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<th>Teaching on the net - from constructivism to active learning : staffing the information marketplace</th>
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<td>Author(s)</td>
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Teaching on the Net—From Constructivism to Active Learning: Staffing the Information Market Place

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Abstract

This paper is meant to serve as a useful reference for the communication educators who are interested in learning more about how computers are currently being used in the classroom. More importantly, author argues that teacher involvement, full student interactivity, and richness of content are all prerequisites for effective use of technology in the classroom in the higher education in Asia. The author has explained the benefits of IT in teaching using the constructivism model of teaching and learning.

World Wide Web has been growing at a phenomenal rate. It contains a vast array of information ranging from news, to government information, to entertainment, to the ability to purchase pizzas and visit Santa Claus. The next generation of entrants to higher education are going to be both well aware of its existence and IT confident, that is, well beyond basic IT literacy. They are going to demand access to it will be highly motivated to explore and discover the breadth of information it contains. As educators, we can either allow students complete undirected access, or we can learn what is available on it and adjust our approach to education in the light of the possibilities that it offers. This paper reviews what the Web and computer mediated teaching currently offers to educators, using communication education as an example, and considers ways in which it may impact upon our current approaches to teaching and learning in Asia.

Introduction

In recent years higher education, like other sectors of society, has undergone a technological revolution. More diversified student bodies, new and changing demands from society, declining resources and escalating costs all are contributing to a fundamental reassessment of universities' missions and goals. Concerns that the quality of higher education has eroded and that students are not prepared for today's or tomorrow's technological world have contributed to the pressure to reanalyze higher education's priorities (Benjamin et al., 1993; Denning, 1993; Denning, 1994). With increasing emphasis on the information society and the development of communication networks or the national information infrastructure in each country in Asia, it is essential that everyone be empowered to use such networks.

Today's students often arrive at college and universities with considerable experience of computer use. As well as the university library they expect access to the resources of the Internet and World Wide Web, they communicate by email, they word-process their assignments, and their course may well include some form of computer assisted learning or assessment. After
graduating they will join a workforce which requires 90 per cent of them to have skills in IT.

Teaching and learning on the net does not simply mean replacing lecturers with computers. Like other teaching tools, educational technology is effective only when it is designed to meet specific learning needs and when it enhances the learning experience for the student.

Teaching and Learning on the net mean any of the following:

- lecture notes and other resource material posted on the Web to help students prepare for tutorials
- information retrieval exercises using online reports, journals and databases, electronic archives, hypertext and hypermedia documents
- interactive computer assisted learning courseware — developed in-house, bought off the peg, or tailored to students' own requirements
- email noticeboards to encourage student discussion reinforcement of important ideas with drill and practice packages or self-assessment exercises
- open access materials on a departmental server to enable students to follow up class work in their own time collaborative projects with other institutions using email, videoconferencing, a shared Web site.
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- a question library providing constructive feedback as students prepare for exams an archive of student assignments for other (and future) course members
- students acquiring a range of IT skills — in email, word processing, presentations, spreadsheets, databases, and different types of computer assisted learning — as part of their coursework
- establishing a newsletter, noticeboard or conference page for a course or module
- simulation software to model real-world situations or run experiments which would be impractical in the laboratory
- introducing new concepts with a computer microworld or problem-solving environment, which allows students to structure their own learning
- simultaneous real/virtual seminars, allowing distant students to work alongside campus-based students.
In any consideration of the education and training of future professional communicators, consideration must be given to the implications for the profession of the accelerating developments in the area of information technology. Such developments prescribe a new approach to communication education and training. This will require that the latest tools and techniques of high technology be integrated into the professional pre-qualification education, training and lifetime learning of the future communication professionals. World Wide Web represents a new concept in technology, the library on your desktop, the dictionary at your fingertips, the sound at your ear. There is nothing that we hear or see that will not be accessible through WWW. Laser discs and CD-ROMs can both provide similar information in reasonably large quantities, yet the Web has the added advantage of being free (virtually) and not restricted to the amount that can be squeezed onto one CD, or even a lorry load of CDs. With virtually 5 million host computers linked to the Internet, and estimates of many times that number of actual users, there are a huge number of potential Web page authors, each of whom will be adding some new information to the vast reservoir that already exists. The various ways in which the Web can currently be accessed are documented elsewhere.

