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A Brief Critique on the Future of Learning

(Assessing the potential for research)

Abstract

Recent advances in computer and communications technologies are opening up new opportunities for learning design requiring a thorough (perhaps revolutionary) reappraisal of the goals and purpose of education. The potential of the Internet and the technologies it inspires makes it feasible to not only access and manage information in productive and efficient ways, but also to deliver dynamically interactive, personalised solutions tailored to the needs and preferences of all learners. Therefore, it is important to extend our understanding of how computer technologies can enhance student learning whilst providing some insight into the future of learning.

If we accept for the moment that graduates are not adequately equipped to cope with current skill requirements, and combine this view with the complexity of devising suitable electronic delivery methods, there is cause for concern as to the capacity of current learning design models to cater for the diverse skill demands of a technologically driven world. Such concern for the future is not new, but certain emerging factors suggest there is merit in constructing advanced learning models that take advantage of the growing sophistication of computer technologies. The challenge will be to harness technological innovations in ways that will assist to deliver high quality learning outcomes relevant to the changing needs of learners.

Introduction

Computers and communications technologies have influenced almost every facet of our lives, including the way we view the world around us. Over the past ten years or so, we have witnessed the widespread integration of information technology systems into classrooms, libraries, homes, businesses and communities. In turn, the use of educational technologies has led to unprecedented access to vast repositories of information paralleled by a pronounced transformation in the type, production, and ease of access to high quality teaching and learning resources. The problem however, is that for the most part, the current debate on the use of educational technologies is directed toward deriving a plausible purpose rather than determining how the same technologies may assist to enhance learning. Instead of posing the question "how can this technology be used?" a more appropriate question should be along the lines of: "what is it about the learning process that needs to be improved?" The question that naturally follows is "in what ways might the technology enable such improvements?" Taking this line of thought further, we must also reflect on the implications these questions hold for the future of education. Analysing such potential changes gives rise to the question of "how is it possible to derive knowledge from a vast storehouse of disorganised data and information that is expanding at rates impossible for any individual to process?" As will be emphasised, in answering the latter question it becomes apparent there is an uneasy tension between what is possible, and what is actually needed (McLean and Clifford, 2004, p 2).

In many instances, learning is viewed as a one-way, 'distribute-then-learn' system. Teaching is not about delivering content that can be channelled down a pipe like water nor can the process of learning be compared to filling an empty bucket with water. Such a model cannot embrace all the complexities of learning. We have reached a point where information and the knowledge that can be derived from it have become far too prodigious and unmanageable for it to be absorbed in the minds of individuals. As information and knowledge increases in size and in complexity, it will, out of necessity, become the shared property of networked individuals and communities. That is, for the individual to cope with increasing complexity, the production of knowledge must be viewed as a communal activity.

The growing recognition of the untapped power of educational technologies is an area that researchers are only just beginning to explore. Consider for example, the potential of technology inspired delivery techniques and strategies for creating learning environments designed to manage and facilitate an unfettered exploration of the countless relationships that thread throughout globally distributed networked repositories of knowledge and information. Given this potential, consider also that the capacity to extend the learning experience beyond accepted epistemological distinctions as delineated by established disciplines and specialist subject areas is now technically feasible. Using advanced technologies such as the Internet and learning objects, traditionally separate nodes of data and information can be dynamically interlinked in

highly imaginative and novel ways. It is also feasible for example, to enhance the learner's capacity to generate new knowledge by designing learning environments that assist to connect prior insights and understandings to multiple, at times incongruent contexts.

If we reflect on the implications these musings present, it is conceivable that education as we have known it over the past century is poised on the verge of entering into new realms of possibilities that will revolutionise the long held views on the purpose of learning. The emergent power of the web and related technologies makes it both desirable and viable to not only access and manage far more information than previously thought possible, but also to deliver learning environments anytime and anywhere convenient to the learner. Regardless of the obvious appeal of such prospects, we must not lose sight of the fact that ready access to information does not always equate to being educated, in particular where asynchronous and computer-mediated 'distance' communication modes are concerned. As indicated, it is not enough to simply deliver information and assume learning will ensue. In practice, the issues and strategies for designing effective learning environments are highly complex and diverse.

It is not just bridging the transition from 'traditional' learning to electronically mediated learning that is fraught with difficulties. The speed of change in the socio-economic and education environments necessitates a continuous search for radically different and innovative teaching strategies and learning models to address the learning requirements of future graduates. For example, any attempt to accommodate the skill needs and preferences of current generation, computer 'literate' students will inevitably compel educational designers to think entirely "outside the box" and consider design strategies that are more in line with student's expectations and demands. In order to satisfy the needs of the new Internet 'literate', it will be necessary to provide content interactive features that permit users to search by preferred keyword, annotate at will, dynamically hyperlink to alternative materials relative to the current context, and generate customised interactive assessment and feedback responses tailored to their immediate learning needs.

Unless we think about learning as a flexible process that takes into account place, time, and context, then it is likely that the new technologies will not enhance the learning experience. On the contrary, the absence of these factors may act as an impediment to the resultant depth and quality of learning. New models of learning are required that connect people to people and people to technology. With these goals in mind, this chapter will explore the issues related to current and future trends with a view to gaining an insight into the role and purpose of learning as derived from an understanding how the delivery of education may be shaped and refined by technology in the next decade. To this end, several research studies will be proposed that share a central aim of devising innovative teaching strategies and design techniques for delivering advanced learning solutions in a technologically driven future. A common thread underpinning the discussions to follow will be the potential for emerging technologies to improving the quality and effectiveness of learning.

Technology is Redefining Traditional Boundaries

The characteristics of the emerging technologies are such that they play a significant role in breaking down the mental barriers imposed by industrial centric thinking, which if sustained, will prove inadequate for resolving the demands that will be placed on education over the next decade. While some countries are experiencing a transitional stage of actively re-examining their education system, others are resisting change and react only to the pressures imposed by the demands made at the local level. It is significant that education in general is still described using the language and metaphors of the industrial era while school organisations continue to reflect the practices and beliefs of the industrial model. A failure to integrate information technology into the school curricula is often the result of a mismatch between the values of the school organisation and the values ascribed to the new technologies. However, change is inevitable, and a reluctance to accommodate the effects brought about by change could result in a formal education system that is out of step with the goals and needs of an information society. Only those educational institutions willing to take advantage of the opportunity to overcome and lead the processes of change will be prepared for the challenges of the future (McCune, 1991, p 3). However, there are signs that not all educational institutions are resisting change as indicated by their growing recognition of several worldwide phenomena: an information explosion of unprecedented magnitude; the rapid proliferation of new advanced technologies; significant changes in work practices; an increasingly fragile environment; the expanding interdependence of societies; and concerns about changes in established values and institutional practices.

As the restrictions of time and space become less problematic, new connections are being electronically forged from which the concepts of 'global villages' and 'networked communities' have gradually assumed prominence in learning design. Universities must acknowledge the realities of an electronically connected world otherwise they risk losing a unique opportunity to become the main drivers of a new dynamic vision for the future of learning. Just as the origins of the modern university arose out of the decisive changes that ultimately defined the existing boundaries of knowledge and learning, the new reality is that the old traditions are fast becoming obsolete due to the pressures information and communications technologies (ICT) are exerting on the role and purpose of learning.

