Introduction to the Evolution of Teaching and Learning Paradigms

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Summary. The increasing popularity of the move to e-learning or web-based education throughout the world has not only accompanied advances in information technology, but has brought about a recognition of the importance of the need for teachers to keep pace with changes in teaching and learning in areas of organisation, curriculum, infrastructure and pedagogy. Constructivism has been an underlying pedagogy that has influenced education since the middle of the twentieth century and continues to form an important foundation for e-learning. It continues to guide the move to help students acquire the higher level cognitive abilities of comprehension, application, analysis, evaluation and hypothesis creation. This chapter provides a brief overview of the changes in teaching and learning including the latest ideas, theories and technologies being applied in web-based education world-wide.

1 Introduction

Evolution and change in information technology and educational technologies are important forces driving developments in education [1]. These changes have significant impacts on educators and developers. Claus Pahl illustrated the impact of change through emphasising the interrelationship of organisation, curriculum, infrastructure and pedagogy in the construction of the teaching and learning environment (TLE). Advances in cognitive sciences and education usually precede the development of the conceptual frameworks for learning support so staff involved in teaching and learning need to keep pace with changes in all four areas of the TLE and be able to adapt to the changes and to manage the changes.

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During the mid to late 1900s, Benjamin Bloom and his colleagues recognised that learning could be divided into three categories or domains (Bloom's taxonomy of learning behaviours); cognitive (knowledge), affective (attitude) and psychomotor (skills) [2–5]. For each of these domains there exists a hierarchy of learning behaviours starting from the ability of the student to acquire knowledge or recall information, ideas and principles, through to abilities to comprehend, apply, analyse, evaluate and finally create new structures, hypotheses, programs etc. Educators in the secondary (high school students) and tertiary (universities, colleges etc) sectors have had varying successes in helping students reach the higher levels of this hierarchy. There are still university courses where teaching and learning are largely teacher centred and reward knowledge acquisition and understanding with little opportunities for application and no opportunities for students to reach the higher levels of the cognitive processes. However, there has been an underlying pedagogy that has influenced education throughout the latter half of the twentieth century and guided the move to help students acquire these higher level cognitive abilities. This is constructivism.

Piaget recognised that education cannot succeed without recognising, using and extending the "authentic activity" with which a child is "endowed" [6]. He further acknowledged that schooling should be adapted to the child and in doing so educators should consider the psychological development of the child in the design of educational activities. Thus, Piaget was an early advocate of the constructivist pedagogy. In the constructivist view of learning, meaning that is constructed by an individual is dependent on the situation itself and the individual's purposes and active construction of meaning [7]. Constructivism recognises that prior experience has an influence on the way phenomena are perceived and interpreted. These authors recognised the importance of active construction of meaning on the part of the learner.

Hendry and King [8] have approached constructivism with a view to understanding the neurological processes that are occurring during learning. They view specific knowledge as specific spatio-temporal patterns of impulses and completion of a pattern of impulses knows, that is perceiving, ideating or reasoning. Along with Iran-Nejad [9] they interpret construction as the integration of patterns in a new form in the same region through synaptic growth. Simultaneous construction in various modality specific sensory areas was considered to be equivalent to Iran-Njad's [9] idea of dynamic self-regulation. Hence, to help young people construct knowledge the teacher must ascertain children's ideas evoked by various contexts [8, 10].

2 Chapters Included in this Book

This book on the evolution of teaching and learning paradigms in intelligent environment presents the latest ideas pertaining to educational pedagogy. The authors have recognised the role of constructivist thinking in teaching and learning plus the importance of providing a wide range of mental resources to encourage cognitive growth in students as recognised by Bereiter [11].

In their chapter on the influence of constructivist thinking in the design of e-learning, Nunes and McPherson emphasise that only with a clear sense of the theoretical foundations that underpin assumptions about learning and cognition, can an efficient online learning environment be appropriately designed. Technology should empower the learning process. It is important not to neglect educational issues during the systematic analysis and design of the technologies for specific learning purposes. Constructivism in online learning is not intuitive to either learners or tutors. Constructivist e-learning requires a set of information, communication and social skills that need to be acquired prior to engaging with online learning activities. Additionally, and during the delivery process, both tutors and learners need the support of adequate learning resources, designed explicitly according to a constructivist approach.

The chapter by Raymond Tedman, Heather Alexander and Robert Loudon illustrates this interaction between pedagogy and technology through a case study into the development of a new medical curriculum using Problem-Based Learning as an underpinning teaching/learning strategy. In this curriculum, the latest developments in constructivist learning guided the design and implementation of an online delivery system that emphasised staff–student interaction in teaching, learning, assessment and evaluation at a new medical school in Griffith University on the Gold Coast, Australia.

