had asked us to do, we knew absolutely nothing about what he was doing or why he was doing it. When I began conducting this research, I was asked to submit an application for ethical approval. I was informed that I could not start my research if I did not have an approval number from the Human Research Ethics

Committee (see Appendix 4). Honestly, I had considered it as an afterthought (Hesse-Biber & Leavy, 2011). I did not imagine 'ethics in research' to be important at this level or that its approval was going to involve such a long process; I thought it would be an easy thing to do. After getting involved in the process, however, I realized how simplistic I had been. I thought that I could say whatever I wanted to say about my experience without considering the involvement of others (e.g., teachers, students, institutions, and my society). This research taught me to consider the potential impact on those involved (Elliot, 2005). It taught me also to not believe only in my right as an inquirer to seek understanding about my teaching and learning experience and my research participants' as well, but also to give great consideration to their dignity, privacy and self-determination (Cohen et all., 2011).

Critical auto-ethnographic research allowed me as a researcher to use my own experience as the central subject of this research. It also allowed me to interview pre-service teachers, asking them about their own experiences. The ethics of this type of inquiry were subject to evaluation and reflection by me (Corbin & Morse, 2003), because they derive from my own and participants' experiences of pre-service teacher education and the experience of teaching and learning in the Saudi mathematics classroom. Also, the critical dimension was very important in my research as it empowered me to employ the emancipatory interest and to take action on that basis. However, there could have been a negative side effect if I had not handled this dimension ethically. It might have upset 'some' involved in the events I criticised or have resulted in a job loss (Creswell, 2014).

So, I want to say clearly that my aim in criticising certain challenging educational issues was only an attempt to bring them forward for discussion explicitly as they – I believe – hold the system back from being transformed. Ethically, I need to be very careful in exploring my experience and my research participants' experiences, and the Saudi mathematics education culture. So, in the process of representing my experiences with my Saudi colleagues, such as in stories or conversations, the names I have used refer to composite characters (Taylor, 2002) that represent common traits and regular social practices or norms of thinking that I wanted to investigate in my thesis. Those names do not necessarily represent exact persons. My concern is to represent the quality of and typical attitudes that comprise mathematics education

culture in Saudi Arabia, not the persons themselves. Also, I have tried to use an appropriate language to not bring harm to myself or my professional career when I return back to my institution. Having said that, I have accepted my own vulnerability that could result from my exposure of aspects of both my personality and professionalism, which can be concerning for me, but vulnerability also "can be the source of growth and understanding" (Ellis & Bochner, 2000).

To make my inquiry ethically responsible, I abided by the following ethical principles throughout this research.

Access and acceptance

To abide by this ethical dimension, I applied first to the 'Human Research Ethics Committee' at Curtin University to obtain the approval to conduct my research. Afterwards, by submitting the outline of my research, the Curtin Ethics Approval Form and a support letter from my supervisor, I formally requested the 'King Abdulaziz University' to give me official permission to carry out an interview with pre-service mathematics teachers. After obtaining permission, I contacted the course supervisor of the pre-service teachers who, in response, gave me a list of ten current pre-service teachers performing their 'field experience' with their phone numbers and the schools where they were practising. After phoning the pre-service teachers and involving them in the process of negotiation, I obtained initial verbal acceptance from them. Later, I visited in person the principal of each school to get access to the school and make actual contact in person with each participant. Subsequently, I started the procedure of 'informed consent', to receive in writing the full and final acceptance of the research participants. I went through these steps not only to abide by 'the ethical approval' process, but also to present my credentials as a serious inquirer and to establish my own ethical position with respect to my research (Cohen et al., 2011).

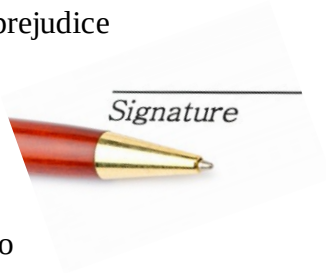
Informed consent

The principle of informed consent arises from my future teachers' (the participants') right to freedom and self-determination. To abide by this principle, therefore, I - before the participants were involved in my research - gave them a comprehensive

explanation of the potential benefits of the research and their rights, and ensured them that no risks or danger would occur for them as a consequence of their participation in my research.

I tried to do my best to provide a complete and clear verbal and written information and a fair and understandable description of my research as it "would be likely to influence their decisions" (Diener & Crandall, 1978, p. 57 as cited in Cohen et al., 2011) one way or the other. I tried to be honest; I told them that my interview with them would be part of my PhD degree, and that they would be doing me a favour and that I would be very thankful to them. Also, I told them about: who I am, what I want to do, the exact nature of my research, the aims, the procedures and the purpose of my research. As well, I gave them an information sheet that explained my research (see Appendix 2). And to reach the level of fully understanding what I was doing or what they were about to do, I asked them to ask me about anything that needed to be clarified (Cohen et al., 2011).

I also informed them that their involvement would be voluntary at all times and they would be free to withdraw their consent at any time without prejudice to them (Cohen et al., 2011; Josselson, 2007) (see Appendix 3). Consequently, six participants agreed and four refused to be interviewed. I did not report to anyone who participated and who did not. I am the only one who knows. The consent forms they signed guaranteed to protect and respect their self-determination and also placed responsibility on them for their decisions (Cohen et al., 2011).



Anonymity and confidentiality

The essence of anonymity is that the information I provided in this research about my participants does not reveal their identity. I promised and assured my participants that they would remain anonymous and that all the information would be treated with the strictest confidentiality. So, to enhance their anonymity, I used aliases instead of their real names. Besides, I separated the identifying information from the research data (Cohen et al., 2011). And to protect the confidentiality of all the interviewees, I stored the transcripts on my own password protected computer

while the analyses were completed. It was only my supervisor and I who are able to access the transcripts (Josselson, 2007). The data files remain confidential and anonymous, and will be maintained electronically protected for five years after which they will be destroyed.

Non-maleficence and beneficence

I acknowledge that a conflict of interest might crop up between my research participants and me. Therefore, I assured them that their involvement in this research would not cause harm to them (Cohen et al., 2011). I abided by what the Prophet (PBUH) said: "There should be neither harming [Darar] nor reciprocating harm [Diraar]" (Ibn Majah, No. 1910). Hence, I considered 'anonymity and confidentiality' to be one of the key ethical issues in my research to protect and safeguard my participants' identity (see above). Second, their involvement addressed issues about teaching and learning mathematics that would be hopefully beneficial to Saudi mathematics education and to them as well, as they will be teachers in the future. Moreover, I intentionally stimulated them to think reflectively and critically about their own experience, hoping that this might increase their awareness of what they think and do as teachers (see Chapter 5), hoping further that their involvement would empower them to rethink the culture of the Saudi mathematics classroom, and aiming to let them leave the interview with a feeling that they had learnt something (Cohen et al., 2011) or at least had become more aware of their own experiences.

As I am myself part of this study, I acknowledge that I am responsible for what I have written. Besides that, I acknowledge that I owe my gratitude to the participants and I thank them very much for their participation in this research.

QUALITY STANDARDS

A movie cannot be judged based solely on the quality standards of the manufacturing process. There are specific standards that are compatible with its artistic nature and it needs to be also judged based on them. Likewise, the quality of my research cannot be judged based on positivist research's quality standards of objectivity, validity and

reliability. My research needs and has to be judged and regulated in accordance with its epistemological standards that are associated with the interpretive, critical and postmodern paradigms, as it has been influenced and its nature has been shaped by these worldviews of research. In particular, the quality standards that are applicable to my research are: trustworthiness (transferability), ideology critique, critical reflexivity, verisimilitude, pedagogical thoughtfulness, substantial contribution to the field and aesthetic merit.

Trustworthiness: the trustworthiness of my research "lies not in its basis in 'fact' but in its power to recreate [my] experiences as visible and immediate to the reader, providing readers with the means to construct an analogous experience" (Cain, 1995, p. 41). I guess trustworthiness is a metaphorical reliability[2]. One of the trustworthiness criteria is transferability.

Transferability: this criterion (Guba & Lincoln, 1989, 2005) is based on the degree of similarity between the context of my research and the contexts of my readers who are considered to be the judges of this criterion by acting on the transferring. They are those who decide whether or not my research speaks to them about their experiences, or about the lives of others they know (Ellis, 2004; Ellis, Adams & Bochner, 2011), by checking the degree of similarity between the context of my research and their own contexts, or maybe other contexts they may know, and "by thinking about how our lives are similar and different and the reasons why" (Ellis, 2004, p. 195). I could say then that transferability is a metaphorical generalizability. Guba and Lincoln consider transferability as parallel to generalizability in which my 'findings' in this research could be generalised to other applicable contexts or subjects.

To achieve this criterion, I have attempted to make the context of Saudi mathematics education more visible, so that my readers would be able to understand the context and then act on the transferring. And to make the context more visible, I have used

[2] Although I have learned that reliability, validity and generalizability are well-known terms of the positivist paradigm and they have their specific meanings there which do not 'fit' in my research, I thought of using the same terms in my multiple-paradigms research for the following reasons: 1. To show that those criteria do not have an absolute definition. 2. To show that a criterion can have different meanings in different contexts. 3. To show that a criterion can be modified to 'fit' in other contexts. 4. To make it easy for novice researchers who are hegemonised by positivism to understand my alternative criteria. 5. To show tolerance amongst the followers of different paradigms in which the interpretivist researcher can use positivist terms as a kind of homeliness/affableness. Another point: I added 'metaphorical' to show that I am not using the conventional meaning of the criterion, and I do not want to redefine it according to my research.

‘thick description’ in establishing the context of my study by describing my experience of the Saudi mathematics education culture extensively and carefully in terms of several dimensions such as the time, the place and the circumstances. Also, I use ‘my first person voice’ of narrative writing to make the personalised approach in my inquiry noticeable. Moreover, I use ‘probabilistic reasoning’ in my writing to express the uncertainty of my interpretations of the culture of Saudi mathematics education (Taylor, 2014). Clearly, I try to engage you, the reader, to think about what I have experienced by providing a ‘thick description’ of my context that might transfer to your context or other contexts you know.

Ideology critique: this criterion “describes the process by which people learn to recognise how uncritically accepted and unjust dominant ideologies are embedded in everyday situations and practices” (Brookfield, 2000, p. 128). Hence, I have chosen this criterion as one in my quality standards of this research to signify the extent to which my critical understanding of the vital sources of Saudi traditional teaching and learning, within the dominant culture of Saudi mathematics education and the habituated roles of enculturated teachers and students (Taylor, 2008), is available to the readers.

To achieve this criterion I expressed my critical perspective regarding the dominant objectivist ideology that seems to shape the culture of the Saudi mathematics classroom and decides the professional teaching practices (Taylor, 2014). So, I endeavoured to de-dominate my own professional practices of the dominant ideology of teaching and learning mathematics - that serves only what Aikenhead (2000) named ‘elite’ mathematics students - such as decontextualized or dehumanized mathematics, in order to create an emancipatory learning culture in which all students develop critical consciousness and higher-order thinking skills (Taylor, 2008). My critical perspective is based on my critical reflections on my experiences of that culture as a student teacher and then mathematics teacher in Saudi Arabia. Brookfield (1995) proposed four lenses to the process of critical reflection: (1) autobiographical experience of the culture, (2) students’ eyes toward the same educational culture, (3) colleagues’ experience of the culture, and (4) the theoretical literature on professional practice within the dominant culture.

Critical reflexivity: this criterion is related to critical thinking, reflective thinking, and reflective practice, and more importantly to its strong foundation in critical theory and its richness of postmodern ideas. It connects reflection explicitly with social, cultural and political purposes and makes it critical by involving ideology critique (see above) (Kreber, 2012). In my research, critical reflexivity focuses on helping me, my research participants, Saudi mathematics teachers and educators, and readers as well, to come to an awareness of how (objectivism/positivism) shapes our belief systems of teaching and learning and defines our assumptions (ideologies) (Brookfield, 2000) of mathematics education that validate and continue to decontextualize and dehumanise mathematics learning.

To achieve this criterion, I have attempted to demonstrate critical awareness of the Saudi mathematics education culture by: (1) reflecting critically upon my assumptions, values, interests and actions of that culture, (2) exposing paradoxes that constrain my professional practice in that culture, and (3) by critically and consciously examining my unintentional support of that culture, that includes reproducing uncritically the same actions, serving unwillingly the same interests and promoting simply the same assumptions (Taylor, 2008; Taylor, 2014).

Verisimilitude: for me, verisimilitude is a metaphorical validity. And to achieve this criterion, I tend to stimulate my readers to reconstruct my experience for themselves (Cain, 1995), to arouse them to "experience an experience" (Ellis, 1993, p. 711), to evoke a feeling in them that my experience is 'lifelike', 'believable' and 'possible' (Ellis & Bochner, 2000; Ellis, 2004) a feeling that the experiences I represent could be true (Ellis, Adams and Bochner, 2010) and/or correspond with their own experiences (Adler & Adler, 1994). To accomplish this, I describe my experiences in an evocative way of writing (e.g. see Chapter 5) by adopting literary genres, such as narrative, poetry and autobiography of confessional and impressionistic writing (van Maanen, 1988), that take my voice beyond the typical voice of realism, "with the goal of broadening [my] and [the] readers' perspectives, helping them to understand empathically the different other and thus overcome their own self-absorption" (Taylor, 2014, p. 49).

I need to indicate here that the value of my impressionistic writing needs to be assessed in terms of its interest, coherence and fidelity as well as its plausibility or

believability rather than its accuracy (Taylor, 2002) and also by whether it helps readers and my participants to communicate with others different from themselves, or offers a way to elaborate their understanding about the culture of mathematics education in Saudi Arabia (Ellis & Bochner, 2000). "What matters [here] is the way in which [my] story enables the reader to enter the subjective world of [mine] - to see the world from [my] point of view, even if this world does not 'match reality'" (Plummer, 2001, p. 401).

Pedagogical thoughtfulness: to achieve this criterion (van Manen, 1991) I write my research in a narrative style that involves my critical reflection about educational issues in Saudi Arabia, such as the established values and beliefs that underpin my teaching and learning, and events that contain dilemmas, trying to engage my readers in the same process that I follow, by inviting them to reflect upon their own perspectives on issues being discussed and prompting them to examine, question and reflect on their own professional practices with the aim of developing my own and their pedagogical thoughtfulness (Taylor & Wallace, 1996). Within the narrative structure, I use an evocative form of writing as "through it we can experience the self-reflexive and transformational process of self-creation" (Richardson, 2000, p. 931).

Substantive contribution: to accomplish this criterion (Richardson & St. Pierre, 2005) I have attempted to make a substantial contribution to my readers' understanding of Saudi mathematics education culture, including the Saudi education process, by telling my stories and my experiences of teaching and learning which show some of the aspects of my school life and the picture of Saudi mathematics education. So, my readers could provide 'validation' by feeling that my experiences of the culture of Saudi mathematics education and my stories about teaching and learning mathematics in Saudi Arabia have informed them and may have raised their knowing "about unfamiliar people or lives" (Ellis, 2004, p. 195).

Aesthetic merit: this criterion (Richardson & St Pierre, 2005) is based on the extent to which my thesis succeeds aesthetically. To achieve this criterion I have used non-traditional ways of writing that include stories, poems and Arabic script, as well as several images aiming to make my writing artistically shaped, satisfying, complex and not boring. Also, I have used innovative analytical practices that include

evocative writing to open up my experience of teaching and learning and to invite my reader to have an interpretive response.

SUMMARY

In this chapter, I have presented the story of my constructing an Arts-based critical auto-ethnography as my research methodology, drawing from the paradigms of Interpretivism, Criticalism, Postmodernism and Integralism. I use Arts-based critical auto/ethnography as a tool that engages me in critical reflexivity to transform my (and perhaps others') professionalism. The approach is unconventional in that it is based on myself as a researcher, my personal lived experiences and the culture of Saudi mathematics education. Arts-based critical auto/ethnography enables me as a novice educational researcher to be involved firsthand in a process of transformative learning which lies at the heart of transformative education.

I use Arts-based critical auto/ethnography not only as a tool to generate my data and conduct my research, but also as a transformative learning tool that enables me to generate new levels and forms of meaning and understanding, which can in turn transform my perspectives and actions (Krauss, 2005), and perhaps provide me with new lenses for re-envisioning the future of Saudi mathematics education culture.

In addition, I have discussed the ethical considerations in conducting this inquiry, and finished the chapter by addressing seven quality standards which I think are the appropriate ones to judge the quality of my work.

CHAPTER 3

ME, CULTURE/RELIGION, EDUCATION AND SAUDI ARABIA

INTRODUCTION

The purpose of this chapter is to provide information that is important to make clear the context of my research. This chapter might seem to be a bit 'dry' compared to other chapters that involve my own experience which, in turn, makes them 'alive'. However, it is imperative to make the context of my research clear with the aim of helping the reader to have a better engagement. Thus, I will talk first about Saudi Arabia, including a brief account of its geographical location, its history, and its constitution. Then, I will mention Islamic religion as a very influential factor in shaping every aspect of Saudi Arabia: education, economics, and social life. I will next give an overview of the education system of Saudi Arabia in general, and mathematics education in particular.

I AM...

In Chapter One I identified myself; I said that I am a Saudi Arabian Muslim man who also can be called Hejazi. To clarify these names I would say that 'Hejazi' refers to people who inhabit the region of Al-Hejaz in the west of Saudi Arabia (see Map 1). 'Saudi' refers to the name of the nationality of citizens of Saudi Arabia situated in southwest Asia (see Map 2). 'Arabian' refers to people who speak Arabic, originally from or living in the Arabic region. There are 22 Arabic countries that are members of the 'League of Arab States' (see Map 3). 'Muslim' refers to people who embrace the Islamic religion. There are 57 countries that are members of the 'Organisation of Islamic Cooperation' (see Map 4).

Map 1: The region of Hejaz

Map 2: Saudi Arabia Location

Map 3: The Arab World

Map 4: Organisation of Islamic Cooperation

SAUDI ARABIA

Saudi Arabia is a country that is located in the Arabian Peninsula in southwest Asia. It is the second largest country in the Arab World, with an estimation area of 2 million square kilometres and a population of about 30 million (10 million non-Saudi) (Saudi Central Department of Statistics and Information, 2013). Saudi Arabia is bordered by Jordan and Iraq to the north, Kuwait to the northeast, the Arabian Gulf, Bahrain, Qatar and the United Arab Emirates to the east, Oman to the southeast, Yemen to the south, and the Red Sea to the west.

Historians created three Saudi Countries or States. The first Saudi State was established in 1744 when Muhammad bin Saud (the founder of the dynasty) joined Muhammad bin Abdulwahab (the religious leader) to establish the State which ended

in 1818. The Second Saudi country was between 1824 and 1891. The third and current Saudi country was established in 1932 by King Abdulaziz Al-Saud and is officially known as the Kingdom of Saudi Arabia (المملكة العربية السعودية; al-Mamlakah al-ʻArabiyyah as-Suʻūdiyyah).

Saudi Arabia is considered to be the birthplace of Islam, so to speak[3], in which the Holy Qur'an was revealed to the Prophet Muhammad - peace be upon him (PBUH) - in Makkah. Saudi Arabia has the two holiest places in Islam; Al-Masjid al-Haram (see Image 1) (in Makkah), and Al-Masjid al-Nabawi (see Image 2) (in Medina). Therefore, it is sometimes called "the Land of the Two Holy Mosques". Islam is the official religion of the country and Arabic is the official language. Saudi Arabia is considered to be an Islamic monarchy with the Qur'an and the Sunnah (what the Prophet did, said or agreed) to be its constitution. The Basic Law of Government (1992) states in 'Chapter One: General Principle' (Article One) that: "The Kingdom of Saudi Arabia is a sovereign Arab Islamic State. Its religion is Islam. Its constitution is Almighty God's Book; The Holy Qur'an, and the Sunnah (Tradition) of the Prophet (PBUH). Arabic is the language of the Kingdom. The City of Riyadh is the capital". 'Chapter Two: The Law of Government' (Article Seven) states that:

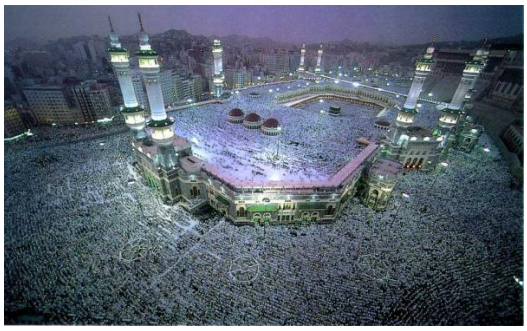


Image 1: Al-Masjid al-Haram

Image 2: Al-Masjid al-Nabawi

"Government in the Kingdom of Saudi Arabia derives its authority from the Book of God and the Sunnah of the Prophet (PBUH), which are the ultimate sources of reference for this Law and the other laws of the State". In Chapter Two (Article Eight), it states that: "Government in the Kingdom of Saudi Arabia is based on justice, Shura (consultation) and equality according to Islamic Sharia".

[3] Islam began in 610 AD while Saudi Arabia was established in 1932.

The flag of Saudi Arabia has a green background featuring a white inscription above a white horizontal sword. The text is known as 'Shahada' or the Islamic statement of faith, (لا إله إلا الله محمد رسول الله ; Lā ʾilāha ʾillā l-lāh, Muḥammadun rasūlu l-lāh) "There is no God but Allah, Muhammad is the Messenger of Allah" (see Image 3). The flag was officially adopted on March 15, 1973. The national Emblem is a palm tree (representing vitality and growth), and two crossed swords (symbolizing justice and strength) (see Image 4).

Image 3: The Flag of Saudi Arabia

Image 4: The Emblem of Saudi Arabia

Regarding the climate of Saudi Arabia, it is mostly arid in which 80% of the country is desert that includes the world's largest contiguous sand desert (Rub' al Khali; الربع الخالي), or "Empty Quarter"; 647,500 square kilometers (see Images 5, 6 and 7). There are virtually no rivers or lakes. However, there is rainfall in the north and along the mountain range to the west, especially in the far southwest, which receives the monsoon rains in summer. Sporadic rain can also occur elsewhere, sometimes very heavily.

Image 5: Rub' Al Khali

Image 6: Rub' Al Khali

Image 7: Rub' Al Khali

Riyadh is the capital city of Saudi Arabia and is located in the central province. Makkah is the birthplace of the Prophet Muhammad (PBUH) and the focal point of Hajj, the Islamic pilgrimage in which three to four million Muslims from all parts of the world participate every year. Medina is the city where the Prophet Muhammad (PBUH) emigrated and lived. Jeddah is the commercial capital of Saudi Arabia, and serves as an entrance to the rest of the peninsula. It is located along the eastern coast of the Red Sea. Jeddah is where I studied, was educated and worked. It is the context of this study and where the Teachers' College is situated.

RELIGION

The religion of Islam is considered as the most important aspect of every Saudis' national identity. All Saudi citizens are considered to be Muslims. And generally, it shapes almost all aspects of Saudis' social life. For me, *I* consider Islam as a complete way of life. Islam shapes every aspect of my life, as it should. This might sound a bit 'creepy' for non-Muslims who have a negative view towards Muslims. I have encountered several incidents during my stay in Australia (a Western country) where the propaganda against Islam or the negative image of Islam seems to be dominant. I have had heard words like “terrorist” or “bomber”, and have been treated differently. As a normal person, I felt so bad. I was really sad as well as scared. I did not know what I was supposed to do. I always wanted to say that we are not what they think. I always wanted to say that Islam has nothing to do with terrorism. I always wanted to say that Islam does not teach us to kill or hate. However, I preferred to be silent; I thought that was the best way to be safe. Australia is not my country; it has a different culture, different language, different people, different thinking. But now, after spending some years in the country, I can excuse people. I have come to understand why they said such hurtful things. I had thought that everything they did or said to me was based on what they hear about Islam or Muslims, and what they heard about Islam or Muslims mostly comes from 'non-neutral Media' or what I call ‘politicized Media’.

‘What do you know about Islam?’ I used to ask this question to people who asked me about Islam. I found that they only know what the Media raises. So, Islam is about Jihad and hijab, it is about repressing women … etc., simply it is terrorism as the Media seems to express. This might be not the place to clarify all these things. However, I raise here some questions for those who would confront me about Islam.


A brave snake saving a fish from drowning

What is terrorism? Is it violence?!! Or is it something else? Why is violence called terrorism when a Muslim does it but is called a crime when a non-Muslim does it? Why – when a Muslim does a horrible thing – is it referred to as his/her religion and uses the label of terrorism, while it is referred to as nationality and uses the label of crime when the subject is non-Muslim? Simply, can any non-Muslim who does a horrible thing be called a terrorist? By the way, who started the First World War? Who started the Second World War? Who killed about 20 million Aborigines in Australia? Who sent the nuclear bombs of Hiroshima and Nagasaki? Who killed more than 100 million Native Americans in North America? Who killed more than 50 million Indians in South America? Who took about 180 million of African people as slaves and 88% of them died and were thrown in to the Atlantic Ocean? Who killed 6 million Jews in Germany? Were they Muslims?? (Vogel, 2011).

From a constructivist perspective, people’s behaviours toward me are based on their current understanding about Islam, and I guess if they build the 'correct' understanding about Islam they might change their behaviours toward Muslim people. They might realise that Muslim people are like everybody else. The difference is that they embrace Islam and they try to follow its teachings.

Anyway, Islam has a major influence on Saudis' life, and due to that, I thought to give a brief overview about it. 'Islam' refers to the name of the religion, and 'Muslim' refers to people who embrace Islam. Islam means submission to Allah. Muslims believe in one God (Allah) and Muhammad is Allah's Messenger. They also believe that the Qur'an is the Word of Allah that was revealed to the Prophet Muhammad (PBUH) through the

Archangel Gabriel in Makkah in 610 AD. All the instructions of Islam must only come from the Qur'an and the Sunnah.

Islamic teachings are very comprehensive. They cover everything that humans need to do in this life. Islamic teachings are not confined to worship activities such as performing prayers or fasting during the month of Ramadan or performing Hajj. Islam is more concerned with all aspects of human life. Islam teaches us how to live life. It teaches us to exhort others to perform good acts and to abstain from evil. Muslims are expected to act ethically towards each other all of the time as morals lie at the heart of Islamic teaching (Mukandala, 2006). The Prophet (PBUH) said: "None of you is a true believer until you love for your brother what you love for yourself" (Narrated by Al-Bukhari, No. 13 and Muslim, No. 45). He (PBUH) also said: "Verily, making high morals complete and perfect is the main part and aim of my mission" (Narrated by Al-Bukhari, No. 2583). And said elsewhere: "The best among you are those who have the best manners and character" (Narrated by Al-Bukhari, No. 3559).

Islamic teaching also teaches us how to treat not only humans but also animals, plants and the environment. For example, the Prophet (PBUH) said regarding cats that, "They [cats] are not impure and they intermingle with you" (Narrated by Abu Dawud, No. 76). More than that, Islam considers that evil acts towards animals should have severe punishment. The Messenger of Allah (PBUH) said, "a woman was tortured and was put in Hell because of a cat which she had kept locked up til it died of hunger, she neither fed it nor watered it when she locked it up, nor did she set it free to eat the insects of the earth" (Narrated by Al-Bukhari, No. 3482 and Muslim No. 2242). And regarding our life, the Prophet (PBUH) taught us everything we need. He taught us how to live our life, how to eat, drink, and even when one needs to go to bed to sleep. He also taught us values that if a human follows, s/he will live a happy, successful and great life.

He also gave us teachings regarding our environment. For example, the Prophet Muhammad (PBUH) forbade us to waste water; he said: ". . . even if you were at a running stream" (Narrated by Ibn Majah, No. 425). Surprisingly, I found an Australian water

Image 8: Water Company attaches Hadith

company attaches this 'Hadith' to its water bottles (see Image 8). He (PBUH) also taught us that "removing harmful things from the pathway is a charity" (Narrated by Al-Bukhari, No. 2989 and Muslim, No. 1009). Islamic teachings are inclusive of all life's aspects. However, in this research, I need to move beyond Islamic teachings, 'the content', to the way of providing the teachings.

As a Muslim I could also learn not only from the teachings (the content) that the Qur'an or the Prophet provided but also from how the teachings are provided. I think this is a very good point to focus on, because generally the focus has mainly been on the content with no emphasis on the way of providing the content. I consider these as ways of teaching. Here is an example that clarifies this point:

Abu Umamah said: "A young man came to the Prophet (PBUH) and said, "O Messenger of Allah! Give me permission to commit Zina [unlawful sex]". The people surrounded him and rebuked him, saying "Stop! Stop!". The Prophet said, "Come here". The young man came close to him, and The Prophet said, "Sit down". The Prophet said, "Would you like it [unlawful sex] for your mother"? He said, "No, by Allah, may I be ransomed for you". The Prophet said, "Neither do the people like it for their mothers". The Prophet said, "Would you like it for your daughter"? He said, "No, by Allah, may I be ransomed for you". The Prophet said, "Neither do the people like it for their daughters". The Prophet said, "Would you like it for your sister"? He said, "No, by Allah, may I be ransomed for you". The Prophet said, "Neither do the people like it for their sisters". The Prophet said, "Would you like it for your paternal aunt"? He said, "No, by Allah, O Allah's Messenger! May I be ransomed for you". The Prophet said, "Neither do the people like it for their paternal aunts". The Prophet said, "Would you like it for your maternal aunt"? He said, "No, by Allah, O Allah's Messenger! May I be ransomed for you". The Prophet said, "Neither do the people like it for their maternal aunts". Then the Prophet put his hand on him and said, "O Allah, forgive his sin, purify his heart and guard his chastity". After that the young man never paid attention to anything of that nature" (Narrated by Imam Ahmed, No. 21708).

Even though he is the Prophet, he did not take advantage of it to act as a controller. He did not punish the young man. He did not underestimate him. He did not say something like; this is the instructions of Islam that you have to follow. Instead, he

asked him to sit and tried to convince him why he should not do that, by asking him questions that let him think about himself in the same situation. The young man got to understand and was persuaded. If the Prophet's reaction was based on 'controlling', rather than 'hermeneutics', he would say something like; this is the instruction and you have to follow, or he could have punished him for his request. Consequently, if this had happened, the young man might not have responded, or said nothing, but he might acted out what was in his mind. Likewise, teachers need to deal respectfully with their students even if teachers might be asked strange questions or questions whose answers are well known. In many cases, students might know the answer of their questions but they want to be convinced. Here is an example of a question that is usually asked by students "can we use a calculator in mathematics test?" I have never heard an acceptable answer for this question to which the usual responses are such as "don't be silly", "just zip your mouth"... etc.

Another story...

Anas Ibn Malik, May Allah be pleased with him, said: "Whilst we were in the Mosque with the Messenger of Allah, a Bedouin came and stood urinating in the Mosque. The Companions of the Messenger of Allah said "Stop it! Stop it!" and were about to attack him. But the Messenger of Allah said, "Do not interrupt him, leave him alone". So they left him until he had finished urinating, then the Messenger of Allah called him and said to him, "In these Mosques it is not right to do anything like urinating or defecating; they are only for remembering Allah, praying and reading Qur'an", or words to that effect. Then he (PBUH) commanded a man who was there to bring a bucket of water and throw it over the [urine]" (Narrated by Muslim, No. 285).

I learn from this story that students sometimes need to be informed when they do a mistake instead of insulted. I remember a story of a student who was hit by his mathematics teacher due to an incorrect answer that he wrote in his mathematics textbook. The kid later said to his father, I really like the teacher and if he had told me about my mistake I would have fixed it.

The Qur'an and the Sunnah use different teaching methods. One of the most common ways of teaching in the Qur'an and the Sunnah is by telling stories. The Qur'an has many stories and the Prophet told us many stories in many different aspects. Telling

a story might be much better than saying instructions as though saying commands. For example, instead of talking about the importance of sincerity, the Prophet told us a story about it. The story combines several dimensions such as morality, emotionality, hermeneutics … etc. (see Chapter 8, the Power of a Story). Story-telling can be used in Saudi education as a way of teaching that empowers as does the Qur'an and the Sunnah.

EDUCATION

In 1970, the Supreme Committee for Education Policy issued the document, 'Education Policy in Saudi Arabia'. The document states in (Article One) that "the educational policy in the Kingdom of Saudi Arabia emanates from Islam, which the nation upholds as a faith, a source of worship, morality, law, governance and an integrated system of life. It is an essential part of the general policy of the State". Therefore, the Saudi educational system is called Islamic, so to speak[4], in which everything in the education system is supposed to not go against Islamic teachings. This Committee (established in 1963) is the highest authority that supervises education in Saudi Arabia and is headed by the King.

The general principles underlying education

The education policy document states 26 articles that provide the general principles underlying education in Saudi Arabia. The main principles are:

- The belief in Allah as the Lord, in Islam as the religion, and in Muhammad (PBUH) as the prophet and messenger.
- The complete Islamic conception of the universe, humans, and life, in which the entire universe is subjected to the laws of Allah Almighty, that enable each creature to fulfil its duty without any defect or disorder.
- The belief in human dignity as decreed by the Holy Qur'an.
- Seeking education is a duty for every individual by virtue of Islam, and the government's duty is to provide education in its various stages.

[4] When Saudi education is named as Islamic, does it mean that other education systems in other 'Islamic' countries are not Islamic? Also, what does it mean to be Islamic? Is it for the Islamic studies to be dominant? Is it for all subjects to be Islamic? Is there 'Islamic mathematics'? Or is it about Islamic values that are embedded or need to be embedded amongst the subjects?

- Females' right to suitable education is equal to that of males; "Women are the twin halves of men" (Reported by Abu Dawud, No. 236).
- Taking advantage of all types of useful human knowledge in the light of Islam; "Wisdom is the lost treasure of the believer, he seeks it wherever he may find it".
- Conscious interaction with the developments of world civilisations in the fields of science, culture and Arts.
- The Arabic language is the language of instruction, except where another language is required.

The purpose and general objectives of education

The education policy in Saudi Arabia identifies the purpose of education as "to have students understand Islam in a correct and comprehensive manner; to plant and spread the Islamic creed; to provide students with the values, teachings and ideals of Islam; to equip them with various skills and knowledge; to develop their conduct in constructive directions; to develop the society economically and culturally; and to prepare the individual to be a useful member in the building of his/her community" (1970, Article 28).

The education policy document states 33 articles that provide the general goals and objectives of education which stem from the previous general principles of education. They emphasise the special directives regarding the role of culture and religion. The main objectives among these directives are:

- Furthering loyalty to Islam.
- Demonstrating the complete compatibility between science and the religion of Islam.
- Encouraging and developing the methodological scientific search for knowledge; strengthening the skills of observation and thinking; providing students with the means of recognising Allah’s manifest signs in the universe; and thus enabling the individual to play an active role in the healthy development of social life and interaction.

- Understanding the environment, and enlarging students' knowledge of countries and regions of the world.
- Providing students with proficiency in another modern language as a means of acquiring knowledge in the fields of sciences, arts and new inventions, and of transferring knowledge and the sciences to other communities, in an effort to contribute to the spread of the faith of Islam and service humanity.
- Keeping up to date with the stages of the mental development of the young in order to help the individual achieve healthy spiritual, mental, emotional and social growth, emphasising the Islamic spiritual aspect of this growth.
- Recognising individual differences among students in an effort to properly place them and assist their growth based on their capabilities and inclinations.
- Caring for the learning disabled and setting up special programs for them.
- Setting up special education programs for physically and mentally handicapped students.
- Recognising gifted students and setting up special programs for them.
- Setting up human-resources training programs, with special emphasis on vocational education.
- Deepening the sense of work ethics and emphasising special academic skills and practical applications in school curricula. Promoting students through the development of artistic handicrafts and productive experiments in laboratories, workshops, and field work.

