50. Augmenting the Power of Networked Learning Communities

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Abstract

Alongside the rapid acceptance of global networked technologies and the omnipresent revolution in information distribution, Information and Communications Technologies (ICT) have spawned hitherto unknown dimensions in human communications and expression that challenge the accepted cultural, educational, and institutional boundaries. Most notably, the convergence of computers and communication technologies has produced 'virtual' networked communities and organisations in many fields of endeavour. A beneficial outcome has been the abolition of time and distance as barriers to worldwide collaboration on a broad range of tasks and activities. As a result, teachers and students located anywhere throughout the globe are now able to 'meet', collaborate, and exchange views at will. The impact of recent technological developments on the way humans interact, construct and apply knowledge is at present unknown, particularly in relation to education. It is known however, that in addition to using printed text, many students are highly proficient in exploiting nonlinear electronic media (hypermedia), and applying interactive annotation and authoring tools as a means of exchanging ideas and generating new knowledge. Learners are now afforded an opportunity to move beyond the linear structure of print and engage in learning activities where they are no longer confined to the passive role of memorisation. To date, educators have grasped little more than a partial insight into the enormous potential of online networking as a productive tool for enhancing learning through collaboration and discussion. The significance of this new potential is accentuated by a marked absence of a theoretical foundation for the design of web-based solutions that may serve as a catalyst for advancing creative learning communities.

Removing the Barriers to Creative Learning

Over the course of the coming decade, technology will play a major role in breaking down the mental barriers imposed by industrial centric thinking, which if sustained, could prove inadequate for resolving the educational demands that will emerge as the twenty-first century unfolds. Until now, technology has been applied in an industrial-centric mode, which increasingly, will be at odds with the needs of a modern world. 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 exerted at the local level. It is significant that education in general is still described using the language and metaphors of the industrial era, and 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 of 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). There are signs however, 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 growing interdependence of societies; and concerns about unexpected shifts in established values and institutional practices.

As the restrictions of time and space recede, new connections are being electronically forged out of which the concepts of 'global villages' and 'networked communities' are gradually assuming prominence in online learning design. Universities must acknowledge the new realities, 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 present day boundaries of

knowledge and learning, the new reality is that the old traditions are becoming obsolete as information and communications technologies (ICT) influence the nature and purpose of learning.
Redefining the institutional barriers that exist both within and outside the university sector will be the key to ensuring the future relevance of great universities. At the local, national, and international levels, networked groups and organisations will assume greater prominence through inter-institutional cooperation and the convergence of knowledge boundaries as a result of the interplay between 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 the notion of genuine 'collaboration' as opposed to the longstanding industrial notion of 'competition'. 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 information revolution. 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 practice, 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 the organisation and the individual are now viewed as learning organisms. Increased attention to information and 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) are now supported by technology
- 'know-how' and 'know-what' are being supplemented with 'know-where' (an understanding of where to locate the knowledge required to complete a task).

If the implications of technology-directed change are ignored, especially in relation to learning, then the task of managing an exploding information and knowledge base will soon become unmanageable. As Hill and Hannafin (2001, p 1) observe, while the potential of today's technologies for enhancing teaching and learning may be substantial, it may also be the case that current educational practices will not prepare graduates for the demands of an information driven economy. Thus, it would seem prudent that in order to manage the effects of change, all current teaching and learning practices must be exposed to continual questioning and refinement. Otherwise, it is likely that within the coming decade, the skills and thinking abilities currently taught to students will not meet their future career needs.

Technology is Transforming the Role and Purpose of Learning

The rapid acceptance of the Internet, combined with the World Wide Web inspired revolution in ICT has created new, previously unknown dimensions in human communications and expression that directly challenge our cultural and institutional boundaries. Moreover, the convergence between computers and communications has created 'virtual' communities and organisations in all fields of endeavour. In the past, the barriers of time and space have 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.