Redefining the boundaries both within and outside the university sector will be the key to ensuring its relevance in the coming decade. At each of the local, national, and international levels, networked groups and organisations will assume greater prominence through inter-institutional cooperation and the interconnection of knowledge disciplines that will result from the convergence of highly advanced learning environments and 'just-in-time' access to vast repositories of networked resources. Collectively, these factors will lead to a radical rethink on the value of the relationships that are conducive to achieving genuine 'collaboration' as opposed to the longstanding industrial notion of 'competition'. In time, the traditional classroom may be replaced by 'virtual' communities of learning as new forms of delivery are devised and the purpose of learning is tested against the demands of the digital age. A number of significant trends support these claims (Siemens, 2004, p 1):

- many learners will move into a variety of unrelated careers over the course of their lifetime
- informal learning is now recognised as a significant aspect of the learning experience. Learning now occurs in a variety of ways – through communities of interest, personal networks, and work-related activities. Formal education is no longer the primary source of learning.
- learning is a continual process lasting a lifetime, so that learning and work related activities are no longer separate. For many individuals, they are the same.
- technology is altering (rewiring) our brains. The tools we use define and reshape our thinking.
- both organisations and the individual are now viewed as learning organisms. Increased attention to information/knowledge management highlights the need for a theoretical base on which to explain the link between individual and organised learning.
- many of the processes previously structured by learning theories (especially cognitive information processing and constructivism) are now supported by technology
- 'know-how' and 'know-what' are being supplemented with 'know-where' (an understanding of where to locate the knowledge needed to complete a task).

If the implications of technology-directed change are ignored, most notably in relation to learning, then the task of managing an exploding information and knowledge base will soon become insurmountable. As Hill and Hannafin (2001, p 1) observe, while the potential of technology for enhancing teaching and learning may be substantial, it may also be the case that accepted educational practices will not prepare graduates for the demands of an information driven society. Thus, it would seem prudent that in order to manage change, education must first identify the changes to teaching and learning that are now occurring in response to the rising influence of the digital world. Otherwise, it is likely that within the coming decade, the skills and thinking abilities currently taught to students will not support their career needs once they graduate. Some understanding of the issues and preferences that need to be addressed in relation to current and future graduates is provided in a report recently released by the Greater Expectations National Panel (2005, pp 1 - 3). The key findings and recommendations contained within the report are paraphrased as follows:

- The report calls for a dramatic reorganisation of undergraduate education to ensure that all college aspirants gain not just entry into college, but access to an education of lasting value. A new vision points to the kind of learning students will need to manage the challenges of a changing workplace in a complex, interconnected world.
- College attendance has grown so rapidly over the past four decades that seventy-five percent of high school graduates enter into postsecondary education within two years of receiving their diplomas. Students are flocking to college because the world is complex, turbulent, and more reliant on knowledge than ever before. But educational practices invented when higher education served only the few are increasingly disconnected from the needs of contemporary students. Even as college attendance is rising, the performance of too many students is faltering.
- Today's college students come from an extraordinarily diverse array of national, racial/ethnic, and socio-economic backgrounds. They bring great vitality to campus, but also place significant new demands on faculty knowledge and skills. Students also attend college today in very different ways. An increasing majority pursue a degree by attending two or more institutions. Part-time enrolment and distance learning are now common. Many students navigate this new terrain without clear direction or educational maps, collecting credits haphazardly as they go.

- Many students and parents see college primarily as the springboard to employment; they want job-related courses. Policy makers view college as a spur to regional economic growth, and they urge highly targeted workforce development. Business leaders seek graduates who can think analytically, communicate effectively, and solve problems in collaboration with diverse groups of colleagues, clients, or customers. Faculty members want students to develop sophisticated intellectual skills and to learn about science, society, the arts, and human culture. For the higher education community as a whole, college is a time when faculty and students can explore important issues in ways that respect a variety of viewpoints and deepen understanding.
- Many college students now juggle multiple demands, including an increased financial burden, full- or part-time employment, and family obligations. Students typically spend less than half the time on their studies that faculty expect. All these conditions complicate efforts to achieve greater expectations for aspiring college graduates - especially if these new realities are not taken into account in a comprehensive reform of undergraduate education. The key to successful reform is a clear focus on the kinds of learning that students need for a complex world.
- Students will continue to pursue different specialisations in college. Across all fields, the panel calls for higher education to help college students become intentional learners who can adapt to new environments, integrate knowledge from different sources, and continue learning throughout their lives. To thrive in a complex world, intentional learners should also be:
    - empowered through the mastery of intellectual and practical skills
    - informed by knowledge about the natural and social worlds and about forms of inquiry that are fundamental to these studies
    - responsible for their personal actions and for civic values.

A review of the current research literature reveals that within the Australian context, technology is changing at such an accelerated rate it is difficult to comprehend the full extent of the possibilities that will emerge as a result. The consensus is that the student of the future must develop a broad knowledge base and prepare to be flexible in all their endeavours. Students will need to absorb new concepts and technologies quickly and understand that without the skills to learn they will not be equipped to compete in a complex digital world. The graduate of the future cannot afford to focus only on one discipline without a good understanding of at least one other discipline. Thus, part of the new flexibility will be to undertake cross-discipline research and studies. Preferably, future graduates will need to acquire a balanced mix of several disciplines all of which require a technological mindset. Teaching must therefore move away from core disciplines and faculties, and embrace an interdisciplinary model. As a start, the most optimal strategy is for educators to encourage students to apply a lifelong approach to all their learning and research activities. Increasingly, Australian tertiary institutions permit students to undertake hybrid degrees as research expands into cross-disciplinary research and studies. In effect, as students seek to gain access to academics from a number of campuses, the notion of competing universities will become obsolete. In summary, as they progress through grades K-12 and then onto the undergraduate years, and at successively more challenging levels, students should learn to:

- effectively communicate orally, visually, in writing, and in a second language
- understand and employ quantitative and qualitative analysis to solve problems
- interpret and evaluate information from a variety of sources
- understand and work within complex systems and with diverse groups
- demonstrate intellectual agility and the ability to manage change
- transform information into knowledge and knowledge into judgment and action.

Technology is Transforming the Role and Purpose of Learning

The rapid acceptance of the Internet, combined with the inexorable World Wide Web led revolution in information distribution has given rise to new, previously unknown dimensions in human communications and expression that directly challenge accepted cultural and institutional boundaries. Moreover, the convergence between computers and communications has created ‘virtual’ communities and organisations in all fields of endeavour made possible due to the removal of the age-old barriers of time and distance. In the past, these barriers precluded collaboration on a wide range of tasks and activities. Because these restrictions are no longer a factor, it has become feasible for students and teachers from all over the world to ‘meet’, collaborate, and exchange views. However, the impact of the recent developments on the way humans interact, construct and apply knowledge using ICT is at present unknown, particularly in relation to education. What is known is that students can be taught to be competent in the use nonlinear forms of digitised text and images that encourage the application of visual literacy skills and permit interactive authoring. Static print formats and passive absorption of knowledge can be replaced with the provision of multiple connections to electronic information augmented by active participation in the construction of

knowledge. To date, educators have acquired little more than a brief insight into the enormous potential of technology as an aid to learning.

Even though fifteen years have passed, Healy (1991, pp 52-3) proposed that if students are to experience the type of meaningful learning that will enable them to manage the challenges of the information age, then three convergent elements are necessary. That is, meaningful learning occurs at the point where developmental readiness, curiosity, and new subject matter combine to create previously unrecognised learning experiences. However, the task of bringing all three elements together to produce quality learning is not always a straightforward process. This is because the culture of many organisations and homes are characterised by fast-paced lifestyles combined with an increasing desire for instant, visual gratification, which to some extent is attributable to a growing need to cope with rapid technological change. Healy further warned that these new cultural 'norms' may in effect impede meaningful learning as indicated by shorter attention spans, an inability to express ideas verbally, a reduced capacity to reason analytically, and an absence of transferable problem solving skills.