The problems for communication educators are knowing how to find appropriate information, knowing how to use it, and knowing what to tell the students. The rest of this paper addresses each of these issues. For the computer to bring about a revolution in higher education, its introduction must be accompanied by improvements in our understanding of learning and teaching.

Many educators and technology experts believe in the immense potential of computers as learning tools. "They offer an opportunity to deliver on a promise often made but too often broken; namely, that learning can be an intriguing journey through our world (O'Malley, 1989). Moreover, "learning... is what virtually all adults will do for a living by the beginning of the 21st century." (Perelman, 1992). To realize the potential of the computer for learning and teaching, however, we have to rethink what we teach, how we teach, and most of all how we learn. In my search for guidelines in the development of multimedia learning environments, I found rich learning and teaching resources in diverse disciplines, from epistemology to engineering. I have become particularly impressed with Piaget (1954) the author of constructivism, who together with other great minds (such as Dewey and Lewin) laid the foundations of experience-based learning (Bennis, 1984). The objective of this article is to provide a brief tour from constructivism to active learning.

Constructivism

The basic idea of constructivism (Bringuier, 1980) is that knowledge must be constructed by the learner, it cannot be supplied by the teacher. This is vividly expressed by the Farsi proverb: "A well must produce its own water."

A clue to how learning can be nurtured is provided by Piaget's definitions of knowledge (Bringuier, 1980)

- **Knowledge is an interaction between subject and object...**
- **Knowledge... is a perpetual construction made by exchanges between... thought and**
its object . . .

- Knowledge . . . isn't a copy of reality . . . it's a reconstitution of reality by the concepts of the subject, who, progressively and with all kinds of experimental probes, approaches the object without ever attaining it in itself.

Thus, the construction of knowledge is a dynamic process that requires the active engagement of the learner. The implications of constructivism relative to learning and teaching are as follows:

We are all responsible for our own learning; the teacher is responsible for creating an effective learning environment.

Nicholas Negroponte, Mitchel Resnick, and Justine Cassell (1997), professors from the Massachusetts Institute of Technology, argue in "Creating a Learning Revolution" that digital technologies can enable students to become more active and independent learners. The Internet will allow new "knowledge-building communities" in which children and adults from around the globe can collaborate and learn from each other. Computers will allow students to take charge of their own learning through direct exploration, expression, and experience. This shifts the student's role from "being taught" to "learning" and the teacher's role from "expert" to "collaborator" or "guide." These ideas are an integral part of constructionism.

Constructionism is both a theory of learning and a strategy for education. It builds on the "constructivist" theories of the child psychologist Jean Piaget (1954), and asserts that knowledge is not simply transmitted from teacher to student, but rather is actively constructed in the mind of the learner. This theory suggests a strong connection between doing and learning: It asserts that activities such as making, building, and programming provide a rich context for learning (Kafi and Resnick, 1996; Resnick, 1996).
Mitchell Resnick (1996) writes in "New Paradigms for Computing, New Paradigms for Thinking" that the best computational tools do not simply offer the same content in new clothing. Rather, they aim to recast areas of knowledge, suggesting new ways of thinking and allowing students to explore concepts that were previously inaccessible.

In an interview in Wired magazine, Mitchell Resnick (1996) said, "In the same way that people have grown to understand the importance of diversity in an ecological system, we need to understand the importance of diversity in educational systems." In order to allow students to take more responsibility for their learning we must allow them to put concepts into personally meaningful contexts. Students retain more information and have more fun learning when material is presented in this way. Computers make these meaningful contexts possible by providing students with highly individualized education.

Another important application of computer technology is simulation. Computer simulation allows students to explore phenomena that would otherwise be too expensive or too impractical for the classroom. Simulations are effective because they provide a guiding context for students to integrate what they learn. They learn details in the context of a larger task and are not faced with decontextualized facts that have no relevance to their lives or goals (Shank & Cleary, 1995).