The effect of technology on the way humans interact, construct and apply knowledge is not yet fully understood particularly in relation to how such skills should be taught using ICT. There is some evidence however, to suggest that students can achieve competency in the use of nonlinear forms of digitised text and images that encourage the use visual literacy skills and permit interactive authoring. Linear print formats and a reliance on the passive absorption of knowledge have been replaced by a need to form multiple connections to related information and active participation in the construction of knowledge. Until now, educators have acquired little more than a brief insight into the enormous potential of technology as an aid to learning.

If students are to experience the type of meaningful learning that will enable them to meet the challenges of the information age, three convergent elements are needed. That is, meaningful learning occurs at the point where developmental readiness, curiosity, and subject matter combine to form new learning opportunities. However, the task of bringing all three factors together to produce quality learning is not always a straightforward process.

This is because the culture of many organisations and homes of today 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. These new cultural 'norms' may in effect, act as impediments to meaningful learning as indicated by shorter attention spans, an inability to express ideas verbally, a reduced capacity to reason analytically, and a lack of transferable problem solving skills (Healy, 1991, pp 1 - 2).

If no attempt is made to address the learning deficiencies noted above it will become increasingly difficult if not impossible, to equip students with the skills required for success in a global economy. The transition from formal education to coping with the demands of a fast changing future will for the most part remain contingent upon ensuring students are equipped with the 'traditional' skills of critical thinking, rational analysis, problem-solving, research, communication and writing. Equally important, will be the need for skills that are best developed through teamwork, group presentation, negotiation, and conflict resolution. Such skills are further refined through the provision and acceptance of feedback, active listening, cross-cultural communication, and the application of proven time and project management practices. What is being alluded to here is the educational significance and value of collaborative learning where it is recognised that the acquisition of thinking skills and the conversion of information into knowledge are not isolated cognitive processes. Many factors must converge to create a learning environment in which team-based skills may be cultivated. Often, group dynamics produce an interactive synergy from which the whole becomes more than the sum of the parts. Given the complexity of the task, how can educators begin to teach thinking skills to our students? The short answer is that the level of competency and complexity required is such that it will be necessary for learners to apply information processing skills in addition to the traditional and collaborative skills referred to above.

Meaningful Connections and the Context of Learning

Simply providing access to information without the benefit of equipping students with the cognitive skills to convert information into knowledge will not equip graduates for the challenges to come. Learners need to reflect on new material, discuss their tentative understandings with others, actively search for additional information in ways that may further illuminate or strengthen their understanding and ultimately, build conceptual connections to their existing cognitive framework (Brown & Thompson, 1997, p 75). Thus, the importance of understanding the relationship between data (facts), information and knowledge is highlighted as supported by the work of Megarry (1989, p 50):

> Knowledge is not merely a collection of facts. Although we may be able to memorise isolated undigested facts for short while at least, meaningful learning demands that we internalise the information: we break it down, digest it and locate it in our pre-existing, highly complex web of interconnected knowledge and ideas, building fresh links and restructuring old ones.

Megarry's insights introduce a number of critical issues that require further thought. If future graduates are to be proficient in creating new knowledge, then a clear understanding of the relationship between data, information and knowledge is critical. An examination of how these relationships are derived reveals a useful theoretical framework for describing the process of converting data into information and then into knowledge (the process of knowledge conversion or knowledge construction). This framework comprises three distinct stages of a knowledge construction continuum:

- data that is collected and stored
- information that is extracted from organised data
- knowledge that is construed from information (knowledge construction) - by implication, this latter stage involves the cognitive processes of learning and conceptual understanding.