Administration and management of the education system

Education in Saudi Arabia is under the responsibility of the Ministry of Education, the Ministry of Higher Education, and the Technical and Vocational Training Corporation. The school year begins in September and ends in June, and consists of 38 weeks for secondary and higher education and 32 weeks for elementary and intermediate education, divided into two semesters. Schools are not co-educational except for kindergartens.

The Ministry of Education (established in 1953) is in charge of: general education (elementary, intermediate and secondary), special education and adult education and literacy.

The Ministry of Higher Education (established in 1975) supervises the execution of the Kingdom's policy in the field of higher education, including teachers' colleges and girls' colleges (previously under the Ministry of Education). Higher education is provided by 28 public universities and 8 private universities.

The Technical and Vocational Training Corporation (established in 1980) is the result of the integration of institutes and training centres. One of the purposes is to develop national human resources by addressing labour market demands for competent individuals through training.

GENERAL EDUCATION

General education is under the responsibility of the Ministry of Education. There are 42 regional and provincial educational bodies that look after the public and private schools in Saudi Arabia for 4 stages; pre-primary, primary, intermediate and secondary education.

Pre-primary education

Kindergartens provide for children aged 3-5 years. Kindergartens are not part of the official education ladder and are not a prerequisite for enrolment in grade 1 of elementary education. The main objectives at this level are the following:

- Nurturing the instincts of the children and looking after their moral, mental and physical growth in a natural environment similar to their family, and complying with the injunctions of Islam.
- Familiarising the children with the school atmosphere and preparing them for school life.
- Teaching the children easy fundamentals that suit their age and are related to their surroundings.

- Encouraging children's imaginative thinking, polishing their taste, and opening the doors for their energies to blossom under guidance.
- Protecting the children against dangers, treating the early signs of bad conduct and facing childhood problems in an adequate manner.

Table 1: General statistics on early childhood education in KSA, academic year 2009-2010

Year	Gender	Kindergartens	Students	Teachers
2009	Boys and Girls	1,521	106,301	10,337

Source: (World Data on Education, 2010/11).

Primary education

Children enter elementary education at the age of 6 years (it can be also for those who are aged 3 months under 6 years). The duration of this level is 6 years. The main objectives of elementary education are the following:

- Instilling the correct Islamic creed in the spirit of the children and providing them with comprehensive Islamic education and feelings of belonging to the Islamic nation.
- Developing various basic skills, especially language, numeracy and physical skills.
- Developing the feeling of responsibility to understand rights and duties within the limits of children's age and the characteristics of their stage of development, and foster love of their country and loyalty to their rulers.
- Creating in the children the desire to learn, as well as for useful work and training to make good use of their leisure time.

Table 2: General statistics on primary education in KSA, academic year 2009-2010

Year	Gender	Schools	Students	Teachers
2009	Boys	6,767	1,265,426	110,850
	Girls	6,836	1,227,699	112,661

Source: (World Data on Education, 2010/11).

Intermediate education

This follows elementary education and lasts for 3 years, from grade 7 to grade 9. The main objectives of the intermediate stage of education are the following:

- Supplying students with skills and knowledge suitable to their age, enabling them to learn the general principles and fundamental rules of education and sciences.
- Stimulating the students to search for knowledge and getting them used to scientific thinking.
- Developing, orienting and refining the various mental faculties and skills in the students.
- Nurturing the students along the Islamic social life which is marked by fraternity, cooperation, and sense of duty and shouldering of responsibility.
- Stimulating the students' ambition to restore the glory of the Islamic nation to which they belong and resume the march on the path of dignity and glory.
- Training students to use their time for useful reading and in religious activities and to employ their efforts in strengthening and advancing their Islamic character.

Table 3: General statistics on intermediate education in KSA, academic year 2009-2010

Year	Gender	Schools	Students	Teachers
2009	Boys	4,130	634,927	58,989
	Girls	3,780	553,415	58,381

Source: (World Data on Education, 2010/11).

Secondary education

This is the final stage of general education and lasts for 3 years, from grade 10 to grade 12. In regular secondary schools, students study a general curriculum during the first year and then choose for the remaining two years one of the following tracks: Administration and Social Sciences, Natural Science or Shariah (Islamic) and Arabic studies. Technical and vocational education is provided at technical secondary institutes. The main objectives of secondary education are the following:

- Strengthening the Islamic doctrine which gives the student a correct understanding of the universe, humans and life on earth and in heaven, and supplying the students with basic concepts and Islamic education which enables them to be proud of Islam and capable of preaching and defending it.
- Looking after the students' gifts and various capabilities which unfold at this stage and directing them appropriately, thus achieving the objectives of Islamic education in its general sense.
- Developing the students' scientific thinking and instilling in them the spirit of research, systematic analysis and the use of reference sources, and the practice of sound academic methods.
- Opening opportunities to competent students and enabling them to continue their studies in higher institutes and universities of all specialties.
- Imparting in students the best and useful reading habits and the desire to broaden their scop of knowledge and to use their leisure time in activities that improve their personality and the conditions of their community.

Table 4: General statistics on secondary education in KSA, academic year 2009-2010

Year	Gender	Schools	Students	Teachers
2009	Boys	2,469	606,062	47,353
	Girls	2,440	490,112	52,400

Source: (World Data on Education, 2010/11).

SPECIAL AND ADULT EDUCATION

The Special Education Department of the Ministry of Education operates schools for the blind, deaf, and the physically and mentally handicapped.

Table 5: General statistics on Special education in KSA, academic year 2009-2010

Year	Gender	Schools	Students	Teachers
2009	Boys	1,064	17,393	5,383
	Girls	487	8,932	2,419

Source: (The Ministry of Education, 2010).

Adult education is another part of the educational program in Saudi Arabia. It established a large number of adult education centres in order to make education available to everyone and to eliminate illiteracy. It is for people who are living in isolated rural areas, and it takes place as an intensive three-month course during the summer. In 2004, the literacy rate for Saudis above 15 is 87.5% for men, and 76.3% for women (The Ministry of Education, 2008). The literacy rate for children under 15 is 89.2 % for boys and 93.2 % for girls (Royal Embassy of Saudi Arabia, Washington, DC, 2010).

Table 6: General statistics on adult education in KSA, academic year 2009-2010

Year	Gender	Schools	Students	Teachers
2009	Male	768	12,671	Secondary teachers
	Female	3,156	70,100	13,319

Source: (The Ministry of Education, 2010).

HIGHER EDUCATION

Universities, colleges and higher education institutes offer a range of programs and specialities in several fields. The duration of the undergraduate program leading to a bachelor's degree is normally 4 years (5 years in the case of architecture, agriculture, engineering, pharmacy, and veterinary; 6 years in the case of medicine and law). At the postgraduate level, 1 year for higher diploma in education, 2 years to complete a Master degree, and at least 3 years for doctoral degree.

The main objectives of higher education are the following:

- Developing the doctrine of loyalty to Allah and continuing to provide students the Islamic culture which makes him/her responsible before Allah for the Nation of Islam, to ensure that his/her scientific and practical capacities are useful and fruitful.
- Preparing competent and qualified citizens to perform their duties in the service of their country for the progress of their nation in the light of sound Islamic principles and ideology.
- Providing gifted students with the opportunity for postgraduate studies in various scientific disciplines.

- Performing a positive role in the field of scientific research which contributes to world progress in art, Sciences and inventions, and finding sound solutions for the requirements of developed life and technological trends.
- Promoting authoring and scientific production in bringing the sciences into the service of Islamic thought and to enable the country to perform its leadership role in building human civilization on Islam's genuine principles that steer mankind to righteousness.
- Translating science and useful arts of knowledge into Arabic and enriching the Arabic language with new expressions to fill the need of Arabicization, and putting knowledge at the disposal of the largest number of citizens.
- Offering training services and reorientation courses to enable graduates who are already working to keep pace with new developments.

Table 7: General statistics on higher education in KSA, academic year 2006-2007

Year	Gender	Higher diploma	Bachelor	Master	Ph.D.
2006	Male	1,548	187,489	5,551	1,293
	Female	405	340,657	4,217	1,117

Source: (The Ministry of Economics and Planning, 2008).

Teachers' colleges

One of the key institutions in Saudi higher education is teachers' colleges. Teachers' colleges were established in 1975 under the name of senior colleges with the primary goal of increasing the number of teachers. By 1987, the decision was made to transform the senior colleges to teachers colleges that award a Bachelor degree in elementary teaching. Teachers colleges are the only specialized educational institutions for the preparation of elementary school teachers in Saudi Arabia since all faculties of education in the universities are concerned with the preparation of intermediate and secondary school teachers. Teachers' colleges follow a quarterly system, where the academic year is divided into two semesters. Teachers colleges were under the supervision of The Ministry of Education until 2007 when the decision was made to link the teachers' colleges to the universities.

Jeddah Teachers' College

This is one of the 18 teachers' colleges in the Kingdom, and is where I gained my Bachelor's degree and then worked as a mathematics teacher educator. Until I started this doctoral research, it is where I taught and monitored my pre-service mathematics teachers. It is called Jeddah Teachers' College due to its location in the city of Jeddah. It was established in 1988 with the aim of preparing teachers for the elementary stage of education, and consists of 14 departments that include mathematics. In 2007, the college came under the responsibility of Kind Abdulaziz University. Students who are undertaking the 'Mathematics Education' program must study one of the key units called 'Methods of Teaching Mathematics' in the first semester of their final year. The aim of this course is to equip students with information, ideas, concepts and methods that contribute to making them able to use and employ the skills to teach efficiently mathematics at the elementary level. In the last semester (which is called The Field Experience or Practical Education), students spend a whole semester in schools practising and applying what they have learned. They are required to work as in-service teachers but with a low teaching load of 8 to 12 lessons per week for the semester. In the field experience, mathematics teacher educators from the college (I am one of them) are required to visit the students in their schools and monitor their teaching. It was from there that the idea of this doctoral research began.

MATHEMATICS EDUCATION

There is no doubt about the importance of mathematics in all aspects of life and in many fields such as engineering, medicine, social sciences and even in Islamic studies. Mathematics as a subject has been regarded by the government, teachers and parents as one of the most important subjects in school. Accordingly, a lot of attention is given to mathematics, starting with making the subject compulsory in all levels and stages of Saudi Education. This attention has continued with the organisation of 'mathematics education' programs in teachers' colleges to provide qualified mathematics teachers for schools, including preparing them with innovative teaching methods such as collaborative learning and problem solving.

Later, this special attention shaped the project to reform science and mathematics curricula that was launched in 2008 after the disappointing results that Saudi students obtained in TIMSS[5] 2003 and 2007. Unfortunately, Saudi students showed a very low performance (below the average scale) in science and mathematics during their participation in the International Study of Mathematics and Science "TIMSS" in 2003 and 2007. In 2003, Saudi Arabia ranked 43 out of 45 countries that participated in the study. In 2007, Saudi Arabia ranked 47 out of 49 participating countries (TIMSS, 2003, 2007). The aim of the 2008 project was to prepare, print and supply textbooks and other educational materials for science and mathematics, based on the translation of the international series of science and mathematics textbooks of countries that achieved high levels in TIMSS, adapting them for the Saudi environment (Mathematics and Natural Sciences Curricula Development Project, 2008).

In 2009, 'King Abdullah bin Abdulaziz Public Education Development Project' was launched as the biggest development project for education in Saudi history. This project has a budget of SR9 Billion (US$2.4 Billion). One of the main programs in this project is 'training science and mathematics teachers' program that aims to develop the educational outcomes in science and mathematics, and raise the quality of learning by providing teachers with the necessary knowledge and skills (Tatweer, 2012). This is an important issue for the significance of this research (see Chapter 5).

تطوير
مشروع الملك عبدالله بن عبدالعزيز لتطوير التعليم العام
King Abdullah bin Abdulaziz Public Education Development Project

SUMMARY

In this chapter, I have presented the context and the background of my research, starting by introducing who I am. Then, I gave an overview about Saudi Arabia, the Islamic religion, the Education system and ended by outlining mathematics education in the country. I have situated this as the third chapter to make the context of this

[5] Trends in International Mathematics and Science Study (TIMSS).

thesis research clear in its early stage, as the context of my inquiry is considered to be a crucial point in making my research and my experience more understandable.

CHAPTER 4

A NEED FOR RECONCEPTUALISATION: LOOKING BACK AND LOOKING FORWARD

INTRODUCTION

The purpose of writing this chapter in my inquiry is to enable me to have a scholarly standpoint that looks to my past and present and envisions my future as I undertake my role as a critical auto/ethnographic inquirer reconceptualising his previous school experience. I outline the underlying educational and sociological theories that became part of my research as my inquiry progressed. In particular, I describe my transformation from objectivism to critical constructivism, using critical self-reflective thinking, and I explain transformative learning theory. I also demonstrate the theory of 'three human interests' and its significant influence on me and my research. It is vital to say that, in describing my transformation from the objectivist paradigm, I do not reject it nor do I leave this paradigm behind. The idea is to show the significance of this paradigm and its power by engaging critically with it (Ernest, 1995).

OBJECTIVISM

- **Objectivist paradigm of learning**

The paradigm of objectivism was formed by the Western rational tradition which is a set of assumptions based upon key concepts of reality, learning and education (Searle, 1993). It can be understood from two aspects: (i) the nature of the world is independent of any human understanding; and (ii) the nature of human cognition, knowledge and language is based on the metaphor of 'mind as a mirror of nature' (Lakoff, 1990). This long-established paradigm with its restricted (and restrictive) assumptions has been privileged and has prevailed for a long period of time, and it constitutes the objectivist paradigm of

learning (Mezirow, 1996). Learning within objectivism (i.e., objectivist learning or instrumental learning) “tends to depersonalize, objectify, to involve technical control and manipulation, and to lead to commodifying the culture” (Mezriow, 1996, p.169).

In this conventional culture, learning takes place within ‘learning structures’ that have been established before students commence their learning. In these learning structures, teachers are permitted to create a new structure only within traditional assumptions. Learners have no meaningful roles in shaping this conventional classroom culture. As knowledge is considered to be objective, students may not be encouraged to reflect on their subjective experiences to find out whether or not what they learn fits their interest. As language is considered to convey only one meaning within objectivist learning, students are expected to listen carefully to their teacher’s meaning which is being ‘transmitted’ to them by the vehicle of language, to memorise it as it is.

- **Its domination in my educational life**

If you return with me a few years ago before I had commenced my study for a Master’s degree at SMEC, I could say that my beliefs about and perspective on teaching, learning, curriculum and research were minimal. Put another way, I actually had never thought about or engaged in discussion with others or even had a

communication with others on this matter during all my journey of studying as a student or as a pre-service teacher or during my short working time as a mathematics teacher, or later still when I became a mathematics teacher educator. However, this does not mean that I had no beliefs about teaching, learning, curriculum and research. I had beliefs, and a perspective, but they were unclear to me. They were not specified. They were not identified. To make it short, they were not an issue. I did not realize them. All that I had was merely a common view towards teaching and learning (see Chapter 6). In addition, I did not see any mathematics teacher practising an alternative perspective of teaching. I had not been involved in or saw any other classroom culture but the regular one. So, it was not apparent to me that I was adopting a particular perspective of teaching or learning. In different words, I was not conscious that I was following a particular standpoint of teaching and learning. I

basically taught as any other mathematics teacher did and learnt as any other student learnt. It was not a concern.

Furthermore, it had been supported unintentionally but powerfully until it had become embodied in my mind. For this, I can say that - at that time - my viewpoint towards teaching, learning, curriculum and research were not explicitly conceptualized in my mind. By the way, this is what 'hegemonic' means: we are not aware of our concepts of teaching, learning, curriculum and research. Comaroff and Comaroff (as cited in Merry, 2003) define hegemony as “that order of signs and practices, relations and distinctions, images and epistemologies—drawn from a historically situated cultural field—that come to be taken-for-granted as the natural and received shape of the world and everything that inhabits it” (p. 462). In my case, the traditional culture of teaching and learning is the hegemonic culture of mathematics education in Saudi Arabia that I am not aware of. The domination of this widespread conservative culture makes it seem natural and suppresses forms of resistance (Merry, 2003).

However, I can now (after engaging in critical reflexivity with metaphorical thinking) formulate my previous positions and perceptions towards teaching, learning and curriculum - derived from my learning and teaching experiences at that time. It seems that the domination of objectivist thinking and behaviourist learning theory had shaped my thoughts to perceive the main role of the teacher in terms of “teaching as training” which meant telling, lecturing, explaining, describing and controlling the classroom. Also, it contributed to shaping my philosophy of education to be restricted to 'teaching the right answer' instead of aiming to generate understanding.

And for the students’ role, I had grasped it in terms of “learning as performing” which meant listening to the teacher, reading the curriculum, memorizing what the teacher says and what they read from the curriculum, doing their homework and preparing for exams. It reduced learning to a model where the fundamental principle was the 'law of effect'. Behaviourists say that students will only learn if they are rewarded for doing so. Basically, they argue that any action that is ‘positively’ reinforced will be

repeated (Sutherland, 1992; Flora, 2004). So, students tend to repeat 'the desired response', that is, what the teacher wants. This way of learning tends to focus attention on students' performance rather than on their reasoning. In this case, students repeat what they had been repeating (based on the power of reinforcement) regardless of their understanding of the problem and also regardless of the logic that distinguishes the correct solution from inadequate responses (von Glasersfeld, 1995).

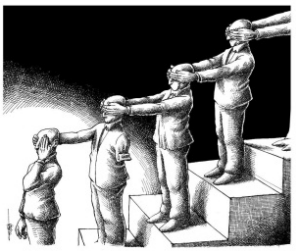
And for the curriculum, I conceived of it in terms of a "textbook" which I considered to be a container of knowledge. And I thought that knowledge should be transmitted

from the curriculum to the students. I understood curriculum as content or subject matter in which curriculum is equated with the subjects to be taught (Schubert, 1986). This understanding led me to focus only on topics to be customarily covered, and to neglect students' higher-order thinking such as critical thinking, reflective thinking, creative thinking, deep cognitive understanding and personal growth. It also led me to ignore students' attitudes, students' social (classroom?) interactions and their prior knowledge.

And regarding research, my understanding of it was in terms of 'finding the truth'. And truth is a matter of the accuracy of representation. Any statement I provide is an attempt to describe how things actually are in the world. And what I describe is considered to be true only if my statements about things describe things as they really are in the world (Searle, 1993). For me, research had to be objective and value-free. My understanding was that quantitative research is more powerful, reliable and legitimate than qualitative research. Questionnaires and (less common) interviews were the only legitimate ways to find or to collect research data. My positions towards teaching, learning, curriculum and research were seemingly more compatible with the objectivist paradigm. Later, while I was doing a Master's degree, I came to link the name of 'objectivism' to these positions.

On reflection it seems to me that objectivism has been privileged over non-objectivism in the Saudi education system, in general, and in mathematics education, in particular. More specifically, objectivism has been privileged in the pre-service unit of 'Methods of Teaching Mathematics', which ignores alternative

epistemologies when introducing student-centred approaches (see Chapter 5). Essentially, the only available epistemology of teaching, learning and researching was objectivism. The most important issue here is that the objectivist perspective did not come from 'nowhere'. It was not accidentally cultivated in my consciousness and it was not privileged arbitrarily. Although I had never been taught to adopt an objectivist perspective, or to be like an objectivist, it simply happened. I was not aware that I was embracing objectivism. I simply followed what I used to see of other teachers in the classroom. To be clearer, I was not specifically taught that in school. Due to its daily application in school, however, I indirectly learned it, and it strongly shaped my viewpoints about teaching and learning. For my entire previous learning experiences in Saudi Arabia, I mostly had the same classroom environment in which a teacher presents the subject content to a silent classroom (see Chapter 6). As a student for sixteen years, I had met many different teachers but all had similar classroom roles. For sixteen years, my role as a student in receiving knowledge was shaped by each teacher's role in transmitting knowledge. Hence, my teaching and learning experiences should be a matter of investigation.



It is Objectivism...

I live within it ... I grow up with it.

Wherever I go … I find it … It is objectivism.

I'm free … But it restricts me

I'm cool … But I became tough … Due to objectivism.

I might know … But not understand

I can memorize … But what does it mean? … It is objectivism.

What do I need to do? … Tell me what you want me to do

You have to do so! … Don't ask me why … It is objectivism.

I can smell it … But it's not fragrant

I can touch it … But I can't feel it

I can hear it … Without voice

I can taste it … But I can't enjoy it

I can see it … Without colour … It is objectivism.

It is one … And more than one.

It is in my genes … But in everyone else's … It is objectivism.

It is in my mind ... Do you see it?

It is in yours ... I see it ... Do you feel it?

It is in your partner ... Do you smell it? … It is objectivism.

It is strong … but it can be beaten.

I want to get rid of it … but it's not easy … It is objectivism.

Can I understand?

It makes me feel better

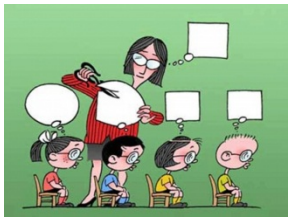
I want to make sense, can I? … It is Not objectivism.

- **First human interest: the technical interest**

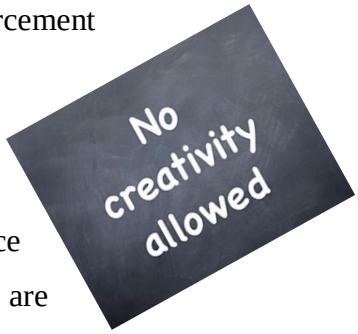
The German philosopher Jurgen Habermas' (1972) theory of knowledge and human interests proposed the theory of 'knowledge-constitutive interests'. It is a theory about the fundamental human interests which influence how knowledge is 'constituted' or constructed (Grundy, 1987). Habermas identified three basic knowledge-constitutive interests: technical, practical and emancipatory. These three interests each play a part in constituting three forms of knowledge. They could also be called 'action-constitutive' interests (Habermas, 1972, p. 211). Simply, they are considered to be three ways of acquiring knowledge. In this part, I explain the first human interest; the technical cognitive interest while practical and emancipatory interests will be explained in the sections on constructivism and transformative learning theory, respectively.

The technical human interest entails an empirical-analytical way of knowing that exemplifies the world in terms of objects, processes, and laws (Grundy, 1987). Technical human interest is associated with the cultural myth of objectivism that preserves the empirical-analytical sciences (including mathematics) as the source of privileged knowledge of the world (Taylor, 1996). It constitutes an objective form of knowledge (Taylor & Campbell-Williams, 1993) and promotes objective thinking. Technical interest advocates 'instrumental learning' (Habermas, 1984). Thus my

learning and teaching experiences were "based on empirical knowledge, and [were] governed by technical rules" (Mezirow, 1981, p. 4). Empirical-analytic science provides knowledge that is governed by an interest in explaining, that provides the basis of prediction which, in turn, provides the basis for the control of the environment (Grundy, 1987). The purpose of empirical-analytic knowing is to discover law-like regularities to apply to educational practice to improve efficiency (Ewert, 1991).



So, because the technical interest that guides empirical-analytic science is concerned with identifying the culture of the classroom, it is possible to formulate rules and roles for teaching and learning practice based upon that culture. For example, if we discover that positive reinforcement is a standard factor in memorizing the times table, a set of rules about the application of positive reinforcement will most probably lead students to memorize the times table. The technical interest is positioned in the need of the teachers and students to repeat knowledge defined as what has been written in the curriculum and to reproduce cultural dimensions of the mathematics classroom which are deemed to be of most worth. To accomplish this function, teachers have a fundamental orientation towards controlling and managing the classroom environment.



CONSTRUCTIVISM

With the emergence of the constructivist paradigm of learning, objectivist assumptions about teaching, learning and researching were challenged. Once the challenges of the constructivist paradigm (see the boxed text) encountered the objectivist assumptions, the concepts of learning, teaching and research started to be transformed.

Constructivism is a metaphor of construction, describing understanding as the building of mental structures, and

The challenges

1- Individuals' ability to organize and select.

2- Individuals' natural knowledge which might lead to individual structures.

3- Individuals' subjectivities.

4- Cognitive revolution.

5- Social reality.

reconstruction is a metaphor for conceptual change or accommodation (Ernest, 1995). With the subsequent expansion and elaboration of constructivism, however, it is important to clarify what I mean when I say 'constructivism', especially within the field of education where most specialists and experts of constructivism are situated.

It is quite common that the most frequent understanding about constructivism is that we never learn something from 'scratch', but we have an idea and build on it. This understanding has been recognised as the simplest form of constructivism, the basic form and the root of all other 'faces' of constructivism. This understanding derives from Jean Piaget, a pioneer of constructivist thought, and has become known as 'trivial' constructivism (von Glasersfeld, 1990) and also as 'personal' constructivism and 'cognitive' constructivism. Von Glasersfeld (1989) considered this as the first

principle of constructivism: "knowledge is not passively received but actively built up by the cognizing subject" (p.162). According to this principle, knowing is considered as active, individual and personal, and is based on previously constructed knowledge (Ernest, 1994a, 1995, 2010). Knowledge is actively constructed by the learner, not passively received from the environment (Dougiamas, 1998). So, students do not *learn* only by passively receiving information from their teachers (metaphorically as information-receptionist), rather, they *learn* by actively constructing their knowledge. This perspective is not like traditional epistemologies that promote simple transmission of meaning from a teacher to students. Personal constructivism considers that students' prior knowledge is essential to be able to 'actively' construct new knowledge (Dougiamas, 1998).

However, my research has been influenced by more sophisticated features of constructivism which are not included in the previous principle alone. There are many types of constructivism (Ernest, 1991, 2010; Dougiamas, 1998) and the differences between their various positions are significant as they make a significant difference in practice (Ernest, 1995). Thus, I think that saying 'constructivism' alone does not really clarify specifically its orientation. Initially, I was thinking that I am a constructivist researcher because I used qualitative methods. However, I had ignored that my research approach was based on an absolutist epistemology. I think it is

important here to draw out the differences between the different constructivist positions.

Even though the distinction between different forms of constructivism seems to be not clear cut amongst a number of constructivists, I have attempted to briefly summarize what Paul Ernest (1995, pp. 459-486) has demonstrated in his chapter "The One and the Many" in terms of the contrasting metaphors of the mind and metaphors of the world. He has considered seven different paradigms as follows:

Metaphor of the / Theory	Mind	World
Traditional empiricism	Mind is an empty bucket, a blank page or a tabula rasa; it needs to be filled with sense impressions. Also, mind is a mirror; that passively reflects reality. It reflects the objects in the material world.	World is an absolute Newtonian physical space; in which permanent material objects are positioned and move.
Information-processing theory	Mind as a computer; it actively processes information and retrieval of data, but incoming information or knowledge must simply be received by the cognizing subject.	World is a Newtonian absolute space occupied by material objects.
Trivial constructivism	Mind is the brain, self-constructing the data (by means of information from the world). Knowledge is constructed to match the world, not as a recursive	World is an Absolute Newtonian physical space.

	construction based on previous constructions. Individual's constructions are correct representations of the external world.	
Socio-cultural cognition	Mind as a game player and strategist; it takes social interaction and its socio-cultural contexts in its account. This metaphor goes beyond the mind as computer because it admits social interaction.	World is an absolute Newtonian space but it includes human society.
Radical constructivism	Mind as organism undergoing evolution; it is a creature that organizes the data through its cognitive processes. It generates cognitive schemas to represent its experiences, which can be tested according to how well they 'fit' the world of its experience. It is individually and personally constructed based on its experience of the world. For example, I as a researcher, build my understanding of the phenomena (or the problems) of Saudi education based on	World as it is in itself; it is independent of the mind. It is experienceable, but not accessible to the human being. So, when I construct my knowledge I construct it based on my mind and my cognitive processes, in dialogue with my own experience of the world, not the world itself. So, students learn from their own experiences of the world.

	my experience of the problem. What I generate is my understanding of the phenomena that I had experienced.	
Social constructivism	In social constructivism, mind's metaphor cannot be isolated. It cannot be seen as an individual. Mind is seen as a person in meaningful conversation and dialogue, and interaction with others; it is social construction of meaning.	World is seen as a shared experience of physical reality. It is socially constructed, and the process of its construction should not be stopped. It needs to be modified and interacted with all the time to 'fit' the ontological reality. Even though it cannot give a true picture of it, it has to have a continuous process of construction. So, there is a world out there that we only have shared access to; we cannot have a true picture of it, or get certain knowledge of it. We never know exactly. World cannot be known with certainty.
Social constructionism	The difference between social constructivism and social constructionism is that the latter prioritizes the social above the individual. Mind as a dialogue or an actor plays in a drama, it is introjected social dimension. The evidence of the mental is to be found in social	World is social reality. It is what we do and perform in society with others. So, social constructionism considers, for example, that the phenomena (or the situation) of the mathematics classroom in Saudi Arabia is created (or constructed) by the Saudi mathematics teacher. The focus of social constructionism

	performance and public display.	is not on the individual teacher, it is on the situation of the mathematics classroom that is created through the practice of teachers in that classroom. It focuses on the construction of their perceived social reality which is what we call the 'classroom'.

That was a brief summary to place constructivism within a big picture. Now, I discuss what has influenced me and has driven my research in relation to the most sophisticated forms of constructivism.

- **Radical, social and critical constructivism**

Radical and/or social constructivism

I am not really concerned about the differences between radical and social constructivism in this inquiry. Hence, I am not going to *talk*[6] about issues such as whether an idea is supposed to be under the radical or social constructivist paradigm. It is not my focus/attention in this study. My concern is about the underlying epistemology of constructivism and both radical and social constructivism explicitly adopt a non-absolutist and non-objectivist epistemology. Both embrace the same fallibilistic epistemology. Both require reflexivity and both - in this research - give me the role of knowledge constructing and meaning making. Both problematize the whole relationship between me as the knower and the known. Both accept that I cannot obtain *the* absolute knowledge (See below: the section on constructivist epistemology). Though, I tend to prefer the version of radical constructivism that is close to social constructivism.

Radical constructivists identify the social dimension as a very important component of the learning process (Hardy & Taylor, 1997). Von Glasersfeld (1990) said that

[6] Actually I write not talk but we metaphorically understand write now in terms of talk☺.

every individual's abstraction of experiential items is constrained (and thus guided) by social interaction. Cobb (1994) contended that constructivist and sociocultural perspectives are complementary. The way that one acquires knowledge is through social interaction. Language might be the most frequent form. From this constructivist perspective, we construct our understanding by reflecting on our experiences of the world. And there is no doubt that our experiences include communication and interaction with others. Our sense-making is meditated by the way others make sense of their experience of the same phenomena.

Radical constructivism adds a second principle to trivial constructivism (von Glasersfeld, 1990), which can be expressed as "Coming to know is a process of dynamic adaptation towards viable interpretations of experience. The knower does not necessarily construct knowledge of a 'real' world" (Dougiamas, 1998). To bring them together using von Glasersfeld's words, radical constructivism puts forward two main claims: "(a) Knowledge is not passively received but actively built up by the cognizing subject; and (b) the function of cognition is adaptive and serves the [learner's] organization of the experiential world, not the discovery of ontological reality" (von Glasersfeld 1989, p. 162). Radical (and social) constructivists believe that learners individually construct their knowledge through social interactions and interpreting their experiences in a real world context. So, their knowledge about the world corresponds to reality as they experience and make sense of it.

My research methodology has been influenced significantly by radical constructivism. It has contributed to shaping how to do my research. Radical constructivism challenges the notion of external reality. It does not deny an objective reality but it states that we have no way to know exactly what the reality is. We do not have any method of attaining objective knowledge (von Glasersfeld, 1992). Moreover, radical constructivism asserts that existing reality is "a matter of preferred belief, and as such is not within the scope of cognition" (Quale, 2007, p. 233). Reality in radical constructivism is what we have constructed in our mind based on our experience of the experiential world. Accordingly, radical constructivism gives high priority to one's experience and considers it as the tool of knowing by making sense of that experience. My experience is considered as a 'window' that I open to know the world I experience. My experience is my 'eye' developed in the environment I have been in. Consequently, you will find this research is based

mainly on my own experience of teaching and learning. Based on my experience I have constructed my reality of the situation in Saudi mathematics classrooms (see Chapter 2). From this perspective, I cannot pretend to have an 'objective' view of how the Saudi mathematics classroom's state of affairs came about, but I have a view nevertheless.

Critical Constructivism

Why the critical dimension of constructivism?

The central idea of constructivist learning theory is that students' learning is constructed, so students build their new knowledge upon the basis of their previous learning (Hoover, 1996). They do not learn absolutely from 'scratch'; they construct their new understandings by using what they already know. So, when students come to the classroom, they come with their knowledge that they gained from their previous experience, and that prior knowledge might influence their new knowledge that they will construct from their new learning experiences. What students already know is considered to be the most central factor that influences their new learning. As a teacher who *learnt* about constructivism, I had been told to ascertain what learners already know, and then to teach them accordingly. Based on this, a good teacher takes the students from where they are by expanding what they already have.

However, what students (in my case: pre-service mathematics teachers) already know about (or are familiar with) teaching and learning might be the main factor that hinders the improvement and the reform of mathematics teaching and learning in Saudi Arabia. I argue that prospective Saudi mathematics teachers are not supposed simply to build what they learn about innovative teaching methods on what they already know (their prior knowledge) towards mathematics teaching and learning. I do not want them to learn simply according to what they already have experienced. They are often unable to discern the ways that their past classroom experience and their cultural classroom environment shape their perception of the mathematics classroom (Kincheloe, 2005). I want them (first) to be aware of what they already have (i.e., their current understanding and assumptions of teaching and learning), and (second) to analyse those assumptions based on their new learning about improving and transforming Saudi mathematics classroom culture. Teaching and learning innovative pedagogies based on constructivism might contradict what they already

have. So, simply expanding what they already have experienced of objectivist teaching and learning would not necessarily fit their new learning of constructivist pedagogies. I think that without the critical dimension, changing what they already know or are familiar with (i.e., their novice assumptions about mathematics learning and teaching) seems to be very difficult. Without the critical dimension, changing the status quo of the traditional culture of the Saudi mathematics classroom looks to be out of reach. I consider the critical dimension to be crucial in my case. Critical dimension in my case is concerned with extending Saudi student teachers' consciousness of themselves as mathematics classroom teachers in light of the way dominant power operates to manage the classroom culture (Kincheloe, 2005). I consider critical constructivism an essential theory that shapes both me and my inquiry.

Critical constructivism (Taylor, 1996) looks at constructivism within the social and cultural environment of the classroom, but importantly adds a critical dimension that aims to transform the current environment of the classroom in order to improve the success of applying constructivism. When critical constructivism aims to transform the classroom, it attempts to do so in relation to the social culture of the classroom. The social culture of the Saudi mathematics classroom currently gives a privileged value to teacher control and student conformity (see Chapter 6). Simply, the social reality of the mathematics classroom is governed by the traditional but powerful assumptions of teaching and learning that restrain the discursive practices of teachers and students. I believe that critical constructivism might provide a theoretical referent that would be viable in deconstructing the hegemony of those assumptions and be practical in dealing with this issue.