The presence of technology in society is a major factor in changing the entire learning environment. Technology is the impetus behind fundamental changes in the curriculum; it allows teachers to educate students in ways that correspond more closely to the way they learn naturally (Papert, 1997; Gooden, 1996).

David Dockterman (1997) advocates the use of the computer as a discussion generator. The Decisions Decisions series of role-playing software packages help teachers to generate informed discussion and decision-making in the classroom. In Decisions Decisions News, for example, students in the class role-play the News Editor confronted with the problem of re-election as boat loads of refugees land on the shores of the country. Each student is provided with a different booklet that allows them to role-play a different perspective such as "The Counsel to the President" or "The Chief of Domestic Policy." This generates rich classroom discussion with many diverse points of view. The computer drives the discussion, but the kids and their ideas are the center of attention.

A Congressionally mandated study, in the United States, comparing multimedia and more conventional instruction found time savings of 30 percent, cost saving of 30 to 40 percent, improved student achievement, and a direct, positive link between interactivity and instructional effectiveness (SPA, 1993). The studies on the computer-mediated teaching in military applications in the USA found that students reach similar levels of achievement in 30 percent less time than those using more traditional teaching methods.

Active Learning

In active learning, "knowledge is directly experienced, constructed, acted upon, tested, or revised by the learner (Thompson, 1989). The question is, how can we design a creative learning environment that promotes active learning?"
Compared with students enrolled in conventionally taught courses, students who are provided regular access to well-crafted computer-mediated instructional materials generally achieve higher scores on summary examinations (improved learner effectiveness), learn their lessons in less time (increased learner efficiency), like their classes more (greater learner engagement) and develop more positive attitudes toward the discipline under inquiry (enhanced learner interest) (Baker et. al., 1997). These results hold for a broad range of students, stretching from elementary to college students, studying across a broad range of disciplines, from mathematics to the social sciences to the humanities.

The findings also hold for students who vary greatly in terms of their prior knowledge, educational experiences, and preferences for particular types of instructional assistance and English language proficiency. The empirical data substantiating these findings are to be found in a steady stream of studies published since 1990, summarizing the experimental results obtained by a large number of researchers (Anderson, et. al., 1995; Ayersman, 1996; Boettcher, 1993; Fletcher-Flinn, 1995; Hannafin, et. al., 1996; Khalili and Shashaani, 1994; Kulik and Kulik, 1991; Kulik, 1994; McCoy, 1996; Schofield, 1995; and Weller, 1996). The experimental data has been subjected to a range of meta-analytic techniques, specifically designed to enable researchers to contrast and compare research findings across an breadth of instructional environments, implementation models and evaluation methods (Glass, 1976; Glass, McGraw and Smith, 1981; Hunter, 1990; Kulik and Kulik, 1989; Straf, 1990).

Authentic Activities

According to Papert (1991) learning "building knowledge structures" happens especially felicitously when the learner is consciously engaged in meaningful activities that can be shared with others. DeCort suggests that these activities should be representative of future tasks and problems, provide many opportunities for social interactions, and be rich in learning resources (Beichner, 1993; DeCort, 1991). The teaching on the net provide the following advantages to enhance the authentic activities:

- greater access to the subject content;
- increased flexibility in their times and pace of study;
- the opportunity to develop more autonomous methods of study but at the same time to provide them with a reasonably structured learning experience;
- a better understanding of the visual and practical elements of the module.

Authentic activities form the core of many new learning environments that are concerned with active learning. Examples includes: experiential learning (Kolb, 1984; Laws, 1991) collaborative learning (Beichner, 1993; Felder, 1993) context-based learning, (Lumsdaine, 1993) and computer-based learning (Laws, 1993; Redish, 1992; Sheiderman, 1993).

The effective integration of information technology into the curriculum is needed to design appropriate learning environments for students rather than just concentrating on the delivery medium per se. Information technology is not chiefly concerned with using computers, video
recorders, audiotapes or any other form of technology. Rather, it is concerned with a systematic approach to the planning and delivery of the educational experience. In other words, it should be more concerned with the design of the whole learning experience than with any particular delivery medium. From good design, it should become clear how best to deliver a quality learning experience.