Hendry and King [8] believe that we need to modify our commonsense notion of communication as a transmission of knowledge to the relativity of evocation of knowledge. Knowledge is evoked in others through speech and writing and the meaning to words comes from the neural processes. The theory implies that within a classroom, with universal stimulus situations and given that children can have different ideational and logico-mathematical patterns, students might become interested or curious at different times and in various parts of a situation and exhibit different performance outcomes. This reinforces the importance of personalised learning ontology. The chapter on educational ontologies for personalised learning by Fok and IP addresses the issues and methodologies in the design and construction of education ontology and discusses the necessities and issues

of an education ontology that can help retrieving, organising and recommending educational resources for personalised learning.

The theme of personalised learning is further investigated in the chapter by Gutierrez and Pardo on sequencing in web-based education. These authors discuss the customising of learning material and activities to provide a personal environment for each learning activity. This means adapting the learning content, its sequencing and maybe some aspects of the learning process. This chapter presents several approaches to the problem of adaptive sequencing – sequencing of learning units so that it can be adapted to different users with different capabilities. The chapter also reviews initiatives in the field of standardisation of sequencing of web-based education. Two important problems are raised: Where to find good learning content and How to sequence to maximise learning?

Iran-Nejad [9] advocated a global restructuring strategy for education in order to prepare a generation of resourceful learners who can take advantage of the many sources that must contribute to learning simultaneously. Increasingly, there is a move towards using the advances in information technology to develop multi-user domains or MUDs to further extend and develop the neural and social aspects of learning that are important in education [12]. Throughout the secondary school years (students in the early to late teens) it is recognised that students process information and construct their understandings by being actively engaged in doing complex tasks. Today's "digital kids" are equally as comfortable with virtual, screen-to-screen relationships as they are with face-to-face relationships [13]. Electronic learning or e-learning is rapidly transforming the TLEs of tertiary education facilities, further moulding the educational pedagogy to match the virtual digital modes of communication favoured by teenagers during their secondary education. The chapter by Slator et al. traces the evolution of MUDs from simple meeting and discussion places to immersive virtual environments, further extending the view of Piaget that "schooling should be adapted to the child".

Debra Tedman has shown in her chapter, *The Development of an Approach to Learning within the Middle Schooling Paradigm*, how constructivist theories can be incorporated into middle schooling to emphasise the importance of affective domain as well as cognitive domain learning outcomes in young teenagers. She reinforces the need to develop teaching/learning strategies that take into consideration the abilities and learning styles of students and provides a case study demonstrating the use of thematic units whereby students investigate issues related to Science, Technology and Society.

Accompanying the expansion of e-learning in university as well as business environments, there has been a need to develop data mining techniques to extract information regarding student behaviour. The chapters by Castro

et al. and Vellido et al. review the current research and applications of data mining methods in e-learning. Castro et al. investigated the data mining methods used to classify e-learning problems, e.g. to detect irregular learning behaviours, to study learning system navigation and optimisation, to investigate clustering according to e-learning system usage and to improve systems' adaptability to students' requirements and capacities. Vellido et al. utilise data mining techniques for extracting knowledge from virtual campus data concerning students' system usage behaviour in order to study e-learning problems such as characterisation of atypical students' behaviour and prediction of students' performance. They presented a case study where a partially virtual campus offers postgraduate courses and continuous education to Latin-American students.

Data mining techniques are also being used in a web-based educational delivery system called AHA! (Adaptive Hypermedia Architecture). The chapter by Paul De Bra, Natalia Stash and David Smits, presents a case study of how authoring and management tools have been used to assist teachers and students maximise the benefits of e-learning.

Riitta Penttinen and Sari Minkkinen have reviewed the gap between technology and pedagogy, emphasising the importance of understanding pedagogy in developing processes on how to teach and learn technology. They illustrated the dilemmas faced by staff in attempting to understand the language used in the fields of technology versus educational pedagogy in their attempts to improve the teaching and learning of technology.

3 Conclusion

A good understanding of the theoretical foundations to learning and cognition is vital to the development of an efficient online learning environment. This chapter introduces the concept of change or evolution in teaching and learning, which is explored in this book, by emphasizing that educational issues must underlie the systematic analysis and design of technologies for specific learning purposes. E-learning permits the elaboration of personalised learning to help students develop higher level cognitive abilities. To achieve this, there has been a recognition of the need to accompany the expansion of e-learning with an increasing emphasis on developing data mining techniques to help teachers investigate irregular learning behaviours plus improve the e-learning systems' adaptability to students' requirements and capacities as well as to improve prediction of students' performance. In addition, many writers in this book describe the latest developments and future directions in software for e-learning.

4 References and Further Readings

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