Radical (social) constructivism alone seems to be not enough for me to use as a referent to empower Saudi mathematics teachers to overcome their prevailing objectivist cultural tradition (Hardy & Taylor, 1997). I need the self-critical dimension to transform Saudi mathematics classrooms. In transforming Saudi mathematics teacher's professional practice, I need to engage them critically in relation to their own classroom experiences that have shaped their teaching and learning conceptions.

What has been focused on in mathematics education in Saudi Arabia is pedagogical reform. As a result, pre-service mathematics teachers have been required to learn alternative pedagogies based on constructivist learning theory, such as collaborative learning and problem solving (see Chapter 5). However, I argue that learning those innovative teaching methods *simply by means of the transmitting-receiving approach* is not sufficient to empower teachers to change. Transforming Saudi mathematics education needs not only pedagogical reform but also an epistemological reform that empowers teacher educators to engage their pre-service mathematics teachers "in discursive practices that emancipate them from the indoctrinating and dehumanising influence of repressive cultural myths" (Taylor, 1996, p. 167). Transforming the culture of Saudi mathematics classrooms is a matter of reconstructing teachers' social reality of the mathematics classroom that has been set up in their minds. It is a matter of mental reform.

Taylor (1996) describes critical constructivism as a "social epistemology that addresses the socio-cultural context of knowledge construction and serves as a [powerful] referent for cultural reform . . . [It] confirms the epistemological relativism of radical constructivism, but [also] identifies the epistemic being as a socio-cultural being suspended historically in semiotic systems whose invisibility is potentially disempowering" (p. 159). Critical constructivism adds greater emphasis to the actions for change of a pre-service teacher. It is a theoretical framework using the critical theory of Jurgen Habermas to help make potentially disempowering cultural myths more visible, and hence more open to question through conversation and critical self-reflection. It enhances pre-service teachers to "reveal how their own perspective came to be constructed and how the social values, ideologies and information they encounter shape their pedagogies and worldviews" (Kincheloe, 2005, p. 4) An important part of that framework is the promotion of 'communicative ethics' to establish dialogue oriented towards achieving mutual understanding (Taylor, 1998).

Critical constructivism advocates critical self-reflexive awareness as a vital factor of mathematics educational reform, especially reform that aims to facilitate teachers' professional development of reconstructing the traditional culture of mathematics

classroom settings. Critical constructivism serves as a powerful theoretical framework for making visible and deconstructing repressive cultural myths of the classroom that distort and, at best, restrict the teacher's role and his/her teaching practices.

- **The concept of Epistemology**

Epistemology is my concern in this research (see above) because it strongly affects my thoughts about professional practice (see below). It affects how I think, my thoughts about teaching and learning, and how I conduct research. Epistemology has two main contexts: psychological and philosophical. The term 'epistemology' is significant for clarifying and justifying the way of knowing. Epistemology is concerned with what we can know about reality and how we can know it. Epistemology is about theories of knowledge (Willis, 2007). It is about the nature of knowledge and its forms and how it can be acquired. Also, it could be about the nature of the relationship between me as an inquirer and what can be known.

There are differences between constructivists and others in terms of their epistemologies. Constructivism is said to be 'post-epistemological' (Noddings, 1990) as it breaks with traditional epistemology (von Glasersfeld, 1992, 1995). It is proposed as an alternative to the long-dominant epistemological theory of objectivism (Hardy & Taylor, 1997).

The following table expresses key distinctions between constructivist epistemology and the traditional objectivist epistemology (von Glasersfeld, 1990, 1995; Ernest, 1995).

Constructivist epistemology	Objectivist epistemology
It is based on philosophy.	It is based on psychology.
The epistemology is fallibilist, sceptical and anti-objectivist.	The epistemology is objectivist and absolutist.
It is the theory of knowledge. It	It concerns theories of knowledge

concerns and emphasises the logical categories and rational classification of knowledge and its justificational basis.	growth and development. It concerns genesis, nature, structure and development of knowledge, and its relationship with individual knower.
Person's knowledge is stronger than his/her belief.	Beliefs are stronger than knowledge.
It concerns the context of justification of knowledge. Knowledge in this epistemology needs to be justified.	It concerns the context of discovery of knowledge. Knowledge in this epistemology needs to be discovered.
Knowledge is actively built up by the individual. It is adaptive. It is active, subjective and personal, and constructed based on previously constructed knowledge.	Knowledge is objective. It is fact and truth, and can be received and transmitted from one to another who only needs to store it and recall it when one needs it. It is independent of the knower. It is called scientific knowledge or (neo-) positivistic knowledge.
Knowledge represents what we can do in our experiential world. What human reason produces of constructed knowledge can never be claimed as 'Truth' (or absolute truth).	Knowledge should represent a real world which is existing, separate and independent of the knower. Objectivists produce true knowledge which accurately represents or corresponds to an external world.
No ultimate true knowledge is possible about the state of affairs of the world. No one can produce an ultimate true representation of an objective world. This epistemology problematizes the whole relationship between the knower and the known, and considers that no absolute knowledge can be achieved by the knower. This does not mean that constructivists cannot have knowledge but they need to	True knowledge of the state of affairs in the world is possible. Knowledge is true if and only if it correctly reflects an independent objective world. This epistemology does not require any reflexivity or doubt about one's role in having meaning or acquiring knowledge.

justify (not prove) what they produce of their constructed knowledge.	
There is always more than one way of solving a problem and/or achieving a goal.	There is only one ultimate truth (or Truth) that describes the world.
This epistemology has replaced 'Truth' by the notion of 'viability'. Viability is relative to a context of goals and purposes. So, concepts, models and theories are viable if they work well enough in the contexts in which they were created.	This epistemology has a concept of Truth. Truth is the correct representation of states or events of an external world.
This epistemology supports a more interactive perspective, involving the selection, processing and assimilation of information according to the state of the learner's mind.	This epistemology supports a naive transmission view of teaching and a passive-receptive view of learning.
This epistemology implies that if something does not make good sense to the students, this might lead to misconceptions and errors among learners.	This epistemology implies that the misconceptions of students are due to faulty memorization or recall.
This epistemology includes other epistemologies in which constructivists agree that there are matters which can or probably must be learned in a mechanical way.	This epistemology does not include the epistemology of constructivism.

This table shows the differences between constructivist epistemology and objectivist epistemology in terms of several dimensions. One of the key differences is that the constructivist epistemological way of thinking has replaced the traditional conception of truth by the notion of viability. Constructivist epistemology has adopted subjective

viability as the key alternative or as a metaphor of the customary criterion of objective truth.

- **The concept of Viability**

Von Glasersfeld (1989) pointed out in his chapter "Constructivism in Education" the two principles of constructivism. The first principle is that knowledge is not passively received, but it is actively built up by the cognizing subject. So, knowledge in this point of view is self-organized cognitive process of the human mind, not as several objects that are absorbable by the human mind as objective truths (Holtorf, 1997). The second principle is that the function of cognition is adaptive, tending towards fit or viability, and cognition serves the subject's organization of the experiential world, not the discovery of an objective ontological reality. Accordingly, the purpose of constructing our knowledge is not to claim or find the absolute truth, rather it is to 'match' or 'fit' what we have constructed as knowledge with the constraints of the world as we experience it. The notion of viability has superseded the concept of truth in constructivist way of thinking. Viability is relative to the context of goals and purposes in which concepts, models and theories are viable if they prove adequate in the contexts in which they were belong or created (Von Glasersfeld, 1995). Clearly, "a viable construction is any mental or physical action that is consistent with one's experiences AND fulfils an intended purpose" (Hardy & Taylor, 1997, p. 138)

Metaphorically speaking, 'fit' as a 'key' metaphor could explore the meaning of viability. A key fits if it opens the lock. Here, the point is about the key, whether it fits or not, it is not about the lock. The 'fit' describes the capacity of the key, not of the lock. The question here is: do we hold only one key that unlocks our door? The answer probably is yes, we have one key that opens our door. However, this is not the case for professional burglars who have key/s that are shaped quite differently from our keys but they unlock our doors. In this metaphor, we (students, teachers, researchers … etc.) are just like 'burglars' who face a lock (our environment, mathematics classroom, teaching, learning …etc.) that we have to unlock. The lock is one but the key is several in which every 'burglar' has his/her way to unlock the lock (von Glasersfeld, 1984).

By contrast, the concept of Truth means that there is only one correct view and only one way to get to that true view. From a constructivist epistemology, however, what I perceive of the external world may be different from what you perceive. This difference comes from our different viable experiences of that world. We might also have different meanings of what we hear. This difference comes from our individual different interpretations (or subjective constructions) of what we hear, as a result of our different subjective experiential worlds. Consequently, if we hold the 'Truth' perspective, this means one of us must have an incorrect view or wrong understanding while the other 'gets' *not* 'builds or constructs' the correct one. Conversely, if we hold the 'viability' perspective, each one of us has his own correct view and right understanding. We both have our own 'truth'. Yes, in constructivist epistemology we can have multiple truths in the cognitions of different knowers.

The epistemology of constructivism expresses that there always must be more than one truth, and more than one way to obtain the truths which describe the world around us. So, the notion of viability gives the opportunity to show that there are many different ways of solving a problem or achieving a goal. I think that to be a constructivist I necessarily have to change my concept of how we acquire knowledge (Von Glasersfeld, 1995). Learners construct their knowledge on the basis of their cognitive processes in dialogue with their *experience* of the world not of the world itself. So, to the constructivist, this knowledge is what is viable rather than what is True.

- **Second human interest: the practical interest**

The second of Habermas's knowledge-constitutive interests, the practical interest, is compatible with the idea of constructivism in which subjective knowledge is generated. However, critical constructivism involves both the practical and emancipatory interests. While the basic orientation of the technical interest is toward control, the basic orientation of the practical interest is toward reciprocal understanding (Grundy, 1987). The practical human interest entails historical-hermeneutic ways of "knowing and acting that [are] oriented toward communicating with others [and intersubjectivity] for the purpose of [building consensus or sharing] mutual understanding" (Taylor, 1996, p. 161). It represents the physical, social, and

cultural worlds as "texts" in which these need to be interpreted in order for meaning to emerge (Streibel, 1991). The practical interest is consonant with interpretive inquiry. The word ‘interpret’ means to understand the meaning of something, the meaning of a text, the teacher’s talk or the meaning of what has been discussed or communicated. The practical interest which tends to that meaning may not be carried by the language. Meaning needs to be constructed and understood based on the meaning-maker’s thinking. In research, Interpretive inquiry puts emphasis on the acquisition of understanding. It seeks to understand the meaning-perspectives of teachers and students in mathematics classrooms, rather than to establish causality (Mezirow, 1981). It gives rise to teaching and learning experiences to be interpreted and for meaning to emerge. Simply, practical interest seeks ‘true’ understandings not the one ‘Truth’. Practical interest motivates me to use interpretive inquiry in my research to explain and clarify the assumptions underlying teaching and learning in order to understand the culture that shapes the mathematics classroom in Saudi Arabia. “Understanding is inherently a social rather than a biological act; it cannot be cut away from the socio-cultural circumstances of the [Saudi mathematics classroom]” (Mezirow, 1996, p. 160).

- **Pedagogical implications of constructivism**

There are many pedagogical implications of constructivism that could influence the culture of the Saudi mathematics classroom needing to be transformed, and I start with what Paul Ernest (1995) has suggested. First, the teacher needs to pay attention and be aware of learners’ prior knowledge, accepting that they are not empty, tabula rasa (Hoover, 1996) or blank slates (Tytler, 2002b) when they come to the classroom. The teacher needs to monitor what knowledge students already have. The teacher must engage students in learning, bringing their current views to the forefront (Hoover, 1996) "for discussion and evaluation in the light of evidence" (Tytler, 2002a, p. 30). This matter has become very important in the educational field; it may help the teacher to avoid learners’ further errors and misconceptions due to their previous knowledge. Learners may come to the classroom with their novice ideas which may not be compatible with their new learning. On the other hand, some students may come to the classroom with their ideas which help the teacher to build

on them. Second, the teacher may not be able to regulate the knowledge in the learners' minds, so the teacher needs to be aware of strategic self-regulation of students which might encourage the teacher to think about multiple representations of such concepts. Third, the importance of the learners' goals should be realized as well as the dichotomy between them and the teacher's goals. Fourth, the significance of the social context also should be recognized, such as the difference between school mathematics and street mathematics.

Beyond these implications, Paul Ernest (1995) suggested other pedagogical implications which are stronger; they follow from radical and social constructivism. First, knowledge as a whole is problematized. So, teachers should give learners an opportunity to solve those problems. They may have different ways of solving them which could be better than what teachers do. Some students may already have experience of dealing with such problems. Second, because there is no "royal road" leading us to Truth, we as teachers need to be aware of various methodological approaches. We have to be more careful of what, how and why such an approach should be used. Third, the teacher's concern should include learners' beliefs and conceptions of knowledge, not just their cognitions. Fourth, the important point is not only what knowledge teachers have but also their beliefs, conceptual understandings and their personal theories of teaching and learning. Fifth, teachers and learners have epistemological realities independent of each other. The teacher may come to know learners' understandings by interpreting their language and actions through his/her own conceptual constructs. However, the teacher should never take learners' conceptual realities as fixed. Sixth, learners need opportunities to discuss and share their meanings and experiences with their fellows. Collaborative learning methods could help with this point.

Furthermore, von Glasersfeld (1995) has mentioned some pedagogical implications of radical constructivism. The first is that learning by reflecting and abstracting requires self-regulation and the building of conceptual structures in the learner's mind. So, learning is not passively receiving information; but it is more interactive, processing and justifying of knowledge according to the set-up of the learner's mind. The constructivist teacher does not take the role of the 'sage on the stage', instead, s/he act as a 'guide on the side' (Hoover, 1996) who provides students with opportunities to reflect on their current understandings. The second is that problems

are not solved by recalling what we call the ‘right’ answer, but by viewing a problem as our own problem. By engaging students in one’s-own-problem situation, one needs to search to find a path to *a* solution rather than to be told *the* right one. This way of searching and finding might provide more pleasure and satisfaction for students compared with when they are simply told the correct answer. By the way, what students find is considered to be a ‘viable way of solving’ rather than the only way to solve a problem. Their finding of viable solution strategies does not mean that there is no other way of solving the problem. Consequently, it does not eliminate motivation to search further in which the solution itself may give more motivation to find another, more satisfactory, way of solving the problem if the first solution seems inapplicable due to reasons such as effort or time. And satisfaction is personal and subjective. Third, the implication is that the teacher's concern with changing a student’s conceptual structures needs to focus on what goes on in the student’s mind. For example, in my case, teaching pre-service teachers a collaborative learning approach entails conceptual knowledge change on their part. Accordingly, the teacher should first listen to the students to interpret what they say in attempting to build up a model of their conceptual constructs. This helps the teacher to understand how students have arrived at their answers (the answers might make no sense to the teacher, but at that moment it makes sense to the student) and gives the teacher a key to change the student’s conceptual structures.

Taylor's (1996) critical constructivism adds more implications that require high levels of thinking and deep understanding. Teacher educators need to engage their pre-service teachers in open and critical forms of discourse (Taylor & Campbell-Williams, 1993). Open discourse aims to explain pre-service teachers' meaning-perspectives by exploring their learning experiences, especially their conceptual understanding of teaching and learning. Teacher educators need to create a stimulating classroom environment that involves mutual trust, respect and good will, qualities that are essential for pre-service teachers to explore their personally significant meaning-perspectives. Implications are extended to involve pre-service teachers in learning to develop their skills of critical self-reflection. Critical discourse aims to engage teacher educators and their pre-service teachers critically in negotiation about the status quo of the classroom learning environment. Teacher

educators need to provide activities that entail giving pre-service teachers a critical voice to express their views reflectively and critically (Taylor, 1996) (see Chapter 5).

TRANSFORMATIVE LEARNING THEORY

I found transformative learning theory very compatible with my concerns. It does not only provide me with a deeper understanding of my concern but also with powerful tools for taking action. Also, I found the core point of transformative learning theory has a high degree of similarity with Taylor's (1996) critical constructivism. Jack Mezirow (1991) clearly described transformative learning theory as a theory based on constructivist assumptions. He also (2006) considers critical reflection and critical discourse as two major elements of transformative learning. These are key features of critical constructivism, the aim of which is to change the status quo of the current culture of the classroom.

The concept ‘to transform’ means to convert or to change. When I consider transforming mathematics education, I mean to change the form of mathematics education to something that would be very different from present practice. 'Transform' is quite different from 'reform'. I do not aim to reform mathematics education in Saudi Arabia, because its current fundamental assumptions, principles and values do not 'fit' my goal of an alternative and innovative form of mathematics education. Instead, I aim to transform (or metamorphosis); to move from where I was to where I want to be. To transform mathematics education, I need to know and express what has been going on in the past. I need to understand critically what, how and why I did what I was doing as a student, teacher and teacher educator. To transform mathematics education is to establish alternative assumptions, conceptions and perceptions about teaching and learning.

In transformative learning, students and teachers endeavor to be liberated from the hegemony of objectivist thinking. They engage in emancipated transformative thinking. Transformative learning theory follows Habermas, and as Mezirow (1996) has stated: it "is based on [the] emancipatory paradigm, and constitutes a dialectical

synthesis of the objectivist paradigm of learning and the interpretive paradigm of learning" (p.158). Transformation theory is "a critical theory of adult learning [which] provides a dialectical synthesis and a third alternative with a fresh look at the nature of learning and learning theory" (Mezirow, 1996, p. 158).

- **What is transformative learning?**

Transformative learning describes a process of learning as not assimilating knowledge and information without any kind of reflection, rather it is a process of making meaning of what has been communicated between teacher and learners. Jack Mezirow (2000) says transformative learning describes a learning process of "becoming critically aware of one's own tacit assumptions and expectations and those of others and assessing their relevance for making an interpretation" (p. 4). Transformative learning moreover can be understood as "the process of using a prior interpretation to construe [or to bring about] a new or a revised interpretation of the meaning of one's experiences [as a] guide [to] future action" (Mezirow, 1996, p.162).

Accordingly, transformative learning for student teachers involves becoming critically reflective and aware of their own implicit assumptions and expectations towards mathematics teaching and learning, and to assess their relevance to what they learn of constructivist pedagogies. Transformative learning is a theory of deep learning that goes beyond objectivist learning in which the latter emphasizes content knowledge acquisition or memorizing what has been written in the text book. Transformative learning is learning to think for ourselves, through emancipation from what we have come to know as a result of our previous experiences in schools, especially our predisposition to passive engagement and not questioning how and why we know what we know about the culture of mathematics education. How did we come to know our roles as teachers? How did we come to know students' roles? How did we come to know a particular image of mathematics? Transformative learning involves reflecting critically on those assumptions by assessing the related reasons for holding them. Transformative learning aims to raise our consciousness about the way we came to know what we currently know.

Transformative learning pertains to both meta-cognitive reasoning (Mezirow, 2003) and 'epistemic cognition' (Mezirow, 2012) that deals with reflection on how we arrive at such knowledge (the sources of knowledge), the structure (or the nature) of knowledge and the certainty of knowledge. Epistemic assumptions influence how we understand the nature of problems and decide what kinds of strategies are appropriate for solving them (Kitchner, 1983). Transformative learning involves not only being aware of the source or the context of the knowledge but *also* reflecting critically on the validity of our assumptions and premises (Mezirow, 2012). Therefore, transformative learning is a way of learning to transform what we have taken-for-granted (i.e., teachers' roles, students' roles, the nature of mathematics, and the nature of knowledge ...etc) to make our thinking more open, inclusive and reflective. Hence, we may generate opinions that might be more compatible (or 'fit') with what we learn about innovative methods of teaching. Thus, it seems quite clear that transformative learning focuses on how *we* learn (self is very important), to negotiate and act on our own purposes, values and meanings (of what we have learned) rather than acting on what we have uncritically absorbed from our previous experience of teaching and learning in the traditional culture of the mathematics classroom.

Cognition

Kitchener (1983, p.222) suggested a three-level model of cognitive processing:

1. Cognition: content knowledge; student computes, memorizes, reads and comprehends.

2. Meta-cognition: student monitors his/her own progress and products when s/he is engaged in first-order cognitive tasks.

3. Epistemic cognition: student reflects on the limits of knowing, the certainty of knowing and criteria of knowing.

Meaning perspective

The construction of our assumptions towards mathematics teaching, learning and the nature of mathematics is the result of ways of interpreting our experience in the mathematics classroom. Mezirow (2000) named that construction as a 'frame of reference' or 'meaning perspective'. It shapes and delimits our perception and cognition of how we teach, how students learn and how we view the nature of mathematics. Our frame of reference (or our meaning perspective) seems mostly to be outside our awareness because it is inferred not from our thinking but "from repetitive affective experience outside of awareness" (Mezirow, 2012, p. 82). Hence, it is necessary to become aware of our assumptions or our 'meaning perspectives'

about mathematics education; it probably helps us to understand our school experience as a teacher much better, in a clearer context.

Meaning structures act as culturally defined frames of reference that are inclusive of meaning schemes and meaning perspectives. Meaning schemes (or points of view) are constituted by specific beliefs, knowledge and attitudes that shape interpretation of experience (Mezirow, 1991, 1996). Changes in our meaning schemes are a regular and frequent occurrence. Meaning perspective (or habits of mind) is a general frame of reference (or personal worldview), broad, orienting and acting that is influenced by cultural and social assumptions (Mezirow, 1997) and involves "a collection of meaning schemes" (Mezirow, 1990, p. 2) which "provide us criteria of . . . evaluating" (Mezirow, 1991, p. 44). Usually, as pre-service teachers we acquire our meaning perspective uncritically, most frequently during our prolonged learning experiences in schools with teachers. Having congruent experiences all the time leads us to embed deeply those meaning perspectives in our minds. A transformed meaning perspective constitutes the development of a new meaning structure. This development is usually the result of a conflict due to a disparate epistemology of pre-service teachers in relation to a critical revision of previous assumptions (Taylor, 2002). This change in our meaning perspective is at the heart of transformative learning.

Accordingly, transformative learning is learning that "transforms problematic frames of reference . . . to make them more inclusive, discriminating, open, reflective, and emotionally able to change" (Mezirow, 2003, p.58). Transformative learning in my inquiry refers to transforming the problematic culture of the Saudi mathematics classroom to make it more dependable in our context of teaching and learning by generating opinions and interpretations that are more justified and compatible with what we learn about innovative teaching methods, through engaging in critical reflection on our problematic beliefs, uncritical assumptions and premises of teaching and learning (Cranton, 1994; Taylor, 1996, 2013a, 2013b; Mezirow, 2012).

Transformative and communicative learning

Transformative learning offers an explanation for change in meaning structures that evolves in two domains of learning based on the epistemology of Habermas' communicative theory (Taylor, 2002). Habermas (1984) identified two major domains of learning. The first is 'Instrumental learning' which follows a hypothetical-deductive logic and empirical methods, and aims to control and manipulate the environment or other people's learning with the goal of improving prediction and performance. It focuses on learning through task-oriented problem solving and determination of cause and effect relationships. Learning is based on empirical-analytic discovery, and involves assessing truth claims. The second is 'Communicative learning' which follows a logic of metaphorical analogic-abductive inference (see the logic) and qualitative methods, and aims to understand what others mean when they communicate; it requires assessing the meanings behind the words (see below: emancipatory interest section). "The process of understanding involves assessing claims to rightness, [its relevance] . . . and appropriateness rather than assessing a truth claim" (Mezirow, 2003, p. 59). The emphasis is on critical reflection and critical self-reflection that involve assessing what has been taken for granted (self-beliefs) to arrive at or to make a more 'fitting' dependable judgment (Mezirow, 1996, 2003, 2012; Taylor, 1996, 2013a, 2013b; Taylor, 2002).

The logic

Deductive: it is reasoning that starts with a general rule, leading to a guaranteed specific conclusion.

Inductive: it is reasoning that begins with specifics, leading to a likely generalized conclusion.

Abductive: it is "reasoning from concrete instances to an abstract conceptualization" (Mezirow, 2003, p. 59).

- **Critical reflective thinking**

Critical reflection is thinking critically about ourselves, who we are, and how we act and why we act in such ways. Autobiography is a reflection on a personal life. It tells us implicitly who we are. Personal (or self) reflection is like an autobiography that illustrates one's own experience. And by adding a critical dimension, it goes beyond exploring one's own experience to critically reasoning about it. It goes beyond *self*-boundary to thinking outside one's current framework. Critical reflective thinking

involves engaging in *self*-thinking by looking for our assumptions that we are mostly unaware of but which underpin our practice, exploring the hidden dimensions of this practice, and then investigating and scrutinizing the validity or viability of those unrealized assumptions against our interest in transformative practice.

Critical reflection is central to transformational learning (Mezirow, 1997). It "blends learning through experience with theoretical and technical learning to form new knowledge constructions and new behaviors or insights" (Stein, 2000, p.1). By critical reflection, prospective teachers create new understandings through making conscious their professional assumptions about teaching, learning and the nature of mathematics which are constraining or supporting their actions in the mathematics classroom context (Ecclestone 1996; Mackintosh 1998 as cited in Stein, 2000). Unconscious assumptions are what we have been taking for granted about teaching, learning, knowledge, the image of mathematics and the whole culture of Saudi mathematics education. Critical reflection enables pre-service teachers to be aware of the status quo in the field of teaching and learning. It is to uncover their hegemonic assumptions. It is to raise their consciousness about how they teach and how and why their students learn (or don't learn). Critical reflection is the process by which pre-service teachers identify the assumptions that dominate their teaching and learning, the assumptions that give meaning and purpose to who they are and what they do, to question the meaning of those assumptions, challenge the prevailing professional ways of teaching and learning, and develop alternative ways of teaching (Brookfeild, 1995; Cranton, 1996). So, through the process of critical reflection, pre-service teachers may come to interpret and create new knowledge and actions from their experiences (Stein, 2000).

Without critical reflection on how and why we teach and learn, we tend to not only accept the problematic classroom culture and to suffer from a situation not of our own making (Brookfield, 1995), but to endorse that culture by following *uncritically* what has been established. We continue in taking action, and making meaning, based on unexamined assumptions about teaching and learning. We continue to be hegemonized by those assumptions and to think that they are in our best interest, but they actually have been governed by repressive powerful cultural myths of cold reason and hard control (Taylor, 1996). Unexamined common-sense assumptions are a defective guide to action (Brookfield, 1995).

- **Third human interest: the emancipatory interest**

The third of Habermas's knowledge-constitutive interests is the emancipatory cognitive one that is expressed from within a critical theory of social action which generates self-critical reflective knowledge (Taylor, 1996). While the technical and practical interests are concerned with control and understanding respectively, the basic orientation of the emancipatory interest is toward empowerment. The emancipatory cognitive interest identifies with autonomy and responsibility. Emancipation means 'independence from all [external influences] that is outside the individual' (Grundy, 1987). It aims to transform the current conservative classroom culture by freeing it from dominating educational ideologies associated with a pervasive technical interest. This emancipatory interest is concerned with the ability of pre-service teachers to take control of their own learning in autonomous and responsible ways. Self-reflection seems to be one of the great and powerful ways to emancipation, perceived as the means by which pre-service teachers can deconstruct predominant constraints that seem to be natural. The emancipatory interest entails a reciprocal relationship between self-reflection and action (praxis). It entails a critically oriented way of knowing: (1) to generate critical theories that are gleaned through collective critical reflection on pre-service teachers' assumptions and the mathematics classroom's culture (e.g., cold reason and hard control) that explain how they operate to inhibit transforming the mathematics classroom culture, and then (2) to use those critical ways of knowing to reconstruct or transform future actions (Grundy, 1987; Streibel, 1991; Taylor, 1996).

Habermas states that emancipation can only be achieved through democracy where democracy means all that is done 'in' and 'through' two-way communicative interaction. So, a new (or transformative) culture of the mathematics classroom and the work of emancipation grow out of this classroom communication interaction (Pusey, 2002). Hence, to foster transformative learning, communicative learning needs to be involved as one of the most significant learnings by pre-service teachers. "Communicative learning involves identifying problematic ideas, values, beliefs, and feelings [towards the culture of the mathematics classroom], critically examining the assumptions upon which they are based, testing their justification through rational discourse and making decisions predicated upon the resulting consensus" (Mezirow 1995, p. 58). I consider this as the central activity to be fostered by adult educators.

Thus, I interpret emancipation here as the process of transformative learning that frequently takes the form of critical self-reflection referred to in the two-way communicative learning situation in the classroom (Mezirow, 2003).

Consequently, adult educators in transformative (or communicative) learning do not indoctrinate, instead they create opportunities for a democratic learning environment and foster practices that support pre-service teachers to fully participate in open and critical discourse (Taylor, 1996; Mezirow, 2012). I consider democracy in pre-service mathematics teachers' education as a process of shared learning that involves achievement resulting from collaboration between the pre-service teachers and their teacher educator. Accordingly, feelings of trust, solidarity, security, empathy, equality, mutuality, autonomy and justice among learners should prevail. These feelings are essential preconditions for free and full participation in discourse (Pusey, 2002; Mezirow, 2012).

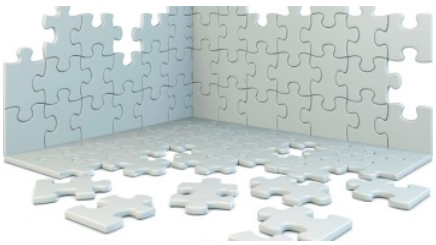
Accordingly, the ideal speech situation - where the ideal conditions of rational discourse and communicative discourse are promoted - is essential to successfully fostering transformative (or communicative) learning (Mezirow, 1996). It is the way to attain authentic consensus amongst pre-service teachers in their professional discourse (Taylor & Campbell-Williams, 1993). Taylor and Campbell-Williams (1993) identified the ideal speech situation as occurring in conditions that are parallel to the ideas of truth, justice and freedom of Hamermas's notions of the 'good life'. The conditions are: (1) there are no constraints (such as lack of time) upon discussion. Therefore, any participant has full opportunity to question the truth of another's argument in arriving at a consensus; (2) all participants having ample opportunities for self-representation. That is, they are willing to disclose their true intentions and motives, and they give each other equal opportunity to express themselves; and (3) all participants are free of coercion (such as bullying), and possess equal right to the respect of others. They are willing to accept responsibility for their own actions, and may expect the same of others (p. 8).

Mezirow (1996) stated similar ideal conditions for rational discourse with some elaboration: (1) to have accurate and complete information; (2) to be free from coercion and distorting self-deception; (3) to be able to weigh evidence and assess arguments as objectively as possible; (4) to be open to alternative perspectives; (5) to

be able to critically reflect upon presuppositions and their consequences; (6) to have equal opportunity to (including the opportunity to challenge) question, refute, and reflect and to hear others do the same; and (7) to be able to accept an informed, objective, and rational consensus as a legitimate test of validity (p. 171). I consider the ideal speech situation as an environment for empowerment and as an opportunity for truth, justice and freedom (Taylor & Campbell-Williams, 1993).

- **Curriculum as currere**

Pinar (1975) described currere as a method to education. It is the viewing of what has been conceptualised over time. It is an autobiographical method that provides a novel framework for reflecting on mathematics educational experiences from a subjective and personal narrative perspective (Pinar, 2004). Schubert (1986) proposed 'curriculum as currere' as one of eight curriculum images that he categorised as major conceptions of curriculum. Currere calls attention to our own ability to reconceptualise our autobiography. Pinar (and Schubert) view the curriculum as a reconfiguration of one's perspective on life. I introduce this image of curriculum under transformative learning theory for two reasons. First, I think this image is more suitable for pre-service teachers as adult learners than for young learners, as is the case with transformative learning theory. Second, I think it can be worthwhile and useful to be adopted in teaching Saudi pre-service teachers who need to be engaged in their autobiographical experience in schools to (a) reconceptualise their taken-for-granted thoughts, and to (b) emancipate them from constraints of ideologies about teaching and learning. Curriculum as currere encourages pre-service teachers to engage in their own emancipation.



Thus, currere can be understood as the process of reconstruction and reconceptualisation of one's own school experience. These are very important tools for thinking in the context of a critical constructivist mathematics classroom (or a transformative mathematics classroom) due to what has been learnt indirectly within the mathematics classroom, or/and what has been constructed or conceptualised as a result of uncritical naïve experience within the hegemonic prevailing culture of the

mathematics classroom. From a social constructivist point of view, the concept of teaching and learning has been socially constructed in our minds based on our previous experience in interaction with others. So, the idea is not only to engage in reflective learning to understand our lives, but we should actively engage in efforts to overcome the forces (e.g., cold reason and hard control) which have been unintentionally socially constructed in our minds, in many cases, and that tend to control our minds and our lives (Taylor, 1996; Schubert, 2004). The most important reconceptualisations and reconstructions of experience derive from informal conversations between the student teachers and teacher educator (Schubert, 2004).

Pinar (1975, 2004) suggested four steps for applying currere as a method of autobiographical study of educational experience that "provides strategy for students . . . to study the relations between [their] academic knowledge and life history in the interest of self-understanding and social reconstruction" (2004, p. 35). The four steps are: regressive, progressive, analytical and synthetical.

Regressive: it is to return to our past to capture it as it was, and as it hangs over our present. I think our previous educational experience greatly contributes to shaping our present experience, and the more we ignore it, the more our present experience is affected by it. So, returning to our previous educational experience seems to be very important in order to know what we currently have and do, how we arrived at what we currently have and do, and why it is like this. Moreover, the purpose of returning to our past is not only to see what we had seen but to see what is not ordinarily seen, to see what had been taken-for-granted. Finding our past does not mean we let it control us. In fact, our past experience should not control our practice in the present time. Yes, our experience in the past is ours but we are living in the here and now (see Chapter 8; past experience: Curse or boon??). Our current place is different to our place in the past. We are different now and we see the past differently from what we had seen it then. So, we examine our functioning in the past (what we did in the mathematics classroom, how we did it and/or why we did it in that way) by observing and recording that includes our current responses to what we observed.

Progressive: it is to look to our future, to take the way opposite to regression. The idea of this step is to imagine without boundaries, to envision without restraint and without thinking of whether what we create by imagining is reasonable or

unreasonable. We are encouraged in this step to release our "buried visions" (p. 10) or to let them emerge.

Analytical: it is to bring our previous educational experience and our imagination of envisioning the future into our current investigation. In this step, we could study, interpret or critically reflect on our past, present and future by answering questions like: What are our past, present and future? What are their complex interrelations? What fundamental ontological and epistemological themes do they express? And more importantly, Why are they as they are?

Synthetical: it is to unite the previous three steps together in attempting to meet our own best present intellectual interests. So, in this step, we attempt to create our transformative mathematics classroom culture by using insights from our past and present and from our conceptions of the future, and in the light of the knowledge and understanding that we gain from the three previous steps.

SUMMARY

In this chapter I have expressed reflectively the key underlying theories that guide my involvement in the process of reconceptualising my own previous experiences as I seek to answer my research questions. I have examined the hegemonic grip of objectivism and the technical human interest on the culture of the mathematics classroom in Saudi Arabia and its power in restricting my understanding about teaching and learning, and in preventing innovations in my teaching practice.

I have outlined my understanding of (critical) constructivism and transformative learning theory, along with the practical and emancipatory human interests, in relation to my own previous experiences, aiming to reconceptualise what I have taken for granted. My reconceptualisation (or transformation) empowers me to emancipate myself from my earlier disempowering culture of teaching and learning and to look outside that culture, and it also encourages me to take control of my own future professional life in autonomous and responsible ways.

