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Rewiring Learning on the Web

- Shaping Education in Cyberspace

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ABSTRACT

Proponents of multimedia and Internet based educational tools have long claimed their potential. This paper reports on experimental work in Singapore, which was designed to establish a supportable theoretical foundation for the hypothesis that the use of information technology (IT) resources in education, does improve pedagogic outcomes. The authors reach a positive conclusion, and attribute those improved outcomes to the use of IT resources through the conduit of improved student motivation. The paper also draws the important distinction between using multimedia and the Internet as a facilitator of learning rather than teaching. The authors also propose a model to explain the underlying theoretical foundation by which Internet learning takes place in an educational environment. The model is not a continuum at all but is orbicular and is contrasted with the established view of Bloom's taxonomy. Responding to the IT environment, the model recognises that after the higher level skills of synthesis and evaluation have been achieved, the product of that achievement, which we call discovery, becomes new knowledge available for others at the lower level of Bloom's taxonomy. In essence the model explains, in an IT environment, what happens at the end of a continuum. Bloom left the issue unanswered.

MOTIVATION

Educationalists have continued to support the view that effective learning can not take place without motivation.

As far back as 1983, Steffin, (building on the original book "Events of Instruction", by Gagne and Briggs) proposed his first of eight cognitive based requisites for computer aided learning as "providing for attention and motivation".

Scott Paris and Julianne Turner - authors of "Situation Motivation", reflect popular views in education that motivation is a characteristic of people, and they assert that motivation therefore elicits different courses of action, different emotions and different cognitive interpretations of events

from learners.

Sue Wynn, "Interactive Multimedia: Ensuring Motivation of the Learner" extends the importance of motivation even further, concluding that ongoing motivation leads to lifelong learning.

As to whether contemporary technological convergence negates this paradigm, was the subject of research at Ngee Ann Polytechnic in Singapore. Parameters of the experiment were set to examine whether the use of IT resources in a formal educational environment would increase or reduce motivation, and hence impact learning outcomes. Contemporaneously, researchers sought to identify whether particular elements of IT design, increased or reduced motivation more than others. Five factors were identified as potential motivators for students in an IT environment:

Opportunity for responsive feedback and individual involvement,

Motivating instructors,

Learners to be active - able to make their own choice of pace and content,

Collaborative learning,

Curiosity and self discovery.

Each of these separate factors were adapted as design elements and incorporated into the Internet site used in the experiment as follows:

Opportunity for responsive feedback and individual involvement

The hypothesis was that responsive feedback and individual involvement would be highly motivating. Internet e-mail and teleconferencing were therefore built into the site design. Students were offered Internet e-mail access to lecturers, and a bi-weekly teleconferencing meeting was also available for their use, whereby students could participate in electronic chat sessions with staff and fellow students.

Motivating instructors

A teacher who cannot motivate students in the conventional classroom is likely to face the same situation using computers. The hypothesis was that multimedia and Internet programs, designed by motivating instructors, should encourage students to learn. The lecturing staff therefore encouraged students and demonstrated a passionate commitment to the Internet Site.

Learners to be active - able to make their own choice of pace and content

The premise of this test was the work done by Paul Pintrich that "when the instructional focus is on practice, rote application of rules and adherence to teacher specified activities, students place little value on the tasks and display less motivation". The Internet site design therefore followed Pintrich's premise that "learners are motivated when allowed to choose how they will act and how much effort they would expend on each task". It was felt that by giving students this choice, motivation, commitment, deep involvement and strategic thinking about tasks, would improve. Students were permitted to choose the path, content, pace and nature of the material, within a framework of "guided discovery".

Collaborative learning

The hypothesis to be tested was the conclusion reached by Maryellen Weiner in her paper "Student Motivation Not a Desperate Situation", that "collaboration builds motivation". The Internet Site design therefore incorporated Tutorial Home Pages, whereby students in each tutorial would work on projects, and post the results of their work on to the Tutorial Home Pages for review by their peers. Paris and Turner also hypothesised that "peer observations and insights often surprise fellow classmates who may have never considered a concept in a way advanced by a classmate".

Curiosity and self discovery

It was also suggested before the research work began, that "curiosity is an important element in attaining and keeping the learner's attention. The Internet site design therefore enabled the introduction of many changing facets, unavailable with traditional course delivery methods, such as on-demand videos and graphics.

TEACHING AND LEARNING

During the design phase of the experiment, the traditional teaching and learning dichotomy also became a relevant issue for the key design decisions. The question to be resolved was whether the Internet site design should focus primarily on learning outcomes or teaching facilitation.

There are competing viewpoints on education. Instructionists advocate the traditional belief of education, whereby students learn better through improvement of teaching instruction. Teachers are active. Students are passive. Antithetically, constructionists believe that students advance through discovery and participation - learning and remembering, by discovering the specific knowledge they require and not simply receiving it from others. To improve this learning process, constructionists maintain that minimal structured individual guidance from teachers is needed.

In this context, Information Technology (IT) resources, as an adjunct to human teachers, continue to confront educators with opportunities and challenges. Constructionists and Instructionists continue to debate the relative merits or otherwise of IT in support of their respective points of view. For example, constructionists hasten to add, that teachers cannot be replaced with computers. Teachers are extremely versatile and adaptive - their pedagogic ability greatly exceeds any computer learning packages.