At the level of what we perceive as reality, data at its most fundamental level is derived through the human senses. It may be recorded on paper or magnetic tape, or stored in computer systems as digitised bits. In all cases, data represents a fact or statement of an event that is devoid of explicit relationships to other data or facts and is therefore symbolic as illustrated in the statement, "it is raining". Information relates to a description, definition, or perspective of data that has been identified as useful in some way to be useful. It provides answers to the 'what', 'who', 'when', and 'where' questions and embodies the notion of relationship such as cause and effect for example. Building on the previous example, we can say that, "the temperature dropped fifteen degrees and then it started raining". At the next level of "making sense" of data is interpretation, which leads to the creation of knowledge due to 'higher levels' of cognitive processing and adaptation. Knowledge requires the

application of strategy, practice, and method to discern the pattern of relationships that serve to make sense of the given information. To derive knowledge requires the application of data and information to determine the answers to the 'how' questions. Once discerned, cognitive patterns provide a high level of predictability as to what can be described or what will happen next. Consider for example the statement "if the humidity is very high and the temperature drops substantially, then the atmosphere is unable to hold moisture, thus resulting in rain". From this statement, we can see that understanding is a cognitive and analytical process in which previously held knowledge is integrated with new information and then synthesised to generate additional knowledge. In other words, it provides an appreciation of the 'why' factor as derived from the available data, information, knowledge and prior understandings.

Given there are important distinctions to be made between the concepts of data, information and knowledge, then the next step is to determine how to manage information (information literacy), and most critically how information literacy skills can be applied to the task of converting information into knowledge. However, competence in information literacy does not necessarily lead to a capacity to understand what information is and how that understanding can be applied in productive and creative ways. If for example, students are to be equipped with the skills to discriminate accurate information from inaccurate information then a deeper understanding of what information is and how meaning is derived must accompany the process. In essence, successful participation the new economy prescribes a need for competency in information processing skills at many levels of complexity and sophistication. However, before any attempt is made to produce graduates suited to the new skill demands, several additional requirements must be addressed. As will be explained, high levels of competency in information processing skills requires learning models that are modelled on the concept of networked systems.

The Learning Value of Connections

In light of the discussions thus far, it is argued that technology has created a level of complexity that extends well beyond the explanatory scope of the traditional reductionist approach to deriving knowledge. It is further argued that to understand, interpret, synthesise, and derive new knowledge, a more complete, networked systems design model is required to manage the vast quantities of information that will be produced over the next decade. All this poses a serious challenge in that it compels us to acknowledge one crucial question: how can we even begin to manage such complex issues?

When considered in isolation, concepts may be viewed as nodes in an interconnected, networked system. Representing knowledge as an integrated network of concepts and ideas as opposed to a pre-structured sequence of facts and information assists students to identify meaningful relationships and work through the connections to derive new insights and understandings. In other words, a networked structure of concepts permits students to conduct critical interrogations to derive new conceptual understandings as each new concept is mastered. While on occasion, there may be a need to impose a more sequential or hierarchical structure to comply with predefined learning outcomes, some allowance can be given to providing flexibility to satisfy individual learning preferences where students are encouraged to reconstruct the network (or part of it) so that it aligns more closely with their own cognitive framework. In addition, it is possible to provide a networked structure of data and information in which predefined nodes are connected within a given website that is also interconnected with many other websites. A potentially useful advantage of this design approach is that access to connected information and related media could further prompt students to conceptualise and formulate a non-linear or multidimensional exploration of the presented teaching content (Harris, 2000, pp 36 - 7). To illustrate the holistic, 'greater than the whole' effect that can emerge from connected networks, consider the following account from Bloom (1995, pp 140 - 1) who describes the connectionist intelligence of bees:

> It is possible for a community of bees to solve problems that could not be tackled by a single bee. An experiment was undertaken where sugar water was placed at the exit of a hive, which over time was moved a few inches, then a few feet, then a few feet more. Each time the bowl was moved, the distance was increased by a precise increment. Initially, the bees followed the movements of the dish but after a few days the bees would fly from the hive and cluster on a spot where the dish had not been placed – the site where the insects anticipated exactly where the bowl would be placed next. In each instance their calculations were precisely on target. Even though the brain of a bee is insubstantial – a slender thread of neural fibre barely capable of any process we would regard as intelligence, the bees had worked as a mass brain.