CHAPTER 5

MY LEARNING EXPERIENCE DURING THE PRE-SERVICE PREPARATION PERIOD

INTRODUCTION

My purpose in this chapter is to critically illustrate my learning experience during my study as a pre-service mathematics teacher at the Teachers' College in Saudi Arabia; particularly, my experience in studying a course named 'Methods of Teaching Mathematics' (MTM); the key course in teaching future teachers of mathematics alternative and innovative teaching pedagogies. I describe and evaluate the extent of the influence of my traditional learning experience on my professional teaching practice by exploring how I learnt and how I was taught in this course. I then discuss how alternative learning experiences, involving an open and critical discourse approach based on 'transformative learning', could have made my learning experience more valuable and meaningful to me, and could also have helped improve my teaching practice.

MY EPISODE

> *Venue: Teachers' College (formerly), Faculty of Education (currently), a university, in the Kingdom of Saudi Arabia.*
>
> *Time: First Semester 2003 AD*
>
> *We are Saudi pre-service mathematics teachers … Sitting in the classroom on brown wooden chairs … Waiting for a mathematics teacher educator who will teach us a unit titled "Methods of Teaching Mathematics (MTM)" ... The weather is quite hot … It is around 35 degrees outside … The air-conditioning is on ... We are around 40 mathematics teacher candidates ... During our waiting for the teacher educator … We are talking about the semester that has just started … "Guys this is the final semester of our study", a*

colleague shouts … "We are about to be teachers. How cool is that?", I say ... The following semester will be the practicum (practical teaching) in primary schools ... We are so happy that we have almost completed our study and we will be in-service mathematics teachers soon.

Whilst we are chatting with each other … A middle aged man walks in and takes a quick look at the class … He goes to his desk at the front of the room ... He clears his throat … The classroom hushes ... We rearrange ourselves … Arrange our tables … We turn our chairs to face the blackboard and to look at him .... He introduces himself in a thick Egyptian accent. "Assalamu Alikum guys, I am Dr. Ahmed" ... He takes a pen and writes – using his left hand - his name on the blackboard behind him ... "I am the Doctor who is going to teach you a unit of MTM", Dr. Ahmed speaks. "This class is to teach you to teach!" … He raises his left hand holding a book and slams the book on the desk saying "This is your curriculum ... All exam questions will come from this book ... You have to know that you are going to perform three tests; two small quizzes during the semester ... The first one will be in the fifth week and the second one will be in the tenth week ... While the final test will be as you know at the end of the semester ... The final exam has 60 percent weight with 20 percent for each small quiz" ... While Dr. Ahmed is talking we are taking notes of what he is saying in our notebooks.

"As you may find from the title of this unit", Dr. Ahmed continues ... "This unit consists of several methods of teaching that you need to employ in your teaching practice of mathematics ... It is very de-motivating for a mathematics teacher who solely utilizes one method of teaching ... Likewise, students who are involved every day and in every class in the same style of teaching will have the same feeling ... So, it is imperative for you as you are about to be mathematics teachers to learn several methods of teaching mathematics that may be different from the ordinary manner of teaching that you are familiar with".

Twenty minutes pass...

Abruptly, "What are the methods of teaching that I have just mentioned which you will learn during this current semester?", my colleague (Khalid) who sits next to me is asked … "Collaborative learning approach ... discussion and dialogue method ... inductive way ... problem solving approach", Khalid repeats. "Good", Dr. Ahmed shouts. "I just wanted to know whether you were following me or not" … "Phew, he did not ask me", I whisper … "I am a visual person and I learn by seeing".

"Since today is the first lecture, we will not study a new topic", Dr. Ahmed resumes... "It will be just an introduction for the unit ... From the following lecture, we will launch officially into studying the unit ... Anyway, here are some of the instructions ... You have to know that there are no particular methods for mathematics teaching ... There are no designed methods only for mathematics … Approaches of teaching are considered generic for all disciplines .... In this unit I am going to teach you how to employ them in teaching mathematics ... There is no particular approach better than another … They are all good methods".

Dr. Ahmed gives us several general instructions about using several approaches of teaching mathematics ... Lesson ends ... "Any questions? … See you next week at the same time", Dr. Ahmed farewells us ... Quickly, I collect my stuff ... Go out of the classroom … Other students are waiting outside the classroom for the next lecture that will be presented in the same classroom...

Several weeks pass...

It could be any week during the semester...

The classroom circumstances are quite similar ... We are the same students … Sitting on the same chairs … In the same classroom … At the same regular time … Waiting for the same lecturer ... to study the same course ... Dr. Ahmed enters saying "Assalamu

Alikum" ... We repeat his Salam ... He asks for a chair … Several students race to give him one … He sits on it ... "Today I am going to teach you a method that I picked out for you", Dr. Ahmed starts his speech (teaching?) ... He opens the book ... Reads what has been written in the book ... The definition of 'Collaborative Learning Approach (CLA)' ... What is this method? … The main principles of using it ... The goals of using it ... The reasons for using it ... Its importance ... How to implement it ... etc. ... He repeats what he just has read (he might think that he explains better what he has read by repeating it) ... Two hours later ... Dr. Ahmed closes the book ... "Any questions?", he asks ... Of course, there are questions. But we do not ask!! … "See you next week at the same time", Dr. Ahmed farewells us.

Week after week …

Almost at the end of the semester…

It could be any day in the last week of the month of November 2003 ... A time when I finished attending most of the lectures of MTM … I see Saud (a student teacher colleague of mine) coming towards me ... He looks unhappy and worried about something ... "Salam Saud, How are you doing brother? How is your study?" I invite him to talk ... "It is not as I wished, Naif", Saud responds ... "I wonder about Dr. Ahmed, in every class he frequently instructs us by saying 'You have to use several approaches in your teaching ... You have to change your teaching style', while he never applies any of them in his own teaching ... He never changes his teaching style ... Why does he not employ or implement what he is teaching us if he is really interested in using innovative methods of teaching?"

The exam arrives ... I prepare myself by memorizing what has been written in the book. I could not find another way of preparing.

During the exam...

I open the test paper ... I read the questions ... All the questions are about recalling facts, restating what has been written in the curriculum such as: What are the principles of using a problem solving approach? ... There are five benefits of using collaborative learning approach, state them! ... What are the steps of applying the inductive way? ... The author has mentioned five reasons for using the deductive way, what are they? In this last question, I remember only three reasons ... "Can I add two reasonable reasons of mine? Or do they have to be what the 'author' stated in his book?", I ask ... Dr. Ahmed looks at me and nods his head while he is closing his eyes ... I feel embarrassed … "I should not ask" I say regretfully to myself … Anyway, I write what I remember ... Finish ... Submit it ... Go free...

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The above scenario describes my experience while I was undertaking a very important unit; Methods of Teaching Mathematics. The aim of this course is 'teaching' mathematics teacher candidates the latest educational ideas of innovative teaching methods (such as collaborative learning, problem solving, etc...) in order to improve their teaching and their students' learning of mathematics. This course aims to enhance Saudi mathematics future teachers to use modern approaches of teaching that lead to producing alternative ways of learning. The modern approaches of teaching have major common characteristics of allowing, enhancing and encouraging students to be active learners by participating in the mathematics classroom. Despite the importance of this unit in increasing Saudi future mathematics teachers' knowledge about several teaching techniques, it was not good enough to enhance them to apply and implement what they learnt. The aim of using innovative teaching methods of mathematics education seems not to have been reached. The problem as I see it is not connected with the content we as student teachers learnt but was more associated with the way of teaching the content, and the way and the reason of learning it. I think the unit was good but how and why it was taught and learnt is the key point.

HOW AND WHY I LEARNT

Although the questions of 'how and why I learn what I learn' were never discussed or even asked about during my undergraduate study, they are very important and crucial ones in demonstrating my learning experience. They are very much different from the most common question concerning 'what I learn'.

My learning experience during this unit was limited to attending the lecture, listening to the lecturer and taking notes. Because this traditional approach of learning is guided by the idea of passing the exams, I only needed to memorise the 'curriculum content' in order to achieve the major goal of passing the exam at the end of the semester. Consequently, I was not aware that I might need what I learnt in my future teaching. Aikenhead (2000) described this level of learning as a 'shallow learning' where the goal is simply to cover the content of the curriculum for assessment purposes. Ibrahim, a research participant, explained the aim of learning this unit as follows:

> *We were memorizing these [teaching methods] to pass the exams. We did not think of [our future] teaching. We became aware of it when we got into schools (interview, 7/12/2010).*

It was not only us as students who hold this view. The first thing I learnt in this unit was about the exams. Dr. Ahmed began his lecture talking about the exams; where the exam questions will come from and how many exams we will have, before we knew anything about the unit and its content.

> *All exam questions will come from this book ... You have to know that you are going to perform three tests; two small quizzes during the semester ... The first one will be in the fifth week and the second one will be in the tenth week ... While the final test will be as you know at the end of the semester ... The final exam has 60 percent weight with 20 percent for each small quiz (Dr. Ahmed, first lecture)*

Does this not give an impression that we learn not to learn but to do an exam? Frankly, Dr. Ahmed did not *explicitly* tell us that we learn to do exams but the learning experience I had caused me to study simply to pass the exams.

Hence, my job as a learner and as a pre-service teacher was to listen attentively, write endlessly, memorise rigorously and pass the exams successfully. Also, my job was to

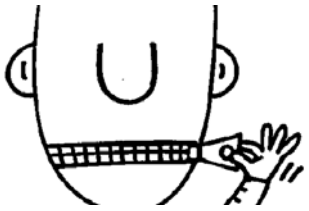
keep what I learned in a safe place to recall at the time of examinations. All that I was given should be stored away free from any adaptations or changes. Thinking could be a major tool that affects the quality of what I have learned. If I deeply thought about what I learnt, I might find that those innovative teaching approaches are not applicable to the current culture of Saudi mathematics classroom and/or not compatible with what I already know about teaching and learning. If I deeply thought about what I learnt, I might raise questions comparing what I learned with what I was familiar with.

My research participants recalled similar learning experiences when I asked about their learning experiences in this unit.

> *[The unit] was like any other normal unit that we studied to pass exams. Basically we memorised it for the exam only, and if you asked me after the exam, I would have remembered nothing. [Teaching methods] were just theoretical and they entered in this ear and went out from this ear. They were just bland information. We did not even think that we were going to use them in our teaching practice. As I said, it was just to pass the exams (Majid, interview, 7/12/2010).*

> *We were sitting down silent to write what is important and what is going to be in the exam and what is important theory. We thought only about how to pass the unit. So, we memorised and did exams to pass. I do not think that anyone was attending in order to help himself in his teaching practice. All was just theoretical and we did not practise it. It was like taking this information and that was it (Musa, interview, 15/12/2010).*

Well, it is very obvious that our learning experience was frameworked inside the objectivist paradigm of learning and dominated by the technical cognitive interest (see Chapter 4). Consequently, we did not ask questions even if we had one. We did not give comments even if we had one to make. When Dr. Ahmad, for example, said that "*there is no particular approach better than another … They are all good methods"*, I had to agree. But why was that? I think one approach can be better to use than another in such and such a context. "*Oh, sorry for this silly question!! Don't I have to ask myself why? Am I serious in asking this question?!!!! No, I've gotta be kidding. Dr. Ahmed is my teacher. He is the*



'omniscient' one in the class. What a shame if I do not trust my teacher!! I am just wasting his time and the time of the class. Do I think he is lying to me? Anyway, at the end of the day, I'll come to know that he is right. So, I'll take the truth from him right now!!!".

Week of observation

Another part of our learning experience in this course was the 'week of observation'. I consider it as one of the major focuses during our pre-service teacher education where we were asked to visit schools to observe in-service mathematics teachers to see how they teach in their real mathematics classrooms. The idea was to place us within a school setting and to watch and follow the actions of the experienced mathematics teachers.

I asked my research participants about their experience in this task:

> *The lecturer educator asked us to visit schools to gain some experiences of how to teach. So, we got into mathematics classrooms and saw how in-service mathematics teachers teach. By the way, this is the only practical experience we had. We saw how teachers teach. We were pleased when we visited schools. I wished I could visit schools whenever I wanted during the semester to watch how mathematics teachers teach and to get some ideas. I think we should have more visits, not only one week (Majid, interview, 7/12/2010).*
>
> *We did not learn how to stand up as a teacher in front of students, how to write on the blackboard, how to organize it, using clear big fonts and different colours ... We did not learn that, in the College. We learned these issues when we got into practice here in the school. In the week of observation, I got into the classroom while the mathematics teacher was teaching, and I saw how he taught (Eissa, interview, 14/12/2010).*
>
> *The purpose of the visits was not clear. To be honest with you I for example gave my observing week's form to my uncle [who is the school principal] and he signed it. It was due to the lack of consciousness and lack of guidance (Osama, interview, 8/12/2010).*

Whether my research participants found the visits useful or not, whether they liked them or not, whether they attended the school or not, it is not my concern here. They might have found them useful because visits gave them some practical sense of how to teach. They might have liked the visits because they fitted their technical interest

and matched the familiar traditional learning environment. However, my concern here is what they gained from the experience. My concern is whether they discussed what they observed or not, whether they presented what they found and talked about it or not, whether they judged what they observed against what they learnt in the lectures at the College or not, whether what they found was what the unit was trying to achieve or not. Yes, we visited schools and we watched how in-service mathematics teachers teach in 'reality'. However, what did we find? What was our opinion about it? How did experienced mathematics teachers teach?

Anyhow, 'how and why I learnt' was shaped based on 'how the unit was taught' which brings me to my next point.

HOW I WAS TAUGHT

My learning experience in the unit shows that I had been involved with traditional teaching that did not pay attention to our understanding, cognition or thinking. Dr. Ahmed emphasized to us the availability of alternative teaching methods; the meaning of each method, the steps in each method, the advantages and the disadvantages of each method ... etc. There was no opportunity for dialogue or discussion about what we were learning.

During my interview with my research participants, I asked them about how the unit had been taught. How was their involvement in the classroom? Whether they had been, for example, engaged in discussion or interacted with each other? Whether they actively participated in their learning process? And their responses were as follows:

> *I found [the teaching] very normal. The doctor put the laptop on the table and connected it to the projector and displayed his material on the screen. He displayed our curriculum. He displayed it as would show any historical unit. There was nothing special (Eissa, interview, 14/12/2010).*
>
> *It was a lecture situation. It was like indoctrination. I do not remember that I discussed anything with him. The unit was the usual type, nothing new; all was speech (Majid, interview, 7/12/2010).*

[The teacher educator] talked to us about [the teaching approaches] but we had no discussion about them (Musa, interview, 15/12/2010).

We just listened and left (Ibrahim, interview, 7/12/2010).

It is quite obvious that the teacher-centred approach was dominant. The way of teaching that Dr. Ahmed embraced was intellectually superficial. The 'instrumental' learning and the technical interest and its controlling orientation (see Chapter 4) were very much apparent. If you remember his question to my colleague Khalid about the methods that we were going to study, it shows the extent of the instrumental learning we had. Dr. Ahmed was so glad that Khalid repeated the methods correctly. To remind you … This is what happened!!

Abruptly, "What are the methods of teaching that I have just mentioned which you will learn during this current semester?", my colleague (Khalid) who sits next to me is asked … "Collaborative learning approach ... discussion and dialogue ... inductive way ... problem solving approach", Khalid repeats. "Good", Dr. Ahmed shouts. "I just wanted to know whether you were following me or not" (Dr. Ahmed, first lecture).

Good for what?!!!, I surmise. What is the point of repeating these methods' names? Does Khalid understand what he has repeated? Does he perceive what these methods really mean? Does he realize how any of these methods can be implemented? Well, he is not there yet!! So, 'good' for what?!! Good to repeat Dr. Ahmed's talk?!! It seems that Dr. Ahmed indirectly reinforces (celebrates?) his talk. Goodness me!!, we are nearly becoming teachers!! Is this the way that we should be taught?

Moreover, this is another example of the way this unit was taught which shows the extent of the technical interest in controlling our thinking in learning the methods:

As you may find from the title of this unit, ... This unit consists of several methods of teaching that you need to employ in your teaching of mathematics ... It is very de-motivating for a mathematics teacher who solely utilizes one way of teaching ... Likewise, students who are involved every day and in every class in the same style of teaching could have the same feeling ... So, it is imperative for you as prospective mathematics teachers to learn alternative methods of teaching mathematics that may reform the ordinary manner of teaching that you are familiar with (Dr. Ahmed, first lecture).

What do you think if he had asked us about our expectations of this unit before telling us what it is about? He says *"You may find from the title of this unit"*, so, why does he not ask us what we might find from the title, what do we understand from it, have we had different learning experiences with any particular method, or do we know or have we heard about any teaching methods? How about if he asked us about our learning experiences in the mathematics classroom while we were students? Were those experiences boring? And why?

How would this lecture proceed if he asked us about our familiarity with different methods? How did we find them? What if he had allowed us to reflect critically on the common style of teaching that he briefly mentioned? What if he gave us an opportunity to reflect on our learning experience of what he called the conventional style of the classroom? What if we had had a chance to present our thoughts about teaching and learning? Most - if not all - of us might have experienced such a repressive classroom situation in our student days. We are very much familiar with it. Actually, it was the only way of teaching we experienced. I think this moment is very suitable for thinking and reflecting carefully and critically – and maybe also creatively- about our prior learning experiences in the mathematics classroom.

I would like here to borrow Freire's metaphor of education as 'banking' to link it to the traditional education I had. Paulo Freire used this metaphor in his highly influential book 'Pedagogy of the Oppressed' (2005) to describe critically the traditional form of education whereby the teacher deposits the information into students' accounts who in turn have to store them till the time of assessment. Freire claims that the 'banking' model results in the 'dehumanization' of the students and the teachers. It turns students into 'receptacles' to be 'filled' by the teacher. "The more completely she fills the receptacles, the better a teacher she is. The more meekly the receptacles permit themselves to be filled, the better students they are" (p. 72). Moreover, it makes students become dependent on their teacher for knowledge and they do not learn to think for themselves (Kitchenham, 2008). "The more students work at storing the deposits entrusted to them, the less they develop the critical consciousness which would result from their intervention in the world as transformers of that world. The more completely they accept the passive role imposed on them, the more they tend simply to adapt to the world as it is and to the fragmented view of reality deposited in them" (Freire, 2005, p. 73).

Despite the significance of the theoretical knowledge that we gained from the unit, no amount of such knowledge can fully prescribe appropriate practice. We would not change our methods of teaching to new methods simply by being told to do so. New approaches to teaching and learning would require that we become serious learners in and around our future teaching practice, rather than gathering a large amount of bland information about teaching methods (Ball & Cohen, 1999).

Unfortunately, this course aimed to improve teaching and learning pedagogies, and there was no sign of care toward our professional development, no room for us to actively participate in our own learning process to identify with the efforts to create a new culture of mathematics education, and no room for us to reflectively and critically engage in what was underpinning our teaching practice even though we would be responsible for practising what we learnt. The way of teaching we experienced did not serve our interest in becoming engaged in and developing our intellectual and practical professional skills. It did not help us to develop our personal and professional 'critical consciousness' about the mathematics classroom culture as a major component of pre-service teacher education (Gay & Kirkland, 2003), so that we could build an in-depth understanding and critically perceive the current culture of the Saudi mathematics classroom (Freire, 2013).

According to our unengaged learning experience and to the traditional and technical way of teaching of this unit, the question I need to ask is: to what extent did the unit influence our professional teaching practice? It is very disappointing to realise that we were not aware that what we were learning was important for us in our future teaching.

MY LEARNING OUTCOME

Although we ‘learnt’ several innovative approaches to teaching mathematics, what we learnt had no impact on how we currently teach mathematics. This does not mean that the innovative teaching approaches were useless in themselves. Rather, I think the way we learnt about them was not very useful. Applying the new approaches cannot be completely prepared for just by presenting several well-considered bodies of knowledge (Ball & Cohen, 1999). This is in fact an insufficient approach to

enabling pre-service teachers to change how they teach. Consequently, pre-service teachers might not see the benefits of the course in improving the pedagogies of the mathematics classroom. I asked my research participants for their opinions about the benefits of studying this unit for their teaching practices.

> *For teaching, not at all. It was just a huge amount of abstracted talk. It was a lot of talking without making any sense. For me, it all was just hot air. We studied it only to pass exams. I personally do not think there were any students who got benefits from it (Ibrahim, interview, 7/12/2010).*
>
> *I got little benefit. Most of it was just theoretical. The benefit I got was in how to start the lesson and how to write lesson plans. So, I have now become able to prepare the lessons (Musa, interview, 15/12/2010).*
>
> *Nothing was there. All was exams and talks. If you asked me after the exam, I would have remembered nothing (Majid, interview, 7/12/2010).*
>
> *We learned how to do the daily preparation, the goals, the required teacher behaviours, etc. (Eissa, interview, 14/12/2010).*
>
> *For me, I liked the subject and got benefit from it. There were many nice thoughts but unfortunately all were ink on paper. I studied it one and a half year ago. So, I forget the information (Osama, interview, 8/12/2010).*

Actually, I am not surprised at their responses as our main goal of learning the methods was merely to pass the exam, not to use them in our professional teaching practice. I agree that we 'learnt' some information about teaching mathematics as the participants, Musa and Eissa, mentioned regarding how to make a plan and prepare the lessons. However, this knowledge should not be the ultimate outcome of studying this unit. The aim of studying this unit was to 'learn' and then to practise the innovative methods of teaching. The aim was to enhance mathematics classroom pedagogies. We 'learnt' teaching methods to use them, didn't we?!!

Worse yet, our conventional learning experience did not only restrict us from achieving the maximum benefits, but it also contributed to creating an environment that maintained our misconceptions. Constructivistly, we tried to make sense of what was taught by trying to fit it with our own experience (Lorsbach & Tobin, 1997).

However, the innovative student-centred approaches we were taught did not fit with our conservative previous experience in schools. And as we did not think reflectively on what we were learning, nor think critically about our previous learning experiences, the potential contradiction between what was taught and our experience and the possible consequent misunderstandings were likely to remain a problem.

MY MISUNDERSTANDING

The well-established way of teaching was not sufficient for preparing pre-service teachers to practise what they learnt. Pre-service teachers, in fact, need to be engaged in discussion, collaboration, reflection and critical thinking. They learn best by doing and reflecting, and by collaborating with their colleagues (Darling-Hammond, 1998). However, because we did not think reflectively nor critically about our learning, we not only got limited benefits but we also retained incomplete perceptions about teaching and learning (see Chapter 6) and/or held misunderstandings about why we need several teaching methods which, in turn, impactd on our professional practice.

- Why methods of teaching?

Dr. Ahmed mentioned the reason – in general - of why we should employ alternative teaching approaches. He said: *"it is very de-motivating for a mathematics teacher who solely utilizes a traditional teacher-centred teaching approach"*. I knew that mathematics is a boring subject for many students. I grew up knowing this view. Many students whom I have met have the same view. Many colleagues whom I know think so. Many people when they know that my area is mathematics say so. My research participants likewise deem it so.

> *It is meaningless subject and everybody hates it (Ibrahim, interview, 7/12/2010).*
>
> *It is dry and abstract subject (Osama, interview, 8/12/2010).*

Therefore, when I became a mathematics teacher I thought that to change the negative view about mathematics was via changing the way of my teaching. So, my

point in using different teaching approaches was to make the mathematics classroom not boring (see Chapter 7).

Moreover, when I asked my research participants why we need several methods of teaching, they seemed to agree that the main reason is to change the environment of the mathematics classroom to not be boring.

> *Naif:* *Do you think that you need several methods of teaching? And why?*
>
> *Ibrahim:* *Yes, I do ... because we need to make change and to do something new (interview, 7/12/2010).*
>
> *Majid:* *I think the unchanging routine is the main cause of killing all students' willingness to learn mathematics. We teach them every day by the same way (interview, 7/12/2010).*
>
> *Khalid:* *Yes, I do for many reasons such as for attracting more attention from the students (interview, 13/12/2010).*
>
> *Eissa:* *I think that one method is not enough because it will be boring. When a student becomes familiar with one method of teaching, he will be bored. There is nothing to be entertained (interview, 14/12/2010).*

So, we did not perceive alternative teaching methods as being potentially beneficial to the process of students' learning. We perceived them as related only to changing the atmosphere of the classroom in a more interesting direction. Although this reason was important, it was not supposed to be the essential reason for using the innovative methods of teaching. I should practise them not merely to create a different classroom atmosphere but to make student learning more active, to help them make sense of what they are learning and to make their learning not only enjoyable but meaningful as well. The whole idea is to engage students actively in their learning process.

After my research participants gave their opinions about the need for using several teaching approaches, I asked them: "You agree that teachers need to use different methods of teaching but at the same time you did not use the methods you had learned. What did you do, then, to fill that need? How did you change your teaching?"

I taught [students] in their classroom located upstairs on one day, and I took them downstairs to the 'resources' room' on another day, and some days I put them into groups. The semester will proceed with no one being bored. Sometimes I wrote examples on the blackboard and let a student answer them (Majid, interview, 7/12/2010).

Every two weeks, I let [students] go downstairs to the 'resource room'; they feel that they have started another life, not like the life in the environment of the classroom. [The student] feels that he has moved to another place. Even the seating is different (Eissa, interview, 14/12/2010).

I use Dienes Blocks and sometimes I use the Abacus, (Khalid, interview, 13/12/2010).

(See what I did in chapter 7, becoming a mathematics teacher)

We mistakenly thought that we had changed our teaching radically simply because we tried to attract the students' attention and/or to vary the classroom routine. We did not think about enabling the students to become more active leaners. I believe that this misunderstanding existed due to the traditional pre-service education approach that did not allow student teachers to present and then develop their own understandings. This misunderstanding could have been easily clarified by adopting 'transformative learning' (see Chapter 4) that allows student teachers to participate as active learners. Clarifying through discussion about why we were learning what we were learning, reflecting upon what we were learning and examining our prior experiences seems to me now a better way for pre-service teachers to be more zealous towards and aware of why they study this unit. Professional education should emphasize questions, investigations, analysis and criticism (Ball & Cohen, 1999).

REFLECTION

Thinking meditatively on what I learnt about using several methods in teaching mathematics ... I thought … "Yeah, it is an interesting topic ... We as prospective mathematics teachers should learn several methods of teaching ... It is quite unreasonable for a mathematics teacher who holds a Bachelor of Education in Mathematics to apply only one

style of teaching all the time for diverse topics ... Each topic in mathematics has a somewhat different goal, so we need to have several approaches to achieve these disparate goals ... We might not always be able to attain these different goals by always employing the same approach ... Maybe therefore, while we have various 'what to teach' we also ought to have various 'how to teach'. As we usually think firstly about 'what to teach' we then also have to think about 'how and why to teach'".

Thinking culturally … I am from an Islamic background; I wished Dr. Ahmed, the teacher educator, had brought our Islamic culture in the classroom. We as a Muslim society privilege and respect what our Prophet Mohammed (PBUH) did and said. We consider him the first teacher and the best educator. Besides the 'Islamic teachings' (the content) we have learnt from him, what about the way the Prophet taught his Companions. For instance in the didactic side, he (PBUH) did not follow only one way of instructing his Companions, but he switched methods based on who was listening, based on the subject that he wanted to discuss with others, based on the situation, based on the goal and the purpose, etc. Moreover, from time to time, even though there was a lack of resources, he used such materials as were available to him fourteen hundreds years ago which helped him to explain an idea (e.g., he used to draw on the sand for his Companions as a means of illustration - what I can now call a concept map), and sometimes he used analogical or metaphorical examples to explain and clarify a topic. He used examples that were derived from their familiar environment.

For instance, Abu Hurayra said, "I heard the Messenger of Allah, may Allah bless him and grant him peace, say, 'What do you think would happen if there was a river by someone's door in which he washed five times every day? Do you think that any dirt would remain on him?' They [the companions] said, 'Not a scrap of dirt would remain on him.' He said, 'That is a metaphor of the five prayers by which Allah wipes out wrong actions'" (Al-Bukhaari; 528 & Muslim; 667). Although it was possible for him to state the idea directly (such as: when you perform the five daily prayers, your sins shall be obliterated), he did not do that. Instead, he made the metaphorical

example to link between the spiritual worship and the concrete example, so that his Companions might reflect on it and be mindful, and have a deeper understanding.

Furthermore, stories, illustrations, proverbs, practical demonstrations were approaches that The Prophet used when he was educating his Companions. In addition, he sometimes launched his speech by questioning them in order to listen to their ideas and/or to attract their attention. What I want to say is that we, as prospective Saudi mathematics teachers who are expected to have the Islamic culture and background as our inspiration, can be motivated therefore by The Prophet in using a range of teaching approaches.

Reflecting critically … I began my research by questioning why pre-service Saudi mathematics teachers neglect what they had learnt about innovative methods of teaching. By reflecting critically on my own and my research participants' experience during the preparation period where we learnt what we were expected to apply in our teaching practice, I agree, now, that it is great to learn new teaching methods. However, my concern here in this thesis is not about what we learnt, my concern is about how and why we learnt. I consider now that the traditional learning experience we had had was and is one of the major factors making us neglect what we had learnt. Therefore, my argument is that our conventional learning experience has influenced us to neglect what we learnt, *and* if we had been involved in 'transformative learning' (see Chapter 4) then I think what we learnt would be more meaningful, understandable, and beneficial and could transform the culture of our professional teaching practice.

Continuing my critical reflection … I consider the way we had been taught as a kind of hypocrisy in which Dr. Ahmed claimed that those methods were good to use in teaching but he never used them himself in his teaching with us. Basically, he taught us about the pioneering teaching methods but he himself used only the traditional pedagogy, lecture style. That situation seems contradictory to me now. How can we *learn* innovative teaching approaches within the instrumental mode of the classroom?!! How can we believe in those approaches? How can we be confident about those innovative

methods? How can we trust the lecturer? Here, I quote what Saud, my colleague, said about this issue:

> *I wonder about Dr. Ahmed, in every class he frequently instructs us by saying 'You have to use several approaches in your teaching ... You have to change your teaching style', while he never applies any of them in his own teaching ... He never changes his teaching style ... Why does he not employ or implement what he is teaching us if he is really interested in using innovative methods of teaching?*

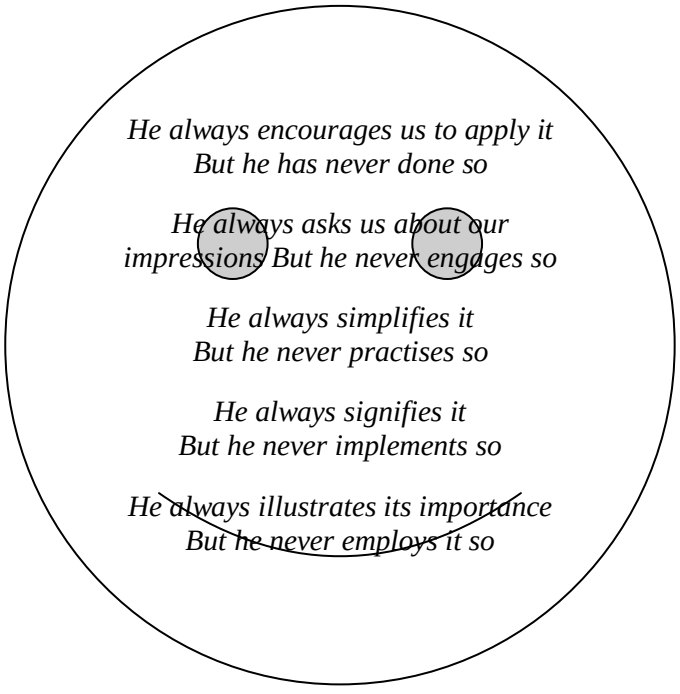
From an Islamic view, this is a bad practice to follow. Allah said in the Quran:

﴿ يَا أَيُّهَا الَّذِينَ آمَنُوا لِمَ تَقُولُونَ مَا لَا تَفْعَلُونَ (2) كَبُرَ مَقْتًا عِنْدَ اللَّهِ أَنْ تَقُولُوا مَا لَا تَفْعَلُونَ ﴾

"O you who believe, why do you say what you do not do? It is most hateful to Allah for you to say what you do not do" (The Qur'an, 61: 2-3). The most helpless one to reform others is s/he who is unable to reform him/herself. In another Surah Allah said:

﴿ أَتَأْمُرُونَ النَّاسَ بِالْبِرِّ وَتَنسَوْنَ أَنفُسَكُمْ وَأَنتُمْ تَتْلُونَ الْكِتَابَ أَفَلاَ تَعْقِلُونَ ﴾

"Do you order righteousness for the people and forget yourselves while you recite the Scripture? Then will you not reason?" (The Qur'an, 2:44). This verse teaches us to learn how to think rather than just what to think (Eldin, 2009). It stimulates us to look at ourselves critically so that we may realise what we are doing or saying.



Continuing my critical reflection … I consider our visits to schools to observe in-service mathematics teachers to have no meaning at all if we do not become involved in 'open and critical discourse' about what we have observed. Analysing what we have observed is more significant than our visiting. It is all about professional learning where we are supposed to be actively engaged in our learning experience. Hence, to move in any vital way beyond rhetoric to practice, we would need to have opportunities to reconsider our current ideas of practice and to examine others (Ball & Cohen, 1999).

Worse yet, our visits enhanced and enriched the same hegemonic classroom culture and the same ideologies of teaching and learning that we conceptualised through our learning experiences while we were students in schools. The teacher educator by using conservative teaching methods, himself, offers a weak antidote to the powerful, hegemonic and controlling teaching culture that occurs in our own prior experience as students (Ball & Cohen, 1999). What Dan Lortie (1975) called the "apprenticeship of observation" is typically more effective than what we learnt in formal pre-service teacher education, and the lessons of that apprenticeship ordinarily are reinforced by what we observe in schools and by our learning experience in most courses including the MTM unit (Ball & Cohen, 1999).

During my discussions with my research participants about their teaching practice, they (after becoming more aware of their learning experience, -see below-) stated that most of their learning about teaching came from their own prior learning experience in schools and from their observations, not from what they learnt at Teacher's College. The following is an example of one such conversation:

> *Naif, do you think our teaching practice should relate to something we learnt from college? Trust me; we learnt a lot from being here in school. We spent a week going with teachers to their classrooms to watch how they taught. So later I could imitate them. For example, Mr. Ali is a mathematics teacher. I imitated him in how he teaches in the classroom. Also, I sometimes tried to remember how my former teachers taught us (Majid, interview, 7/12/2010).*

In point of fact, I personally had similar experiences, and I thought that the teaching practice of my participants came from their own experience not from the college. So,

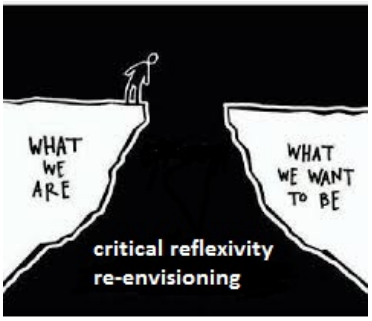
my conversation with them about their teaching practice was actually for two reasons. First, I wanted them to be aware that they were simply following the prevailing pattern without deeply thinking about it. Then, to say: "it is good to learn from others but what about what you learnt at the Teachers' College? Where have those ideas gone to? Why did not you practise what you had learnt?"