Similarly, the development of media-based materials is important, but delivery is paramount. The most stunning educational materials ever developed will fail to teach if the context of delivery fails. Conversely, good delivery can retrieve poor materials. The context of delivery means more than a delivery system, such as lectures, mail or broadcasting. It refers to the provision of whatever supports it takes to enable students to achieve the maximum benefit from their study.

Students' Views

We should seek and value students' views because they are windows to their knowledge, their reasoning (Brooks, 1993). Awareness of students' views gives us the opportunity to facilitate learning. "Learning is a journey, not a destination. Each point of view is a temporary intellectual stop along the path of ever-increasing knowledge. (Brooks, 1993).

Students' views are accessible through open-ended questions and encouraged by nonjudgmental feedback. In contrast, narrow single-answer (right/wrong) questions tend to discourage risk taking and creativity of students (Brooks, 1993).

Authentic Assessment

Authentic assessment, like learning, occurs most naturally and lastingly when it is in a meaningful context and when it relates to authentic concerns and problems faced by students (Brooks, 1993). Meaningful tasks for context-based assessment are difficult to construct, but they provide many benefits (Brooks, 1993). Learning continues because solving complex problems requires the application and adaptation of knowledge to new situations; the teacher can discriminate between rote memorization and constructed knowledge; and multiple solutions are possible.

Innovative Curriculum

In order to promote active learning, we need an innovative curriculum that provides opportunities for students to inquire, explore, experiment, collaborate, and experience the joy of discovery. "Real inquiry is inherently interdisciplinary, and interdisciplinary problems are inherently broad and open ended. Such problems rarely have one, easily accessible right answer (Anderson, 1994; Brooks, 1993).

Digital Pedagogy

Learner-centered approach to instruction and learning that takes advantage of the combined strengths of the instructor, the learner and multimedia technology to create an individualized learning environment and increase student academic achievement.
The basic computer mediated learning is simple. It preserves the core elements of the traditional model of instruction -- student, faculty, and text -- and it introduces a new element, computer-mediated instruction, assessment and support. The new model modifies the role of each element of instruction so that the individual needs of the student are addressed. It gives students better access to more learning resources, when they need them and at the level they require. Faculty can leverage scarce and valuable resources -- including their expertise and their time -- and gain more flexibility in the allocation of resources within their department.

The technology supporting the teaching on the net approach is a highly effective combination of multimedia instructional software, real-time assessment and feedback, and an advanced Instructional Support System that provides useful information to instructors and valuable guidance to students.

- Increased student achievement
- More flexibility for faculty and students
- Distributed learning over wide area networks
- Better use of resources

It enhances the flexibility, reach and impact of computer mediated learning by making courses available over interactive networks that extend across campuses and communities.

The promise of teaching on the Web is greater learning success, greater student retention, a more rewarding environment for faculty, and a transformation of higher education to meet the new challenges facing colleges and universities today.

Over the last several years, there has been a proliferation of WWW-delivered courses. Much discussion has occurred regarding the relative merits of lecture-based versus WWW-based education (Goldberg, 1996). The usual argument against WWW-based learning is the loss of interaction or student participation. Student participation here refers to the level of interaction between a student and the course material, a student and other students, and a student and the instructor.

As a result, some WWW-based educational environments have attempted to create opportunities for interactions with the course material, the instructor, and other students. The problem, however, is that even though these opportunities for student participation has been created, their effect on the level of student participation is rarely quantified. Likewise, student progress through the material is usually measured only indirectly through assignments or exams.

In a lecture-based course, measuring student participation is easy. Does the student show up for class? Does the student appear to listen attentively? Does the student ask meaningful questions and participate in class discussions? The answers to these questions provide a strong indication of the level of a student's participation. Unfortunately, student participation and progress can be difficult to measure in WWW-based courses. Often little or no information is available and even a simple question such as "has student X even begun the course" can be difficult to answer until the student has fallen behind and missed a quiz or assignment. Effective student participation and progress tracking would help answer this and many related questions.
Different Pedagogical Tools on the Net

Course bulletin-board allows communication among all course participants (instructor, markers and students). The bulletin board can be searched for content, sender, date of sending, and more. Articles can have embedded URLs. The bulletin board can have any number of fora.