> The strength of a networked intelligence is not dependent on the limited capacities of any one of its many nodes, but is the result of a 'connectionist intelligence' – the problem solving ability of the network itself. That is, a single bee did not solve the problem of where the bowl would be placed next, but resulted from the interconnected mass of bee's brains. The social network manages to solve problems in the world around it by the same principle that underlies the net. Connections the systems finds useful are strengthened, connections that prove useless are weakened.

Given the potential for enabling a holistic design approach, the educational implications for networked learning are profound. Beyond allowing students to proceed through a website by taking prescribed pathways in a linear, regulated pace (the once-heralded attributes of computer-aided instruction), students can instead focus their investigations on questions that are informed by their own unique interests and experiences. In this way, they are afforded the opportunity to organise and proceed through the displayed learning materials in ways that make sense to them, developing and comprehending their own heuristics. As new understandings emerge, they can discuss their findings with their tutor and their fellow peers at will. This flexible 'connectivist' approach to inquiry and discussion has many advantages, not the least of which is the capacity to accommodate diverse personal and cultural learning styles. However, in order to manage a high level of autonomy and faculty, learners must be experienced in the explicit use of tutorials, guidelines, indexes, and supporting materials designed to provide a basic grasp of what the teaching materials contain along with the basic models and strategies to be learned and adapted as they gradually become confident, autonomous learners.

A Shift to an Economy of Ideas

The emergence of globally connected technologies and related systems has compelled many countries to re-examine their key economic and cultural drivers. The role of knowledge, ideas, creativity and learning are pivotal factors in this crucial re-evaluation process and point to a much more complex picture of the future, one in which education will need to be redefined and if needed, repurposed. Furthermore, the characteristics of a post-industrial society are not always easily recognisable as a major shift in thinking in terms of the economic and social factors that affect our daily lives. These changes are forcing all knowledge domains to re-think the basic tenets and frameworks that describe how all systems (natural and artificial) function and how such changes can be managed. In the Western world, these changes are more accurately viewed as a shift from an economy of materials to an economy of ideas. Take for example the Apple iPod, which has rapidly become an omnipresent gadget that is assembled in China from parts made throughout Asia. Apple Computers originated the idea and the design capability, and now reaps eighty percent of the profit although it is not involved in the actual production of the iPod.

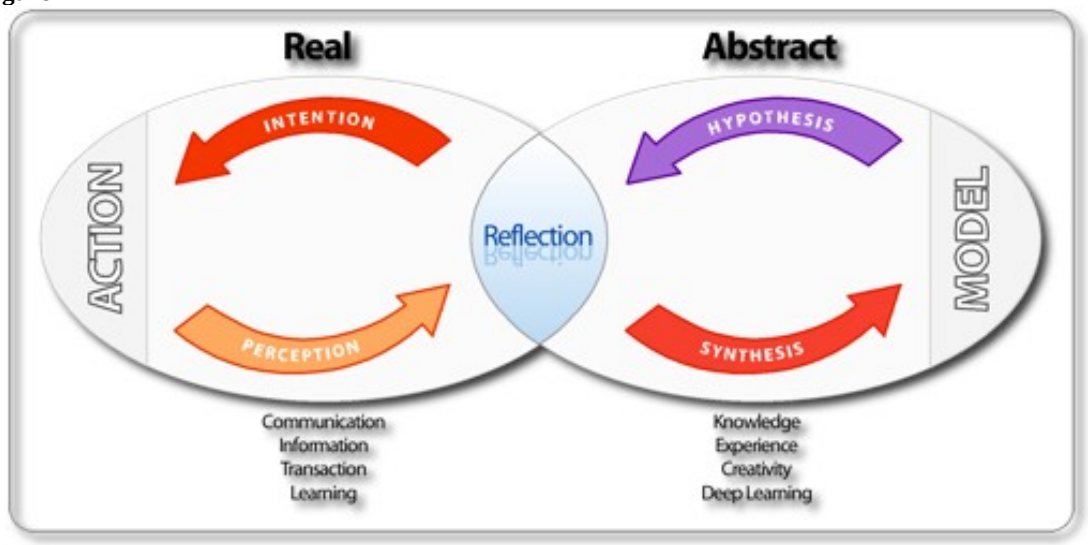
The iPod is one example of a shift to an economy of ideas. The work of Florida (2003) highlights several economic and social trends that were analysed to determine the demographics of occupations in the United States (US). His findings, along with other related factors were then compared to economic growth. The study identified the role of what he termed the 'Creative Classes' that are indicative of the high growth economies in the US. These groups were not so much described as a class in their own right, but the fact that they displayed a coherence and recognition of shared values revealed a new aggregation of occupations that are exerting a major influence on economic growth.