> *At the beginning I thought I was going to use them but after coming here [school], no. I did not use them. But I really do not know why. When I came to the school I saw all teachers were the same in their teaching. It was like an essential and a fixed way of teaching. So, I followed their lead. However, if our viewing was with a teacher who was using alternative methods, that might encourage me and enthuse me to follow his example. But when all explanation and teaching was through the blackboard and everyone was using the same technique, it was the same as how I learnt in primary and high school. All were following the same way (Musa, interview, 15/12/2010).*

The status quo of traditional teaching is privileged without needing to call on critical thinking. The teacher educator would need to become sufficiently effective to immunize the pre-service teachers against the conservative lessons that they mostly learn from past experience. It is not an easy task for a teacher educator to become an agent of professional change contrary to what has been socialised (Ball & Cohen, 1999) or derived from the prevailing classroom culture. However, critical reflexivity could play a major role in deconstructing the hegemony of the status quo of the current culture of the Saudi mathematics classroom.

My reflection shows that there is a gap between 'what we are' and 'what we want to be'. My reflection shows that my learning experience was "intellectually superficial, disconnected from deep issues of curriculum and learning, fragmented, and noncumulative" (Ball & Cohen, 1999, pp. 3-4). My reflection shows that our neglecting of what we learnt was not due to 'the content' we learnt but it was due to how we had been taught and why we learnt that content. My reflection shows that our prior learning experiences and observing experienced teachers play a crucial role in how and why we teach.

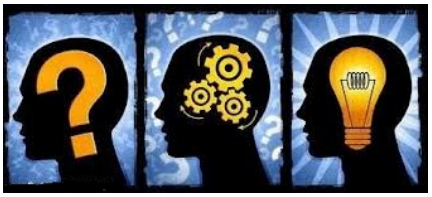
Only realising that my experience in the traditional classroom culture has restricted my teaching practice is not enough for me. So, I thought about what pre-service Saudi mathematics teachers might need? What could make their learning experience more meaningful? What could motivate them to be more aware of what they learn? What can they do to make what they learn have an impact on their teaching practice? I argue that pre-service Saudi teachers need to be involved in 'transformative learning' which is much more than the traditional transmission and acquisition of objective knowledge and skills. They need to be engaged in 'transformative learning' where they are able to be part of their own on-going learning process, where they are encouraged to think reflectively and critically about what they learn, where they are stimulated to question their assumptions about teaching and learning. To influence what the pre-service teachers learn, teacher educators should consider their own pedagogy of teaching: (i) what pre-service teachers would have opportunities to learn and (ii) how they would be taught (Elmore, Peterson, & McCarthey, 1996).



In this chapter, I propose an open and critical discourse approach where the teacher educator can encourage future teachers to engage in critical reflexivity about their own experience and to re-envision the culture of mathematics education in Saudi Arabia. Through a process of critical self-reflection on their learning experiences and on the culture of mathematics education (which includes their beliefs about themselves and their roles in the mathematics classroom – see the following chapter –), pre-service teachers might develop new perspectives about themselves, new understandings about their experience and/or new visions about the culture of the mathematics education, the mathematics classroom culture, the school … etc. (Mezirow, 2000).

In the proposed open and critical discourse approach, the referent needs to be critical constructivism and learning needs to be according to transformative learning theory. Critical constructivism and transformative learning go beyond 'objective learning' or 'instrumental learning' and the 'technical interest'. Both – critical constructivism and transformative learning – advocate critical self-reflection, as well as an open and critical form of discourse. Both endorse 'communicative learning' and express the 'practical and emancipatory interests'. Open and critical discourse seems to be a

valuable common feature of critical constructivism and transformative learning and a good for accomplishing their aims. Using an open and critical discourse approach



would allow pre-service teachers to have opportunities to practise critical consciousness. Furthermore, in an open and critical discourse approach, teacher educators would be able to adopt Pinar's (1975, 2004) four steps of 'currere' where pre-service teachers would be involved in the process of reconstruction and reconceptualisation of their own school experience (see Chapter 4 for more and deeper details about critical constructivism, transformative learning theory and the method of 'currere').

- Open and critical discourse (or discussion)

Brookfield (1985) suggests that definitions of discussion "seem to cluster at different points along a continuum distinguished by the degree of control that the teacher exercises over discussion procedures and content" (p.56). So, on the one hand, discussion is open and free where it welcomes unanticipated learning issues. On the other hand, the discussion is guided where the general direction is under the strict control of the teacher educator as well as the opportunities for the pre-service teachers to make comments or ask questions (Brookfield, 1985; Galbraith & Zelenak, 1991). Discourse includes "words, acts, values, beliefs, attitudes and social identities" (Gee, 1992, p. 107). It also can be described as a "pedagogical communicative relation" (Burbules, 1993, p. 8).

The purpose of discussion is oriented toward cognitive change. Brookfield (1990) writes that the specifically cognitive aims for the use of discussion should be:

- To expose learners to a diversity of perspectives on an issue, topic, or theme;
- To help learners to externalize the assumptions underlying their values, beliefs, and actions;
- To assist learners in [adopting varied perspectives]; that is, in coming to see the world as others see it;
- To introduce learners to elements of complexity and ambiguity in an issue, topic, or theme (p.192).

I need to emphasize here an important issue that the *traditional* group discussion where prospective teachers are merely having a good conversation is insufficient due to the lack of *criticality*, an element that is central to the pre-service teachers' deep engagement (Miller, 2006). More so, discussion is not fundamentally a form of question-answer communication, but an engaging 'social relation' (Burbules, 1993, p. 19). Thus, student teachers need to go beyond discussing the surface aspects of their status quo about teaching and learning. They need to openly and critically explore the prospects of reconstructing the *microculture* of the traditional classroom learning environment (Taylor & Campbell-Williams, 1993). Open and critical discourse might, therefore, stimulate student teachers to reveal and subject to scrutiny the constraining nature of the traditional *hidden* frames of reference (Taylor & Campbell-Williams, 1993) that traditional discussion would not do. Unlike traditional discussion where technical understanding - unlikely to identify an additional source of multiple meaning due to the authority, monologue, and the role of the privileged or the expert - is dominant, open and critical discourse must be undertaken in a spirit of mutual respect and concern (Burbules, 1993) to create a culture and establish norms that promote mutual understanding that critical constructivism and transformative learning theory aim at (Taylor, 1998; Taylor & Campbell-Williams, 1993; Mezirow, 1996; Miller, 2006).

The aim of open discourse is to understand pre-service teachers' meaning-perspectives toward the mathematics classroom culture. It opens windows for pre-service teachers to speak about themselves, to share their own learning experiences, to explore their beliefs about teaching and learning, to clearly communicate their own views about the culture of the mathematics classroom, and to negotiate with each other and with their teacher educator about what they are learning about teaching methods. Open discourse would also stimulate pre-service teachers to participate in reconstructing the culture of mathematics education in Saudi Arabia (Taylor, 2002; Taylor, Fraser, Fisher, 1997). On the other hand, the aim of critical discourse is to enable pre-service teachers to become critically aware of the dominant classroom culture of teaching and learning. It also aims to deconstruct the hegemonic myths of Saudi mathematics education that distort any attempt at professional development of teaching and learning (Taylor & Campbell-Williams, 1993; Taylor, 1996; Milne & Taylor, 1998).

Accordingly, open and critical discourse would motivate us (pre-service teachers) to become critical thinkers to question and scrutinize the real issues within mathematics education, especially those that do not surface such as our previously held assumptions, beliefs, values, and practice in the traditional mathematics classroom culture. Such open discourse, at the same time, would stimulate us to become more reflective and aware of our contextuality (Brookfield, 1987).

More so, open and critical discourse could help us in increasing our awareness of what we learn. Open and critical discourse that includes reflection could transform us from being passive listeners to active learners. It would create a culture of the classroom where our thinking (our initial conceptions) about teaching and learning can be revealed. So, we would be aware of our pre-conceptions which are affecting our teaching practice. Open and critical discourse about our thinking would engage us in working on our pre-conceptions, challenge them, and draw out our potential misunderstanding (or misconceptions), and then construct a more viable conception or change it if appropriate. Gee (1992) indicated that when we have meta-cognitive awareness and understanding of the school, mathematics education and the mathematics classroom, we are more empowered as learners to engage in, examine, and change the practice of the mathematic classroom. Transformative change occurs only if we examine and understand the real issues (Habermas, 1984) about mathematics education and the classroom culture.

Moreover, open and critical discourse with pre-service teachers allows us to bring forward what is in our mind. So, we may be able to discuss an issue that concerns us even if it was not pre-planned as part of the lesson. This is a major characteristic of discussion. “If we knew exactly what was going to happen in a session, [and all was pre-planned], it would cease to be a [real] discussion in any meaningful sense” (Brookfield, 1990, p. 195). Galbraith and Zelenak (1991) state that “if one word categorises discussion it has to be unpredictability” (p. 106).

In addition, via critical discourse, we would be able to critically think about our own thinking. We would be stimulated to be involved in higher-order reflective thinking about our learning process. Engaging in critical discourse would help us to reflect on our own learning and understanding as we are making use of our own and others’ experiences. This might lead us to think critically about what we do and what we are

supposed to do in our future classroom practice. Hence, critical discourse might allow us to experience alternative ways of thinking about our assumptions, values, beliefs and actions. It would allow us to address an issue from a perspective different from that which we usually employ (Galbraith & Zelenak, 1991).

And last but not least, learning through critical discourse is an important way of engaging in praxis, which is seen "as necessary for pursuing transformative ends in the engagement interface" (Miller, 2006, p. 110) with others. It is an expression of praxis (Burbules, 1993) where we as student teachers can acquire a critical awareness of our own mathematics classroom culture to reflect and act upon it in order to transform it (Freire, 2005).

Discussion …

I like to keep it up … wherever I will be

When I engage in it … it dawns on me

Within discussion … I can share stories about me

Within discussion … there is a chance to understand me

Discussion makes me realise … how I think and how to be

It may raise even your consciousness … about what you really see

If you want to see things differently … If you want to think reflectively

If you want to envision creatively … if you want to reflect critically

Involve in discussion…you won't lose anything… but you will thank me

We may name it differently … it is all good to me

Conversation, discourse or discussion … it doesn't matter to me

As long as we talk … we can name it whatever it be

- Discussion and my research participants

I did not record my experience of undergraduate study contemporaneously. I have written about it retrospectively during this thesis research; after becoming aware of it. At the time of my undergraduate study, I actually was not aware of any problem in my learning. I did not give any thought to any other way of teaching or learning. I

thought that this is what should be happening (see Chapter 6). This is how the way of teaching should go and this is how the way of learning should be. The teacher should work hard explaining everything to students and students should follow their teacher by keeping their mind focused on the classroom context. In the same way, I found my research participants' thoughts were similar to mine.

At the beginning of my interview with my research participants, it seemed that they were not aware of the availability of any alternative classroom culture that might provide an alternative learning experience for the students. Consequently, their early responses regarding my questions (such as what did you think of the unit? how did the teacher run the classroom?) were similar to what I would have said if I had been asked at that time. What were we supposed to say?!! We had nothing to do with the structure of the unit or the way of teaching and learning. So, their early responses were very accepting of what had been presented in the lecture room and showed no critical or reflective thinking. Their responses were as follow:

> *[The unit] was good and well organised. Everyone takes notes about such a method; its advantages and its disadvantages. He [the teacher educator] left 15 minutes at the end of the lecture for us to ask questions (Eissa, interview, 14/12/2010).*
>
> *It was beautiful unit; [the teacher educator] was asking us to do some tasks and gives us interesting things to do (Osama, interview, 8/12/2010).*
>
> *It was a nice unit; he explained well and worked hard with us (Khalid, interview, 13/12/2010).*

I want to say here that I believe that the hegemony of the traditional educational classroom culture played a central role in making our prior learning experience inexplicit to us. So, uncritical responses were what we were supposed to give. However, when I delved more deeply, asking my research participants about their own learning experience during their study in the unit, it suddenly dawned on them. I asked them questions like: what were you doing, what were your roles in the classroom, what kind of participation did you have? I let them think about whether they had reflected on what they learnt, whether they were involved in any discussion or engagement about why they learnt what they learnt with their teacher or their colleagues, whether they thought critically about what they learnt, whether they

presented their own thoughts about what they learnt, whether they shared their own experience of school learning using the traditional teaching method. These questions were so strange to them. They thought they had no experience because they had not done any of these things; they had just listened and left.

> *I do not remember that I discussed with [the teacher educator] or presented my thoughts. The classroom was normal, nothing new (Majid, interview, 7/12/2010).*
>
> *I never engaged in discussion with my colleagues (Ibrahim, interview, 7/12/2010).*

I remember when these questions raised the ire of Ibrahim. He interrupted me many times saying: *"no, no, it was only a lecture"*. I thought that they would not have had any discussion and would not have engaged in activities that entailed reflection or critical thinking, but I asked them to cause them to think about it. I wanted to engage them critically with their own learning experiences. I believed that involving and engaging them would generate reflective thinking (Brookfield, 1985) and high quality learning (Coates, 2005). Thus, I asked these questions for two reasons: firstly, to raise their consciousness about what they were doing[7], and secondly, to lead *me* to ask questions like: what do you think would have happened if you had had the opportunity to participate in the classroom? What do you think would have happened if you had talked about your future teaching practice? What do you think would have happened if you had presented what concerned you about teaching alternative methods?

It seems that my questions woke them up and made them think again about what they were doing and what they might need to do and how they might need to learn. Therefore, as I went ahead with my research participants in the discussion interview, their responses showed inconsistency. I found later that their responses became more reflective and critical. I found their awareness about their learning experience had increased.

> *We [pre-service teachers] are adult. We do not need someone just to read to us, we can read ourselves (Majid, interview, 7/12/2010).*

[7] This is an example of one of my ethical considerations (beneficence) to my research participants in this study.

Moreover, when I engaged them in discussion during my interview about whether they practised what they learnt, whether what they learnt affected their thinking about how they might teach, I found that their awareness was raised and became present in their responses. Their comments had changed to what I presented in the previous part of this chapter. They started responding reflexively and critically, and they even criticised their previous unawareness of their learning.

> *[About learning the unit] we took it as information to be memorised. But if I had thought that I was studying the unit in order to obtain its benefits in my future teaching, I would have asked how these benefits could be achieved. But we all were just writing down information and theories in our notebooks. We did not think that we were going to use it in our future teaching, but now after I have had a school experience, I feel that the unit has big potential benefits. I wish now I could go back to learn more and ask about something not understood (Musa, interview, 15/12/2010).*

> *[About the way of teaching] this is what killed the education system here in Saudi Arabia. The teacher only talks all the time. In primary, junior and senior high school, I sit on the chair without even moving; for sure I am going to be lazy. Some colleagues studied with me for four months, I never even heard their voices, and I swear that some of them studied with me four or five years, I do not know even their names (Majid, interview, 7/12/2010).*

SUMMARY

In this chapter I have advocated fundamental changes in the principles and the standards of mathematics education and the culture of the classroom in Saudi Arabia, not only in the classroom atmosphere or routine. Transforming Saudi mathematics classroom culture is not an easy task; it is very challenging. However, one step that could help in transforming the classroom culture is by engaging pre-service teachers in 'transformative learning'. Saudi teacher educators need to go beyond transmitting the curriculum content, they need to help their student teachers to become competent and skilled, and to understand, 'not only memorise', what they are learning, and to effectively communicate, 'not being silent' (Ball & Cohen, 1999).

This chapter suggests the importance of the perception that pre-service mathematics teachers do not need to be told alternative teaching approaches as much as they need

to reflect critically and engage in open and critical discourse on what they are learning. They do not 'learn' simply by listening. Pre-service teachers need to be engaged in a transformative classroom culture that enables them to become critically reflective teachers. They need opportunities that stimulate them to think reflectively and critically. They need to be engaged in their learning process by examining their previous learning experience and their visits to schools (their observations), in relation to what they are learning. In other words, teacher educators might need to turn their attention toward pre-service teachers' professional learning, not only focusing on changes of classroom teaching practice. This would increase student teachers' awareness of what they do and make their learning more meaningful. Once they begin to become involved in the process of critical self-reflection, they would be more aware of themselves and their own experience of learning. They would be aware of the classroom culture they had been involved in. They might also be able to reconsider their current teaching practices and to examine possible alternatives.

The crucial point about transformative learning is that it adopts fundamentally different ideas about what we have already learnt. Transformative learning has very different education principles. So, the practice, the attitudes and the culture in general would be different too. For example, in transformative learning culture, schools are not isolated from the society; they are intended to be connected with their communities. More so, in transformative learning, student teachers' prior learning experience is considered to be a vital component in developing their professional teaching practice. Moreover, discourse, in transformative learning, is not simply conversation about what is being learned but it "challenges hierarchy and authority, supports diversity, avoids teleology, rests on reciprocity, and embraces a range of communicative styles and voices" (Dillon, 2000, p. 878). Generally, new roles and relationships need to be adopted.

What I like more about transformative learning, beside what I have already said, is that it does not attempt to change the culture of mathematics classroom dramatically from outside and does not aim to turn the classroom system upside down in one session. Transformative learning begins with pre-service teachers themselves. Transformative learning would gradually enable them to interrogate and explore themselves first, their past experiences, their novice assumptions and their

envisioned future practice, and then to take action as long as they keep engaging in reflective thinking and critical thinking and, more importantly, creative thinking.

CHAPTER 6

DURING MY PRACTICAL FIELD TEACHING/TRAINING EXPERIENCE

INTRODUCTION

In the previous chapter I presented my learning experience during my undergraduate study and discussed how being involved in 'transformative learning' could have made my experience more effective. Transformative learning includes a change in my underlying beliefs about myself and the assumptions I hold about teaching and learning of mathematics. In this chapter my aim is to critically explore my practical field teaching experience; particularly, my beliefs (perspectives) about teaching and learning, and my understanding of my role as a mathematics teacher and my students' role as learners in the mathematics classroom, and the consequences of re-structuring my professional practice. I endeavour to illustrate the importance of using metaphor as a tool of transformative learning in portraying my beliefs about teaching and learning. Also, I demonstrate the significance of using metaphor as a tool in elaborating my conceptual understanding of the process of teaching and learning, and its implications for restructuring my professional practice.

THE TEACHING STYLE THAT I TEACH BY

> *It could be any day during the second semester of 2003; the semester of field experience. I enter my year 5 mathematics classroom. "Our lesson today is going to be about …", I say. It could be any topic from the 'curriculum'. I open my textbook after asking every student to do so. I write the rule on the blackboard. I pick out an example from the textbook. I write the answer to the example after explaining how to use the rule in answering the question posed. I ask students to copy the answer into their textbooks. I write the second example from the textbook on the blackboard. I again explain how to use the rule to answer the*

question. I repeat the explanation of how the rule should be used over and over again. I ask students if anyone has a question or has not understood yet. At the end of the lesson, I give the students the rest of the examples of the textbook as homework. The next day, I start my teaching by answering the homework examples. So, students have to copy the correct answer if their answers are wrong.

The above paragraph portrays the teaching style that I teach by. It describes how I used to teach. It illustrates my commonplace classroom teaching practice. 'How I teach' seems to be a facsimile of how the pre-service mathematics teachers who are participants in my research teach. Individually, I had conversations with them about their experiences of teaching and learning, and I asked them to describe their usual role in the classroom as mathematics teachers. During our conversation, I asked: *how do you usually teach?* My research participants' responses were as follows:

At the beginning, I give students a 'rule', then I ask someone to read it at aloud, then I explain the rule and answer the questions in examples (Ibrahim, interview, 7/12/2010).

Well, I start by reminding students about the previous lesson, then I begin to explain, I give the normal explanation, and answer the questions in the examples, then I give them examples to answer in the classroom, then I give them homework (Majid, interview, 7/12/2010).

I always follow the textbook. I start by writing the title of the lesson and the definitions and the rules and the examples. Then I ask students to copy down what I wrote, in their notebook (Musa, interview, 15/12/2010).

I write the examples on the blackboard and answer the first one and the second one until I am certain that most of students understand, and then I ask them to answer two examples in the textbook. When they finish I answer those two questions on the blackboard, and whoever has made a mistake has to revise it and I explain to him why this is a mistake and ask him to follow my explanation on the blackboard. Finally, the rest of the textbook's examples are for homework (Eissa, interview, 14/12/2010).

This way of teaching by my participants was not only dominant, but was the only available way of teaching they had. "*Do you have another way of teaching?*", I asked following up the previous question.

> *I always run my classrooms like this (Eissa, interview, 14/12/2010).*
>
> *No, I have only one method; indoctrination (Ibrahim, interview, 7/12/2010).*

Although we, as mathematics pre-service teachers in Saudi Arabia, have learnt several innovative teaching approaches to use in our professional teaching practice (see Chapter 5), it seems that we are practising only the conventional teaching approach: the teacher-centred one. My participants and I described our method of teaching by saying, "*I write, I ask and I explain*". There is absolutely no mention of letting students say or do something outside the set lesson framework. It seems quite clear that we fail to practise what we have learnt about alternative student-centred teaching approaches. It appears that the technical control culture of the classroom is our default classroom tradition.

On the other hand, there might be others who attempt to practise what we have learnt about innovative teaching methods. After I became a mathematics teacher, for instance, I endeavoured to apply a collaborative learning approach (CLA) as a new way of teaching in my mathematics classroom. After reflecting critically on my teaching experience of collaborative learning, however, I now realise that my teaching style was governed by the conventional classroom culture. It followed the traditional view of teaching and learning (see Chapter 7).

I found my experience of using CLA similar to Eissa who teaches in a school that takes collaborative learning as a default approach of teaching. Every classroom has been designed to be compatible with the collaborative learning teaching method. Every classroom has been shaped for students to be in small groups. Eissa said:

> *I am obliged to use collaborative learning in this school because students are in groups and the classroom is prepared for this method. So, I fix in my mind that I am certainly going to use collaborative learning (interview, 14/12/2010).*

Eissa thinks that he uses a collaborative learning approach in his teaching, but only because students are sitting in small groups. However, based on his thoughts about his practice, it seems that he only uses a teacher-centred approach. A collaborative learning approach entails an alternative teaching role for the teacher. It gives students more responsibility for their learning. It requires them to be actively involved in their learning process. It requires them also to be involved in interactions with each other. However, Eissa and I did not adopt an alternative teaching role when we used this method. We simply followed and practised what we were used to seeing in the mathematics classroom during our lives as students (see Chapter 7).

THOUGHTS THAT I 'THINK BY'

During my field teaching experience, my thoughts about my role as a mathematics teacher (whatever was the teaching method I utilized) was that I had the pivotal role in the classroom while my students needed only to pay attention to me. I believed that the teacher's role was essential for transmitting the knowledge from the 'curriculum' to the students, so s/he needs to do whatever it takes to play that role. And I believed that the students' role was limited to listening to their teachers, memorising and copying everything their teachers had written on the blackboard, so they could pass the exams.

I discussed this issue with my research participants, and their thoughts were as follows.

Naif: *What do you think is the role of the mathematics teacher in the classroom?*

Ibrahim: *Explain the lesson and ensure the classroom is well disciplined (interview, 7/12/2010).*

Musa: *His role is essential in everything. He is the one who conveys the information to students. I mean, without the teacher students cannot understand and cannot get the information. So, he has the essential role (interview, 15/12/2010).*

Eissa: *Transfer the information to the students. He has to do that (interview, 14/12/2010).*

Khalid: *Prepare the lesson and give it to the student via educational tools. Taking the information from the textbook and transmitting it to the student is the role of the teacher (interview, 13/12/2010).*

Naif: *What about the students' role in the classroom?*

Ibrahim: *Listen to the teacher, and ask only if they do not understand and then do their homework (interview, 7/12/2010).*

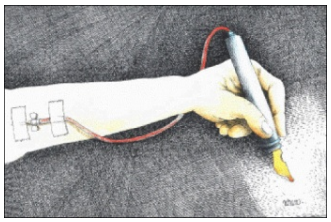
Musa: *To be receivers of the information and listeners (interview, 15/12/2010).*

Eissa: *At the beginning, of course, they will be listeners. They have to obtain the information, understand it and then answer the examples (interview, 14/12/2010).*

When I believe that the students' role is to be attentive listeners, what do you think I will do? Will I allow them to speak? Will I allow them to communicate with each other? What will be the culture of the classroom? What will be the learning activities? Moreover, when I believe that my role as a teacher is limited to transmitting knowledge, how will I teach? Will I allow students to play an active part in building their understanding? Will I think about making what they learn meaningful to them? What is the point of learning different teaching approaches, anyway, if my role and the students' role are unchanging? I am, as I see myself, enthusiastic about practising what I have learnt, enthusiastic about altering the culture of the classroom; but, during my practical teaching, I did not even think to change my conventional role of teaching.

MY BELIEF VS MY PERFORMANCE

The crucial point is that the conventional concepts of teaching and learning that governed my thoughts also governed my everyday teaching performance in the



mathematics classroom, down to the most routine details (Lakoff & Johnosn, 1980; Thompson, 1992). My conceptual understanding of the conventional concepts of teaching and learning played a significant role in structuring my experience (Lakoff & Johnson, 1980, 1999; Thompson, 1984). Consequently, my traditional view of teaching and learning impacted on structuring my role as a teacher as being transmitter and controller, and my students' role as learners to be passive receivers and attentive listeners. It structured the pedagogy of my teaching; how I taught and how I communicated with my students. It structured the reason for my teaching; why I taught and what it was for. It structured how I perceived my students' learning; how they learnt and why. It structured how I perceived the culture of the mathematics classroom.

This indicates the importance of my beliefs about teaching and learning in constructing my experience. It also indicates the importance of engaging pre-service mathematics teachers in activities that stimulate them to examine critically their novice beliefs about teaching and learning in order to build a more inclusive view, rather than having the limited view of a transferring-receiving knowledge process. It is easy for Saudi pre-service teachers to 'learn' new teaching methods, but actual teaching methods are highly influenced by the teacher's conceptions and beliefs (Marsick & Watkins, 1991). Many research studies have been conducted and articles written regarding the influence of mathematics teachers' beliefs about teaching and learning on their classroom teaching performance (e.g., Barkatsas-Tasos & Malone, 2005; Beswick, 2006; Stipek, Givvin, Salmon & MacGyuers, 2001; Thompson, 1984, 1992; Jaberg, Lubinski & Yazujian, 2002; Ernest, 1989). In this chapter, however, I do not want to *only* identify my previous beliefs about teaching and learning and their possible influence on orienting my teaching performance. The more important concern here is: were the beliefs about teaching and learning that structured my actions clear to me? Were they visible to me? Was I aware of them? Did I intentionally follow them? Or did I just follow what everybody normally did without thinking deeply?

TEACHING AND LEARNING

After describing what I did in the mathematics classroom and demonstrating my role and my students' role, I now need to ask myself, what does teaching and learning essentially mean to me? Frankly, I found the concept of teaching and learning to be ambiguous and tacit. It seems to be difficult for pre-service teachers to elaborate their concept of teaching and learning and is seldom the focus of discussions between teacher educators and their prospective teachers (Thomas, 2006). I asked this question of my research participants to find out what it meant to them.

Naif: *What does teaching and learning mean to you?*

Ibrahim: *Teaching is a responsibility that I have to do it; which is to teach (interview, 7/12/2010).*

Majid: *I hate this question. Learning … Teaching … Education and what else?!! For me, there is no difference between teaching and education. This question kills me because I cannot make any difference between them; education and learning!!?? (interview, 7/12/2010).*

Osama: *From the beginning in primary school to finishing high school, our conception of learning is that I work hard to get a high mark to pass the exam and move to the next level (interview, 8/12/2010).*

Musa: *These are connected together and lead to education. So education includes these two things; students who receive the information, the teacher who explains and transmits the information that students receive (interview, 15/12/2010).*

Khalid: *Learning means to learn something, teaching means to teach students the curriculum (interview, 13/12/2010).*

During our conversation, it appeared to me that my participants had never thought deeply about this question. And this was completely true for me as well. I do not remember that I ever thought deeply about these issues in my previous experience of learning or teaching.

Despite the importance of my conceptual understanding of teaching and learning for my professional practice, my perspective of teaching and learning had not been examined, discussed, or made explicit to myself. I did not, for example, engage in activities such as reflective thinking that might stimulate me to explore my conceptual understanding of teaching and learning. Thus, I was not explicitly aware of my perspective on teaching and learning during my practical teaching experience. I simply thought and acted automatically in accordance with the commonplace and unidentified conventional ideology of teaching and learning. My ordinary conceptual understanding of teaching and learning was not something that I was aware of.

UNDERSTANDING MY CONCEPTUALISATION OF TEACHING

During this research I found that my conceptual understanding of teaching could be portrayed explicitly by representing my teaching experiences in terms of something familiar to me. To do so, I needed a tool that enabled me to represent my experience: a tool that I could use to make my conception of teaching 'visible'. I found 'metaphor' very helpful for seeking to access my subconscious understanding of teaching.

- Metaphor vs belief

My metaphors of teaching and learning reflect and represent my underlying beliefs, as a practical mathematics teacher that govern my performance in the mathematics classroom (e.g. Munby 1987; Munby 1990; Tobin 1990; Ritchie 1994; Saban, Kocbeker & Saban, 2007). Because metaphors represent beliefs, metaphorical language helped me as an educational researcher to understand and represent my professional thinking as a practical teacher (Marshall 1990). Metaphors provided a powerful cognitive tool for gaining insight into my professional thinking (Saban, Kocbeker & Saban, 2007).

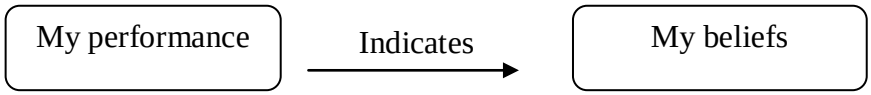
Shuell (1990) asserted that “if a picture is worth 1,000 words, a metaphor is worth 1,000 pictures! For a picture provides only a static image while a metaphor provides a conceptual framework [to stimulate] thinking about something” (p. 102). Metaphor invites researchers to explore comparisons, notice similarities, and use a situation as an image of another. Metaphor acts as a lens, a screen, or a filter through which a subject is (re)viewed and becomes a mental model for thinking about something in light of another. The metaphorical expression “a teacher is a gardener”, for instance, refers not just to what teachers are like, but indeed to “what it is like to be a teacher” (Saban, Kocbeker &, Saban, 2007, p. 124).

Ortony (1991) argued that metaphors enable us to explain and understand an unknown situation in reference to a known and familiar one. Hence, metaphors can assist us to make the unknown known by referring the abstract to what is known or to something concrete in our everyday world. This is concisely the essential nature of metaphor - an atypical juxtaposition of the familiar with the unfamiliar. In essence, metaphors help us reason about a situation from multiple standpoints, which may promote the construction of new concepts (Casakin, 2011). Moreover, metaphorical thought seems to be a kind of imagination which involves seeing (or imaginative understanding of) one kind of thing in terms of another kind of thing. What I like about metaphor is that it unites reason and imagination. Metaphor is imaginative rationality (Lakoff & Johnson, 1980).

Teaching and learning are abstract concepts and to explore and understand them we need to employ metaphor (Yob, 2003). Teaching and learning are not just a reflection of an external reality, but they are crucially shaped by my body and brain (Lakoff & Johnson, 1999). So, being aware of my concepts entails involving my mind in discussion about those concepts. Metaphor has been used as a vehicle for exploring pre-service teachers’ beliefs and conceptions of mathematics teaching and learning (Wolodko, Willson & Johnson, 2003) and also for dissolving the cultural myths of the value of 'hard control' and 'cold reason' (Taylor, 1996) in which each belief and conception can be viewed as having a metaphorical basis (Willison & Taylor, 2006). Thus, discussion of teaching metaphors might be productive in making explicit some of the hidden features of my conceptual understanding of teaching.

In the following section, I use metaphor as a tool to assist me to portray my teaching performance and to express and understand explicitly my implicit beliefs about teaching.

- Employing metaphor to explore beliefs



I may tell you what you think, when you tell me what you do

Tell me your view, I may tell you what you do

If I tell you what I think, you may know what I do

Due to the metaphorical nature of my conceptual understanding (Lakoff & Johnson, 1980, 1999), I could portray my conceptualisation in terms of another known thing. Moreover, because our conceptual system governs our daily actions I could represent my conceptual understanding of teaching by expressing what I was doing in the mathematics classroom. I could create a teaching metaphor that portrays my teaching performance. Bryan (2012) suggested that beliefs are not directly observable, but the actions and statements of the person holding the beliefs can be used to infer them. So, acting and performance is an important source of evidence for what my understanding of teaching is like and what my metaphor of teaching could be. What I do is influenced by my conceptual understanding (my metaphor) that I use in thinking and perceiving. So, by embodying in metaphor my daily performance in the mathematics classroom, I could make my conceptual understanding of teaching visible to me.

To give an example, I could say that 'teaching as transmitting' was the conceptual metaphor that governed my professional teaching practice. It reflected my everyday teaching performance in the mathematics classroom. It enabled me to understand my teaching in terms of the concept of transmitting. Many of the things I did in teaching were partially structured by the concept of transmitting. So, I *transmitted* the knowledge ... my students *received* it ... *receivers* have only the task of receiving

what is *transmitted* ... the *sender* also has no responsibility for how the *receivers* might *receive* ... the *sender's* job ends by *transmitting* ... if the sender asks the receiver to return the commodity, the receiver should resend it as it was ... it does not matter what the sender sends, why s/he sends it, to whom s/he sends it ... the issue is that s/he has to send it … receivers also have no idea where it came from, what it is for, what they should do with it ... the sender and receivers are two separate poles ... there is no importance given to communicating with each other as long as each one does his/her job of transmitting and receiving ... receivers have only two choices:, whether to keep it or reject it. If it fits the receiver, s/he may take it, but if it does not s/he may ignore it. The 'teaching as transmitting' metaphor was one that I used to 'teach by' in the mathematics classroom culture; it structured the actions I performed in my teaching practice.

Another metaphorical concept that describes my role as a teacher is: 'teacher as newscaster'. With this metaphor I portray my role as a teacher in terms of a newscaster's role. S/he reads the news every day. S/he has to start and end at a specific time. S/he reads exactly what has been written in the script. S/he says what s/he has been told to say. S/he does not know his/her audience, what their interest is or what they want. S/he does not interact with them. S/he cannot mention any other news or event – even it relates to what s/he says - unless it has been written in the script. S/he has no idea whether or not his/her viewers have assimilated or understood his/her language of the news presented. His/her concern is to complete his/her job.

Another metaphorical concept that portrays my role as a teacher is 'teacher as pilot'. S/he comes to the airplane that has been chosen for him/her to fly. S/he does not need to know anything about the passengers because s/he has nothing to do with them. S/he only has to fly the airplane. Passengers and pilot have to come to the airplane at a specific time. They find everything has been scheduled; the speed, the height, departure time, arrival time and even the meals they will eat. The pilot has to take all the passengers to the same destination.

REFLECTION

Thanks to metaphor for enabling me to portray explicitly my conceptual understanding of teaching. Thus, I could say that my conceptual understanding of teaching was very much congruent with the perspective of a teacher-centred teaching approach. Having said that, how could this conceptual system of teaching be suitable for practising an innovative approach to teaching such as collaborative learning that I learnt during my undergraduate study? How could I - as a mathematics teacher whose conceptual understanding of his role as a teacher in the classroom is as a pilot in the airplane - practise an alternative role as a guide, for example, in a collaborative learning classroom? Generally, how could a pre-service teacher practise innovative approaches of teaching while the metaphor of 'students as receptacles', based on the idea of 'teaching as knowledge transmission' and 'learning as knowledge acquisition', are expected to be dominant? (Saban, Kocbeker &, Saban, 2007).