Electronic Mail can be added to a course allowing one-to-one message transfer among course participants. Like the Bulletin-Board, messages can be searched for based on the sender, content and the date of sending.

Chat Tool can provide a chat tool for real-time communication among course participants. Multiple chat "rooms" are provided and both public and private chat sessions are possible.

Student Self-Evaluation. Multiple-choice questions can supplement any page of notes. Student responses are automatically marked as correct or incorrect by Web. An explanation can accompany each answer indicating why the chosen answer was correct or incorrect, and perhaps supplying hints or extra information.

Searchable Image Archive. The course-author can upload images to be included in the course. Web can provide a page that allows the association of annotations with each image. Students can search for images based on these annotations, date of addition, image title, image creator, and other attributes.

Searchable and Linkable Glossary of terms can be created by the course-author, and links from the notes to the glossary entries are added automatically.

Student Presentation Areas. Web can allow the designer to designate icons which serve as the document homepage link for student-generated web pages. The designer can give authoring privileges to a single student, a group of students, or to the entire class. Students with authoring privileges can upload pre-prepared web pages to their area for view by all course participants. This tool is useful for displaying course projects, student work, student newsletters and more.

Timed On-Line Quizzes. Quizzes can be written by the designer and delivered on-line on a predetermined day. Once completed and marked, the grade assigned is, along with comments, made available to the student on-line.

External References. This tool allows the placement of a button on the button-bar of a content page, which is linked to an external reference. There are several built-in types of external reference including textbook references, paper references, and URLs.

Indexing and Searching. This tool allows the creation of an index of course content and terms. Index entries are ordered alphabetically. The entire course content can also be searched with the results listed in order of priority. Priority is assigned according to where the word is found (title, heading level, body).

Page Annotation. The designer can add a button to any page of notes which, when clicked by a student, allows that student to make personal annotations for that page of notes. The annotations created are private to that student and persist as long as the student has an account for that
course.

Grade Tool. Each student can view his or her own marks as entered by the designer. The student also has access to minimum, maximum and average marks for each course component (at the discretion of the course designer). Students also have on-line access to the comments and grades for each on-line quiz written and marked.

Shared Whiteboard. This tool is still under development. Groups of students can collaborate by having access to a virtual shared whiteboard. Whatever any student draws or types on the whiteboard is seen by all other students. Whiteboard contents can be saved for later re-editing, display or printing. Used in conjunction with the chat tool, this makes for effective design collaboration.

Student Progress Tracking allows the instructor to monitor student participation and progress. Each provides the instructor with some insight into the progress of the student through the course. It should be noted that all student progress information for a particular student is available not only to the instructor, but also to that student. This way every student can see first hand what information Web.

Technology and Education in Singapore

As an educational tool at Nanyang Technological University, computers are used mainly for communication and information gathering. The current state-of-the-art in most communication classes is a lecturer with e-mail and a web page that provides information about the class such as the syllabus, course handouts, and copies of exams, and relevant links on the WWW. Students are generally regarded as more technologically literate than faculty members, so faculty members may assume that students will find their own technological resources. Since college students are highly motivated and are comfortable with the standard lecture format, there has been little incentive for developers to design educational software at the university level. Also, professors often feel overwhelmed with technology and lack the time and energy to evaluate educational software and begin the process of integrating technology into their courses.

I find technology most useful for communicating with students. The web page provides students with an on-line syllabus, e-mail links to teaching assistants, old copies of tests, relevant links on the WWW, and pointers to newspaper and magazine articles of interest.

Certain topics in communication lend themselves well to interactive education. I would be very interested in software that guided the student through the concepts of writing, layout and design.