What are the implications of this new creative society particularly in relation to what is known (knowledge) that is highly prized as a resource yet is also subject to a rapidly shrinking half-life? Then there is issue of the increasing value placed on the knowledge that is leveraged from the knowledge of others (knowledge leverage) and most valued, the ideas produced (creativity) as a result. In understanding the nature of the changes these issues raise both in terms of the role of learning and the skills required to meet the challenges and opportunities that may emerge, it is important to understand the main characteristics and dynamics of what ideas are and how they are generated.

Ideas are formed in people's minds as abstract concepts. They are transferred to other people by direct verbal communication or through the transmission of recorded information that attempts to describe an idea in a way that is consistent with the cognitive frameworks of other individuals and therefore, can be readily assimilated as an abstract concept in their minds. In the past, the primary mode of delivering learning has been the transmission of information. However, it is now understood that the processes of communication and the assimilation of new concepts into our existing cognitive frameworks are critical to the success of learning and as Figure 1 illustrates, the interplay of both results in the construction of new knowledge. The key to understanding how ideas are generated is found in the 'real' and 'abstract' loops as shown in Figure 1. Both loops are necessary to support the generation of new ideas and to leverage existing knowledge. In this more complete

(holistic) model, the concept of deep learning is introduced which in turn forms the basis for the development of a new approach to support and leverage both the real and abstract loops in an economy of ideas. As Weigel (2002, p 65) puts it, "the knowledge room model of depth education makes it possible to configure every course as an incubator for the development of robust communities of inquiry"

Figure 1



To have any real effect in terms of creativity and productive application, an 'economy of ideas' must extend beyond the level of the individual. An economy of ideas is enhanced when the goal of knowledge leveraging and creativity is placed in the context of innovation. For the purpose of this discussion, innovation as described as the systemic application of knowledge and creativity in the real world and requires both loops as represented in Figure 1. To date, effective systems and approaches have been devised for the 'real' loop but very little attention has been given to the technologies, systems and approaches that support the interaction of the two loops where the process of reflection takes place. Beyond addressing the need to support the individual's capacity to develop their own unique world of ideas, is the issue of individuals working together in sustainable collaborations and communities. This aspect of innovation systems is still being explored as new opportunities and frameworks for success emerge. The role of networked groups of individuals is crucial to innovative knowledge construction and once they become sustainable, such networks can be viewed as communities of practice (or inquiry or interest).

Traditionally, communities have been geographically dispersed and hence much of the study conducted in the area of group dynamics reflects this orientation. However, in recent years the emergence of non-spatial online communities of interest has gained prominence, most notably as the Internet increased its presence on a global scale. In our view, models and systems that support the approach outlined in Figure 1 that also take into account the concept of networked systems are crucial to establishing sustainable, innovative communities. However, the difficulty in implementing a new vision of networked communities is that over last century the dominant model for business and community was aligned to an industrial framework where the need for consistent mass production was the primary focus of activity and the physical co-location of resources was viewed as a distinct advantage. In a similar manner, the industrial mindset significantly influenced the structure of educational institutions and the delivery of teaching and learning. If the goals of an economy of ideas are different from those of the last century, then it is important to ask how these goals differ, and based on that analysis, determine new models of learning that are conducive to facilitating creative communities of interest. This is where the concept of 'ecological communities' provide a useful direction.