In relation to a collaborative learning approach, for example, I learnt that the role of the teacher in this method should be that of a 'guide'. However, I had no idea what it means 'to be a guide', how this could affect the culture of my classroom, how this could influence my performance or change the process of students' learning. All I was required to know, literally, was that the role of the teacher within a collaborative learning classroom is to be 'a guide'. I only had to memorize it, so that if an exam question asks about it I could answer it.

It seems that there was a gap between what was in my head - what I memorised - and what I would do (Siry, 2009). This gap existed due to neglecting my own ordinary conceptual understanding of teaching and learning. The concept of "teacher as a guide" needs to be elaborated; it needs the adoption of an alternative view of the culture of the classroom. It needs the adoption of an alternative theoretical perspective. It would have been great if I had engaged in discussion with my colleagues and my teacher about how I could be a guide in the classroom. However, all that I perceived about the culture of the classroom was objectivism where all the responsibilities are upon the teacher, where students have nothing to say about their own understanding, where meaning is carried by the teacher's words and where the truth is told by the teacher. How could I have been 'a guide' with a positivist belief dominating the classroom culture?

Hence, I wish I had been involved in activities that motivated me to express critically my ordinary beliefs about teaching. I wish I had been engaged in *open and critical discourses* that stimulated me to create an alternative metaphor of teaching. *I argue that teaching prospective mathematics teachers in Saudi Arabia innovative teaching pedagogies from within a positivist belief about the classroom culture is insufficient to enable them to practise what they learn.* Teaching them without enhancing critical reflection on their own everyday beliefs towards teaching and learning leads them to follow what they already believe, rather than the new approaches they learn. Teaching them without involving them in higher-order thinking activities leads them to follow the established hegemonic beliefs about teaching and learning. Teaching them without examining their conceptual understanding of teaching leads them to practise their ordinary teaching strategies.

WHAT MIGHT BE NEEDED?

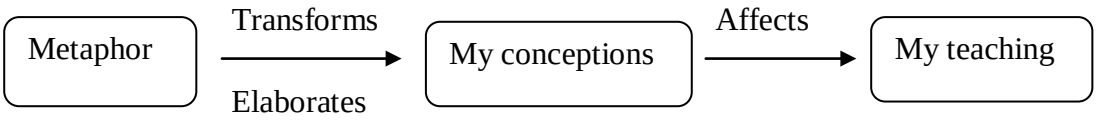
Based on the above argument, future mathematics teachers in Saudi Arabia need to expand and liberate their understanding of the concept of teaching and learning. The focus of concern with future teachers in mathematics education is not only with their knowledge of the subject matter, but with their beliefs and conceptions about teaching and learning (Ernest, 1989). Future teachers need to develop and expand their ideas about teaching and learning, including what it means to teach and what it means to learn, and what helps children learn (Ball & Cohen, 1999). Saudi pre-service mathematics teachers need to maximise the development and enhancement of their metacognition of teaching and learning. They need to have opportunities to consciously reflect on what they learn about new teaching strategies and to assess their viability in practice in relation to their own teaching-learning contexts. They also need to engage in activities that stimulate them to review, scrutinise and criticise their own previous experience which was influenced by the traditional beliefs about the mathematics classroom. Reflection on experience and practice has been found to be a vital feature for improving teaching (Tobin & Fraser, 1990). During reflection "a teacher builds a store of personal practical knowledge that accrues over time and is enriched by a constant checking of the consequences and efficacy of the various

aspects of his or her teaching" (Butler, 1991, as cited in Ritchie, 1994, p. 293). When and if they do so, they may be better able to use their conceptions of teaching and learning as referents in the reflective process. If teacher educators do not explicitly encourage such reflection, pre-service teachers are likely to have no opportunities to develop their metacognition about teaching and learning (Thomas, 2006).

So, prospective teachers might elaborate and change their conceptual understanding of teaching by using 'lateral thinking' rather than 'literal thinking', and that could be achieved by engaging in critical self-reflection and critical discourse - two major elements of transformative learning (Mezirow, 2006) (see the previous chapter) - about the assumptions about teaching that have governed their actions. A change to constructivist mathematics teaching, for instance (see the following chapter), involves much more than the application of a new strategy or recipe; it involves a change in beliefs (and professional practice) about learning and about the teacher's changed role in the teaching-learning process (Ritchie, 1994). Clearly, pre-service teachers' longstanding beliefs and novice assumptions about teaching and learning need to be examined (Ball & Cohen, 1999).

Saudi mathematics teachers could benefit from a tool that elaborates and liberates (or transforms) their understanding of the concept of teaching and learning. In the literature on learning to teach, metaphor is mentioned frequently and is often seen as an element of reflective practice (Russell & Hrycenko, 2006). Metaphors might provide pre-service teachers a way of reflecting on and possibly improving their own practice (Munby & Russell, 1990). As metaphor helped me to conceptualise my original view of teaching and learning, it might also help me to reconceptualise it. Hence, teacher educators could use metaphor as a tool to facilitate two things. First, to make pre-service teachers' conceptions of teaching and learning 'visible' and therefore available for scrutiny. Second, to enable alternative and viable conceptions of teaching and learning to be discussed based on what they are learning and to assess the plausibility of these conceptions and consider their potential viability and value (Thomas, 2006).

METAPHOR TO ELABORATE AND CHANGE CONCEPTIONS



Metaphors help us create new realities for ourselves, especially social realities. A metaphor may thus be a guide for action (Lackoff & Johnson, 1980). Tobin (1990) suggested that metaphors might be used as 'master switches' to change belief sets and teaching practices. Tobin and Tippins (1996) identified metaphors as ‘seeds for conceptual change’. Perry and Cooper (2001) discussed “the use of metaphor as an educative tool for reflection”. They used metaphor to reflect on “personal images of change” that are held by teacher educators (p.41). Metaphors can therefore be used as tools to assist pre-service teachers in examining their personal beliefs about teaching and learning. And by offering alternative teaching metaphors and dialogue about different metaphors between them and their teacher educators, there could be an enhanced opportunity to change the way they think and act. Tobin, Kahle and Fraser (1990) indicated that "the process of teacher change might be initiated by introducing a variety of metaphors and reflecting on the efficacy of basing teaching and learning strategies on each of them" (p. 236). We change our point of view by trying on another's point of view (Mezirow, 2012). Alternative teaching and learning metaphors are like new visions that help to perceive learning and teaching from a different perspective. Alternative metaphors may provide fresh lenses through which prospective teachers become capable of seeing teaching and learning from different theoretical perspectives (Saban, Kocbeker, & Saban, 2007).

By stimulating pre-service teachers to create analogies in the form of metaphors between aspects of teaching and known things, concepts or roles, it is possible to elaborate ideas about teaching and play out the analogy's implications (Snow, 1973, as cited in Ritchie, 1994). For example, pre-service teachers might be stimulated to discuss metaphors that describe traditional conceptions of teaching and learning and metaphors that reflect a more constructivist view.

Changing metaphors and beliefs to reconceptualise their teaching roles raises the possibility of significant change for pre-service teachers in classroom practice. So, they might need to be assisted to understand their teaching roles in terms of new metaphors (Tobin, 1990). New metaphors could stimulate them to be involved in reflective thinking about what they do and critical thinking about what they believe. Without new metaphors, they might find a conflict between what they learn about innovative teaching methods and their commonplace conceptual perceptions of how they should teach and how their students should learn. I came to school with a specific belief couched in the metaphor of 'teacher as controller'. So, I had trouble using collaborative learning and enacting beliefs associated with this teaching metaphor (see the following chapter).

If I had had an alternative metaphorical concept of teaching, my performance, my action and my way of teaching would have been different. If I had had the metaphorical concept of 'teaching as guiding' in my mind, this could have affected the culture of my mathematics classroom. In this classroom culture, there is no sending and receiving. Instead, there is a guide for students who are being shepherded toward a learning goal. There is a guide who has responsibility for providing a range of instructions. Students must be involved personally and move toward that goal. It is their responsibility to engage within the sphere of guidance. If I had understood teaching in terms of guiding, I might have adopted a more flexible role in sharing control and I might have stimulated my students to discuss with each other in order to build their understandings. In this new metaphor for classroom culture, teachers would view teaching differently, experience it differently, carry it out differently, and talk about it differently (Lakoff & Johnson, 1980).

Metaphorical thinking encourages pre-service teachers to think about things they had not previously thought about, especially how and why they actually teach or learn. During my interview with the participants, my questions about teaching and learning seemed strange to them. "*I have never thought about it before*", my participants responded to many of my questions. When I asked them to think about it again, sometimes it went badly. For example, Ibrahim got angry, "*We just come to class and go, that's it*", he said. My participants' knowledge about and conscious awareness of their learning and teaching processes is largely tacit, requiring an

opportunity and a means such as metaphor to make it explicit, and is seldom the object of investigation or reflection.

- Teacher as a travel agent

The teacher educator, in his/her teaching about alternative approaches that entail perspectives such as constructivism, could encourage future teachers to discuss metaphors that encompass managerial roles as well as aspects of constructivist learning theory. 'Teacher as a travel agent' (Ritchie & Russell 1991; Ritchie, 1994) could be appropriate in this context. So, engaging pre-service teachers in *open and critical discourse* (see the previous chapter) about the metaphor of teacher as a travel agent might help to deconstruct their commonplace conceptual understanding of the concept of teaching. The following description of the travel agent metaphor (Ritchie & Russell, 1991) could, for example, help pre-service teachers to elaborate their conceptual understanding of teaching.

> *The travel agent has an office seductively decorated with informative posters, brochures, reference books and souvenirs to entice the client to travel. The classroom can also provide seductive stimuli; those which might encourage a student to undertake a journey of exploration. The stimuli provide not only enticement, but also information. Films and videos for schools are analogous to the travelogues used by travel agents.*
>
> *When clients enter the travel agent's office, the agent determines the clients' background (destination, purpose, previous travelling experience), needs (health, financial constraints), and preferences (individualised itinerary, guided tour, group booking, back-packer special). Similarly, the teacher can determine students' previous experience and knowledge base, as well as learning preferences (individual, group or whole class activities). If necessary, the teacher can advise students on time and resource limits, safety aspects, intellectual demand of tasks, and assessment instruments which need to be taken for particular topics.*

By far the greatest resource available to a travel agent is him/herself. The agent has the information at his/her fingertips, or knows where and how it can be obtained. Usually the agent has already visited the places of interest and knows what clients 'musn't miss'. The teacher, too, has a broad knowledge base and can suggest fundamental, as well as interesting steps in a topic. If required, the teacher/travel agent can act as a tour guide for any size group travelling to a destination, making appropriate stops/detours along the way.

In large group bookings, travel agents can expect a few of their clients to have visited certain locations on previous trips, The teacher, too, often finds that some students (e.g., transfers from other schools, own interests) have already explored a topic. A skilful travel agent/teacher can build on individuals' expertise by encouraging them to take on tour guide responsibilities or by suggesting interesting detours.

After a client has made a commitment the agent/teacher orders the tickets or makes the necessary bookings for the appropriate resources. The successful teacher-cum-travel agent can expect 'postcards' on the progress of the trip, as well as the odd frantic phone call for assistance (pp. 283-284).

SUMMARY

By exploring my (and my research participants') thoughts about teaching and learning, I found that during pre-service teaching training we held only a traditional positivist conception of teaching and learning and that we were largely unaware of it. Today, this conventional conception continues to govern our everyday teaching performance in the mathematics classroom. Lack of conscious awareness of our conventional conceptions has contributed to us thinking and acting automatically in accordance with the traditional commonplace positivist ideology of teaching and learning. As a consequence of this chapter, I propose a tool that could help make

‘visible’ and subject to critical examination Saudi pre-service teachers’ deep-seated conceptions of teaching and learning. The thinking tool of ‘metaphor’ can help to lay bare our implicit pedagogies and perhaps also serve as a 'master switch' to change belief sets and teaching practices.

Accordingly, Saudi mathematics teacher educators are encouraged to employ metaphors as powerful tools in their teaching of pre-service teachers to generate new ways of thinking about teaching and learning of mathematics. Metaphors are considered as a powerful way of representing knowledge about teaching and learning. Consequently, by using metaphors pre-service teachers might be able to reconceptualise their teaching roles and better implement transformative changes (Tobin & Tippins, 1996). The beauty of metaphors is that they invite new perspectives of teaching and can assist prospective teachers to see teaching in totally new ways (Duit, 1991).

By so doing, Saudi pre-service mathematics teachers might be able to see the teacher’s role as more than a ‘transmitter’ and the student’s role as more than a ‘receiver’. They might also be able to envisage the mathematics classroom culture from an alternative perspective, such as a constructivist perspective. In addition, by being involved with alternative teaching and learning metaphors that reflect what they learn about innovative teaching approaches, such as a constructivist view, pre-service teachers would find that what they learn is more understandable and applicable.

Still further, what I like more about metaphor in addition to what I have said already is that: (i) it helps to deconstruct hegemonic thoughts about teaching and learning. So, even if some pre-service teachers might not be able (for some reason) to imagine the mathematics classroom culture in a different way or could not develop an alternative view, they would at least be able to realise that their view about teaching and learning is not the only one available; and (ii) it can help also to awaken pre-service teachers to their own traditional beliefs about teaching and learning. So, even if they teach traditionally, they would at least be aware of the beliefs they hold and be more aware of what they are doing and the ideology they are following.

CHAPTER 7

BECOMING A MATHEMATICS TEACHER

INTRODUCTION

My purpose in this chapter is to critically illustrate my teaching experience in my first year of be(com)ing a mathematics teacher for primary schools in Saudi Arabia. I discuss my initial willingness and ambition for changing the culture of my mathematics classroom, particularly my attempts to utilise innovative teaching methods such as a Collaborative Learning Approach (CLA). I also demonstrate the deep influence of the objectivist epistemology and the technical interest upon my understanding of the need for changing the traditional mathematics classroom culture in Saudi Arabia. I demonstrate the significance for Saudi mathematics teachers to be critically engaged with an alternative (constructivist) epistemology as a way of deconstructing the hegemony of objectivist epistemology in order to carry forward our understanding of the need to transform the Saudi mathematics education culture.

> ***SEPTEMBER 2004,***
>
> *It is two months after graduation ... I am appointed by the Ministry of Education in Saudi Arabia to be a mathematics teacher at a primary school ... The school is not in my city nor in the region that I live in .... I travel to the East Region where the school is ... It is not a small one ... It has three floors and more than 600 students.*
>
> **First day...**
>
> *The clock is indicating 6:15 in the morning when the alarm starts ringing … I wake-up on time ... I go to my school ... Before I go in I stop for a few moments ... I take a deep breath … "This is my first day at school", I say … "I have become a mathematics teacher".*
>
> *After taking my time table from the school principal and while I am walking toward my mathematics classroom ... There are some*

reflections ... Ideas ... Thoughts ... Questions ... Whatever we call them ... Coming to my mind ... How do students look at mathematics teachers? ... What are their attitudes towards the mathematics classroom? ... Do they like the mathematics subject? ... How were their previous learning experiences with mathematics teachers and in the mathematics classroom? ...

These are several of many questions that come to my mind while I am walking towards my classroom ... But, I stop thinking ... "Let's see first how the students are ... Then, decide ... Okay", I say to myself ... I enter the classroom.

I look at the students ... They are in grade four ... I look around the classroom ... There are around thirty-five pupils ..."They are my students", I whisper. "I am a teacher now". It is a mixed feeling - happy, anxious, afraid, enthusiastic ... I look at my students again ... I smile and say...

Naif: Assalamu Alikum. (The Islamic greeting which means "peace be upon you").

Students: Wa Alikum Assalam. (Peace be upon you, too)

Naif: How are you doing?

Students: Fantastic … Thank you teacher.

Naif: Ok, that's good to hear. I am going to be your teacher. What subject do you think I am going to teach you? Have a guess.

Students: Sport ... Art ... Religion ... Language...

"Here we go … No one says mathematics", I whisper.

Naif: Ok ... Fine ... I am going to teach you mathematics ... I hope you enjoy this subject...

The class hushes down ... The smiles are gone ... The murmurs disappear ... Although I am not fully surprised because I was a student and I know students' views toward mathematics, I feel disappointed and a bit sad … "This is what I was afraid of", I whisper … "They seem to not like mathematics … I am going to be an unlikable teacher due to this hateful subject".

One day...

After several weeks and many lessons ... It could be any day in November 2004 … "Why are my students not active in my classroom?", I ask myself ... "Why are they not happy learning mathematics? ... What is the problem? ... There must be something wrong. Ok … let me think … When I was their age, what did I wish there to be in the mathematics classroom? Well, what about trying to use different methods of teaching that I have learnt in the Teacher's College?" (see Chapter 5). For no explicit reason, the Collaborative Learning Approach (CLA) comes to my mind as a teaching strategy I would like to try ... "Yes, why do I not try it? ... Why do I not change my way of teaching? ... Especially since evidence suggests that using a collaborative learning strategy can make the classroom dynamic and enhance students to work and think more effectively, because it prepares students for more and more interaction in the classroom (Holt, Chips, & Wallace, 1991) ... So, let me try ... Hopefully this will change their feelings and views towards mathematics … Hopefully I will became a likeable teacher".

Next day...

I enter the classroom ... It could be any lesson ... I just want to use CLA ... So, I divide the classroom into seven groups ... Each group consists of five students. The number of groups is quite big but I do not have a choice. So, it is ok ... I start ... But!!! ... After a few minutes ... Once students have started working in their small groups ... The class becomes noisy ... Students are talking a lot and

loudly ... I try to keep them quiet but unfortunately I fail ... There are 35 enthusiastic students sitting together ... And for the first time they are allowed to talk and discuss during instruction ... It seems that they have forgotten that they are in a classroom ... Time is up ... I struggle to manage the class in terms of the time and controlling their behaviour. Also, I have not finished what I had planned to do. I have failed to cover the curriculum content ... It is a hard class ... I walk out of the classroom in a rush, feeling tired, bad and angry.

I return home ... I throw myself down on the couch frustrated ... I do not know if I slept or just closed my eyes ... I give myself time to think and reflect on what happened.

Is it a bad way to teach? Asking myself ... There were many obstacles ... I think I will not do it again ... I will forget it ... "No... No ... Please Naif, do not think like that", a sound inside my heart calling me ... think about your students ... your students were so happy ... they found mathematics classroom very interesting ... you are on the way to achieving what you want of changing students' ideas towards mathematics ... you made a comfortable classroom and suitable environment for students to study ... and this is why they were active ... do not drop that ... please continue ...it is normal to encounter some dilemmas but do not let them prevent you from changing ... a good teacher is he who attempts to overcome dilemmas, not who gives up ... no surrender ... the students were joyful and very active ... some said "We want that again" ... "Yeah that is right", I sigh a breath of relief ... "I'll do it again", I say ... "Let me first assess the experience to find out how it was, what went wrong and what needs reform".

Next week...

It could be any lesson. "Today I have learnt from the mistakes that occurred in my first experience with CLA", I encourage myself. After explaining to my students what is going to happen ... I divide

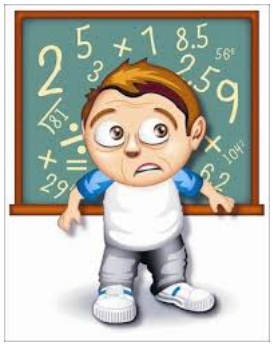
them into groups of five... I remind myself that dividing students into groups means that I act a bit like a social director at a vacation resort or summer camp (Bruffee, 1993).

I wade in to help them rearrange their chairs ... I separate groups to minimize noise from other conversations ... I encourage group members to draw close enough together (knee to knee and eye to eye) to hear one another over the din and to make the group more likely to cohere ... I ask them to introduce themselves and decide on a recorder (a member of the group who will take notes on the group's discussion and report on the consensus the group has reached when the work is over) and a reader, and so on (Bruffee, 1993). I give the students a sheet with a task consisting of questions and examples about the today's lesson ... I write the topic on the blackboard ... I open the curriculum and start explaining the lesson ... writing several examples to repeat the idea of a solution ... I feel that the idea of the lesson is very clear ... I ask students to start working together and answering the tasks ... I ask each group at some point ... How much more time do you think you will need? ... And while students are at work, I manage the time ... The length of time that students spend on a task depends on the extent of their listening and following my teaching.

==========

CAN MY STUDENTS LOVE ME? The willingness to change

The above scenario illustrates my mathematics teaching experience in attempting to accomplish my ambition of changing my students' negative views about mathematics. I came to school holding the view and accumulated impression that mathematics is hateful, boring and uninteresting, and thus my willingness in trying to change this impression. I believed that if students felt comfortable in the classroom they might perform successfully. I also thought that when students like their teacher they may as well like the subject s/he teaches. By the way, my negative view of mathematics did not come from nowhere; it had been constructed in my mind as a result of my learning experience in mathematics classrooms during my studies in



general education in Saudi Arabia. I have seen and met many people who have pessimistic views of mathematics. Historically, the teaching of mathematics has taken place in a rigid atmosphere and one of fear for students (Dossey, 1989). Many people – particularly children – find mathematics dull, boring, and uninteresting and even hateful (Heiede, 1996). Accordingly, as the normal reaction of a keen teacher – as I considered myself to be – I focussed all my attention and efforts on attempting to change the negative impression of mathematics by making the mathematics classroom enjoyable and exciting as much as I could. Thus, rather than being 'boring' and traditional in my teaching, I tried to do something different that students had never before experienced.

Consequently, I 'used' the collaborative learning approach (see the above scenario), trying to practise what I had learnt during my undergraduate study (see Chapter 5). From time to time I made competitions among my students (see below; 'Mathematics that relies on memorisation'). I thought what I did was great for my students and for me as well. It seemed that my students enjoyed their 'learning' by being involved in a different classroom routine. Moreover, I used technology, such as the PowerPoint program, in my teaching. I remember on that day, I asked the school principal to attend my PowerPoint mathematics lesson and in turn he invited the mathematics' supervisor (from the Department of Education) to come with him to watch and observe how I could use technology in teaching mathematics. I am not being biased but I thought it was fascinating; the students were happy, the school principal was happy, the mathematics' supervisor was happy, and I too was very happy. Additionally, my concern about changing the students' negative impression of the mathematics classroom motivated me also to think about alternative ways that could make students more comfortable, such as offering rewards, telling jokes, playing games[8] and dealing with them in a friendly manner.

[8] Those jokes and games were not about/for mathematics.

By the way, what do YOU think? Do you have the same impression of mathematics? Do you think that the negative conception about mathematics is common among students and mathematics teachers? I found that my research participants had the same sense as me and, consequently, they also tried to convey a positive impression about the mathematics classroom to their students. The following excerpts from my interview with them illustrate their views of mathematics and demonstrate what they were doing.

Naif: *What is your view towards the mathematics subject?*

Ibrahim: *It is a meaningless and boring subject and everybody hates it (interview, 7/12/2010).*

Osama: *It is a very dry and an abstract subject (interview, 8/12/2010).*

Naif: *Did you do anything to handle this view?*

Majid: *Yes, I did ... I taught [students] in their classroom located upstairs on one day, and I took them downstairs to the 'resources' room' on another day, and some days I put them into groups. The semester will proceed with no one being bored. Sometimes I wrote examples on the blackboard and let a student answer them (interview, 7/12/2010).*

Eissa: *Well ... every two weeks, I let [students] go downstairs to the 'resources' room'; they feel that they have started another life, not like the life in the environment of the classroom. [The student] feels that he has moved to another place. Even the seating is different (interview, 14/12/2010).*

As you can notice, my research participants and I had similar views towards the undesirable image of mathematics and it seems also that we were trying to do something regarding the negative impression. And this, by the way, indicates that we as Saudi mathematics teachers took responsibility for our students. We had the passion that motivated and enthused us to take action and to make a change. We wanted our students to enjoy their learning. We wanted them to have a more positive view of mathematics. We wanted them to feel that the mathematics classroom is not boring. And this also, by the way, refutes rumours that claim that Saudi teachers do not care enough about their students' 'learning' and do not pay attention to

'improving' their teaching practice. We did what we did as a result of our ambition to improve, and our eagerness and willingness to change the teaching situation. We did what we did to transform the traditional mood of the mathematics classroom culture from being dull and anxiety-ridden to an exciting and joyful one.

In this research I realised that what my research participants and I did could be recognised as a very good attempt to change. Research has found that many students, unfortunately, have negative feelings and attitudes toward mathematics which could lead them to be anxious in their mathematics classroom and might subsequently lead them to perform poorly (Taylor & Brooks, 1986; Post, 1992). And research suggests that changing the mathematics classroom environment by using 'non-traditional teaching approaches' could help to reduce negative feelings toward mathematics and could lead students to being more successful (Vinson, 2001).

THE TURNING POINT

In this research I engaged in critical reflexivity about my experience (including my perspectives and beliefs) about teaching and learning, and realised that … Yes … We had tried to change the mathematics classroom environment, but not 'really' our role of teaching nor 'really' our students' way of learning. The mathematics education culture had not 'really' changed. We were still following the traditional teaching and learning practices that were based only on blackboard presentation and memorisation, neglecting the meaningfulness of students' learning experience.

It is very important here to clarify how I got to this turning point; how I got to realise what I have realised. My realisation - of what I was doing and of what I want to do now - did not come to me by accident, nor did it happen in one day or one setting. My realisation was a process of mental activities that included reflective thinking, critical thinking, metaphorical thinking, creative thinking and envisioning alongside reading, writing and discussing. It is constructive realization. I have constructed my realisation of one thing after another, in one day after another, till I got to my current realisation. Thus, my realisation is not a result of having an epiphany. It is a result of inclusive thinking about myself, my perspectives, my beliefs and my experiences of teaching and learning. It is a result of thinking about what I was doing and why I was

doing it in that way, and what were the consequences. It is a result of examining or evaluating my professional practice. It is a process of freeing my mind from external coercion. It is knowledge beyond the status quo. The following paragraphs show how I involved myself in the process of critical self-realization, aiming to review my attempts to change my classroom routine.

I began by asking myself: "Why did I choose such a method of teaching"? … Well, my earlier concern about change was related only to the classroom routine – only to students' impression – and was not concerned with how my students might be learning – students' learning processes – or why were they learning – students' values – or who they are – students' self-portraits – so, it was not actually a matter of simply what methods of teaching I should choose.

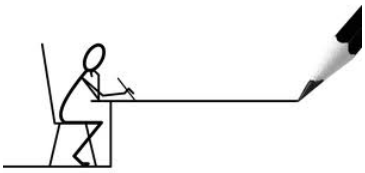
My choice of teaching methods or classroom activities did not depend on the topic that I wanted to teach. It was arbitrary. I did not, for instance, examine the suitability of the mathematics lesson to be taught using PowerPoint technology. I did not think whether such a lesson could be more properly taught collaboratively or not. Although I followed the structure of using CLA, I did not know epistemologically why I used it for teaching that lesson. I did not use it as a method that could be more helpful for students' learning. I did not use it as an approach that encouraged students to construct or develop their own understanding collaboratively (Johnson, Johnson & Stanne, 2000; Palmer, Peters & Streetman, 2003). I did not use it to give students opportunity to support each other throughout their learning experience in ways that would have promoted meaningful interaction, communication and relationships and mutual caring (Grenier & Yeaton, 2012). I chose it only for one reason; to change the depressive routine of the classroom. And honestly, it seems that I was successful; the mathematics classroom could be made attractive; this is what I had been looking for. So, I can say … Yes, my students can love me!!

But, do not ask me about my students' understanding!! Do not ask me whether the students had developed their understandings or they had just memorised the formulas in the mathematics textbook. Do not ask me about students' involvement and participation in the process of their learning. Do not ask me whether there was any development of their higher-order thinking or

their creativity. Do not ask me why students had learned what they had learned. Do not ask me about any values that mathematics could have enhanced. Do not ask me whether I related the lesson to students' lives!! My job was restricted to and focused on transmitting mathematical content from the textbook into the students' heads. My students' job in contrast was restricted to listening and memorisation.

What impression of mathematics as a subject did I convey where what was important was the memorisation of facts? I *realise* now that I had tried to change students' negative feelings of mathematics but not their way of knowing. I *realise* that I was advocating only the instrumental knowing which is indeed "easier to teach and to learn in the short term but it does not provide a basis for developing higher order thinking skills". It does not foster "a perception of mathematics as a fascinating, creative subject which requires imagination, systematic working, persistence, and co-operation" (Tanner & Jones, 2003, p. 215).

Reflecting critically on my mathematics teaching practice and analysing the emphases in my teaching – using CLA or using PowerPoint technology or any other strategies that I thought might go well – shows that most of the time I focused my attention *only* on teaching the facts and conventions, skills and routines, and I paid no attention to conceptual structures, techniques and results or mathematical process and thinking (Tanner & Jones, 2003). My critical reflection shows also that I adopted a value-free educational approach. I did not engage my students meaningfully and imaginatively in the process of their own education.



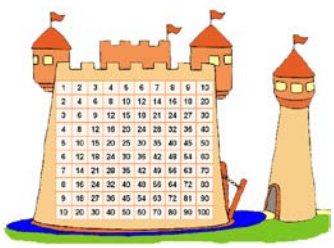
Reflecting critically on my teaching practice has made me realise that it did not address two important things; epistemology and values. So, questions associated with epistemological change and values education have since emerged for me. What is the goal of learning mathematics? Is it sufficient for the students simply to enjoy their 'learning' regardless of their understanding of what they learn? Do they need to learn what they learn in a manner which emphasises meaning? Do they need to think about mathematics in their own lives? Moreover, what is the real point of teaching mathematics? Is it only to prepare students to perform exams successfully? Do we teach mathematics only for school purposes? What about students' lives?

I have come to realise that making a mathematics classroom enjoyable is an important factor, but it should not be the ultimate goal of future Saudi teaching practice to achieve Saudi educational aims (see Chapter 3). Yes for sure, it could change or reduce students' negative feelings towards mathematics but this is not enough by itself for epistemological change.

From a constructivist perspective, students need to understand and make sense of what they learn. They need to make sense of the new ideas and the mathematics activities in terms of their existing knowledge and experiences (Skelton, 2005). Students need to participate in actively constructing their conceptions of mathematics. Students need a good environment, not achieved by simply changing the routine, but by enabling them to actively construct their own mathematical knowledge by being involved in "doing mathematics" (Dossey, 1989). Students need to value and make what they learn useful in their own lives. Students need to have learning experiences that extend their existing frames of reference and understanding (Skelton, 20005).

Hence, focusing simply on changing students' negative impression of mathematics by merely making a classroom enjoyable is neither necessarily helpful nor desirable. Students might 'enjoy learning' mathematics but perhaps without making sense of what they learn. Moreover, students perhaps enjoy and change their negative impression of mathematics when they find it meaningful, relevant and useful in their life. Students may perhaps build a more positive impression of mathematics when they see its values in the areas of interpretation and analysis as applicable in their own daily lives.

MATHEMATICS THAT RELIES ON MEMORISATION: My experience in teaching multiplication



There has been controversy about the need to memorize 'math facts' since the introduction of significant reforms in mathematics curricula in the 1990s (Groves, 2011) and the debate has been about how math facts should be taught, whether through rote memorization or through

explicit strategy instruction (Woodward, 2006). Many educators, for example, believe that it is necessary for young pupils to memorize the times table up to 9 × 9 or even sometimes up to 25 × 25 as John Leslie (1820) recommended in his book, The Philosophy of Arithmetic. Moreover, the National Council of Teachers of Mathematics (NCTM, 2000) states that it never intended that mathematics teachers should throw out memorization of math facts, and the new guidelines state that second graders should be able to quickly recall basic addition and subtraction facts and fourth graders must have quick recall of multiplication tables and division facts. Accordingly, if we ask a fourth grade student a question regarding the times tables, s/he should not need to *think*, s/he should be able to give the answer right away.

During my learning and teaching experience I encountered a common view that multiplication tables are one of the most crucial acquisitions for young pupils in their learning of mathematics. And memorization seemed not only the better way of 'learning' multiplication but the only one that was available. Moreover, I have found in the research literature support that makes my earlier view legitimate: there are many mathematics teachers and educators who advocate memorization believing that rote memorization helps students successfully in learning their math facts (Caron, 2007). So, it was like a given that when I talked with my research participants about the times tables I should bring up memorization as a method of learning. Examples of our discussion are:

Multiplication is my friend

> *Mathematics has been built essentially on the times tables. If [the student] does not memorize it, what is the benefit? In my teaching, I give [students] one times table every day. I let them write it down on paper and I check them one by one to make sure that everyone has memorised it (Eissa, interview, 14/12/2010).*

> *[The student] in school has to memorize the times table from year two or three, to help him in calculations. So that, he will not need a calculator (Khalid, interview, 13/12/2010).*

From my research participants' and my perspective, we considered multiplication as a big thing in learning mathematics, and the way of teaching it was simply to ask students to memorise it. Nevertheless, because I was concerned about students' negative feelings towards mathematics and because I was keen to change those feelings, I decided to do something quite different.

I set up a competition among my students after dividing them into small groups. I thought I was using CLA by putting them in groups. The competition focused on which group was quicker in responding to my questions about multiplication. Indeed, I found my classroom to be very active and students enjoyed participating in the competition. The reason for doing the competition was to encourage the students' memorisation of multiplication. I found many students were keen to memorise the times tables but only to win the game. For me, it was good enough as long as I achieved my limited goal of making them keen to memorise and to succeed at it. So, they can easily pass the exam and achieve high marks.

Well, I think now that my dad (who was a soldier) could have done that; he could have asked children to memorise the times tables and then have tested them. Actually, anyone can do that; asking students to memorise multiplication does not require a Bachelor Degree in Mathematics Education.

After engaging in critical reflexivity in this research, I have come to realise that I did not fundamentally change my teaching or my students' learning. I, unfortunately, had only ordered my students to memorise multiplication - but in a different way. My change was only circumstantial not epistemological. My technical interest (see Chapter 4) was dominant in the classroom. I privileged teaching that relied only on memorization. Consequently, I was probably considering the students who memorised the times tables and gave an instant answer ‘smarter’ than those who did not or who needed extra time to think in order to solve the problem. What and whose purposes were being served here!!?

Some of my later reflections are as follows:

Well, why do students only have to memorise multiplication tables? What is the point of memorising them up to 9 as many educators suggest, or up to 10 as I was required to do, or up to 12 as my daughter Raneem now is required to do, or up to 25 as John Leslie recommended? Who made these rules?!! What is multiplication, anyway? Isn’t it a process of repeated addition (Leslie, 1820)? Well, why do not students memorise addition, then? Why not? Why only multiplication? Also, why do we ask for instant response only to multiplication questions? Why do we not give time to students to

think of the answer to multiplication while at the same time we allow them to think and count in addition questions? For example, when I ask 4+8, I allow grade-two students to have some time to count but I ask for an instant response when I ask them 4X8. Why are not they allowed to think? Why does their answer have to be instantaneous? I found some students who might instantly respond to 4X8 but not to 8X4. It seems that they do not know deeply about multiplication. They just memorise the algorithm. Knowing meaningfully about mathematics means more than memorising math facts. If they know deeply about mathematics, they would know that changing the order of numbers in multiplication does not change the answer. If students know about math, they can apply their skills (Martin, 2006).