If no attempt is made to address the potential barriers to learning noted above it will become increasingly difficult, if not impossible, to equip students with the skills required for managing the demands of the digital age. The successful transition from formal education to coping with the demands of a fast changing future remains largely contingent upon ensuring students are equipped with the 'traditional' skills of higher order thinking, critical analysis, problem-solving, research, communication and writing. Equally important, is the need for skills that are best developed through teamwork: group presentation, negotiation and conflict resolution, the provision and acceptance of feedback, active listening, cross-cultural communication, and last but not least, time and project management. What I am alluding to here is the educational significance and value of collaborative learning environments. The acquisition of thinking skills and the conversion of information into knowledge are not isolated processes. Many factors must contribute to the creation of learning environments in which the requisite skills of an information age may be cultivated. Often the outcome is the result of group dynamics forming an interactive synergy in which the whole becomes more than the sum of the parts. Given the complexity of the task, how can educators begin to teach students the skills that are relevant to a digital world? The short answer is that the level of competency and complexity required is such that learners must also acquire information processing and knowledge creation skills.

Managing an Expanding Body of Knowledge

As the new computer and communications technologies become more sophisticated and enhance the processes by which information can be manipulated and distributed, our understanding of knowledge is constantly being transformed and redescribed. The problems and possibilities that emerge whenever information is applied to divergent knowledge domains are highly varied and unpredictable. The inevitable outcome of these complex processes is increasing quantities of information and knowledge produced at rates that are impossible for the human mind to comprehend. In the face of rapidly expanding networks of readily accessible information, the implications for sustaining productive management and critical inquiry should not be ignored.

Then there is also the blurring of boundaries between discipline areas to consider. As the quantum of available information expands, newer, more diverse fields of knowledge are being defined and redefined, making it difficult to preserve existing boundaries and avoid further diversification and division. An increase in the number of speciality disciplines reduces the learner's capacity to grasp the broader conceptual underpinnings that thread throughout all areas of knowledge. The effective and creative management of an exponentially expanding knowledge base requires the strategic application of higher order thinking skills combined with a need to remember that each area of knowledge is in fact an integral part of a broader epistemological whole.

If university graduates are to cope with future skill demands and work practices, they must understand knowledge is constantly subject to change. The only constant is change itself. It is also vital that teachers encourage students to develop advanced levels of proficiency in problem-solving and critical analysis skills. Otherwise, their ability to derive new or useful knowledge from information (knowledge construction) is adversely limited. Any increase in the volume of available information diminishes the capacity to discern fact from fiction, useful information from useless information, and to convert quality information into

meaningful knowledge. To have any chance of success in achieving complex levels of critical awareness, not only must learners apply higher order cognitive skills to enable the collection, management and analysis of data and information (information processing), but systems thinking and metacognition skills must also be mastered in ways that enhance the effective management of information. Thus, it is increasingly essential learners develop a heightened awareness of the many complex and multi-faceted issues that will be encountered during the course of their life. As a useful starting point, Schuur (2003, pp 3 and 7) outlines the design of learning environments for the future and provides a vision of ICT based learning by raising a series of discussion points aimed at promoting greater awareness of the issues involved:

- eLearning should offer possibilities for ordering and classifying the most important information and knowledge and make it accessible both technically and through the use of mental schemas
- in the age of networking, community networks are crucial. Given that a network consists of nodes and connections, eLearning should focus on strengthening the competencies of the individual and on developing connections between individuals (communication).
- although learning is important in terms of content, the focus of design should also be on the development of processes in learning delivery and on managing the complexities of the system
- new learning paradigms should be defined and adopted where learning systems are not restricted to existing learning philosophies and become relevant to a networked society
- eLearning environments should fulfil the needs of the user. Often a simple resource can be more effective than a well-composed, complete and complex learning environment, and
- evaluation of eLearning environments must be a continuous iterative process, and should focus more on the criteria of the user, than on design, functionality, or cost benefit.

Accommodating the Needs of Learners

The increasing presence of ubiquitous, flexible technologies has led to new complex interactions between the technology-based classroom activities of today's youth and their out of school, post school experiences. Where young people are concerned, the new technologies constitute a natural part of the environment. As they grow into adulthood, they will naturally strive to extend the boundaries of the available digital innovations and associated activities, which could for example extend to self-directed learning. In the process, it is likely that innovations in information and communication technologies will continue to be adapted and refined to support the complex, learning activities of diverse and widely distributed networks of online users (Candy, 2004, p 234). Thus, designers of learning environments must distinguish between the information-age mindset that has become more common amongst students growing up in a globally connected, digitally defined information culture, and the more prevalent industrial mode of thinking.

In his examination of current generational uses of information and communication technologies, Candy (2004, p 232) concludes that an unexpected yet fundamental reconceptualisation of the purpose of learning has emerged over recent years. The extent of this shift is such that it represents a marked transformation in the learning expectations of young people, which is partly attributable to the fact that they are viewed as the most innovative exploiters of the new mediums, and partly because they will become the next generation of self-directed adult learners. The Millennials (approximate birth years 1976 to 2000) for example, have grown up in a world where computers, cell phones, and cable television are a normal part of everyday life. They are inundated with information from a multitude of sources, and are capable of using a wide variety of media and devices to communicate, learn, and to be entertained. The most favoured methods are those that permit instantaneous, concurrent communication with multiple people regardless of geographic boundaries. Millennials are also a genuinely interactive generation (Mask, 2002, pp 3 – 4) in that virtual chat is used to communicate directly with their peers. Chat archives attest to the frequent and topical use of the Internet in late night, peer-to-peer conversations that are conducted within the boundaries of their own unique cultural framework (Carmean and Haefner, 2002, p 5). Today's students not only regularly engage in interactive communications, they expect it. As a result, they are exposed to an unprecedented flow of customs and ideas that is so unique it may represent a significant step in the development of human cognitive processing.

Success in meeting the needs of future learners requires radically new design methods and learning strategies. Such strategies may include the provision of content interactive features that offer for example: 'intelligent' search tools capable of meaningfully interpreting learner input; the ability to input and record ideas online that automatically trigger dedicated 'intelligent agents' designed to seek out and display supporting information; user (manual) and dynamically (automatic) generated supplementary materials

relative to students' progress, learning styles, and visual preferences; and the 'intelligent' display of customised content such as interactive assessments and constructive feedback tailored to students' immediate learning needs. For such interventions and strategies to be effective, university libraries must become a key source of learning materials in a vast, complex network of digitised information and resources. In effect, the fundamental nature of the online learning environment must undergo dramatic transformation, in particular the use of ICT, educational design, online learning strategies, and universal access to high quality learning resources irrespective of device, location and time.

If resolving the diverse needs and expectations outlined above seem difficult enough, then consider that the Internet may be cultivating a new type of user who is developing hitherto unexpected proficiencies in navigating electronic environments. Students of today display a remarkable adeptness in juggling text, popup-windows, and hyperlinks simultaneously – strong indicators of a transition in culture and cognition. Current generation students are developing the ability to operate in complex digital environments and no longer prefer to use the printed page. What at first may appear to be an inability to focus might in fact be a preference for working in digital environments. As alluded to earlier, we may be witnessing the emergence of new cognitive capabilities.

A thorough understanding of how students cope in complex information environments will inevitably trigger a major rethink on human computer interfaces (HCI), web layout design, and navigation strategies. The development of delivery systems and interfaces to support the changing needs of learners raises a number of fundamental research issues around the use of flexible, adaptive HCI based on natural forms of interaction and intelligent response mechanisms tailored to the expectations of both current and future generations. In practice, these preferences may compel educational designers to rethink their approach to learning design. We have known for some time that it is no longer adequate to convert printed materials into a digital format without further adjustment. Many users do not respond to the screen in the same way as they do to the printed page. Hence, particular emphasis is placed on screen layout, image position, animation, video, audio, colours, textures, font type, size and style. Page sequencing, navigation and hyperlink options are designed first to attract the learner's attention and second, as a prompt for locating and accessing information.