Ecological Learning Environments and Self-Organising Networks

The term 'ecology' refers to an open, complex, adaptive system comprised of elements that are dynamic and interdependent. In nature, species exist in an ecological community as part of a rich network of connections, forming a local ecosystem that displays systemic properties (Lewin, 2001, p 198). Businesses and corporations

for example, now operate within rich networks of interactions, first by forming a community of interest at the local level, then larger communities at the national scale, leading onto broader communities at the global scale. The nature of these communities are such that the formal, static, linear thinking of the industrial era is now evolving into a dynamic, non-linear, multi-levelled, interconnected network of interactive relationships and activities. Unpredictability and chaotic disorder become an essential part of the learning process producing an 'eco-system' from which the properties of creativity and innovation naturally emerge. These same principles can be applied to the design of electronic learning environments.

An ecological learning environment can assist learners to seek greater value from their learning experiences. The fundamental ingredients are people, places and ideas connected through a loose combination of planned design and random chance to produce the conditions needed for inspiring creative thinking and innovation. In turn, the interactions that occur among all the components cultivate a climate in which new processes and systems may evolve or even arise spontaneously on occasion. Learners come to understand that learning ensues in networked community environments where people are encouraged to interact with new ideas and concepts. Nevertheless, learning is not the only outcome. Learning networks may also provide the catalyst to redefine what education, schooling, training, curriculum, instruction, teaching, evaluation, and ultimately, what universities do. However, to achieve any of these goals requires a willingness to question the assumptions that are enshrined in the current educational ideologies and to examine the purpose and aims of the social and organisational structures that support them. To be more specific, the nature of power, control, authority, responsibility and entitlement in learning must be transformed into a highly interactive, self-organising, networked ecosystem of individual learners, teachers, groups and organisations. In emphasising the importance of collaboration in forming the innate meanings that individuals develop over time, Campos (2004, p 7) writes:

> The *ecological constructivist perspective* suggests that the social environment and the individuals are part of a symbolic ecosystem which is the networked cognitive communication. Configurations of meanings (meanings upon logical structures) are shared and evolve in collaboration across time.

One factor that makes the concept of an ecological network of learners so powerful and adaptive to new environments is its diversity. Consider for example, the learning ecology that has formed around what is now called Web 2.0. First, consider that the web is much more than network of computers, it is a transformative medium that facilitates multiples intelligences (abstract, textual, visual, musical, social, and kinaesthetic) and individual learning styles. That is, the Web introduces for the first time the potential to match the medium with the specific needs of learners. The Web is also a medium that enables the many to leverage their relatively smaller individual efforts without being overwhelmed by the larger efforts of the few. Thus, the value of Internet-based communities of interest is in its untapped capacity to transform the nature and purpose of learning.

Now, consider the Web as comprising a vast number of 'authors' each of whom are members of separate interest groups, many of which embody a great deal of expertise in both written and tacit form. Given the vastness of the Web, it is relatively easy to find a niche community with the required expertise or perhaps a special interest group whose interests coincide with that of the learner. The diversity of input and comments adds texture to the area of knowledge under examination and enables the Web to be used in ways that were never intended by the original designers. In essence, the Web can be described as an ecological learning environment that is characterised as:

- a collection of interdependent and fluid (virtual) communities of interest
- a medium for cross pollinating ideas and knowledge
- constantly evolving and adapting to change and new ideas
- dynamic and self-organising