Memorisation = No failure
No memorisation = failure

Collection of equations together

(Memorisation + No memorisation) = (Failure + No Failure)

Take a common factor

Memorisation (1 + No) = Failure (1 + No)

Dividing the result by the common factor:

Memorisation = failure ☺

My daughter (Raneem, 8 years old, grade three) started to study multiplication. But I did not <u>yet</u> ask her to memorise the tables. I did not want to send her a wrong message that all of maths is to be memorised instead of understood. I only described to her what 'times' means. I wanted her to understand multiplication and its relationship with addition. When she got to know that, she could answer (5 X 5) although she had not yet 'studied' the 5X table. I admit that her answer was not instant, she took some time but she was able to "think" and give it a try and reach success. Mathematics is about formulating and solving problems. It is not simply about recitation. So, when I asked her a question by putting it in a context, I found that she did not care whether my question was about addition or multiplication. She was thinking of how to solve the problem. I asked her this question: "If you want to buy 3 presents", she interrupted me "For whom"? "For you, your sister and your mum", I said. She asked "What about you? Why not"? I did not have an answer. I just wanted to choose a small number. I said "Well … Ok ... 4 presents (which made the number higher) and each present costs 3 dollars, how many dollars do you need?" She took a few seconds then said: "12". "Alhamdulillah"[9], I whisper … and then she said "Easy peasy Japanesey". I asked her "how did you do that?" She said:

[9] Alhamdulillah is an Islamic <u>and Arabic</u> phrase that Muslims say when they get pleased.

"easy, I just counted my 3 and my sister's 3 and mum's and yours". She did not say "I did the times" although we were talking about times. She counted and took the process of multiplication. Later, after Raneem spent some time learning about the times tables in her school, I still found her answers not to be instant. And I wanted to know 'how' she could solve problems involving big numbers. I asked her a direct question: "What is 9X8?" After a few seconds she said "72". I asked her "how did you solve it. Did you think about it as 9+9+9 ... 8 times?" She said "Nooo Daaad ...this is gonna take ages. I thought 10X8 is 80, then 80-8 is 72". "That's very clever, Raneem", I encouraged her. "Hey hey I am good in maths", She sang. I believe if I had asked her initially to memorise the times tables, she would not come up with this creative way to solve a multiplication problem, nor have this feeling of happiness when she worked it out. The issue of using only memorisation method is that it does not help to enhance students' problem solving and logical processing and thus makes maths for life difficult to achieve.

So, understanding mathematics facts, what are they, how they work, why students need them, and when they can be used seems to me to be more important than only memorising them. It might be enough that often they know about the facts. However, due to the big debate about using traditional teaching methods (that focus on memorisation) versus constructivist approaches (that focus on understanding and learning processes), I would say that if students have to memorise the mathematics facts, they might do so but not before they understand them relationally and meaningfully, not before they know why they have to do so. The reasons given should relate to their own lives, relate to them in their living, not focus only on their successful study in the future. It has been made into propaganda that for students who do not memorise multiplication tables their future academic study will be difficult and they will not be able to solve complex maths problems. Due to this propaganda, memorising multiplication tables has become a students' goal in itself not as a means to solve problems.

For me, memorising multiplication tables for students only for them to be able to give an instant answer seems to be meaningless. In our digital world where we find calculators everywhere (phone, iPad …), getting the

instant answer is not an issue anymore. Understanding what multiplication means, how and when it works needs to be the point. I have friends who are doing a PhD degree and they need to use a calculator to find out, for example, the answer to 6X8. Some research shows that rote rehearsal alone does not produce automaticity of math facts (Caron, 2007). I think that pushing students to learn maths facts only through rote memorisation can be counterproductive. Students need also to be actively thinking about what they are learning in order to apply it to more complex maths tasks (Wakefield, 1997). It is also a commonly held belief among some scholars that students do not need to memorize maths facts. Those scholars note that students should understand and practise maths facts over an extended period until those facts become part and parcel of their permanent memory (Caron, 2007).

BACK TO EPISTEMOLOGY AND VALUES EDUCATION

Arguably, although memorisation seems – in some ways - to be a good method to develop instant recall, is this all that we need? Is this what mathematics is all about? Is this why students come to school?

Well, why do we limit mathematics in this way in schools? Why are students not asked to use mathematical ideas outside school? Does mathematics exist in their lives? Do they have opportunities to think about using it in their lives? When they go shopping, do they think that they are doing mathematics? Moreover, if I ask a primary school student how many students are there in your classroom (bearing in mind that there is the same number of students in each row), will s/he count them individually, one by one, or s/he will be able to do multiplication by counting the rows and students in a row, and then multiply them together. Students need to get rich ideas like this about the benefit of mathematics in their lives.

Cultural reflection

From the Islamic point of view, we are *not* encouraged to only memorise even the Holy Qur'an. For Muslims, reciting the Quran is good and memorising it is much better. But understanding it and practising it is really what is required. The Prophet's Companion, Abdullah ibn Masud, commented on their learning the Quran: "We used to learn ten verses from the Qur'an and we would not go beyond them until we

comprehended them and acted upon" (Altabari). When students learn mathematics they need to understand what they learn, to know how mathematics may benefit them in their own lives, and realise how to practice mathematics in their own contexts and how mathematics is involved in many aspects of their own lives. Mathematics teachers should stop saying "*it is going to help you in the future*", as the students' need is to learn then and there, not just in the future.

Also, from the Islamic point of view, memorising the Holy Qur'an could be sometimes less than effective if a memoriser does something against it. For example, you memorise verses that ask you to respect your parents but then you do what harms them. The Prophet (PBUH) said, "The Qur'an is an 'argument' either for you or against you" (Muslim, No. 223). On another issue, the Quran regards those who memorise knowledge without practising it are acting like a donkey that carries books on its back and gets nothing from those books except the weight. What is the real benefit of memorising the Quran while the memoriser does not practise it? Similarly, students should understand and practise mathematics in their life. They need to be aware that what they learn is useful and it is a true part of their lives. They need to know that when they go to the market, for example, they are involved in doing mathematics. So, they do not only carry mathematics in their heads, with no benefit in their own lives.

Unpacking my experiences helped me to understand why I did what I did in this way. I found that critically reviewing what I did as a teacher raised several questions such as: Why did my idea for change take account only of the classroom style while ignoring the fundamental teaching and learning processes? Why was my thinking about innovative teaching methods focused only on the design of the classroom environment? To this point, I think it was the hegemony of my objectivist epistemology and technical interest that limited my thinking. The following section clarifies this point.

MY OBJECTIVIST EPISTEMOLOGY AND MY PERFORMANCE

Although I tried to make a change by trying to use what I had learnt at the Teachers' College about innovative teaching methods (see Chapter 5), my later critical reflection on my teaching practice made me *realise* that my thoughts and my practices of change were, unfortunately, simply and only by creating a different mathematics classroom routine and layout. There was no thought about epistemological change, even though the innovative teaching methods entail non-traditional epistemologies of teaching and learning. *The crucial point here is that I thought I was applying the innovative teaching approaches and I did not notice that I was simply following the traditional education methods.* And I think now that this was due to the hegemony of my objectivist epistemology and the technical interest (see Chapter 4) of teaching and learning which is "based on empirical knowledge, and is governed by technical rules" (Mezirow, 1981, p. 14).

Initially, I was not aware of my epistemic norm. I was teaching in accordance with the prevailing classroom norm. However, critical reflective thinking about my teaching practice made me able to become aware of and then formalise my personal epistemology in accordance with which I was acting. My point here about my epistemology (my way of understanding mathematics) is not about how much mathematical knowledge I had but it is about how I perceived and conceived of knowledge which affected my way of making use of my knowledge of mathematics. Perhaps I did not need a huge amount of advanced mathematical knowledge as I was teaching primary schools. However, knowing how, why and whom I teach seem to be what I needed to know more about. These (how, why and who) are as important as what I teach. They are perhaps more important to think about than 'what I teach' *if* I am concerned about the quality of my teaching.

- Emergence of conflict

My critical reflection about my experience shows a conflict between my personal epistemology and innovative pedagogies. Due to my objectivist epistemology, I conceived of knowledge as a didactically

transmittable thing. Moreover, my research participants showed less confidence in using the new methods they learnt at the College. They said they are not effective methods that we can rely on in practice.

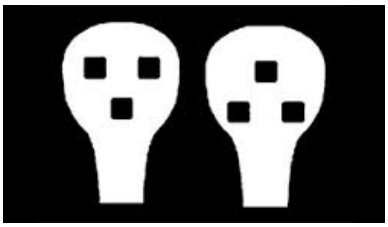
> *I feel that these methods are not able to accomplish my goals of conveying the information as much as the official way. I feel that these methods have lower capability of transmitting the information (Musa, interview, 15/12/2010).*

Due to our objectivist epistemology, my research participants and I were not confident with posing problems to our students and then allowing them to struggle to solve them together. We thought that the best way to fulfil our plan of teaching was by using a teacher-centred approach; 'the official way' as Musa said. Participatory teaching approaches did not seem to be compatible with our teaching plans and goals. Indeed, innovative approaches, such as CLA and problem solving, are based on non-objectivist theory where students need to build actively their own understanding.

Worse yet, due to the conflict between our objectivist epistemology and the epistemology of the new teaching methods, these methods might have been seen as causing problems instead of helping students.

> *I don't see the point of using CLA or problem solving. Indeed, if I implemented them, it may cause chaos in my classroom (Majid, interview, 7/12/2010).*

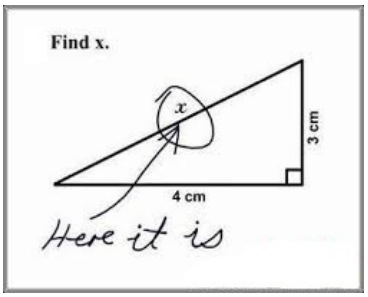
Our objectivist epistemology supports Platonism where knowledge is "conceived as [involving concepts which] have [an] existence independent of the human mind" (Lancaster, 2006, p.2) and as a basis for promoting non-participatory teaching methods (Ernest, 1994b). On the other hand, social constructivist epistemologies conceive of knowledge as an active human construction which calls for participatory teaching methods (CLA is an example). I do not wish here to lay out a detailed argument or to support such a claim. It is beyond my scope. However, the emergence of fallibilist perspectives in the philosophy of mathematics (Ernest, 1991, 1994a, 2004) prompted me to rethink the inherent absolute perspective of mathematics and its extreme influence upon my previous professional teaching practice of



mathematics. Moreover, what makes my argument (support of the introduction of social and critical constructivist epistemology) easy is because the Teachers' College program introduces CLA, problem-solving approach … etc., for pre-service mathematics teachers to use. Well, to make those methods of teaching fit their purpose of sense-making future teachers need to learn that CLA and others methods are based on a detailed and validated constructivist epistemology.

- Images of mathematics

It is due to an objectivist epistemology that I perceived mathematics to be a subject objectively taught with a pre-existing detailed method. Mathematics to me was only about symbols, numbers and shapes. It was pure, abstract, inhuman and meaningless. I conceived its knowledge as an absolute and independent of students' active minds and constructive thinking, "which happens to be useful because of its universal validity; it is value-free and culture-free, for the same reason" (Ernest, 2004, p. 8). Of course I did not formally know that at the time of my previous teaching experience but now, after examining my teaching practice, I am able to epistemologically conceive of it and link it to the objectivist philosophy. The experience that I had of mathematics education in Saudi Arabia 'fitted' and matched the objectivist or 'absolutist' image of mathematics which Ernest (2004b) explained as "rigid, fixed, logical, absolute, inhuman, cold, objective, pure, abstract, remote and ultra-rational" (p. 13). By the way, this image could contribute to creating negative attitudes in the students to mathematics (Ernest, 2004). An objectivist epistemology advocates delivering content by a didactic transmission method.



> *[Mathematics] is content that I convey to the students and that I am compelled to explain and transmit to them (Musa, interview, 15/12/2010).*

- The importance of mathematics

Even though my research participants and I were aware of students' negative impressions towards mathematics, we – at the same time – were aware of the importance of mathematics.

> *It is a hateful subject but it is important (Majid, interview, 7/12/2010).*

However, due to the objectivist epistemology, the importance of mathematics was limited only to the context of school. Its importance served merely the school's purposes. For instance, when I discussed my research participants' views of the importance of teaching and learning multiplication, their responses show this idea:

> *If students do not learn times tables they are neither going to succeed in junior nor senior high school and they will not be able to successfully finish their studies of mathematics. Multiplication is a very important subject (Majid, interview, 7/12/2010).*

> *Mathematics has been built essentially on the times tables. If [the student] does not memorise it, what is the benefit? (Eissa, interview, 14/12/2010)?!!*

I need to state here very clearly that there is no doubt for me about the importance of mathematics as a discipline that promotes logical thinking and analytical reasoning and provides specific formulae to solve 'problems' quickly and effectively. However, why is it – in Saudi Arabia – always presented as abstract, value-free and disembodied? Why does it serve interests separate from those of the students as leaners? Why are students learning mathematics in school only for school? Is mathematics only for solving problems that students did not create and with which they might have nothing to do? Mathematics became like a set of 'invented problems' that students had to deal with. Students might not feel engaged with problems that came from outside of their lives. I remember when I was a pupil in the mathematics classroom, when I had to answer an exercise problem such as 'Ahmed travelled from city A to city B and the distance between the two cities is 80 km. So, if Ahmed was driving at 160km/h, how long would he take to arrive at city B?' I used to say "I wish Ahmed did not travel". On the other hand, students might find mathematics more engaging when they see themselves involved in it. Another issue, in Saudi Arabia we have the highest rate in the world of car accidents, so, can we take this mathematics exercise as an opportunity to talk about this social issue, or it is not the responsibility of 'mathematics'? Well, with these additional challenges what can we do with the existing hegemony of objectivist epistemology??

Many of us view mathematics education only in its narrowest sense which concerns the classroom activity or practice of teaching mathematics (Ernest, 2004). We do not pay sufficient attention to its possible value in Saudi society. The image of mathematics as value-laden is not perceived by the teachers. The relationship between mathematics and values is not obvious for us. Objectivist epistemology and technical interest play a key role in the effective neglect of the important question 'what is the purpose of teaching and learning mathematics' (Ernest, 2004)? Asking my research participants about why they teach what they teach revealed this point. At first, I asked my participants about the importance of teaching and learning multiplication (see above) which led me to ask a broader and more important question.

Objectivism… who needs it? I do not have time... I want it.

Objectivism... who likes it? I am not patient... I love it.

Objectivism... who knows it? I am not a thinker... I am very familiar with it.

Objectivism ... what is it? Seriously!!... Why do you ask?

Naif: *Have you thought about why you teach such a lesson?*

Majid: *I have goals and I have to introduce them to the students. The Education Department has goals and [the students] need to accomplish them. But I have not even thought about that at all (interview, 7/12/2010).*

Eissa: *I have not thought about that because what I teach are essential matters. I teach year five and year six and both include coverage of the times tables, subtraction, dividing and addition that are essential for their future studies (interview, 14/12/2010).*

Musa: *It is in the textbook and I am obligated to explain to students the contents from the beginning to its end (interview, 15/12/2010).*

What my participants say is right. What we teach is important and essential, and we are required to teach it. However, objectivist epistemology has narrowed our view and our reasons for teaching to be only for the ends of schooling. Its importance will be obvious only in students' future studies. It goes without saying, there is no care about their 'mathematical practice' (Ernest, 1991). Even when I used CLA, students' tasks were excerpts from the textbook (of pure mathematics). I did not design an

activity derived from their own interests or environment. I did not teach them from their own stories. Whatever I did, mathematics was still abstract and largely irrelevant to daily life.

Other concerns regarding the aims of teaching and learning mathematics were not employed. The values underpinning such limited purposes were not a matter of concern to the teachers. Questions regarding the role of the teaching and learning of mathematics in promoting or hindering social justice and/or critical citizenship had never been raised in my experience. Objectivist epistemology does not stimulate us to ask question such as, "What is the relationship between mathematics and society? What functions does it perform? Which of these functions are intended and [made] visible? Which functions are unintended or [left] invisible? To what extent do mathematical metaphors (e.g., profit and loss balance sheet) permeate social thinking? What is their philosophical significance? To whom is mathematics accountable? ... How can (and should) mathematics be conceptualised and transformed for educational purposes? What values and goals are involved?" (Ernest, 2004). Does mathematics serve only school purposes? Can we conceptualise it for social purposes? Can we transform it to serve students' broader interests and involvements? .... How does the Islamic identity of the learner change and develop through learning mathematics? How is the Saudi mathematician and the Saudi citizen formed in a particular way through learning mathematics?

Actually, the responses of my research participants to my question, 'what is the purpose of your teaching?', did not surprise me. I had a feeling that their responses would be objectivist-oriented. When I was in their place I thought as they thought. We did not have another view. The reason for my question, however, was to open a further question. I asked about the possibility of connecting mathematics to students' lives. I just wanted them to think out of the box, to think alternatively; to think subjectively, reflectively, and critically.

During the interview, I asked: "Is it possible to make a connection between mathematics and students' lives?" Even though my participants were not aware of this connection, their comments were as follows:

> *[The connection] did not come to my mind (Ibrahim, interview, 7/12/2010).*

> *It was not in our mind, we just thought of 'doing' teaching and how to transmit the information. I have just learned this point from you now, that we can connect mathematics to students' lives and show the importance of mathematics. I did not do that, but [I now realise that] it is possible. Lots of lessons can achieve this connection. Previously, we memorized multiplications 3X4 = 12 like this. They were only numbers that we just recorded in our minds (Majid, interview, 7/12/2010).*

> *Honestly, although there is a big part of mathematics can be used and be beneficial in students' real life, but I have never taught that way before (Musa, interview, 15/12/2010).*

Although I found it interesting that they could easily think and reflect critically upon what they were doing, I do not think this brief experience would be sufficient to stimulate them to teach mathematics in an alternative way. Although we might be aware of the importance of mathematics outside school and the possibilities of matching mathematics to students' lives, this awareness might be not enough for prospective teachers to 'teach' mathematics in alternative ways. Our objectivist epistemology and technical interest might make them still think that they have to tell students about the 'mathematics'.

- Objectivism and curriculum reforming

Furthermore, objectivist epistemology seems to be one of the big problems that continue to hinder reform of Saudi mathematics education. The Ministry of Education in Saudi Arabia has recently (2010) started a new mathematics curriculum reform. The main feature is that it includes lots of practical activities that students should perform in their learning of mathematics. Curriculum reform seems to be compatible with the pedagogical reform that focuses on the student learning process.

> *With the new curriculum, it has been matched and connected to the students' lives. For example, the difference between 100 and 1000 is not just numbers but also involves clarifying its value, not like before by indoctrination (Osama, interview, 8/12/2010).*

It seems good that teachers have learnt innovative methods and that the curriculum now has been reformed to fit what they have learned in their teacher training. However, due to the objectivist epistemology this mandate developed from these

innovative methods is not likely to be sufficient for pre-service teachers to apply these activities.

> *The activities were not implemented. For example, there is an activity introducing the concept of "million". The activity is about using some papers and cutting them and encouraging students to participate with you. However, when I came to school to watch how a mathematics teacher teaches, he 'taught' the lesson in a didactic manner then moved to the examples. When I started teaching, later, I asked [the students] 'did you do the activities?' The students said: 'no, we just take this part and this part'. There are many aspects in the new curriculum that the teacher ignores. If we apply them we will waste all the time in the activities. I cut my throat and my voice has gone in teaching [the students] and at the end of the day they went out of the classroom with no understanding. They even did not take the information from nor really listen well to me (Osama, interview, 8/12/2010).*

I am not being pessimistic, but many Saudi mathematics teachers seem to think like Osama: "*We waste our time in these activities*". The problem is that we do not epistemologically grasp the point of these activities. We are not cognitively aware of the aim of these activities in helping students to understand, for instance, the concept of "million". Due to objectivist thinking, we think that these activities do not need to be part of the way students learn. We think that it is our job to tell students what is the concept of 'million'. From a constructivist perspective, students are not likely to fully develop this concept just by being told the verbal label. They need to be guided. But, as teachers we are not confident in doing that. Osama said: "*I cut my throat and my voice has gone in teaching [the students] and at the end of the day they went out of the classroom with no understanding. They even did not take the information from nor really listen well to me*". This seems exactly what most of us usually do; we keep talking loudly, hoping for the students to 'get it'.

Due to the influence of objectivist epistemology, Saudi mathematics teachers might not see the point of these practical activities. Even though the activities seem well-formed in accordance with constructivist pedagogy, Saudi teachers remain committed to their existing instructional approach and remain anxious to rely on the type of student learning and classroom control promoted by objectivist epistemology.

They continue to focus on what they do instructionally rather than on their students' mental processing (Brooks & Brooks, 1999).

To sum up, what I am trying to explore is that, although we Saudi mathematics teachers are aware of students' negative feelings towards the mathematics classroom, and although we sometimes are concerned about the need to overcome those feelings, objectivist epistemology seems to play a central role in distorting what we have really learnt about innovative teaching methods. Objectivist epistemology focuses our concern on superficial change in classroom routine not on epistemological change. Whatever we think about the need to reform we still think that we have to deliver the content responsibly in our own way. Because of objectivist epistemology we think that we have to tell students exactly what we want them to learn from the mathematics curriculum. Our objectivist epistemology and technical interest impede us from giving students a chance to 'learn' by themselves. Therefore, I argue that it is important that we learn how to deconstruct the sole influence of the objectivist epistemology in order to complement our new learning of innovative teaching methods. Providing an alternative more flexible epistemology could help in doing so. The following section demonstrates this point.

THE NEED FOR A CONSTRUCTIVIST EPISTEMOLOGY

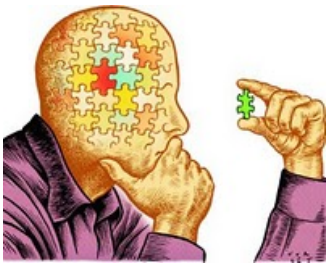
I admit that I 'learnt' several innovative approaches for teaching mathematics at Teachers' College with the aim of improving my teaching pedagogies (see Chapter 5). After re-examining my teaching experiences, however, what I learnt has not impacted on my teaching practice. It seems that the hegemony of objectivist epistemology and the technical interest governed the conventional picture of Saudi mathematics education that I grew up with. Thus, instead of 'teaching' prospective mathematics teachers solely various innovative methods of teaching, I believe that it is important that they also learn about how they perceive in a personal, human way the nature of knowledge and the nature of mathematics. Possession of this higher-level knowledge would more likely strongly affect how they teach.

Exploring my mathematics teaching experience made me think of the need for pre-service teachers, besides learning about innovative teaching pedagogies, to become

aware of how their personal epistemology influences their cognitive process of thinking and reasoning in relation to their future professional teaching practice. Saudi student teachers need to be reflectively engaged in discussion about how they themselves come to know. They need to critically explore the theories and beliefs they hold about knowledge, knowing and the process of acquiring knowledge. They need to consciously address the way their personal epistemology is related to their academic learning (Hofer & Pintrich, 1997; Hofer, 2001, 2002, 2004).

The role of consciousness and the metacognitive processes in prospective teachers' personal epistemologies is an important key. By engaging them in critical reflexivity about their own assumptions about knowledge that they bring to their learning, Saudi teacher educators would be able to play a crucial role in raising pre-service teachers' awareness about their personal epistemology and also could help them to understand how their own epistemology might influence their teaching practice (Bendixen & Corkill, 2012). It might also bring them to perceive the mismatch between their personal epistemology and the epistemologies underpinning the innovative teaching methods they learn.

Based on the previous argument, Saudi pre-service mathematics teachers might need (after raising their consciousness of their own personal epistemology) to be involved in a higher-level learning process that aims to deconstruct the singular hegemony of their objectivist epistemology and the technical interest. This could be done by introducing social and critical constructivist epistemologies that promote non-objectivist epistemologies as well as the practical and emancipatory interests in knowledge acquisition. The common element of a constructivist epistemology is the belief that knowledge is actively constructed by learners in relation to their existing knowledge (see Chapter 4). I need to indicate here that the point is not to completely change their personal epistemology: I am not actually sure if this is possible or indeed beneficial or ethically acceptable. Instead, I think it would be more helpful if pre-service teachers could develop and polish their epistemology by "sanding away misconceptions and adding meaningful supports through explicit experiences" (Fives, 2012, p. 118).



Hence, my current concept of change in Saudi mathematics education does not simply focus on teaching pre-service mathematics teachers several innovative methods of teaching, but focuses also on what their epistemology is and how they conceive of reality. This is a key issue. Saudi mathematics teacher educators have been interested –which is not bad at all – in providing innovative teaching pedagogies in continuously attempting to improve and reform the Saudi mathematics education system. However, I *now* think that this provision of innovative teaching approaches alone is insufficient. Instead we need to have epistemological reform that empowers teachers to engage their students in more discursive learning activities (Taylor, 1996). "Changing what teachers do implies changing what they think knowledge is" (Bruffee, 1993, p. 98).

The crucial point is that their learning of alternative epistemologies should not be done using just traditional educational methods. They should not be asked, for instance, to memorise the definition, the benefits … etc, of alternative epistemologies simply to recall it during exam time. They have to be engaged in critical self-reflective thinking about what they learn in relationship to their own previous learning experiences. They should be engaged in "learning activities that afford high degrees of 'epistemic reflexivity', or reflective thinking on their sedimented epistemologies of learning and teaching" (Taylor, 2004, p. 151). I need to mention here as well that Saudi teacher educators need to introduce those learning activities systematically to pre-service teachers in order to move their personal epistemology from tacit to explicit and from transitional to transformative, well-developed and viable (Gill, Ashton & Algina, 2004; Taylor, 1998).

By using constructivism, and particularly critical constructivism (Taylor, 1996), as a key referent (Tobin & Tippins, 1993), the roles of the teacher and the student may be improved in order to transform the culture of mathematics education in Saudi Arabia. Rather than using constructivism naively as a method of teaching, I propose using it as a way to make sense of what we see, think and do in our learning activities. Constructivism is an epistemology; it is a theory of knowledge which can be used to explain and clarify how we come to know what we know (Lorsbach & Tobin, 1992). Constructivism is compatible with the 'practical interest' which "seeks understanding

of the meaning" (Mezirow, 1981, p. 14). And critical constructivism is compatible with the 'emancipatory interest' which seeks to free student teachers from the hegemony of the conventional epistemology as well as to empower them to take action and transform the current mathematics education culture.

- Values education

Constructivist epistemology does not only promote a different view of knowledge or a different process of acquiring it. Constructivism promotes also a different view of mathematics. Social constructivism, for example, does not see mathematics as a body of abstract knowledge which exists in an objective realm. It sees it as it "is associated with sets of social practices, each with its history, persons, institutions and social locations, symbolic forms, purposes and power relations" (Ernest, 2004). So, the images of mathematics promoted here are not intended to be absolute. Social constructivism proposes images of mathematics as human activity and as the outcome of social processes (Ernest, 1994b). The knowledge of mathematics is understood to be open as its place is in human culture that includes issues of values and education (Ernest, 2004). Social constructivism endorses mathematics to be studied in students' living contexts "which are meaningful and relevant to [them], including [the contexts of] their languages, cultures and everyday lives, as well as [of] their school based experiences" (Ernest, 1991, p. Xii). It supports students to be actively involved in the knowledge they are learning. It empowers them to create their own mathematical knowledge (Ernest, 1991).

Social constructivist epistemology expands the aim of mathematics education to include more than teaching basic numeracy and transmitting the fact of pure mathematics. Social constructivist epistemology promotes creativity and the self-realisation of the students through mathematics learning. It also aims to use mathematics to enhance and develop students' critical awareness and their democratic citizenship. It increases the responsibility of mathematics for its uses and consequences, in education and society (Ernest, 1991). Moreover, social constructivist epistemology encourages mathematics teachers to use mathematics to promote democratic competence and stimulate reflective knowing in their students

which can be seen as a student competence in evaluating applications of mathematics (Skovsmose, 1992, 1994).

Bringing the objectivist and constructivist epistemologies to co-exist in the Saudi mathematics education could create a newer, inclusive, powerful and interesting image of mathematics. Mathematics teachers can discern the role of logic and structure in mathematics as they see mathematics amongst them. They can view mathematics as a "systematic discipline that contains essential content and develops students' ability to abstract and to be disciplined thinkers" (Latterell, 2005, p. 40) as well as they view mathematics as "deep, fundamental and essential to the human experience, [and] it is crying out to be understood" (Lakoff & Núñez, 2000, p. xi).

This inclusive view might be unlikable or unacceptable to many mathematics teachers due to its potential confusion. It has been argued that constructivism and Platonism, as two big theories are incompatible theories (Latterell, 2005). But why do they have to be compatible? I wonder. I believe that the Saudi mathematics education would be healthier when there are multiple views of theory available in its culture. There are many topics, different contexts and several aims in the culture of mathematics education. Why should we hold only one view or one image, as an engineer who holds one hammer to fix all nails on a wall? I am not intending to extend the 'maths war' between traditional and non-traditional images and views of mathematics education. On the contrary, I believe Saudi mathematics education needs both of them for best mathematics instruction[10].

Once social and critical epistemologies are promoted, the practical and emancipatory interests might be developed and flourish, and consequently mathematics can be extended beyond the classroom walls.

I used to collect anything (idea, picture ...) related to mathematics that provides a different view towards what I already know about mathematics. For example, the following writing talks about what mathematics can teach us, but in an uncommon view.

[10] We should not throw out the baby with the bath water☺.

علمتني الرياضيات ... أن السالب بعد السالب يعني موجب ... فلا تيأس، فالمصيبة بعد المصيبة تعني الفرج.

علمتني الرياضيات ... أنه يمكننا الوصول لنتيجة صحيحة بأكثر من طريقة ... فلا تعتقد أنك وحدك صاحب الحقيقة و أن كل من خالفك مخطئ .

علمتني الرياضيات ... أنه يوجد شيء إسمه مالانهاية ... فلا تكن محدود الفكر و الطموح .

علمتني الرياضيات ... أن لكل مجهول قيمة ... فلا تحتقر من لا تعرف.

علمتني الرياضيات ... أن العدد السالب كلما كبرت أرقامه كلما صغرت قيمته ... كالمتعالين على الناس ... كلما إزدادوا تعالياً كلما صغروا في أعين غيرهم .

علمتني الرياضيات ... أن لكل متغير قيمة تؤدي إلى نتيجة ... فاختر متغيراتك جيداً لتصل إلى نتيجة مرضية.

Mathematics taught me... that negative after negative means positive ... so, don't despair; calamity after calamity means comfort.

Mathematics taught me ... that we can reach the correct result via more than one way ... so, don't think that you alone own the Truth and that everyone who does it differently is wrong.

Mathematics taught me ... that there is something called infinity ... so, don't be limited in your thoughts and ambitions

Mathematics taught me ... that there is a value for each unknown ... so, don't despise who you don't know.

Mathematics taught me ... that the negative quantity reduces in value whenever its number increases ... it is like those who privilege themselves over others ... whenever they raise themselves over others, they get smaller in the eyes of others.

Mathematics taught me ... that for each variable a value leads to a result ... so, carefully choose your variable to reach a satisfactory result.

SUMMARY

It seems that most mathematics education reform efforts have focused on the mechanics of pedagogical reform, not on epistemological reform. Thus, it seems that what Saudi mathematics teachers are being called to do is to concentrate on aspects of their pedagogical practice, leaving aside their epistemological issues (i.e., mental

reform). We, as prospective Saudi mathematics teachers, learn about innovative teaching methods. We have a passion for changing the traditional culture of the mathematics classroom. However, we are not inanimate objects that can be changed at will. We are not robots that can implement orders and commands without thinking. We are humans who have beliefs, who have ideologies, who have perspectives, who have ideas, who have experiences and who hold an epistemology. Ignoring these powerful dimensions might lead to ineffective and weak reform. Shifting teachers' approaches to teaching requires more profound changes. It depends on the teacher's system of beliefs (Ernest, 1989).

Without being engaged in critical self-reflective thinking about our own learning experiences and about our personal epistemology of teaching and learning, our reforms might be limited to the physical framework of the classroom rather than to the deeper processes involved in teaching and learning mathematics. There is encouraging evidence to support the idea that critical involvement can impact beliefs. Even though the results of my research are exploratory, rather than confirmatory, the outcomes are "consistent with the growing body of research literature that stresses the important links between constructivist views of teaching and more advanced notions of personal epistemology (i.e., viewing knowledge as complex and uncertain)" (Bendixen & Corkill, 2012, p. 110).

CHAPTER 8

BACKSTAGE OF DOING MY RESEARCH

INTRODUCTION

The aim of this chapter is to uncover what was happening during my writing of this thesis. I want to expose what was going on behind this thesis. However, as there were many things going on in the backstage I cannot reveal them all. So, I have limited them to the following 10 points: the power of objectivism, the danger of extremism, the power of telling stories, my mysterious methodology, my research and my religion, producing knowledge, behind group discussion, the power of critical reflection, past experience: curse or boon?, and thanks thesis. I finish this chapter as well as this thesis by talking about 'what next?'.

THE POWER OF OBJECTIVISM

As I was doing my research, and due to the nature of its methodology that involves my personal experience, I felt that I was the research itself. So, when I talked about my research I talked about myself; my experiences, my beliefs and my perspectives in the field of Saudi mathematics education. Moreover, due to the close relationship between me and the research, I found that it often pushed me to be involved and engaged in discussion with others, especially those who showed some interest in education or who were part of education, such as teachers. Furthermore, due to the unfamiliarity of my research methodology among my Saudi friends, I have been asked about it almost on every occasion. The questions were sometimes about my research topic and sometimes about the methodology. However, my conversations were never easy. They made me realise more and more the extent of absolutist (objectivist) epistemology in Saudi people's thinking. These are some examples:

It happened that I had been asked about what is the major problem in Saudi education. And when I said that the way that we teach our students could be one of the major problems we face in Saudi education, explaining how we as teachers have come to focus only on transmitting the curriculum content instead of developing

students' reasoning, awareness, thinking skills, etc., the interjection was usually similar to: "but this is the teacher's job; s/he has to do it".

A similar incident occurred when I was talking about the 'technical interest' and how it constrained the values of Saudi teaching and learning. The response was similar to: 'does this mean we do not need the technical interest?'

So, I was trying to analyse why the comments and responses were like this. I did not say that we should reject the 'teacher's role in delivering the content' from our education culture. Also, I did not say that the 'technical interest' is no longer needed or that it should no longer be part of the 'interests' that shape our classroom culture in Saudi Arabia. It is needless to say that the 'technical interest' is regarded as a necessary component of contemporary social reality (Taylor & Campbell-Williams, 1993) as is its need in Saudi mathematics education. I was instead criticising the teacher's role in being limited to only transmitting content, and questioning the overworked 'technical interest' and its inappropriate prevalence in Saudi mathematics education. However, why then do those comments indicate that I was recommending the deletion of the teacher's traditional role of transmitting information and the central role of the technical curriculum interest? From my point of view, there could be many reasons, but I believe that it could be due to entrenched absolutist thinking – of my Saudi friends – which is in terms of either black or white, either yes or no, either use a thing or get rid of it. So, when I suggested something, it seemed to mean an absolute replacement, and when I criticised or questioned something, it seemed to mean a complete rejection. This is the kind of way in which absolutists think; they tend to generalise any idea. I agree that absolutist thinking is easy to comprehend and has a quality of being clear. It is simple, unambiguous and offers a sense of security. However, it presents a dilemma for non-objectivists when they talk, as I clarify below.