As an indication of what may be in store for learners, consider the work of the Columbia Centre for New Media, Teaching and Learning (CCNMTL) at Columbia University in New York. The CCNMTL is working closely with the university library to create electronic multimedia study environments (MSEs) on topics ranging from history to literature to sociology. Access to texts is enabled in digital form through MSEs and the Web. At present, searchable text for more than 10,000 books is available online. Faculty and students will are able to access fully digitised encyclopaedia entries, dictionaries and other reference sources such as text, video, and audio collections. These developments permit a 'search inside the book' approach to research and information gathering. For students of the future, search engines and hyperlinks will replace indexes and bibliographies while a 'search inside the book' technology will replace concordances. These transmutations from print-based to digital-based methods are clearly one step removed from delivering 'just-in-time', 'on-the-fly', and incremental learning environments. The notion of a 'borderless learning environment' is becoming a reality.

The Effects of Technological Change

Assumptions, Issues and Challenges

The computer should no longer be viewed just as an analytical device: it is also a gateway to a vast global storehouse of information and teaching resources. The strength of the web is that it is both desirable and feasible to access information and deliver engaging learning environments anywhere, anytime. Using the right technology, traditionally separate nodes of information can be interlinked in highly imaginative and creative ways. For example, learning objects (to be described later) hold the potential to extend the learning experience beyond accepted epistemological boundaries as delineated by established disciplines and specialist subject areas. By designing learning environments that assist learners to connect and reconnect new insights to multiple contexts, it may be possible to enhance their capacity to learn. The vision of a distributed network system of learning resources can be extended to include the delivery of exactly the right content, at the right time, in the right amount of detail, and via the right device to match the specific needs of individual learners. The possibilities are endless.

The assumption (some would say the problem) that has prevailed whenever a new technology is introduced whether it be television, hypertext, hypermedia, multi-media, presentation slides, interactive video or even the web, has been the continual reliance on a transmissionist pedagogy. Still today, we are witnessing the unconscious transference of the same approach to the often-misunderstood terms 'eLearning' and 'flexible learning'. Compounding the confusion even further, are the many attempts to introduce collaborative learning environments intended to emphasise constructivist principles using online discussion boards and chat lines. What is overlooked in many instances is that the transmissionist model prevails while the transference model fails to be fully realised. The irony of a lack of comprehension of what the new technologies afford is that for many decades a well-known example of transference learning has been readily available. It is generally referred to as the 'OxBridge' (Oxford/Cambridge) tutorial model.

While 'technically' students may be ready to engage in the digital world, can we be sure they are adequately prepared for learning in the electronic environment? Using the Internet as a mode for delivering teaching does not necessarily translate to quality learning outcomes (let alone improve learning outcomes). As Taylor (2002, p 11) reminds us, there are many factors to consider:

> In efforts to determine an appropriate approach to online teaching and learning, there is a need to acknowledge the importance of the complex interplay of different epistemologies, modes of thinking and associated types of subject matter in different academic disciplines, different educational objectives for a course of study, and not least, the extant levels of expertise of the student target audience.
>
> With any form of information or knowledge, providing students with access to meaningful content does not guarantee learning, a factor frequently overlooked by developers of WWW based learning materials. What is also important to learning are the levels of learner engagement (Oliver, Omari and Herrington (1998, p 121).

The key to implementing the type of changes necessary for success in delivering quality learning during the coming decade is the need to undo the thinking of the past. A good start, is a planned holistic approach to curriculum design that:

- recognises a larger scale of commitment is required to ensuring the overall quality of teaching resources and learning outcomes are not compromised
- reappraises the nature of 'what is taught' and 'why it is taught'. Teaching materials continue to be delivered using traditional design approaches without recognising that the new technologies have opened up new insights into learning design.
- questions the goals of education and what students are expected to learn by the time they graduate. There is a clear need to prepare graduates for a highly complex, more dynamic future than many of us have experienced. This can be achieved by placing greater emphasis on information and knowledge management, problem solving and analysis skills, and cultivating a lifelong approach to learning.

The challenge for lecturers and content developers is to construct environments that are concurrently learning centred, content centred, community centred, and assessment centred. There is no single, correct medium for delivering eLearning, nor is there a set of formulaic specifications that dictates the kind of interaction most conducive to learning in all domains for all learners. Rather, lecturers must develop their eLearning skills so that they can respond to student and curriculum needs by developing a wide range of activities that are adaptable to the diverse variety of student needs. Table 1 illustrates how the affordances of these emerging technologies can be directed to create environments that support "how people learn" (Anderson, 2004, p 54).

"How people learn" framework (Bransford et al.)	**Affordances of the current Web**	**Affordances of the Emerging Semantic Web**
Learner centred	Capacity to support individualised and community centred learning activities.	Content that changes in response to individualised and group learner models
Knowledge centred	Direct access to vast libraries of content and learning activities organised from a variety of discipline perspectives	Agents for selecting, personalising, and reusing content

"How people learn" framework (Bransford et al.)	**Affordances of the current Web**	**Affordances of the Emerging Semantic Web**
Community centred	Asynchronous and synchronous; collaborative and individual interactions in many formats	Agents for translating, reformatting, time shifting, monitoring, and summarising community interactions
Assessment centred	Shifted multiple time and place opportunities for formative and summative assessment by self, peers, and teachers	Agents for assessing, critiquing, and providing "just in time feedback"

Table 1 - Affordances of the network environment and the attributes of "How people learn."

High on the list of priorities for any educational institution aspiring to promote innovative teaching practices should be a comprehensive research plan for realising the potential advantages of seamlessly blending the known modes of learning with information and communications technologies (ICT) to deliver flexible learning solutions. To this end, the essential focus of all ICT related research is to identify and explore the educational benefits that can be derived by applying advanced learning techniques, methodologies and pedagogical innovations to the complex task of delivering personalised learning environments tailored to the specific needs of all individuals. The development of online delivery systems that support flexible learning options inevitably raises a number of crucial research issues. The first (noted beforehand) applies to the design, development and use of flexible, adaptive human computer interfaces (HCI). To be effective, such interfaces must not only interact with and respond directly to learners' needs, but also intuitively and cost effectively align with the diverse preferences and requirements of lecturers, students, and institutions alike. Then there are the recent innovations aimed at enabling ubiquitous access to learning through the use of portable devices such as laptops and personal digital assistants (PDAs) that further engender issues arising from: the educational value of synchronous and asynchronous interactions; the efficient storage and appropriate display of learning resources to suit all screen sizes; and, the complexities of interface design and performance efficiency. Alongside these complex issues are the broader questions of accepted standards and specifications to permit automatic transference and interoperability of solutions across all delivery platforms regardless of the learner's location and preferred method of access. Most important however, is the need to ensure that the inherent design structures supporting advanced delivery systems at best align with, but preferably exceed proven best practices in ICT supported learning.

Another major challenge for educationalists is to design and deliver innovative solutions that represent and facilitate navigation of complex knowledge structures. In addition, advanced learning design methodologies must be devised that employ emerging technologies to support the refinement of the higher order cognitive skills of analysis, problem-solving, conceptual thinking, and metacognition (which is dependent on tacit, experiential knowledge). Such skills will be highly valued by individuals, organisations, and society in general. However, proficiency in the application of higher order cognitive competencies to the creative construction of knowledge extends well beyond the transmission of prescribed knowledge and related prerequisite skills. This in turn raises the many latent and complex problems of how to model and structure knowledge and how to predetermine the relationships that connect knowledge structures to selected teaching content while taking into account their contextual relevance and innate cultural biases. Resolving such issues requires an unreserved commitment to: identifying the key properties and relationships that serve to model the structure of targeted knowledge domains to provide effective navigational strategies; devising 'intelligent' methods for managing and transferring knowledge skills; and, the strategic deployment of teaching resources through the dynamic generation and contextualisation of the content to be displayed within a given learning environment. With these goals in mind, the ideal learning environment should also assist learners to derive answers to the broad level 'meta-questions' of: how do I know what I need to learn?; how do I get there?; how am I progressing?; are my goals still relevant?; what are the best learning models for me?; and, what are the effects of social change, culture, and market needs on my personal learning goals? The social element of collaborative learning also poses significant challenges to ICT supported systems, in particular environments in which the relationship between collaboration and learning is crucial. As many educators would agree, there are many instances where learning is a collaborative activity, involving active interchange of ideas and views between individuals within a community and between communities, or

amongst individuals and other communities. Some communities may confine their focus to the knowledge and skills of a specific profession or others may span several disciplines united by a common purpose (operating for example, as a multi-disciplinary networked partnership). Alternatively, a networked community may be structured as a single organisation or span many organisations. Given the complexities and issues raised thus far, delivery systems designed for ICT supported collaborative learning must also:

- enable productive social interactions in a virtual world
- identify and provide for the needs of communities of interest established within broader networks of learners
- define learners' roles and accommodate both individual and group preferences and behaviours
- manage the creation and transfer of knowledge within virtual learning communities, and,
- establish the ownership of knowledge generated by individual learners and groups participating within and across networked communities.