We contend this debate is largely irrelevant in an IT environment, and that educators need to distinguish multimedia as a facilitator of learning, rather than teaching. In our view, the concepts of "teaching" and "learning" are separate elements of an education closed-loop model that is borrowed from control engineering theory. It contends that teaching is in the forward path of a closed-loop education system, and learning (and hence tutoring) is in the feedback path (Figure 1)

Click here for Picture

Figure 1 - Closed teaching/learning loop

In this model, teaching takes place using "information" prescribed in a syllabus. Teaching is seen fundamentally as a process in which a large amount of information is compressed and delivered by the teacher to the students in limited lecturing hours. Learning on the other hand, is a slow process of digesting and converting information to knowledge and skills, both during and after lecture hours. Consequently, physical attendance at a lecture by a student does not necessarily mean that learning is taking place or taking place efficiently. Learning efficiency varies from student to student and is largely influenced by students' capability and motivation. Hence, motivation is represented in the feedback path as a switch. When student motivation drops to zero, the feedback path is switched off. The system becomes an open loop. Teachers receive no response from students and will try to work frantically, leading to over teaching. In order to avoid an open-loop situation, it is important to "kick

start" the learning process through motivating and helping students to learn. Once the closed-loop is re-established, teachers begin to receive good responses and feedback from students. Teaching becomes less tedious and professionally more fulfilling. Students begin to recognise their own small achievements which help to further strengthen motivation. In control engineering terms, the education loop is in a "tracking control mode".

The teaching function must always be a human one. Teachers are more flexible and efficient compared with computers, when delivering a large amount of information, in digestible form, in a short period of time. Programming a computer to deliver digestible material to replace a teacher is very time consuming and costly. Hence the use of technology as an adjunct to human teachers is more efficient and practical than replacing human teachers with technology.

Since learning is a slow process, computers can be used to help in the learning/tutoring role just like human tutors are employed to help teachers, hence assuring that the feedback mechanism is in place, motivation is high and therefore teaching becomes more rewarding and productive.

This view became fundamental to the design of the IT based educational materials used in the Singapore experiment, and our research, inter alia, sought to substantiate this model, and the consequent implication thereof, that educational effectiveness was thereby enhanced by a strategy of maintaining good teaching by human teachers, conjointly with innovative and motivated learning - learning which involves IT multimedia.

IT - NOT A PARADIGM SHIFT

The teaching challenge was also to add yet another higher level skill of facilitating student learning using available IT resources. Once this higher level skill is obtained and maintained, generative learning takes place, with minimal "content teaching" intervention in the process. A clearer understanding of the learning process in an IT environment, may now enhance our understanding of this required higher level teaching skill.

Bloom's Taxonomy of Educational Objectives,(Bloom et al, 1956) is now more than 40 years old. In the intervening period since it was first published in 1956, educators have largely embraced the concept, and widely used the tools. Our contention is that Bloom's Taxonomy, within the IT environment is today more fundamentally relevant and deliverable than ever. However there is bifurcation between Bloom's Taxonomy and our proposed model in one crucial respect. Travers (1980) saw Bloom's taxonomy as falling short of a true taxonomy. "Although the major categories give the appearance of a continuum of complexity, this dimension is not clear and the classification is only a rough beginning".

Our proposed orbicular model is not a continuum at all. Responding to the IT environment, the orbicular model recognises that after the higher level skills of synthesis and evaluation have been achieved, the product of that achievement, which we call discovery, becomes new knowledge available for others at the lower level of Bloom's taxonomy. In essence the model is orbicular and explains, in an IT environment, what happens at the end of a continuum. Bloom left the issue unanswered.

We nevertheless embrace the principles of the taxonomy up to that point. Of particular relevance to our model is the issue raised by Bloom, and researched by McKeachie (1963) and Sharan (1963) in separate publications, that teaching methods which emphasise efficient one-way communication (eg lectures) are more useful in helping students to acquire lower-level objectives, while those which emphasise two-way communication either among students themselves or between students and teachers are more useful in helping students achieve higher-order objectives. This proposition has stood the test of time, and been empirically supported by Johnson & Johnson (1994). In an IT learning environment, access to such two-way communication is assured.

Indeed, it is more than two-way, but multi-level communication which is now a central characteristic of Internet learning. The borderless classroom of the late 1990's, is supported by communications technology, text, audio and video, which enables interaction between students, students and teachers, or indeed students and a plethora of relevant experts. Bloom's higher order objectives are achievable for students, irrespective of the barriers otherwise thrown up by didactic teaching styles or economic barriers. The environment is also deliverable by teachers despite the historical general reluctance to inculcate Bloom's taxonomy.

Anderson (1994) concluded that since it was first published in 1956, teachers have made such little use of the taxonomy because:

"the taxonomy takes far more time than teachers typically have at their disposal",

"teachers may believe that many students, particularly those from economically disadvantaged homes, are unable to master objectives much above the lowest level of the taxonomy - knowledge",

"the taxonomy may be too rational or too complex for some teachers"

Anderson went on to explain her meaning of this final point viz. "conceptualising and applying higher-order objectives in planning, teaching, and/or testing may be very difficult for many teachers.....those teachers who are unable to do so lack confidence in their ability and it therefore seems unreasonable to expect they will conceptualise and apply higher order objectives on their own".

Our proposed orbicular model built on Bloom's taxonomy and applied in an IT learning environment removes such barriers.

CONCLUSION

The continued exponential growth of Internet resources, combined with breathtaking technological breakthroughs which emerge almost daily, have the unintended effect of "intimidating" educators who may be unfamiliar with the use of the Internet as an aid to student learning.

In this paper, we have attempted to put these confronting environmental factors, into a meaningful and manageable perspective by explaining the underlying theoretical foundation by which Internet learning takes place in an educational environment.

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