- <u>The dilemma of objectivism</u>

Non-objectivists need to be very careful when they suggest something. I have found that many non-objectivist people, whether in their writing or in their talking, often say: "this does not mean that". For example, when a constructivist talks about constructivist learning, s/he needs to say: "this does not mean that rote learning is useless". Here are some examples, let's start with von Glasersfeld. In his article

(1995), "A Constructivist Approach of Teaching", after saying that constructivism deals with the construction of conceptual knowledge, he said: "This does not mean that, from the constructivist point of view, memorisation and rote learning are considered useless" (P. 3). Likewise, Lakoff and Johnson (1980) talked about 'metaphor and an absolute truth' in their chapter, "The Myths of Objectivism and Subjectivism", and said a similar thing: "We have seen that truth is relative to understanding, which means that there is no absolute standpoint from which to obtain absolute objective truths about the world. This does not mean that there are no truths; it means only that truth is relative to our conceptual system ..." (p. 9). I also said a similar thing (see Chapter 5) when I presented my experience in learning several innovative approaches to teaching mathematics. I was arguing by saying that "What we learnt had no impact on how we currently teach mathematics. This does not mean that the innovative teaching approaches were useless in themselves". The dilemma of objectivist epistemology is that many objectivists tend to take everything for granted and apply it in every context. This dilemma is a result of the dogma of generalization; a characteristic of objectivist epistemology.

THE DANGER OF EXTREMISM

Learning an alternative epistemology such as constructivism, or moving from a school of thought (Objectivism) to another school of thought (Interpretivism) can be dangerous. The danger appears to be when we move from one hegemony to create another hegemony. The danger shows when we change names but still have the same characteristics. At the beginning of my research, as I was trying to find out the problems that hinder Saudi mathematics teachers from improving their teaching, I started by reflecting on the concept of 'learning'. This is the conclusion that I wrote as a result of my early reflective thinking exercise about 'learning'. (See Appendix 1 for the full of my early reflective writing about 'learning').

> *Objectivism vs Transformativism*
>
> *A process of learning can be described in a very restricted perspective as in objectivism: learning is assimilating an objective reality. On the other hand, the learning process can be described in*

> *a very open perspective as a process of making sense of what has been communicated. Habermas stated that there are two distinctive domains of learning with different purposes, logics of inquiry, and modes of validating beliefs: Instrumental learning: learning to control and manipulate the environment or other people, and Communicative learning: learning what others mean when they communicate with you (Mezirow, 2000).*
>
> *In objectivism learners are passive and inactive, while in transformativism they are active and interactive. In objectivism, they are silent and quiet, while in transformativism they talk, converse, speak, dialogue, argue and have a discussion. In objectivism, they learn without thinking; they are told, while in transformativism they interpret, construe, learn with thinking and reflect critically on the meaning, on their experience and on their understanding. In objectivism, learners acquire knowledge from their teacher, while in transformativism they construct knowledge based on their understanding.*

At that time (2010) this was the conclusion of my reflection on the concept of 'learning'. And it now seems to me that a danger appeared when I acted as the one who holds the complete truth about learning. Basically, I was fighting for an alternative perspective of learning (whatever I called it, interpretivism, constructivism, postmodernism, transformativism …), but I was doing so with an objectivist perspective. I was unintentionally fighting for another paradigm of learning to become dominant. My reflection on learning was intended to find out what learning ‘really is’ rather than what it ‘could be’ based on the context and the purpose of my research. So, I was struggling against the dominant paradigm of objectivism but, at the same time, I was using an objectivist epistemology (ironical and contradictory). Moreover, this led me to have dualistic reasoning: objectivism is 'bad' and constructivism is 'good'. I thank dialectical thinking for helping me to solve this dilemma.

THE POWER OF TELLING STORIES

The word ‘story’ might indicate entertainment time for many people. And it might also indicate lack of seriousness. For this reason, I try to avoid using this word when I am asked about my research methodology. Many of those who have heard about my methodology often try to make fun of it when they talk to me. And more so, there are those who do not choose this kind of methodology for their research, not because of its alternative ontology and epistemology but only due to the word ‘story’. I remember those who said to me, “What are you going to say about your research methodology when you go back to your university?” I have been many times seen as cynical when I talk about the importance of stories in our life, and that we could integrate our teaching, learning and research with stories. For this reason, I thought to write my views about the matter.

I think ‘stories’ could have a greater influence on others than anything else. Stories could easily make research more powerful, could easily make teaching more affective and influential, and/or could easily make learning more meaningful. Besides, as a Muslim, I believe that the Qur’an is the word of Allah and that it consists of many stories; and there is a chapter named “The Stories”. Furthermore, Allah said in the Qur’an to the Prophet:

﴿ فَاقْصُصِ الْقَصَصَ لَعَلَّهُمْ يَتَفَكَّرُونَ ﴾

“Tell them such stories; perhaps they may reflect” (Holy Qur’an, 7:176). Allah indicates that ‘stories’ are a good tool that might stimulate people to reflect and think.

I have an example of a story that could make a difference to teachers when they read it. In considering the individual differences amongst students, I could write an article about it, I could teach a topic about it, and I could conduct a research about it. However, to what extent would that affect others who read what I write? To what extent, for example, would Saudi pre-service teachers who study this topic adopt it in their practices? When I was a pre-service teacher, I learned about the importance of taking care of students’ individual differences. I memorised all the advantages of addressing the individual differences amongst students. However, I did not realise the importance of it till I read the following story.

- The story …

There is a story many years ago of an elementary teacher. Her name was Mrs. Thompson. And as she stood in front of her fifth grade class on the very first day of school, she told the children a lie!.

Like most teachers, she looked at her students and said that she loved them all the same. But that was impossible, because there in the front row, slumped in his seat, was a little boy named Teddy Stoddard.

Mrs. Thompson had watched Teddy the year before and noticed that he didn't play well with the other children, which his clothes were messy and that he constantly needed a bath. And Teddy could be unpleasant. It got to the point where Mrs. Thompson would actually take delight in marking his papers with a broad red pen, making bold X's and then putting a big "F" at the top of his papers.

The school where Mrs. Thompson taught required teachers to review each child's past records, and she put Teddy's off until last. However, when she reviewed his file, she was in for a surprise. Teddy's first grade Teacher wrote, "Teddy is a bright child with a ready laugh. He does his work neatly and has good manners...he is a joy to be around."

His second grade teacher wrote, "Teddy is an excellent student, well-liked by his classmates, but he is troubled because his mother has a terminal illness and life at home must be a struggle."

His third grade teacher wrote, "His mother's death has been hard on him. He tries to do his best but his father doesn't show much interest and his home life will soon affect him if some steps aren't taken."

Teddy's fourth grade teacher wrote, "Teddy is withdrawn and doesn't show much interest in school. He doesn't have many friends and sometimes sleeps in class."

By now, Mrs. Thompson realized the problem and she was ashamed of herself. She felt even worse when her students brought her Christmas presents, wrapped in beautiful ribbons and bright paper, except for Teddy's. His present was clumsily wrapped in the heavy, brown paper that he got from a grocery bag.

Mrs. Thompson took pains to open it in the middle of the other presents. Some of the children started to laugh when she found a rhinestone bracelet with some of the stones missing and a bottle that was one quarter full of perfume. But she stifled the children's laughter when she exclaimed, how pretty the bracelet was. She put it on and dabbed some of the perfume on her wrist.

Teddy Stoddard stayed after school that day just long enough to say, "Mrs. Thompson, today you smelled just like my Mom used to." After the children left she cried for at least an hour. On that very day, she quit teaching reading, writing, and arithmetic. Instead, she began to teach children.

Mrs. Thompson paid particular attention to Teddy. As she worked with him, his mind seemed to come alive. The more she encouraged him, the faster he responded. By the end of the year, Teddy had become one of the smartest children in the class and, despite her lie that she would love all the children the same, Teddy became one of her "pets."

A year later, she found a note under her door, from Teddy, telling her that she was still the best teacher he ever had in his whole life. Six years went by before she got another note from Teddy. He then wrote that he had finished high school, third in his class, and she was still the best teacher he ever had in his whole life.

Four years after that, she got another letter, saying that while things had been tough at times, he stayed in school, had stuck with it, and would soon graduate from college with the highest of honors. He assured Mrs. Thompson that she was still the best and favorite teacher he ever had in his whole life.

Then four more years passed and yet another letter came. This time he explained that after he got his bachelor's degree, he decided to go a little further. The letter explained that she was still the best and favourite teacher he ever had. But now his name was a little longer.

The letter was signed, Theodore F. Stoddard, MD.

The story doesn't end there. You see, there was yet another letter that spring. Teddy said he'd met this girl and was going to be married. He explained that his father had died a couple of years ago and he was wondering if Mrs. Thompson might agree to sit in the place at the wedding that was usually reserved for the mother of the groom.

Of course, Mrs. Thompson did. And guess what? She wore that bracelet, the one with several rhinestones missing. And she made sure she was wearing the perfume that Teddy remembered his mother wearing on their last Christmas together.

They hugged each other, and Dr. Stoddard whispered in Mrs. Thompson's ear, "Thank you, Mrs. Thompson, for believing in me. Thank you so much for making me feel important and showing me that I could make a difference." Mrs. Thompson, with tears in her eyes, whispered back. She said, "Teddy, you have it all wrong. You were the one who taught me that I could make a difference. I didn't know how to teach until I met you"[11] *(teachnet.com, n.d.).*

[11] Teddy Stoddard is the Doctor at Iowa Methodist Hospital in Des Moines that has the Stoddard Cancer Wing.

I learned what a teacher is supposed to do with his/her students. I learned to pay attention to students' individual differences and take into account their different backgrounds. However, it was a very boring topic just like any other topic. It did not affect the way I think of my students. It had no influence on me. But this story not only made me cry but also it taught me and showed me how a 'story' could be more powerful and affective on our thinking more than anything. For me, this story can be a reference for this topic. I think it is enough. This story lets me ask "why we do not teach emotionally?". We can learn a lot of lessons from this story. So now, is a story only for entertaining or it can be a lesson?!!

MY MYSTERIOUS METHODOLOGY

My research methodology was a very big issue early in my research. As I only knew the traditional worldview of research, I struggled a lot to get involved in alternative worldviews of research. First of all, there was a dilemma of how to write my research. All I knew was that a researcher has to be objective. So, his/her voice should not be involved in the process of the research. But in the methodology of this research my personal experience needs to be discussed. So, I need to tell my stories. I need to express my experiences. It was a kind of conflict between what I thought as the right way of writing research and what I needed to do. Many times, the 'default' research writing appeared while I was writing this thesis. This dilemma continued until I encountered it by asking this question: what is my epistemology in this methodology?

Another issue, as this methodology was new to me, I was trying to bring everything about my research into a single research methodology template. I was very keen to not miss anything. As I tried to do that, I came across many research methodologies, such as narrative inquiry, writing as inquiry, personal experiences, phenomenology, auto-ethnography. So, my enthusiasm continued in trying to have a clear-cut distinction between each of these research methodologies. I spent around four or five months trying to identify clearly each of these methodologies, separately from others. And as I went along with that goal of defining the absolute definition for every methodology, I found myself losing direction and ending up with nothing. All those methods of inquiry overlap.

Here is an example; is my research a phenomenological study?

Creswell (1998) defines a phenomenological study as one that “describes the meaning of the lived experiences for several individuals about a concept or the phenomenon” (p. 51). Leedy and Ormrod (2005) define a phenomenological study as “a study that attempts to understand people’s perceptions, perspectives and understanding of a particular situation.” (p. 139). Rossman and Rallis (2012) said that the researcher in a phenomenological study “seeks to understand the deep meaning of a person’s experience” (p. 96) and “the purposes of phenomenological inquiry are description, interpretation, and critical self-reflection into the "world as world" (Van Manen, 1990)” (p. 97). Well, my research is a study to understand my perceptions and perspective of the culture of Saudi mathematics education. I seek to understand and to learn about my lived experiences in the Saudi mathematics classroom as well as the experiences of others (pre-service teachers) examining critically our learning and teaching experiences in the culture of the Saudi mathematics classroom, and how we experience our experience.

Another issue with my research methodology was that it was not as easy as some of my friends thought. They used to say something like: ‘You just write some stories about your life. That’s sounds too easy’. However, on the one hand, the exploration of personal experience generates “a lot of fears and self-doubts and emotional pain” (Ellis, 2004, p. xviii). So, they might find unpleasing things about themselves when they face them (Ellis & Bochner, 2000). On the other hand, my research did not follow a specific formula or a pre-designed form. I struggled a lot to construct my research chapters. This type of research did not provide me with a clear structure that I could follow in designing my research. It provided me with the opportunity to design my research as I wished based on the purpose of my inquiry. This might sound good but when you start doing it you might find yourself in a confusing situation, especially if you are, like me, a person who came from the positivist worldview of research. I like the pre-designed form of research; I think it is relatively easy to use. But it was not compatible with my inquiry. So, I had to create the recipe of my research as I conducted it. What made my methodology very challenging was that it did not follow the idea of linearity; instead, it embraced complexity due to the problematic topic of investigation.

- What I like about my methodology?

It allowed me to practise my thoughts. It allowed me to experience my research results. I did not just preach. I exercised what I argued for. For example, I argued for providing pre-service teachers with opportunities that allow them to recall and present their own past learning experiences for the purpose of encouraging them to think carefully and reflect critically and culturally upon their own experiences. In this research, I did the same thing as I practised thinking reflectively and critically upon my own prior experiences of learning and teaching.

MY RESEARCH AND MY RELIGION

Mind and/or religion ... Is religion mind control? ... I heard some people saying that ... However, it is not true in my case. The Qur'an always stimulates us to use our minds, to think and reflect. For example, Allah says in the Qur'an:

﴿ أَفَلا يَتَدَبَّرُونَ الْقُرْآنَ وَلَوْ كَانَ مِنْ عِنْدِ غَيْرِ اللَّهِ لَوَجَدُوا فِيهِ اخْتِلافًا كَثِيرًا ﴾

"Will they not ponder on the Qur'an? If it had been from other than Allah, they would have found therein much discrepancy" (Holy Qur'an, 4:82). Allah asks us to ponder on the Qur'an; not just recite it with no understanding. I found that this research enabled me to have a better understanding of my religion. For example, in the past, I was repeating what others say without thinking. Now, when I recite the Qur'an, I recite it differently. I start reciting while also making sense of it. Allah also said:

﴿ أَفَلَا يَتَدَبَّرُونَ الْقُرْآنَ أَمْ عَلَىٰ قُلُوبٍ أَقْفَالُهَا ﴾

"Will they not then ponder upon the Quran, or are their hearts locked up (from understanding it)?" (Holy Qur'an, 47:24). I found that there are a lot of things in the Qur'an to infer; thanks to this research which made me realise that I was reciting the Qur'an without thinking or meditating on what I was reciting.

PRODUCING KNOWLEDGE

I came to believe that alternative innovative ways of presenting our ideas can be more powerful and can make a huge impact on others more than traditional ways of producing knowledge can do. In 2012, I saw a short video clip made by a Saudi teacher on learning difficulties, her name is Zuhairah. It was derived from a 2007 Indian drama film titled, "Taare Zameen Par". The clip explores the life and imagination of eight-year-old Ishaan. Although he excels in art, his poor academic performance leads his parents to send him to a boarding school. Ishaan's new art teacher suspects that he is dyslexic, and helps him to overcome his disability. The clip was so powerful and very influential. I read viewers' comments on the clip which reveal how much the clip has influenced them. One wrote: "My study is about learning difficulties and after watching this clip I am going to choose this topic". The clip has a very poignant message to teachers to help disabled students to overcome their disabilities. There are lots of messages in this clip for teachers and parents to take care of their children.

I was wondering what it would have been like if I had read about the same learning difficulties only in the third person voice? What if the same teacher, Zuhairah, presented the ideas of the video clip in a passive written form? Would it have had the same influence and impact on the audience? Would anyone read it? People could stay two hours consistently watching a movie while they might get bored if they read the same story in a book. This led me to ask a question similar to 'could a novel be a dissertation?', which is 'could a movie be eligible for a PhD degree'? For me, why not if it produces what a PhD thesis produces about knowledge? I think a movie could have more impact on others than my written thesis could do. A movie that demonstrates my experience and illustrates my research ideas in an imaginative and creative way could have a greater impact than could my thesis. The point of saying this is that alternative ways of producing knowledge could be more powerful than traditional ways. If I am a learning difficulties teacher educator, I will use the video clip in teaching about learning difficulties to pre-service teachers. For me, it is far more powerful than teaching them in a lecture style.

BEHIND GROUP DISCUSSION

I have mentioned many times throughout this study the importance of the discussion method in teaching Saudi pre-service teachers. However, I was thinking about how this could go. Many issues come to my mind when I explain the viability of discussion in teaching Saudi student-teachers.

In my experience, Saudi prospective teachers, and I was one of them, were never (or rarely, to be optimistic) engaged in classroom discussion or participated in a conversation in their classroom. Saudi student teachers seem to have no experience of democratic dialogue where one has the ability to talk with no interruption and respectfully listen to others who hold different views. It was not a feature that had shaped the culture of the mathematics education classroom.

Moreover, Saudi future teachers might get confused and sceptical of group discussion's applications. I remember that when I was attending Dr. Taylor's classes on the Curriculum Unit where we learned several images of curriculum, I engaged in many discussions about the images of curriculum and its applications in teaching and learning. As we moved our discussion from one curriculum image to another, I used to say: "This is it; this is the image of curriculum that we should adopt". But, we kept moving to another image and another view to have another discussion and ended up with another view. Accordingly, I used to ask myself: "So, what should we do? What is the right one? What point of view should we adopt?" I did not realise the point of the discussion. I thought our discussion was intended to look for 'the right one' that needs to be adopted. Surprisingly, it was not only me who thought the same way. When I had a chance to co-teach with my supervisor the same unit, I was asked by some Asian students: "What curriculum image should we use when we go back to teaching? We do not know what to choose!!".

Likewise, Saudi pre-service teachers might get disappointed due to discussion activity. The reason is that Saudi students tend to think that they attend the classroom to hear from the teacher, not to hear from their colleagues. They might also complain that the teacher does not 'teach' s/he just lets students talk. A Saudi Masters student who had similar learning experience to mine at SMEC and had been involved in the same classroom culture came to me once complaining that he has no idea what to do. He said: "We just keep talking and there is no conclusion".

Furthermore, classroom discussion deconstructs the familiar authority that the lecture has. And this could make some trouble among some Saudi pre-service teachers. One of the troubles is making students less confident about their thoughts. I remember during classroom discussion that I used to think whether what I said was acceptable or not? What is the teacher's opinion of what I say? Am I right or wrong? In discussion, there are many thoughts and I do not know which one is the right one.

Another point is that in discussion we are supposed to talk to the whole group, to all students involved in the discussion. However, those who have never been involved in such an experience might find it hard to speak to the whole group. So, when I got involved in discussion at SMEC, I used to look at only the teacher. Moreover, sitting in an open circle instead of rows is another problematic issue. It was not easy for me to have the experience of everyone looking at me.

I think group discussion should not be imposed or applied straightaway in the Saudi context, as if pre-service teachers are familiar with it. As a teacher educator, I might need to use discussion method in a very careful and ethical way (Taylor, 1998).

THE POWER OF CRITICAL REFLECTION

One of the tools that I think is imperative for teachers, learners and researchers is critical reflection. I have mentioned this word a lot in this thesis. The beauty about critical reflection is that it does not stop for me here in submitting my thesis. It is a tool that I need to keep in my mind during my future journey of teaching and researching. Critical reflection is a tool that gives us insight into our experience, to understand it, to investigate it, to improve it and/or to change and transform it. To be a critical reflective teacher and/or researcher is to seek better understanding of what we do and how we do what we do.

Another aspect of the beauty of critical reflection is that it is an ongoing process that lets us think critically about our status quo, and then think again about our new status quo. It is a way to check the viability of new professional practices. It is a continuous process for self-development. It is a suitable approach for traditional teachers and researchers, and also for those who name themselves as 'progressives'. For me, I consider critical reflection to be one of the best methods to use to become

transformed and emancipated from whatever status quo we have, in order to have a more 'fitting' one, and then to have a 'fitter' one, and to keep this process going along, presuming to never be perfect; and, in some situations, we can use critical reflection to celebrate what we have achieved.

PAST EXPERIENCE: CURSE OR BOON??

When I get involved in discussions about the Saudi culture of mathematics education and how the repressive prevalent image of it causes the educational values of mathematics to be dehumanized, I receive questions such as: “But the education culture in Saudi Arabia contributed to making you as you are now” or “How could you be unhappy about your past learning experience when you are talking about a progressive view of teaching and learning which is a product of your past learning experience?”, or “How did you become like this if you did not have those experiences?”. I found these comments very interesting. So, I would say that: Yes I had those experiences and they shaped me; they shaped my thinking and my professional practice. It was and still is part of my life. However, I did not stay there. I learned from those experiences. I brought them into the present, examined them, and investigated some issues about them, trying to have a better understanding of them, and I found that, yes, those experiences shaped my thinking and my professional practice but in a very conservative way. I am thankful to critical reflection, which helped me to become emancipated and transformed from an exclusive culture of education to now have an inclusive vision of education culture. So, I did not let my previous experience of teaching and learning keep constraining me. With the power of critical reflection, I stood up to learn from my past and in my present to envision my future, as well as to celebrate some issues in my past experience.

These questions led me to another question. How about if my previous learning experience had been the same as my current vision of learning? For example, how about if my previous experience of learning had been an experience of transformative learning? What would the consequences have been? Would I have kept going in the same direction or would I have envisioned another direction? Of course, there is no answer right now because I do not know how the circumstances

would have been. However, I can say that with critical reflection (which is by the way a major element of transformative learning), we can decide whether we search for a new status quo or celebrate the current status quo.

THANKS THESIS…

Am I a changed person now? I believe so. This thesis changed me a LOT. It has not only increased my knowledge but has changed me personally as well. It has affected the way I live, the way I think, the way I talk with others, and the way I listen to others. I feel I have become 'calmer'. In many cases, when I have conversations with others, I bring a constructivist epistemology into my mind. So, when I become involved in discussion about something very different from what I think, I just say to myself, this is the level of knowledge construction s/he has made. Maybe s/he needs more time or another experience to build more understanding, or maybe I need more time or another experience to build a broader understanding. So, let them try their understanding and let them live with it as long as it works for them now and it does not harm others … And let me try and live my current understanding ... And with another experience[12] we might find that our understanding needs more building up. Due to this mode of thinking that I have built up during my research, I now feel calm in negotiation with others. However, to avoid 'solipsism', I need to keep my discussion with others meaningful and sincere (Willison & Taylor, 2006). Now, I am enjoying my current Naif at the same time as creating the future Naif. As I am changed now, it means I am growing and, as I am growing, it means I expect another growing Naif. Thanks to the previous Naif … Good luck current Naif … Welcome future Naif.

WHAT NEXT?

Seeing my colleagues graduate and attending their farewell parties was always inspiring me to finish my study. I was always looking forward to this moment. And I kept asking every single one about how they felt. I had a feeling that submitting my

[12] Another experience could be involving in critical reflection about our current understanding, or involving in a meaningful and sincere negotiation.

thesis would be the ultimate goal ever in my life. I thought it would be a huge relief. I thought I would be the happiest person in the world. However, getting close now to submitting, although I am very happy, I feel that I am just getting started now. I said to myself, I have done it, so what? ... Spending some time thinking about 'what next', the first thing I wish to do after getting (hopefully) the degree, is to establish a 'transformative educational research group' (TERG[13]) in Saudi Arabia, aiming to join with other TERGs in Australia, Mozambique, Nepal, Philippines, Japan and Indonesia. I aim to create a network with my colleagues in other TERGs. It would be a very nice source and resource for me, as well as motivating me when I go back to my country. I really do hope that I can contribute to improving mathematics education in Saudi Arabia. I confess that the challenge will not be easy when I go back but the experience, the knowledge, the skills ... etc., I have had during this journey have made me ready and able to face it. With the last sentence in this thesis I welcome my new journey. It begins.

[13] TERG was established in 2006 at Curtin University, led by my advisor Peter Taylor, and comprises graduates, graduate students and committed onlookers worldwide.

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I acknowledge the search engine (www.google.com) for the images that I have used in my thesis.

Every reasonable effort has been made to acknowledge the owners of copyright material. I would be pleased to hear from any copyright owner who has been omitted or incorrectly acknowledged.

Appendix 1

MY EARLY REFLECTIVE WRITING ABOUT 'LEARNING'

- In January 2010, I wrote

Have you ever thought what 'learning' means? Have you ever thought how you learn and why you learn? For me, I have never asked myself or thought about these questions, simply because I was a passive learner. I had not been given a chance to think or to be a thinker. I was learning without thought. I was an assimilating student who absorbed what he listened to without thinking. I was not encouraged to be a thinker, reflector, or critic.

Anyway, even if these questions about learning came into my thoughts, I may ignore thinking about them as they were unnecessary and insignificant to me. So, I just knew that learning means 'come to know' or knowing something new that I did not know before, and that's it. When I knew 'something' which was unknown to me previously, it meant that I had learned that 'something'. This meaning of learning might have seemed to be correct and sufficient at first glance a long time ago, but when I look closely at it again these days I find that the meaning is quite shallow. That is, knowing a thing as something new is not enough to learn it; we might need to practise that thing if it is practicable, we might need to be familiar with it if it is possible, we might need to understand it to make deeper meaning of it, to judge it, to be cognisant of it and/or to find out the consequences of it.

If I know something; does that mean that I learnt that something? Perhaps yes perhaps no, it depends on what I mean by learning. However, I can say that "what we knew is just what we know" or "we knew that something". We might "learn" (which is in this context "knowing something") but we might need to be familiar with that something. So, I can say that knowing something is "learning" and being familiar with that something is another "learning". Moreover, we might be familiarized with (or learn) that something but we might also need to distinguish it from another thing. So, distinguishing could be another "learning".

We may, in the same way, need to think of something we already know - not something new – but to understand it more deeply and intensively. So, can understanding - in this context – be considered learning or not? And what is the difference between learning as knowing and learning as understanding? Thus, learning does not only stand for knowing.

So, what does 'learning' stand for? Or what do I mean by learning? To answer this broad question I can say that learning has and should have many different forms. Learning could be understood in terms of its levels, goals, dimensions and/or methods. The important thing is that I am not suggesting only one form of learning, nor am I privileging a form or a perspective of learning over another. I am, in this research, under the influence of constructivism, and thus I should have more than one idea, more than one perspective, more than one viewpoint of learning; I have to have varied ideas of learning in which contextual circumstances of learning are varied. Thus, not one idea of learning should prevail. I should embrace pluralism.

Learning could be...

Knowing what is unknown yet,

Identifying what is unidentified yet,

Exploring what is unexplored yet,

Seeing what is not seen yet,

Observing what is unobserved yet,

Discovering what is undiscovered yet,

Finding out what is unfound yet,

Recognizing what is unrecognized yet,

Being familiar with what is unfamiliar yet,

Distinguishing what is undistinguished yet,

Noticing what is unnoticed yet,

Realising what is unrealised yet,

Understanding what is not understood yet,

Conceptualising what is unconceptualised yet

And/or could be something else which is unthought of yet.

- In March 2010, I made another reflection about what do I mean by learning?

The meaning of learning depends upon a set of presuppositions (Mezirow, 1996). It depends upon our views toward knowledge and how we see it, how our obtaining of knowledge might be, how our thought is shaped or ideologised. It depends upon our situation and local culture and society. It depends upon which paradigm we deal with, embrace or depend on. It depends upon what we mean by reality, and how we see reality or how reality is seen.

Learning is a process of meaning-making not knowledge reception and memorisation. To explain the process, I would say that a learner interprets data to make meaning and construct knowledge. So, we have data (text words, pictures, teacher's speech, or figures) which need to be interpreted – not to be transmitted by a teacher and accepted by a learner without any reflection. Therefore, a learner can go through a learning process by interpreting data, making meaning and constructing the meaning of data, a process that can be recognized as deep learning. This learning is different from shallow learning where the learner does not go through that process of learning and s/he needs only to memorise the knowledge.

Learners should create an interpretation and construct knowledge (see Statement) that might be more applicable and justified for themselves from those which come from their teachers or others. Jack Mezirow (2000) demonstrated that "our understandings and beliefs are more dependable when they produce interpretations and opinions that are more justifiable or true that would be those predicated upon other understandings or beliefs" (p. 4). So, when mathematics teacher educators dictate their understanding and interpretation to pre-service mathematics teachers without any encouragement to be a creative, critical and/or reflective thinker, pre-service teachers might just memorise what has been dictated to them –even if they are not convinced- to pass the exam. Those interpretations and opinions

Statement

I am constructing knowledge based on my own understanding. My understanding may differ from my supervisor's, as a result of different thinking although data are the same. Peter has never constructed knowledge for me or transmitted his understanding to me. However, he gives me a chance to try, amend and notice to have better understanding rather than dictating his understanding upon me. This does not mean that we do not share our understanding or that we have no consensual understanding but it means that he allows me to have my own understanding even if it still needs more constructing.

might find no room in student teachers' minds. Those opinions might be resisted by what pre-service teachers already believe and understand which have never been presented or discussed. Pre-service teachers might maintain their prior interpretations and opinions which then affect their practice after they finish their studies. I found many students repeatedly say that 'all that we learn is just theory that cannot be implemented'. I have heard also from some postgraduate students at SMEC who had not engaged in discussion about their epistemologies of teaching and learning. Although they were doing a PhD in Science Education or Mathematics Education, unfortunately their epistemologies had not been discussed. So, they might continue their teaching and their endeavours to reform science education or mathematics education in their country with the same epistemologies that they came with and retained.

Learning should have multiple meanings, manifold perspectives, and/or several dimensions. Each meaning, perspective and dimension has been constructed and built upon such assumptions. And we are still waiting for innovative assumptions to generate alternative meanings, perspectives and dimensions of learning. However, we should not necessarily privilege one meaning, perspective and dimension over another. Nevertheless, one meaning, perspective and dimension has been unfortunately privileged and has prevailed for a very long period. That long period was enough to establish it strongly as having a very narrow meaning, perspective and dimension of the concept of learning. It has become a sacrosanct concept that should not be modified or replaced with another. The hegemony of this meaning, perspective and dimension should be de-privileged (see Questions). The concept of learning should be transformed from restricted meaning, limited perspective and constrained dimension to be more open, boundless and postmodern. It is very important that learning in adult learners puts emphasis on "contextual understanding, critical reflection on assumptions and validating meaning by assessing reasons" (Mezirow, 2000, p .3).

Questions

In the absence of fixed truth- Who has the right to privilege one meaning over others?

In the changed circumstances- Why does one perspective prevail?

If one perspective is privileged- What does that mean?

- Objectivism vs Transformativism

A process of learning can be described in a very restricted perspective as in objectivism: learning is assimilating an objective reality. On the other hand, the learning process can be described in a very open perspective as a process of making sense of what has been communicated. Habermas stated that there are two distinctive domains of learning with different purposes, logics of inquiry, and modes of validating beliefs: Instrumental learning: learning to control and manipulate the environment or other people, and Communicative learning: learning what others mean when they communicate with you (Mezirow, 2000).

In objectivism learners are passive and inactive, while in transformativism they are active and interactive. In objectivism, they are silent and quiet, while in transformativism they talk, converse, speak, dialogue, argue and have a discussion. In objectivism, they learn without thinking; they are told, while in transformativism they interpret, construe, learn with thinking and reflect critically on the meaning, on their experience and on their understanding. In objectivism, learners acquire knowledge from their teacher, while in transformativism they construct knowledge based on their understanding.

Appendix 2

PARTICIPANT INFORMATION SHEET

My name is Naif Alsulami and I am currently doing a piece of research for my PhD of Science and Mathematics Education at Curtin University. My research will focus on transforming mathematics education culture in Saudi Arabia.

I am interested in finding out to what extent does objectivist thinking hinder mathematics teachers in Saudi Arabia from utilizing what has been learned of innovative student-centred strategies in their teaching. Also, how they conceive of the culture of the classroom. How they conceive their roles as teachers and their students' role as learners. And what are their beliefs about teaching and learning? Moreover, I am interested to know how they perceive their pre-service learning experience; especially, their experience in learning innovative methods of teaching.

Your involvement in the research is entirely voluntary. You have the right to withdraw at any stage without it affecting your rights or my responsibilities. When you have signed the consent form I will assume that you have agreed to participate and allow me to use your data in my research.

The information you provide will be kept separate from your personal details, and only I and my supervisor will have access to it. The transcript of your interview will not have your name or any other identifying information on it and in adherence to university policy, the transcript will be kept in my own laptop with password protection for five years, before it is deleted.

This research has been reviewed and given approval by Curtin University of Technology Human Research Ethics Committee with approval number SMEC-48-09 (see Appendix 4). If you would like further information about the study, please feel free to contact me on my mobile number 0412434269 or by email: nsulami@hotmail.com. Alternatively, you can contact my supervisor Associate Professor Peter Taylor on +61 8 92667501 or by email P.Taylor@curtin.edu.au.

Thank you very much for your involvement in this research, your participation is greatly appreciated.

Appendix 3

CONSENT FORM

• I understand the purpose and procedures of the study.

• I have been provided with the participant information sheet.

• I understand that the procedure itself may not benefit me.

• I understand that my involvement is voluntary and I can withdraw at any time without problem.

• I understand that no personal identifying information like my name and address will be used and that all information will be securely stored for 5 years before being destroyed.

• I have been given the opportunity to ask questions.

• I agree to participate in the study outlined to me.

Signature _____ Date_____

Witness Signature_____ Date_____

Appendix 4

ETHICS APPROVAL

memorandum

Curtin University of Technology

To	Naif Mastoor Alsulami, SMEC
From	Pauline Howat, Coordinator for Human Research Ethics, Science and Maths Education Centre
Subject	Protocol Approval **SMEC-48-09**
Date	23 October 2009
Copy	Peter Taylor, SMEC Divisional Graduate Studies Officer, Division of Science and Engineering

Office of Research and Development

Human Research Ethics Committee

TELEPHONE 9266 2784
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Thank you for your "Form C Application for Approval of Research with Minimal Risk (Ethical Requirements)" for the project titled "*TRANSFORMING MATHEMATICS CLASSROOM CULTURE IN SAUDI ARABIA: A CRITICAL AUTO/ETHNOGRAPHIC INQUIRY*". On behalf of the Human Research Ethics Committee I am authorised to inform you that the project is approved.

Approval of this project is for a period of twelve months **19th October 2009** to **18th October 2010**.

If at any time during the twelve months changes/amendments occur, or if a serious or unexpected adverse event occurs, please advise me immediately. The approval number for your project is **SMEC-48-09**. *Please quote this number in any future correspondence.*

PAULINE HOWAT
Coordinator for Human Research Ethics
Science and Maths Education Centre

Please Note: The following standard statement must be included in the information sheet to participants: *This study has been approved by the Curtin University Human Research Ethics Committee (Approval Number SMEC-48-09). If needed, verification of approval can be obtained either by writing to the Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University of Technology, GPO Box U1987, Perth, 6845 or by telephoning 9266 2784.*

J:\SMEC\office\Pauline\ETHICS\Ethics Approval Letter 2009\Alsulami.doc