Regardless of what the future holds, we must not lose sight of the fact that ready access to information is not the same as learning, more specifically the depth of learning that takes advantage of the immediacy of face-to-face and ICT mediated communications. In a similar way, the design of most web-based learning solutions has amounted to little more than a digitised replication of traditional publishing formats that rely on fixed modes of delivery. As a result, the learning effectiveness has been open to question and criticism. In a climate where is generally recognised that learning design is shifting towards learner-centric, responsive, and highly flexible modes of delivery, the current use of the web as a learning tool is no longer suited to meeting students' needs. What is required for a technology driven future are delivery platforms that permit content developers to create environments designed to work the way a learner thinks. This model of online learning demands a radically different approach to web design, navigation and interaction that in turn requires a comprehensive reappraisal of content delivery platform functionality. Underpinning this same model is the notion of applying an 'all sizes possible' approach to replace the current pedagogically restrictive 'one size fits all' delivery platforms.

The Key Research Questions

In light of the issues outlined to this point, practical solutions that address the needs of future graduates should be guided by observing the following research questions:

- how to manage the dynamic generation of teaching content so that it aligns with the individual's learning needs and provides interactive learning?
- how to automate the profiling of individual learners' preferences, taking into account their existing and developing skills, prior knowledge, experiences, culture, needs, assumptions, and expectations in the context of learning?
- how to construct 'intelligent' guidance and response methods that assist learners to achieve their personal goals?
- how to impart the higher order thinking skills and knowledge that foster lifelong learning along with a strong emphasis on tacit knowledge and knowledge construction skills?
- how to identify and provide automated support for the needs of networked 'communities of learning' within any given population of learners?
- how to design delivery systems and services that support learning on demand in a way that affords flexible mobility and seamlessly integrates with the personal circumstances of individuals? and,
- how to demonstrate the benefits of advanced ICT solutions (and their advantages over conventional teaching methods) to all key participants, including the learner, tutor/lecturer, and the educational provider?

In line with the need to resolve the identified issues as directed by the preceding research questions, the research study should aim to:

- determine how to enhance the learning process using more autonomous and individualised learning strategies
- develop high quality learning materials by increasing the level of interactivity and directing didactic approaches towards facilitating the needs of individual learners
- provide access to interactive, 'intelligently' managed learning resources and delivery services
- develop new insights into how emerging technologies can support innovative learning strategies and further inspire the development of new technologies, and,
- redefine the role and purpose of learning in the context of a technologically driven future.

All research studies to emerge from this initial exploration of future issues and needs should also aim to evaluate the benefits of new learning methodologies as compared to traditional teaching practices (whether

direct or online). The analysis process should therefore consider the organisational aspects of the solution, the potential barriers to acceptance, as well as the implications for learners and related educational support structures. In other words, research studies that focus on the application of ICT to learning design should demonstrate the learning advantages for all affiliates including the learner, the lecturer/tutor, and the learning institution. The benefits to the learner to be considered should include: an increased capacity to acquire and generate new knowledge; identifiable social benefits in terms of collaborative and team participation skills; enhanced personal motivational and lifelong learning skills; and advanced learning and problem-solving strategies. For the lecturer/tutor the main benefits should include the capacity to access high quality resources for reuse in other learning contexts; provision of automated assessment and feedback tools; the assistance of intelligent software agents that respond directly to learners' immediate needs and deliver customised assemblies of teaching resources tailored to diverse learning styles and generational preferences. The benefits to the learning institution apply to a measurable increase in learners' knowledge and their eventual suitability for employment; calculable cost advantages and procedural efficiencies; the contributions made to achieving organisational goals; and, the status derived through the delivery of innovative teaching solutions in relation to world best practice. The learning design models proposed later in this chapter begin to address many of the research issues raised so far.

Strategies for Designing Advanced Learning Environments

As touched on several times, the new technologies are changing not only what students learn, but also how they learn. That is, curricula must eventually align with the demands of the digital age by focusing less on 'knowing facts' and more on 'strategies for learning that which is not known' (in the sense that learning must be given greater priority over the skill of memorising facts). Success in acquiring such skills requires that learners are provided the freedom and the resources that will motivate them to be active and independent. In this model, the teacher serves as a facilitator or consultant, not as the sole provider of information. Furthermore, access to education should not be confined to schools, technical colleges, and universities. Learning opportunities reside not just within these institutions, but also in homes, community centres, art galleries, museums, and workplaces. Perhaps the direction that needs to be considered is less about choice between institutions, and more about choice in what students learn, and how they prefer to learn. Already there are many educational institutions that advocate a 'learning to learn' agenda that encourages students to be more involved in making decisions about the way they learn (Leadbeater, 2004, p 6). Such shifts in thinking naturally introduce the notion of advanced learning environments in which students are enabled to learn in a way that best matches their individual characteristics and needs.

No longer is it enough to offer information online. Ultimately, researchers will need to devise new learning technologies attuned to the needs of current and future generations of learners. Over the coming decade, new methods for the design and delivery of challenging, highly interactive learning environments are crucial to the success of learning. As made evident thus far, already today's youth show signs of a readiness to be much more creative with computers than many educators recognise. Therefore, it is argued that new learning design models are required that demonstrate how personal needs and preferences can be taken into account within a framework of universal relevance and benefit to divergent generational groups. Leadbeater (2004, p 6) suggests it may be useful to think about learning from another perspective. He points out that today's youth are far more avid and aware than previous generations. They have developed an entrenched sub-culture that is bound to exert an effect on how they perceive learning and education should be provided. Many secondary school age youth now possess mobile phones, which provide instant access to services twenty-four hours, seven days a week, thus creating an expectation that all services should be made available in a similar manner. They have also become accustomed to a world in which they can search for, download and share digital music on the Internet. Their inventiveness and desire for innovative thinking is evidenced in the way they have developed uses for new technologies that were not anticipated by the original designers. A simple but notable example is the pervasive use of SMS messaging, which has led to the invention of a shorthand language for quickly conveying large amounts of information. Hence, the common use of the term 'thumb people' that refers primarily to SMS messages and more generally, to those using the new technologies (Candy, 2004, p 233). What is now needed are the hardware and software solutions that will permit learners to be fully immersed in seeking out and creating new knowledge.