During lectures, slides are displayed on computer monitors in front of each student, and the same slides are made available on the web for students to review. In addition to electronic lecture slides, videos and computer demos are often shown during lecture. The course web page contains the syllabus, teaching assistant hours, on-line resources, and a newsgroup where students can communicate with each other and the teaching assistants. The course work is made up of several programming assignments that illustrate important concepts in the course.
Policy Issues

Bureaucracies at the different levels dominate educational policy. An intellectual establishment whose culture formed under a glacial rate of change dominates educational thinking. The image of "school as we know it" is deeply ingrained in our collective and individual consciousness. In addition, there is widespread confusion about the costs of technology and the costs of failing to provide it (Papert, 1997).

Creating classrooms where students work with technology on individualized and engaging projects requires a fundamental change in the curriculum and the way the universities are organized. It also requires an infusion of new technology, teacher retraining, and the production of excellent educational software. Seymour Papert states that the universities and colleges are lagging further and further behind the society it is intended to serve. Eventually, it will transform itself deeply or breakdown and be replaced by new social structures (Papert, 1997). Technology provides both the impetus and the means for positive educational change in the universities.

At the Nanyang Technological University, the open curriculum, level of student motivation, access to computers, and willingness to experiment with educational change, will help with the task of integrating technology into the curriculum. Providing students in the sciences with valuable tools for simulation, visualization, and exploration has proven to be a challenging problem that requires a great deal of creativity to solve. Even more creativity will be needed to answer questions such as: How would a journalism student use a computer simulation to predict social phenomena in the inner city? Could a student use a graphical representation of historical events to enhance their understanding of history, culture and economy? How can a 3D-information space be used to convey information to a journalism student who is interested in economics reporting? The challenge at Nanyang Technological University is to develop interactive education that provides students with experiences that they can't receive through standard channels such as lecture, research, or experimentation. The challenge for lecturers is especially daunting. In most cases, nothing in their professional training or teaching experience has prepared them to be comfortable with and knowledgeable about technology.

Research Issues

An empirical research program is needed to focus on the issues of adoption of information technology in teaching in higher education and professional training in Asian countries. For the teaching on the net, there is also the implication that we must conduct research that not only builds on the body of knowledge, but also assesses how that knowledge can be integrated within and across disciplines, how it applies within real-world contexts, and how we can best teach and train others using information technology.

Conclusion

New learning environments that are based on the principles of active learning are being developed in many institutions. They reflect a change in the culture of education (Tobia, 1990;
Wagener, 1991) from teacher-centered to learner-centered education. Teacher involvement, full student interactivity, and richness of content are all prerequisites for effective use of technology in the classroom in the higher education. Integration of digital network technologies into broader school reform efforts, providing access to digital libraries, multimedia educational programs and wide-area networking capabilities for improved communication access.

While computers do not provide a panacea, computer assisted learning does offer new ways of meeting the challenges we face: rising student numbers, tighter budgets, a job market which demands flexible and transferable skills, and a society which expects quality and good value from its education system.

The advantages of computer assisted learning over other forms of teaching remain controversial. However, case study evidence suggests that computer assisted learning provides a number of benefits: new technologies provide access to learning at a time and place to suit the student, overcoming many traditional barriers to access appropriate use of computer assisted learning can release staff time, allowing greater investment in small group teaching interactive and multimedia delivery systems enhance motivation and, if used effectively, reinforce learning. It provides a student-centred learning environment tailored to the pace and learning style of the individual students receive immediate feedback and teachers can carry out rapid and continuous assessment real-time or time-independent communication can take place among students and staff within and between institutions access to the Internet and WWW provides vast resources for assignments and research.

This paper has considered a possible scenario whereby failure to embrace the technology in teaching may have serious implications for the quality of teaching and student learning. And it has suggested that educators be proactive in seeking out the technology, learning about what it offers and experimenting with it in order to assess how it should be used. A number of starting points have been offered and material relevant to virtually all courses taught will be found at one or more of those locations. The paper has not considered the research perspective, for which the potential of World Wide Web is, if anything, greater than its teaching potential. That is an issue that should be borne in mind whenever accessing World Wide Web: it is not a docile reference book, or an infrequently updated CD-ROM. It is a dynamic, constantly changing resource of immense potential to change the way we teach and the way we conduct research. If the academic community can grasp the resource early enough they will be better able to shape it for the future and everyone, academic and student alike will be the richer because of it.

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