Constructivism, Learning Methods and Delivery Media: A South African Tale

Marí Peté
Technikon Natal, Durban

This paper reports a follow-up research project and an in-depth examination of issues raised in "The KwaZulu Concept Burger" presented by Clark and Peté at SITE97. This original study focused on the learning experiences of three students during the cooperative construction of a hypertext concept map. These students are residents of the province of KwaZulu Natal and study towards a Master's degree in Education at the University of Pretoria, Gauteng Province, South Africa. This report is of a qualitative, comparative study that reflects upon the spectrum of learning experiences of all eleven students in the class.

The Master's assignment entailed the construction of concept maps on the topic "The evaluation of educational software and its effect on learning". As stated previously, the creators of "The KwaZulu Concept Burger" (the Burger) delivered their product in electronic media. It was prepared in HyperText Markup Language (HTML) and presented through a World Wide Web (WWW) browser. The other maps produced by cooperative groups took the form of physical representations (models or posters).

Since its construction, the Burger has continued to evolve. The initial product was adapted and used by its creators in their working environment. Other concept maps remained static and unused.

This paper investigates (i) the role the chosen *delivery medium* (HTML) played in the learning process. It further aims to (ii) examine *learning methods* which played a role in the learning process. In order to draw any conclusions concerning the influence of delivery media and methods of learning on the learning processes, (iii) the *development of the other concept maps* are analysed and compared to that of the Burger.

Literature Review of Factors Influencing Learning

The literature review of factors that influence learning included reports on both behavioural and constructivist teaching and learning methods. Articles were reviewed also that looked at the different media that influence teaching and learning.

Teaching and Learning Methods

Behavioural Learning. Behavioural learning follows a pattern of stimulus-response-feedback and reinforcement: "Feedback produced by the consequences of behavior may reinforce that behavior" (Cook, 1993, p. 64). Behavioural learning can be used effectively to reinforce basic subskills, in order to attain "automaticity", which Bloom defines as follows: "The mastery of any skill - whether a routine daily task or a highly refined talent - depends on the ability to perform it unconsciously with speed and accuracy while consciously carrying on other brain functions" (1986, p. 70). These higher-level brain functions include "retention, understanding, and active use of knowledge and skills" (Perkins, 1991, p. 18).

In the long term, behavioural learning fails to attain the brain functions mentioned above by Perkins. It furthermore does not effectively facilitate transfer of learning to broader environments, outside of the traditional classroom: "The knowledge so acquired is either not accessible or else not relevant for active use in the real world" (Barras-Baker: 24).

Constructivist Learning. The constructivist learning process addresses the weaknesses of behavioural learning. In a constructivist learning environment, learners actively construct knowledge from personal experiences and interpretations of the world (Merrill, 1991). Learning becomes an active process when learners develop their own mental models. This process involves "the organising of memory into structures" (Merrill (1990b), quoted in Merrill, 1991, p. 45). Merrill states that organisation in learning facilitates later retrieval of information. Organisation entails the structuring of knowledge. Retrieval can also be aided by learners' use of elaboration, which refers to "the explicit specification of relations among knowledge units" (Merrill, 1991, p.45).

Rich Environments for Active Learning (REALS) are a specific form of constructivist learning, and are based on principles such as collaboration, generativity, reflectivity, active engagement and anchored instruction (Dunlap, 1996).

Teaching and Learning Media

Hypertext. Hypertext is "a generic term covering a number of techniques used to create and view multidimensional documents, which may be entered at many points and which may be browsed in any order" (Illingworth, 1990, p. 212). Hypertext can be used in a variety of ways in an educational learning environment. Materials and resources can be delivered to learners in this medium. In addition, learners can output knowledge through hypertext projects.

In either of the above situations, navigation in a hypertext environment provides the learner with the opportunity to develop multiple perspectives. It facilitates the traversal of complex subject matter in non-linear ways. Multi-dimensional navigation enables learners to make links between concepts. Maximum learner control is made possible in such environments. (Mc Manus, 1996; Spiro, Feltovich, Jacobson & Coulson, 1991)

The Internet and The World Wide Web (WWW). The term "Internet" implies the global inter-connectedness of computer networks of information. Web browsers (such as Netscape and Internet Explorer) enable users to access information available on the Internet through a hypertextual Graphical User Interface (GUI).

The Media Debate. Fourteen years ago, Richard Clark stated that media are "mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition" (1983, p. 445). Clark's article provides research evidence that methods and media were confounded in the past, and that the importance of methods of teaching are often overlooked. As a result of evidence that "many very different media attributes accomplish the same learning goal", he suggests that "the attributes must be proxies for some other variables that are instrumental in learning gains" (Clark, 1994 p. 22). In addition Clark states that media may "affect the economics but not the learning effectiveness of instruction" (Clark, 1994, p. 26).

In a constructivist learning environment, learners, rather than instruction being "delivered" to them, construct knowledge. In such situations Clark's media would include the means students use to deliver the products of their learning. This paper investigates whether successful transfer of knowledge (or lack thereof) in the case of the Burger and its counterparts, can be attributed to "proxies for some other variables", rather than to the delivery media chosen by the learners.