On the latter point, learning cannot be assumed to be a process that will automatically produce a positive outcome. Simply making large quantities of information and resources available online may in fact result in disorganised noise. What is required is akin to that which occurs in nature: coherent bits of information presented so that they self-organise into coherent clusters of related phenomena. However, the relationship between self-organisation in nature and the organisation of our individual thoughts is not the same. In the natural world organisation is causal, but in individuals, self-organisation is more complex in that a process of cognitive pattern recognition requires new connections to be formed amongst the available data and information. The key difference is that nature is not inherently organised but appears (on the surface) to display properties of organisation. Thus, nature is inherently chaotic, out of which order is formed. Self-organisation in learners

occurs whenever patterns of connection or organisation are either identified or created and then communicated to others. The process of creation is at one moment the process of internalising recognised order, and in the next, of passing the identified order onto the next person as experience. It is in this sense that the connections between disparate ideas and knowledge fields lead to the emergence of creative thinking and innovation.

Conclusion

The issues and factors touched on in this paper form only a small part of the picture that is now emerging. Consider also for example, how the ongoing global pressure for organisational and product innovation to gain international markets as well as to preserve domestic share has placed considerable emphasis on the value of intellectual development. This emphasis is not only directed towards the traditional preparatory education and training systems, but also through an ongoing process of lifelong learning that for many may extend across multiple career paths. Adding further pressure to the impending changes in learning patterns are the economic, ecological and cultural imperatives of the global economy that in turn are crucial in determining the overall quality and success of the lifelong learning experience. Acknowledgement of these additional factors not only provides the basis for a sound economic outcome, but also ensures sustainable practices in cultural, educational, governmental, and environmental management. Moreover, these same factors underpin the new knowledge-based paradigm where the fundamental principles and dynamics that strengthen competitive advantage no longer apply just to the provision of goods and services, but to the emergence of collaborative networks as the core activity affecting the knowledge creation process. Therefore, it is important educational institutions recognise the need for new forms of literacy based upon technological competence, information processing, and research skills, networked collaborations, and the creative application of abstract and conceptual thinking to resolve complex problems.

As the amount of available knowledge increases, so too will the need for information processing and collaborative skills. The era in which it was sufficient for people to possess minimal literacy and numeracy standards is drawing to an end. These skills alone will no longer ensure continued employment in the digital age. The significance of this observation is made more apparent when it is considered that the growth in available information that will create a demand for new skills and new literacies, which in turn will place new pressures to question the purpose of education and the methods employed to deliver quality learning. As the full potential of the new technologies are gradually realised by greater numbers of individuals and institutions, new learning opportunities will surface, enabling virtual networked communities of learners or "knowledge building communities" to form in which individuals located anywhere in the world collaborate and learn from one another. For these reasons, it is argued that new learning environments designed to accelerate communal inquiry will one day be highly valued.

The liberating power of information and communications technologies extends from their capacity to redefine the nature and purpose of the learning environment. However, technology alone cannot do this. Unless technology is intentionally coupled with reformed educational practice that acknowledges the primacy of the learner rather than the centrality of the institution and the lecturer, then its use will be limited. In turn, a shift in learning focus permits the lecturer to take on the role of facilitator of students' learning as opposed to remaining the sole repository and provider of knowledge. Unrestricted access to information technology provides an opportunity for lecturers to develop and devise learning experiences tuned to individual needs. Most significantly, it affords learners the opportunity to experience both independent and group learning where the emphasis is directed towards establishing connections between individuals, groups, and across knowledge domains. Innovation and creativity will naturally emerge in environments that encourage interconnected webs of peers, mentors, collaborators and learning communities formed around agreed topics of inquiry and interest. In essence, the power of technology lies in its capacity to enable individualised learning whilst encouraging participation in collaborative environments or communities of learners where learning is the focussed intention, not the incidental outcome. As of this point, we have provided little more than a brief synopsis of the strategies that will be needed to address the emerging learning imperatives. For now, the issues and needs raised in this paper underscore the diversity and complexity of establishing a theoretical framework that will inform the design of learning models aimed at meeting the needs of future graduates and ultimately, the broader societies in which we live.

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