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A Constructivist Model for the Technological Enhancement of University Materials

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Abstract: This study is intended to theoretically provide a constructivist approach for the development of university materials to be enhanced with the new media. First, the study explains what merits multimodal technology can provide; second, explanations are supplied to show that the integration of the multimedia into the materials should engage learners and move away from teaching towards learner-driven and participatory learning on a par with constructivism as the appropriate paradigm for learning at the university level and third, a constructivist model for the development of technology enhanced materials is presented and explained. The model suggests that the technology enhanced materials must involve the use of the electronic tools to provoke thinking, debate, reflection and accommodation of multiple viewpoints.

Key words: Constructivism, tertiary education, electronic technology, university materials, accommodation, electronic tools

INTRODUCTION

Tertiary education has always been a challenge in regard to the preparation of instructional design and the necessary teaching materials. This has basically arisen from the nature of post secondary pedagogy which is constituted on the potential practicality of the system on one hand and the promotion of individual status on the other. It seems that the present situation has become more so since new information technologies as a prominent and predominant feature of the era have already influenced the way we live and work. Though some have responded to the presence of the new technologies with disgust or to say the least with inattention, one cannot easily rule out the widespread and prevailing changes that they have made in every aspect of the life, e.g., in business, industry and most importantly in education. Education in general needs to attend to the changes thus made and also take care of the way they should be directed. The society we now live in is best described as knowledge society (Ruschoff, 1999) where education and knowledge stand at the heart of any other enterprise. Therefore there is every reason to exploit the technological advancements in order to initiate the changes in the way we teach and learn. In line with the requirements of the time as briefly put above, this study is intended to demonstrate in what respect the Technology Enhanced Materials (TEM) are necessary which didactic path will be most justified for the TEM and what suggestion are likely for the realization of the technology enhanced materials.

ADVANTAGES OF TECHNOLOGY BASED EDUCATION

No doubt higher education is facing a critical challenge to meet the new demands of the time. These demands can largely be catered for using innovative approaches to provide education not just for larger groups of learners but also in the best practical manner. Employing new information technologies can create a flexible learning environment for an ever-increasing population.

Technology enhanced materials can take up different forms such as CD-enhanced materials, CD Only and Online Presentation (WWW) with different facilities, e.g., hypermodality, multimodality, hypertextuality, navigation, remembering devices, etc. Whatever the form, they can produce some specific wonderful results for the education system, given certain conditions are also met. Some of the advantages can be listed as follows:

First, new technologies can provide innovative, less costly approaches to higher education for a growing number of learners through a flexible learning system. Once infrastructures are prepared, course delivery costs are noticeably reduced.

Second, new technologies encompass a range of virtual as well as face to face delivery mechanisms, introducing new interactive pedagogical techniques such as more hands-on learning opportunities. The new channels of communication can deepen and improve pedagogical outcomes and also exert insightful impacts

on the learners' cognition. Special way of browsing and exploration creates special learning behaviors that are usually associated with higher order learning.

Third, the flexibility of technology based learning makes it possible for the learners to take responsibility for learning and schedule their own study time and pace their learning in a way most suitable to them.

Fourth, such a learning system can ensure that time and space are no longer restrictions for acquiring knowledge. Electronic learning is seen as an alternative to taking courses in the traditional classroom setting, providing convenience in education and training. The employment of new technologies can improve access to advanced educational experiences by letting learners and teachers take part in remote learning contexts using computers at work or at home and improve the quality and effectiveness of education by supporting collaborative learning.

Fifth, advances in information technology and knowledge dissemination are transforming the prospect of the global economy. Knowledge is increasingly becoming a key factor of development. Development is now a days characterized as the provision of conditions where knowledge is created, acquired, transmitted and used more effectively by enterprises, communities and individuals for greater social and economic purposes. Mansell and When (1998) also point out that the term knowledge society has enabled a shift away from technology as a driver of change to a tool that offers new ways of combining the information available with people who will drive development. This shift pressures countries to develop higher education systems that enable skilled people to work within the knowledge society and within the global economy. Thus higher education should not only rely on the information technologies but also attempt to redirect the intended knowledge into the right path of development.

Sixth, incorporation of new technologies in the education systems can make the walls of the learning space transparent, providing a freedom for the learner to explore sources of information outside his institution, even outside his country (OECD, 1994). Greater opportunity for collaboration and greater access to research and reference services are also provided.