One of the strongest arguments for promoting advanced learning environments lies in the potential to improve and even revolutionise teaching and learning. However, the evidence to date does not support this

view as effective forward thinking methods for delivering teaching and learning using ICT have not yet materialised. As a result, a great deal of scepticism surrounds the promises of a revolutionary effect of the new technologies on learning. Of the many approaches available today, learning object technology offers the most potential (OECD, 2005, pp 109 and 221)

Learning objects are the 'technology-in-waiting' that could 'enable' the models described (later) in this chapter to be put into practice. The inherent attributes of learning objects are such that they permit notions of 'systems-based' design models comprised of multiple nested levels, all interrelated through complex networks of connections that provide the means for all participants to contribute to the learning process (for each of the individual, group, and the institutional levels). In this model, it is the 'negotiation of new meanings' rather than 'decision-making' that leads to the emergence of new knowledge. Thus, 'vertical' hierarchies of knowledge transference can be complemented by 'horizontal', knowledge-sharing communities of interest and practice (Wenger, 2005, p 31) where all 'constituent components' (learners, academics, administrators) benefit. Weblogs for example, illustrate this model of learning interactivity. Communities of practice are in effect 'networked learning systems' representing a systemic approach to learning design and delivery that 'connects' all participants and learning system components across multiple levels of practice and inquiry. In brief, the key principles that apply to systems theory include:

- all systems are nested within other systems that interact in a network fashion, or more simply, networks within networks that have no hierarchical structure, only larger or smaller systems networked with other systems.
- nature does not reveal the existence of independent components, but instead appears as a complex web of relationships between the various parts of a unified whole
- all systems are integrated wholes whose properties cannot be reduced to those of the smaller parts. Systemic properties are destroyed when a system is reduced to its component parts.
- the essential or 'systemic' properties of the whole arise from the 'organising relations' of the parts (Sheldrake, 1988, p 314)
- the simple laws that govern the various elements of a system also act to generate behaviour that extends far beyond their individual capacities (Holland, 1998, p 5)
- all system levels represent differing levels of complexity where each level exhibits unique phenomena known as 'emergent' properties
- properties of emergence displayed at one level, do not exist at lower system levels (Capra, 1996, p 37).

The use of digitised learning objects has the capacity to enable learners to explore information and knowledge in ways that until now have not been feasible. Rather than divide the curriculum into bounded disciplines and subject areas, the focus of learning could be directed toward identifying and exploring the rich connections that thread throughout different knowledge domains utilising key concepts, themes, and issues. In this model, concepts that are not introduced until university level could be accessed and made available to learners of all age groups (Resnick, 2002, p 36). As indicated earlier, it should not be assumed that learning takes place within set age groups and confined to timetabled schedules. The new digital technologies permit convenient access to learning from all locations and throughout all stages of life. Thus, the traditional classroom as we know it needs to be fundamentally reorganised. Students should not be grouped according to age, but instead all age groups could be encouraged to work together on team projects thus empowering them to learn from one another and to teach each other. Learners could also be given opportunities to collaborate over extended periods thereby enabling them to explore ideas in more meaningful ways that are relevant to their personal experiences and needs. As the full potential of the new technologies are gradually realised by greater numbers of individuals and institutions, new learning opportunities will surface, prompting the emergence of virtual networked communities or "knowledge building communities" in which individuals located anywhere in the world collaborate and learn.

In practice, learning objects foreshadow the phasing out of the traditional design model where the individual academic is responsible for the majority of the work (and where courses are generally created new rather than complied from existing resources). Instead, the lecturer and content designer can work in partnership to assemble a course largely or entirely from third-party materials, or even adopt a complete third party course (OECD, 2005, p 221). This brief introduction into learning objects underpins all of proposed learning models to be described in the next section. Note also, that the flexible delivery approach applies to all the models described thereafter.

Exploring the Possibilities - Future Trends

With careful planning, it is feasible to structure learning environments that address many of the issues outlined to this point. Future learning models that potentially support research studies aimed at devising advanced learning environments include applications such as: Flexible Learning; Intelligent Learning Support Systems; Individualisation / Personalisation of Learning; Networked Learning Communities; Contextualised Learning; and, Systems Design; each of which could inspire the development of new learning technologies. The models described in the following pages provide some indication of the research to naturally arise from the preceding discussions. Note however, the models as outlined are not exclusively independent. Elements of each may be extracted and recombined in a number of potentially useful ways to form new models more suited to addressing the required learning needs.

Flexible Delivery

The key to visualising a model of learning suited to the needs of learners now and in the future is to examine the implications and benefits of a flexible delivery approach to learning. In general terms, most definitions of flexible delivery encompass dimensions of time (learning opportunities are available anytime) and space (access to learning is provided anywhere from the main campus to many locations around the world). Some definitions may incorporate various mixes of information and communications technologies combined with one or more modes of learning (face-to-face, audio and video resources, print-based material, CD-ROM and other computer-based resources, and online). In essence, most descriptions infer a delivery approach that provides for all possible choices of all available modes, across all courses, for all students. In determining the implications of establishing an effective flexible delivery programme, a useful starting point is to consider the key elements of a working definition of flexible delivery. Two broad descriptions of flexible teaching and learning provide useful directions:

> Flexibility in learning is not an end in itself but a means of achieving core educational objectives, and ultimately producing more skilled and satisfied students and teachers. It should never be simply equated with on-line learning (Reid, 2002, p 9).

> Quality teaching is about finding the right balance between face-to-face communications, interaction via other media and individual work so that each learning experience is maximised. Flexible delivery of teaching is not intended to cut costs but to improve access and the quality of the learning experience for students (DEST, 2002, p 7).

From a teaching and learning perspective, a personal definition of flexible delivery that aspires to accommodate the individual needs of learners is expressed as follows:

> The capacity to deliver any mode of learning, at any time, to any place, in any combination, and permit learners to seamlessly move from any mode to another. All modes must include provision for multiple learning style preferences and permit lecturers to design and deliver teaching solutions using the full spectrum of learning theory principles ranging from behaviourist through to individual constructivist.

Three interdependent aspects are alluded to in the above: flexible delivery, flexible teaching and flexible learning. As a way of highlighting the need to examine what each aspect means in actual practice, it is useful to unpack their essential distinguishing features:

Flexible delivery is relatively easy to explain. The term ‘relative’ is used to highlight the fact that once we enter into an explanation of the remaining two terms it will become evident that not only are all three interrelated, but the level of complexity and the costs required to facilitate flexible teaching and flexible learning escalate considerably as we delve further into what is potentially feasible. An institution’s ability to provide flexible delivery options is dependent on its administrative and technical infrastructure and its preferred modes of delivery. In general, the flexible delivery options provided will encompass face-to-face, paper-based and online distance education, open learning, all electronic modes including CDROM, videoconference, digitised library resources, discussion boards, whiteboards, personal digital assistants (PDAs) and wireless mobile devices.

Flexible teaching requires lecturers and tutors to be proficient in the design, provision, assessment and evaluation of learning materials for all available modes (or combinations thereof) of teaching as described above. The task of the online course designer and the lecturer is to choose, adapt, and perfect (through

feedback, assessment, and reflection) educational activities that maximize the affordances of the chosen technologies. In doing so, they create learning-, knowledge-, assessment-, and community-centred educational experiences aimed at delivering quality learning to all students.

Flexible learning is highly dependent on the available flexible delivery and flexible teaching provisions. As learner's demands for customisation and personalisation increases so too does the requirement to configure a more sophisticated technical infrastructure and either equip or enable lecturing staff to access increasingly higher levels of technical expertise and support. The level of complexity is further compounded by the learner's need for multi-modal delivery options that suit their changing circumstances, individual preferences, skill levels, work and social demands, and access opportunities all of which define their personal learning environment. For learning to be effective, students will need to plan and manage their time and possess the skills required to adapt to any mode of delivery and teaching without difficulty. In this model, students may choose to learn for many reasons: degree course; skills training/competency; professional development; research; collaborative networks (communities of practice / interest); just-in-time learning; on-the-fly learning; and incremental learning.

The ideal flexible delivery system will be based on a plan that flows from a full understanding of two fundamentals. That is, all teaching and learning systems should be built on the needs of students, and the learning outcomes of the course or programme (the knowledge, skills, and attributes that students need). In addition, it should not be assumed that flexible delivery is the same as 'distance education' or even online learning. Flexible learning subsumes all other delivery modes and should enable students to make choices as to how and when to learn in accordance with their unique circumstances and needs.