Execution of Mind Map Projects

Stages of Development of the Burger

The three KwaZulu Natal students sketched the development of the KwaZulu Concept Burger as follows:

During the Master's Module. The original concept map was devised as an examination project for the subject "Evaluation of software and its effect on learning".

Back at Work. After the students submitted the Burger as an examination project, it was continuously updated as it was used in their professional practice. It formed the basis of a variety of workshops presented at tertiary institutions. In addition, educational technologists continued to access the Burger on the Internet, using it to evaluate multimedia products. The Burger was eventually presented at the SITE 97 conference in Orlando, USA.

How the WWW Influenced the Learning Process of the KwaZulu Natal Team. The following information was obtained from on-line questionnaires completed by the students:

Effortless and cost-effective updates were facilitated by the dynamic medium of HTML.

As time passed since the Burger's initial construction, HTML editors became more sophisticated, and their added features (e.g. capability to produce tables) were used to improve the product. The technical improvements enhanced the illustration of important concepts such as the evaluation matrix.

The WWW played a dual role in the Burger creators' learning process: it served as construction tool as well as a content provider in the continuous process of improving the product and writing the conference paper.

The need for retention of information became less important in the learning process, as the Burger's creators and other users could access it at any time on the Internet.

In preparing for presentations, knowledge gained in practice was used to update the Burger. It became more multidimensional, through the fine-tuning of conceptual relationships. This resulted in an on-going learning process in a real life context.

Due to the Burger's availability on the Internet, members of the audience were able to access it after various presentations, and provided presenters with on-line feedback.

The original intention of the product was the representation of a concept map. However, during the evolutionary process, the concept map acquired the additional function of an educational software evaluation tool used in practice.

The team member responsible for the HTML editing, indicated that skills gained during this construction exercise lead to her subsequent choice of "Web-based learning" as a dissertation topic. Her project formed part of an international training programme and she therefore got the opportunity to visit Germany and to collaborate with an international team of experts.

In the space of a year, the Burger became part of a collective knowledge base, when it was linked to virtual classrooms that emerged on the World Wide Web.

Other Factors in the Learning Process

Constructivist Learning. The process of concept map construction is clearly a constructivist exercise, and ties in with Merrill's (1991) reference to the development of

mental models through the organisation of memory into structures.

Aspects of REALs that were particularly prominent during the learning process are:

Collaboration. The Jigsaw cooperative learning model was followed - learners were divided into expert groups and home groups. Members of the KwaZulu Natal home group (who constructed the Burger) each belonged to a different expert group. Expert groups researched a number of topics and fed the information back to their home groups. This procedure enabled students to cover and share a vast range of information in a short space of time. Burger creators indicated unanimously that the cooperative learning process played a major role in the transfer of learning: "The initial probing and struggling for clarity and accessible metaphors facilitated a way through the more abstract, theoretical stuff and makes it easy to remember". Learners from other teams also emphasised the importance of discussions, to clarify relationships between concepts.

Generative learning. After the exchange of information took place amongst expert group team members, home groups spent most of their time generating ideas around the reorganisation of static information into flexible knowledge structures / concept maps (Dunlap, 1996).

Anchored instruction. Anchored instruction occurs within realistic contexts that are appealing and meaningful to students (Dunlap, 1996). The KwaZulu Natal team chose the burger metaphor, as its layered structure and hierarchy of ingredients are representative of the way in which the students envisaged the relationships between various units of information (Clarke & Peté, 1997). The team felt that their choice of metaphor contributed significantly to the learning process: "The burger concept really is easy to internalise".

According to Viau (1994) metaphoric thinking has the potential to reduce the complexity of a situation "through the use of an image which clarifies, unifies, and inspires". However, a "superficial fit" will not have the desired effect on learning. These two statements are supported by the outcome of this study. Apart from the KwaZulu Natal team, one other group testified that their chosen metaphor (a mother with children) aided retention and internalisation, while other groups indicated that their metaphors were ineffective in connecting "unfamiliar situations to deep affective roots" (Viau, 1994).

Conclusion

The choice of HTML as delivery medium undoubtedly played a facilitative role in the KwaZulu Natal team's learning process. However, it is clear that other teams also recall the construction of their concept maps as valid, meaningful learning experiences, which facilitated transfer of knowledge to other situations: "The actual making of the poster enabled me to retain and transfer knowledge". The process of concept map construction involved

constructivist *learning methods* such as "organisation" and "the explicit specification of relations among knowledge units" (Merrill, 1991:45). Elements of the "Rich Environment for Active Learning" within which all students learnt, are collaboration, generative learning and anchored instruction.

The main advantages of HTML as *delivery medium*, are that it is multidimensional, quick to update, and easily accessible. These characteristics have economic benefits that enable cost-effective, on-going learning processes.

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Marí Peté is Coordinator of the Open Learning Centre at Technikon Natal, P. O. Box 953, Durban, 4001, South Africa. Voice, Office: 27 31 204 2554. E-mail: mpete@umfolozi.ntech.ac.za