Seventh, new technologies have the capacity to increase the levels of equity and access among learners of different ages and background.

Eighth, as intelligence is no longer viewed a unitary concept, the multimodal environment new technologies create can actually promote the access to the multiple intelligences, leading to far more consolidated knowledge development.

Now the question that needs to be answered is how this potential can be maximally used for the enhancement of teaching and learning at university level. Until now global attempts have been made to enrich the pedagogical ground for such teaching and learning modes. The good evidence is the proliferation of distance mode education and E-learning across the globe. The conditions thus necessitate the swift change of the direction towards such a globally acclaimed method. But the technologically enhanced teaching materials have not been more than the digitization of the already existing instruments. Though the digital technology added to the instructional materials have been welcomed as the expansion of the relevant activities, it seems that the electronic models of learning used for the technologically presented materials have so far moved in the footsteps of some old and traditional paradigms that need to be reconsidered should we wish to have the highest efficiency out of the activities.

It is hoped to provide justifications for the new perspective through which we can have a new look at the technologies that are to be used for the university students.

NEW LEARNING MODEL FOR THE TECHNOLOGY ENHANCED MATERIALS

Though we can hardly find some university materials enhanced by the new multimedia technology, most of the exotic-origin materials that are probably available on the market follow a traditional computer based training packages. Publishers actually rely on designing impressive multimedia enhanced packages which are basically an adaptation of simple traditional formats to electronic platforms. As Ruschoff (1999) also claims the integration of multimedia options such as sound, picture, animation and video into the courseware are not supposed to assist the learning purposes but they are intended to create some more attractive look which could finally accrue some more commercial profit. The point is that the traditional skills of information gathering and storing as represented in the old books and adapted to the digital media are no longer sufficient to live, work and learn in the present time. This is because learning is viewed as an active, creative and socially interactive process and knowledge acquisition is considered as a process of construction rather than an act of transmission (Florin, 1990). This part is meant to review briefly the history of technology use in the education systems bringing home the point to the new model I believe is most suited to the current situation at the universities.

The substantial theoretical shift from behavioral to cognitive and to constructivist learning perspectives demands a shift in the application of type of multimedia to the instructional materials as well. Though the shifts towards new learning perspectives are vividly before us, the theoretical foundations of interactive multimedia programs are frequently found to be based on behavioral or at best cognitive traditions inherited from educational technology. Thus university materials if necessary to be enhanced need to keep up with the development of the time. In the following part, the developmental stages of instructional technologies based on the learning theories are discussed so that the state of the art is justified for the prospective model.

The learning perspectives and the use of educational technology have witnessed three phases of development and there seems to be another rewarding stage awaiting application.

The first phase was based on the behavioral traditions which gave rise to special instructional design and material development (Dick and Carey, 1985). The computer based education thus followed certain principles underlying behaviorism. The first principle maintained that there was direct relation between stimuli and the outcomes, given certain circumstances are met (predictability of behavior). Another principle adhered to the atomistic view of behaviors, indicating that knowledge and skills could be broken down to their components for the ease of teaching. Moreover, the theory contended that the systematic application of materials would lead to success requiring no interventionist techniques (Gagne and Dick, 1983). The technology used on the basis of this thought basically worked on the content of the course, especially the way the content could have been split into a number of manageable components.

The second stage of technology based education resulted from the shift of attention towards how content could be presented to the learners. The focus on how to learn arose from the reactions against the flawed behavioral perspective of learning which reduced human learning to the modeling of others' habits. To elaborate, the opposing views of learning, namely, cognitive theories claimed that every individual has his own cognitive structure and his own way of learning (Gardner, 1993). Therefore, the instructional methods were also oriented towards catering for the individual learning needs (know-how of materials) rather than the contents of the courseware.

The third developmental stage which has led to the creation of interactive multimedia was based on the conviction that neither content nor how to learn content programs could bear the intended result in learning situations. The proponents of this paradigm contend that learning occurs via the proper interaction maintained between the learner and the program plus the elements involved. Drawing on the Anderson (1983)'s Act, Wenger (1987), Merrill (1993) and Hailes and Hazemi (2002). This is an attempt to develop interactive and intelligent computer-based materials.