In devising an educationally sound flexible delivery model, teaching will involve facilitating learning rather than transmitting content. Learning environments will need to be designed so that they are highly customised and interactive, and challenge students to research, evaluate and apply information to solve complex problems. This means in effect, that academics involved in a flexible delivery programme need to be proficient in the use and application of a range of ICT skills including productivity tools, university delivery systems and the use of design tools for developing and delivering teaching units online. For this to occur, staff also need to work as members of a team to facilitate and support student learning. Thus, for learning to be effective, lecturing staff must share a common understanding of what flexible delivery entails and possess the skills, knowledge, and attitudes needed to support the agreed vision.

Intelligent Learning Support Systems

The higher order thinking skills of problem solving and critical analysis require the ability to: see parts/wholes in relationship to each other; balance the processes of both analysis and synthesis; abstract and manage complex issues; adapt to real world change; and, command multiple strategies for solving problems. A learning model designed to cultivate such skills must first take into account a range of factors that include: the difficulty of interpreting interconnectedness or interdependency in complex systems; the problems of deriving meaning or managing the loss of meaning from a surfeit of information; tracking patterns of connection across divergent systems; and recognising properties of emergence in complex systems that are often difficult to interpret using simple trend analysis and future projection techniques (National Board of Employment, Education and Training, 1996, p 75).

The strategic use of digital technologies has enhanced our capacity to explore the inner workings of natural and human phenomena in ways that until now have not been possible. As a result, not only has there been a noticeable shift in what students learn, but also how they learn. To keep pace with these changes, the task of devising advanced models of learning must embody the development of highly innovative learning techniques, design methodologies and pedagogical strategies that are supported by 'intelligent' software agents. Other strategies that might provide new insights into educational design include the adaptation of games theory principles to enhance student interaction and motivation to engage in teaching content that place less emphasis on memorising facts and more on utilising cognitive strategies for discovering knowledge; and extending the support structures for teaching and learning to utilise digital libraries that deliver more than just content and instead assist the learner to organise, reflect, analyse and synthesise new knowledge. Learning models designed to teach abstract thinking and conceptual understanding could also be supported by 'intelligent' response mechanisms or agents, interfaces and portals that are designed to

accommodate the diverse mental models or cognitive maps that learners draw on in their search for understanding in the construction of knowledge; and, rather than segment the curriculum into bounded disciplines and subject areas, the focus should be directed towards 'intelligently' enabling identification and exploration of the rich connections that thread throughout all knowledge domains.

Individualisation / Personalisation of Learning

Many educators now recognise that the current use of the web is no longer adequate for meeting the individual needs of all learners. In response, electronically mediated learning is moving towards learner-centric, 'intelligently' responsive, highly flexible modes of delivery. The design and development of online delivery solutions that assist learners to cultivate knowledge creation and thinking skills requires several interrelated areas of research: an analysis of the properties, modelling structures and representation of knowledge domains to facilitate strategic navigation using multiple learning pathways; methods for managing and transferring tacit and cognitive knowledge; and the contextualisation of information and knowledge to prompt user identification of the interrelationships that elicit metacognitive thinking. Just as important, the tacit knowledge skills of predictive analysis, creative thinking, entrepreneurial acumen, and the ability to move from problem solving to opportunity identification and acquisition, have not as yet, been comprehensively studied.

A parallel area of research applies to students' learning styles and their emerging cognitive skills. That is, to have any noticeable effect on learning outcomes, attention should be directed toward identifying and profiling learner behaviours to provide a useful benchmark for continuously monitoring, and refining the dynamic display of content based on individual attitudes to learning, technology and display preferences, communication skills, prior knowledge, and personal values. The tools and techniques that may assist to facilitate these goals include: the automation generation and updating of a learner profile utilising a software agent that monitors learner's progress and stores individual learning preferences; the individuation of learning styles and methodologies taking into account the cultural and generational aspects of learner preferences; and, the use of "intelligent' agents designed to provide feedback and interactive responses through the automatic selection and dynamic assembly of contextually relevant learning resources (as informed by the learner profile agent).

The advent of technically sophisticated delivery platforms such as content management systems offer the promise of accessing the myriad sources of digitised teaching resources located throughout the world, thus raising the possibility of 'borderless' learning environments. A networked system of learning resources could be configured to deliver content that extends the learning pathways to subject areas and disciplines that under normal circumstances may never be explored. Add to this vision the capacity for emerging technologies such as learning objects to deliver teaching materials directly matched to individual learning style preferences and the significance of undertaking research in this area is manifestly evident.

Networked Learning Communities

Learning is a collaborative activity involving active dialogue both within and between communities. The rapid acceptance of the Internet combined with the current revolution in information distribution spawned by the convergence of computers and communications technologies has given rise to the concept of 'virtual', networked communities. Composed of modular, interchangeable components, ICT supports the construction of flexible, networked, dynamic solutions for engaging human discourse and interaction. That is, ICT technologically empowers individuals and communities by facilitating the efficient distribution of information and knowledge to geographically dispersed audiences whilst enabling widespread contribution to decision-making activities. ICT also emulates how people function: integrating information, text, voice, images, and video in all their various formats, while providing a cost effective and efficient means of engaging in anywhere, anytime dialogue and collaboration. Students and teachers located around the world can now form communities of interest to discuss and exchange views. These same principles can also be applied to the design of electronic learning environments.

A networked learning environment can assist learners (individuals and groups) to seek greater value from their learning experiences. The fundamental components are people, places and ideas connected through a combination of design and random chance to inspire creative thinking and innovation. In turn, such

interactions motivate learners to understand that a networked learning environment has the capacity to cultivate a climate in which new processes and systems may evolve or even spontaneously surface on occasion. Learning ensues when people interact with new ideas and concepts. Nonetheless, enhanced learning will not be the only outcome. Learning networks may also provide the catalyst to redefine what schools, colleges, and ultimately, what universities will do in the future. Economic and technological factors aside, signs of the complex issues to arise out of the changes described above are becoming evident, much of which will impact on the role of education and how learning will be delivered in the future.

Contextualised Learning

As individuals encounter information from different perspectives and backgrounds, and for different purposes, so too does meaning change. The initial meaning of a picture, report, or graph is continually redefined according to pre-existing actions and events as well as the unique intentions and perceptions of different individuals. Once contextualised meaning has been established, information becomes organised as knowledge operating in a larger context of meaning encompassing many related patterns, biases, and interpretations. These ambiguities raise the perplexing question of how learning can be supported in complex information systems given that the meaning of the available information can change from user to user and in relation to the goals of individual learners.

The design of online environments using learning object technology provides much more than just a new way of organising content and the information it contains. It also has the potential to influence the meaning of the information provided. However, for learning to be effective, teaching resources must be contextualised in a way that governs the intended relevance and meaning and assists to fulfil the expected learning outcomes. An effective pedagogical strategy for influencing learner understanding is to apply selected teaching resources to varying contexts. Although a resource may be inherently meaningless, it is the act of embedding that same resource in alternative contexts that reveals new insights and meanings. As new data and information are presented to the learner, the relationships formed through past experiences are challenged and subsequently realigned, revealing new insights and unknown aspects that previously were not apparent. In this sense, context and content are interdependent. This notion raises deeper questions about knowledge for the act of knowing depends upon the meaningful organisation of data and information. Thus, new methods of organisation imply existing forms of knowledge must change in the process.

By manipulating context, it is not difficult to imagine learning activities where the right technology could assist students to be critical users of information. Learning objects afford the capacity to impose patterns of organisation on existing information and to facilitate the learner's ability to imagine new patterns of organisation through the formation of meaningful relationships. That is, whenever information is processed in some way, and reordered, reorganised, or re-categorised, new relationships and new meanings are formed. Learning objects could also be used to teach students multiple strategies for problem solving and information retrieval. Alternatively, learning objects may be programmed to assemble dynamically in ways that assist lecturers and students alike to focus on the critical processes of interpreting and organising information as opposed to the traditional tasks of acquiring and memorising facts. Lecturers therefore, can encourage learners to explore the interconnections between theory, content, and context. Thus, regardless of the learning activity, there will always remain a crucial role for the lecturer or tutor to provide continual guidance and support.