Against all the above-discussed stances comes a school of thought that has as its foundation the idea of construction of knowledge. The proponents of this position reject all the previous models of learning on different grounds. The main criticism is that other models assume knowledge is transmitted to the learners by the course/program while constructivism argues that knowledge is to be constructed by the learners. The radical constructivists claim that behaviorism and cognitivism are two sides of the same coin, not far removed from each other (Harnad, 1982). Another vigorous criticism of cognitivism is also aimed at its computer metaphor for mind which explains cognition by means of computations based on mathematical functions modeling the cognitive processes. This metaphor deems cognition as symbol manipulation where non-symbolic, non-reflective and first person psychological activity has no place.

There are however, certain other principles which altogether put constructivism to the forefront of learning theories. These principles which mark the deviation of constructivism from both cognitivism and behaviorism set the ground for all the differences to be witnessed in the application of the theory to the multimedia. The major principles are include.

Human beings are informationally closed systems. It means that human beings do not receive the information from outside sources but through certain adaptation mechanisms work on the perturbations in the environment and make the necessary quality or quantity changes in their internal systems which can be viewed as the knowledge constructed (Maturana and Varela, 1987).

The outside world is not objective. It is meant every individual's world is necessarily different from another. Depending on the depth of the concrete experience with the world, everybody is capable of making a different world, one more time emphasizing the role individuals have to construct their own knowledge.

Meaning is created through negotiation and collaboration. As human beings belong to the same species living in the same environment they share the same basic apparatus to detect and adapt to environmental perturbations (Maturana and Varela, 1987). The sameness of the mechanisms and the conditions make it possible for the humans to communicate with each

other and reach agreement on the symbolic use of the world (Vygotsky, 1978). This capacity is referred to as structural coupling (Maturana and Varela, 1987) supposed to be shared among the same species. Therefore any kind of learning occurs via the direct manipulation of the world and the consensus reached among the learners.

These three principles tend to create a situation that is entirely unique. This situation suggests the rejection of traditional teacher centered paradigms in favor of more learner-centered and task based scenarios. As Ruschoff (1999) asserts constructivism abandons the present-practice-produce paradigm in favor of the new paradigm observe-hypothesize-experiment. One point to make is that learner-centeredness and task-basedness are not supposed to be like those in cognitivism in that the former meant the individual's strategic involvement in the presented content and the latter the clear-cut and well-structured tasks to be done or completed. These two views transcend the limits therein and assume a would be constructed position and ill-structured activities, respectively. Educators agree that the adoption of a constructivist approach to learning is more progressive for learning opportunities (Littlejohn *et al*., 2003). Bednar *et al*. (1991) argue that constructivism highlights what is best in the educational technology approach and can serve as its new theoretical center, providing an alternative to the transmission-based instructional systems technology model.

A CONSTRUCTIVIST MODEL OF TECHNOLOGY-ENHANCED MATERIALS

Designing materials which can take full advantage of the benefits of constructivism is not considered a straightforward job to do. That is because constructivism intends to represent the real life conditions which we know are rather inconsistent and far-reaching. However, there seems to be some way out of the complexity in case high quality multimedia is used. To achieve the purpose, we need first of all to see what a constructivist model can include.

A perusal of the previous researches and the relevant theorizations (Brown *et al*., 1989; Lave and Wenger, 1991; Driscoll, 2000) leads to a model which can have the following as the basic instructional tenets:

- Learning must be embedded in complex, relevant, realistic contexts where varied modes of representations are available
- Learning must include negotiation as an integral part
- Learning must value multiple perspectives
- Learning must involve thinking and reflection

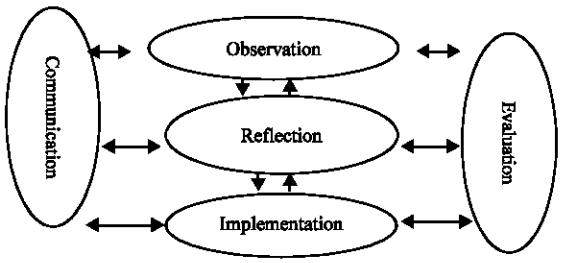

Fig. 1: University research materials

With regard to the four-dimensional design for instruction, the researcher is of the opinion that technology enhanced materials could exploit the potential of the constructivism under the observe, hypothesize and experiment paradigm on one hand and also benefit from online and offline capacity of electronic devices on the other. The format this study suggests for the university materials to be realized electronically as well can be represented and explained as follows (Fig. 1).