A Systems Design Model

An alternative understanding of how information is organised or structured to infer meaning can be derived by determining the existing associations and/or interrelationships between collections and patterns of information (using principles of systems theory as applied to systems, sub-systems, and networked interrelationships). The application of systems principles to learning design provides the means to identify and define conceptual relationships, which in turn has the effect of fostering deeper insights into the information presented to the learner. These principles present a plausible theoretical foundation upon which a new, technologically driven model of learning may be established. Each principle holds the key to devising a range of strategies for manipulating learning objects that may assist learners to develop a broader, more holistic perspective as they work on the given course content. Whether applied separately or integrated as appropriate, a systems approach offers new opportunities to design online teaching environments that

connect with other subject areas and even knowledge disciplines in ways that learners may otherwise not have considered. The benefit of course, is to provide the student increased exposure to new knowledge relationships and in so doing, gradually expand their conceptual schema into wider, more diverse cognitive perspectives. Thus, the significance of learning object technology is again underscored by the fact that it affords considerable flexibility in the design of electronic learning environments.

Given the potential for applying a more inclusive, systems design model, the educational implications of interconnected learning objects are profound. Beyond permitting students to proceed through electronic materials using prescribed pathways, they can focus their investigations on the questions that are informed by their own unique interests and experiences. Students are also able to organise and progress through the learning materials in ways that make sense to them while developing and comprehending their own heuristics. As new understandings emerge, they discuss their findings with their lecturer/tutor and fellow peers. This flexible 'connectivist' approach to inquiry and discussion has many advantages, not the least of which is a capacity to accommodate diverse personal or cultural learning styles. Notwithstanding the potential merits of this design approach, it is imperative to consider the learner's capacity to undertake independent learning. That is, in order to manage high levels of autonomy and faculty, learners must be experienced in identifying the relationships that connect the available data and information and to apply the insights gained to the construction of models and strategies that will assist them to become adept constructors of knowledge.

Final Thoughts: Toward a New Perspective on Learning Design

Although the design strategies proposed above are speculative at this stage, some direction on the future of learning may be gained from current developments. Computer technologies have reached a point where they provide exciting, motivating environments in which students can direct their own learning strategies. As part of their everyday activities, students now use computers to communicate with a diverse audience of teachers, peers, family, and contacts located anywhere throughout the world, all of which encourage the development of collaborative learning skills. The interactive nature of computers means that lecturers can pay more attention to facilitating learning rather than sustain the more traditional expository teaching approach. Of greater significance, the technological changes that are occurring throughout the world at present mean that the hierarchical, pre-structured learning models of the past can soon be replaced with more innovative design strategies. For example, learning environments could be designed to prompt students to reflect on their thinking. Learners could also be encouraged to solve problems for themselves or with their peers, explore alternative solutions to problems, carry out additional research, analyse and plan their work, and evaluate their own progress. From a social standpoint, they need to participate in group-based activities, articulate their ideas to their lecturers and fellow students, and work cooperatively with team members located anywhere around the globe.

With careful planning and judicious choice of design strategy, technology-based teaching and learning can be effective. Students can learn from interaction with multimedia and from collaboration with other students. Because of the improved instructional strategies and enhanced materials facilitated by the various mediums, students are afforded an opportunity to learn more effectively and in many cases, more efficiently. While not denying that some media will suit some students and not others, the provision of alternative media has the potential to match varying learning styles. Thus, the task of choosing a technology becomes one of comparing it with the identified learning needs. Moreover, any concern about choice should be less about the age of a given technology and more about its usefulness as an educational tool. Once freed from the question of which form of technology is superior to another, lecturers can concentrate their efforts towards discovering the most effective means of using technology to facilitate learning. In essence, we should ensure the computer, its software programmes, and most important, the lecturer's instructional approaches function in unison as a bridge between the knowledge to be learned and the learner's need to learn. The technology must also be accessible to the learner and yet remain true to the knowledge it presents. In this sense therefore, it is not appropriate to conclude that the computer, in and of itself, is the only agent of change.

Despite their growing complexity and sophistication, educational technologies alone cannot influence student learning. Computers enable the storage and delivery of information and instructions, but in themselves do not determine the quality of learning. Most research evidence to date suggests that computer-based teaching and learning are not always more effective than traditional teaching and learning practices.

However, comparing the classroom with a computer screen is not a straightforward task. The educational value of computers cannot simply be measured by the manner in which content is displayed onscreen as ultimately, it is the innate processes of teaching and learning that will determine the quality of the educational outcomes. Educational technologies, in whatever form they are applied, are tools that require meticulous, skilled planning. Furthermore, while acknowledging the power of technology, it is essential to be aware of the need to develop a complex matrix of integrated learning tools and teaching strategies based on a proven framework of learning theories, pedagogical practices, and evaluation techniques. Perhaps (and only) then, is it possible to achieve what most educators would regard as an 'enhanced learning outcome' in a future that will be marked by extraordinary technological change.

Given the tenor of the viewpoints raised in this chapter, I re-emphasise that all research studies that focus on learning in the future should demonstrate a clear pedagogical and technological capacity to interweave all aspects of the learning process within a loosely structured (flexible) environment where the focus is on the learning needs of the individual. That is, addressing the quality and effectiveness of learning are not the only factors to consider. Future learning environments, regardless of delivery mode, should be inherently flexible to facilitate support for the divergent needs of current, past, and future generations. These needs apply to the distinctly divergent attributes of; technology use and skills; influences, preferences, needs and aspirations; values, perceptions and attitudes; and, current and future concerns. Emphasis must also be given to identifying and allowing for variations in learner behaviours, inter-personal communication skills, and preferred learning styles relative to all the available modes of learning. In other words, the full potential of educational technology cannot be realized without a detailed analysis of the factors that influence the interplay between technology, communication, media, human behaviour, and cognitive development. In essence, the design of advanced learning environments requires an evolving programme of research, design, experimentation, and development augmented by distinctly identifiable, yet highly interconnected and adaptable forms of delivery, support and resources. In light of the aims, issues, questions, and perspectives raised to this point, the specific outcomes to be derived from further studies are summarised to include:

- an informed analysis of future skills and knowledge expectations to derive a clearer understanding of the changing purpose and role of learning
- a radical reappraisal and redefinition of the roles of all participants engaged in electronic learning environments based on pedagogical paradigms that align with new innovations and directions in learning design
- facilitating learning methodologies that incorporate the principles of multiple intelligences and learning styles theory through the automation and application of learner profiles that manage individualised learning solutions based on technology use, preferences, and attitudes
- an understanding of the motivational factors that influence learners as applied to the generational and cultural distinctions that determine their unique preferences, attitudes, and goals
- the evaluation and development of interactive learning experiences through research on 'intelligent' agent technology
- identifying the unique characteristics of known knowledge domains and their interrelationships, and finally,
- all knowledge gained should build on established practices in the use of ICT-supported learning.

In the final analysis, it is argued that learning in the future should aim to support the lifelong learning and personal development needs of all individuals through the provision of 'intelligently' supported (both the lecturer/tutor and software agents) and self-directed learning environments characterised by flexible, ubiquitous, mobile delivery at any time and to any place. A focus on flexible, individualised learning redirects research towards the design and creation of new models of learning while recognising the emergent need for learners to develop knowledge skills that are in constantly tune with evolving perspectives on the purpose of learning. Finally, in light of the many complexities and issues covered in this chapter, it is fitting the last words are given to David Ward (2000, p 5):

> …the survivors will be those institutions of higher learning with the courage to re-imagine and reinvent themselves and so find a place of intellectual and societal relevance on the beachhead of the twenty-first century.

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