A SUGGESTED CONSTRUCTIVIST MODEL FOR TECHNOLOGY ENHANCED MATERIALS AT UNIVERSITY LEVEL

Observation: The first component of the materials is expected to help with an emancipatory orientation towards the topic under study. The word orientation is used instead of presentation to emphasize the impassivity of the learners in the face of multiplicity of the perspectives. Thus orientation need not be interpreted as the predetermination of the goals. The characteristic feature of this component is the creation of any necessary condition which might potentially exist for the actual manifestation of the topic, problem, etc. More clearly, this is to cater for an array of experiential needs of the learners which could bring together the relevant information of audio, visual, textual or animational quality. From another standpoint, related resources of any kind are to be used to which learners are exposed. Learners are supposed to construct their own positions, nurture ownership and develop independent criteria to approach the resources as desired or found appropriate.

Reflection: The goal of the universities is believed to be producing reflective practitioners. This second component is meant to supplement the first stage where learners are to be supplied with the necessary involvement in the resources. As such, this stage plays an intermediary role between the first and the third. The focus in this part is on the reflective thinking where professionals should learn to analyze existing situations

(rationale, goals, methods), rediscover the underpinning theories, examine merits and demerits, frame and reframe problems and finally draw up the innovative ends and think up the possible means to reach the ends. Building on the research of Barnett (1997) asserts that reflection in education is to be exercised at different levels.

- Technical reflection concerned with the efficiency and effectiveness of means to achieve certain ends
- Practical reflection aimed at open examinations both of means and goals, the assumptions on which these are based and the actual outcomes
- Critical reflection aimed at discovering and criticizing the context that has evolved over time and within which human beings are situated. As regards technology, the belief is that the new technology, say, multimedia can provide a very valuable virtual environment for fostering the reflection considered essential for learning

Implementation: In the light of the knowledge and beliefs gained through reflection, learners can get involved in the actions. Of course, the action part does not rule out the reflection in action as an important strategy which can help with the modification and improvement of the results.

In order to enhance learning, by using multimodal technology learners and teachers can work on types of activities which promote learner-centeredness, process-orientedness and collaboration supported by teachers' coaching and scaffolding at appropriate times. Some such activities include problem-based, case-based, project-based and inquiry-based activities. All these activities rely on and improve important constructivist characteristics such as complexity, realistic contexts, authenticity, cooperation and open-endedness.

Evaluation: Assessment of achievements is an inseparable part of any learning environment. It is however, different in constructivism from other traditional methods. Assessment is more subjective because it does not depend on specific criteria but rather on the processes and self-evaluation of the learners. As such assessment is no longer viewed as an add-on to the model. As shown in the figure, evaluation is an ongoing, all-the-time accompanying part of activities from the very beginning. It is not considered as a separate stage in a linear process pretest and posttest but as an integrated part of learning. McLellan (1993) points out that constructivist assessment can take the form of evaluation measures such as portfolios, summary of the learners' paths through instructional materials, diagnosis and reflection and self-assessment. To assess knowledge construction the emphasis must be on the higher order thinking, divergent responses and the processes followed to achieve the self-defined problems. Constructivists believe that the new technologies with the capabilities of recording, storage, retrieval, navigation, non-linear linking can provide the best available means to achieve the evaluation purposes.

Communication: Learning results from social negotiation of meaning leading to collaborative construction of knowledge. This component is intended to provide a forum for learners, teachers and experts beyond textual sources to have constructive negotiations over processes and products of learning. The researchers believe that the new technology can largely widen the channel of communication among agents involved in the learning. The new technology can be used at different levels: offline at multimodal, hypermodal and hypertextual and also online at e-mail, chat, etc. This communication potential is incomparable to any other traditional way. It is an ideal venue for the realization of the constructivist claim respecting the social collaboration required for the construction of meaning. In actuality, the new technology can do away with the dissatisfaction already expressed as how constructivism could achieve the claims around the issues of collaboration, negotiation and common understanding. An important point to remember is that the communication component is placed along with all other parts to indicate the parallel connecting role it should play with others.

CONCLUSION

Constructivism as an epistemology and a theory for learning offers improvement over traditional theories of learning. Though classical techniques provide closed systems less time-consuming and less expensive than constructivism, researchers believe that constructivism as an open system is more in line with university standards. The theory is most appropriate for university contexts, hence, for the development of university materials where advanced stage of knowledge construction is required. Because constructivism favors the construction of knowledge about the world through multiple realities, real world, case-based contexts, collaboration, etc. the use of new technology in the development of constructivist materials seems most beneficial.

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