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Directions for Future Research in On-line Distance Education

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Introduction

In the last twenty years, educators' interest enhanced dramatically as a result of the great advances in media and telecommunication technology, which resulted in an increase in the subject areas offered by distance education programmes. By the early 1980s, the rapid developments in computer accompanied by easy-to-use, flexible and effective ways of storage and distribution of course materials created a new paradigm of distance education. These features, plus the interactive nature of the computer as an instructional medium for individualised instruction, have attracted distance educators more than any other medium ever and developed the nature of distance education systems to be more effective delivery modes (Gray, 1988).

However, although Computer-Based Instruction is very popular and appropriate for many students, it is characterised by many delivery and pedagogical problems (Keegan, 1988). For example, the feeling of isolation from the tutor and peers, lack of tutor support, lack of convenient and effective interaction, lack of strategies for involving learners actively in the programme, inappropriateness of delivering many subject matters, difficulty of access to appropriate learning resources, unfamiliarity with the self-study approach and problems of managing far students are the most common problems that characterised the use of CAI in distance education programmes (Keegan, 1990; Bates, 1995; Jones et al., 1996).

The real development in computer-based instruction was established when followed by a revolution in the concept of networking and Computer-Mediated Communication (CMC). Using CMC, interaction between the tutor and distance learners has been established using different forms of computer-based conferencing and students have been able to access a variety of learning resources located in other computers and exchange information with one another (Mcmillan, 1997). CMC has become more popular with the evolution of the Internet and the World Wide Web.

A review of the literature showed that although an enormous number of studies were conducted in the area of on-line education, most of them investigated the effectiveness of Web-based interaction or Internet conferencing on learning, not the entire on-line learning environment (Atkinson, 1992; Fulford and Zhang, 1993; Foley and Schuck, 1998; Graham and Scarborough, 1999; Harris, 1999). Even in those studies that investigated entire on-line environments, student achievement was the most common indicator for evaluation and no other indictors or factors (such as student satisfaction), which may influence students' achievement, were investigated to give more comprehensive understanding of the effectiveness of Web-based distance education (Lockee et al., 1999).

Current research in on-line distance education

Although there is a growing interest in offering courses via the Web for remote students, reviewing the distance education literature has shown that research in Web-based distance education accounts for a small portion of this literature. The vast majority of this research has been hypothetical, theoretical or descriptive rather than empirical. The aim of these studies was to investigate the features and capabilities of the Web in order to apply them in designing

and developing future Web-based distance education programmes (e.g., Berge, 2000; Miller and Miller, 2000; Spector and Davidsen, 2000; Weston and Barker, 2001).

Jung and Rha (2000), for example, found that although numerous studies have explored various aspects of on-line education, 'only a few attempts have been made to investigate the effectiveness of online education based on empirical data' (p. 57). In addition, 'a few researchers have offered guidelines for designing technically interactive Web-based learning functions' (Chou, 2003, p. 268). Only in the last few years research has been carried out to 'provide us with information to help in designing programs to better meet the needs of distance education learners' (Chen, 2001, p. 459-460).

The most extensive literature review on Web-based distance education was conducted by Jung (2000), in association with the American Center for the Study of Distance Education. She reviewed the Web-based distance education literature (62 studies) between 1997 and 1999 published in four refereed journals and concluded that:

> 'Most of these studies have focused on the effective design of Internet-based education using the various technical features of this technology. The pedagogical features of Internet-based education have been also discussed, and effects of the Internet on learning, participation, and attitude have been investigated in several studies. In addition, there have been a few papers that report on the cost-effectiveness of the Internet-based education'.

Jung summarised the results of her review according to the research methodology and focus of the study, as shown below (Table 1). The results showed that only 26% of these studies adopted quantitative or qualitative, true or quasi-experiments for their research methodology, while 31% of these studies reported the design and development approaches implemented in developing Web-based educational systems. Out of sixty-two studies, 52% focused only on Web technology as a stand-alone medium, without involving any other technology. Jung expressed the criticism that although the majority of these studies reported the design of research, design of interaction and learners' satisfaction and achievement, few of them explained the pedagogical approach or theory employed in learning, how learning happened and why it happened.

Table 1. Classification of Web-based distance education research by methodology and focus (adapted from Jung, 2000)

Classification	Category	Number (Percent)
Methodology	Developmental studies	19 (31%)
	Experiments	16 (26%)
	Evaluation studies	15 (24%)
	Ideas and positions	12 (19%)
	Total	62 (100%)
Focus	Internet-based education in specific	32 (52%)
	Internet-based education along with other technologies	17 (27%)
	Computer conferencing in general	13 (21%)
	Total	62 (100%)

Based on Jung's framework of review, examples of developmental, empirical and evaluation studies are reviewed in the present study to shed light on current research in Web-based

education. Basically, the studies reviewed fall into four major categories, as shown below.

Strengths and weaknesses of on-line learning

The most common type of developmental studies in Web-based instruction was conducted to investigate the strengths and weakness of the design of on-line environments. One of the earlier studies was conducted by Heath (1997) who designed, developed and evaluated the strengths and weakness of a 'virtual' online classroom. The purpose of Heath's study was to suggest a model to be followed in further development research. Heath surveyed and interviewed twenty college students, as well as experts, to gather suggestions and critiques to be used in future design of virtual classes. The results revealed that most students favoured the user-friendly design of the user interface and a straightforward navigation system. However, the major weakness was found in the design of discussion boards that require reading, jumping forward and back, thinking and posting. Heath concluded that:

> 'Some students did not understand the concept of threading and posting to existing messages. And as a result, new threads were frequently incorrectly posted. This often made the direction of the discussion confusing' (Heath, 1997, p. 141).

In this study, students' feedback and behaviour in discussions emphasised the importance of instructor's participation, the need to reduce the number of threads per discussion and the need to prepare students to learn and interact on-line.

Another approach to conduct more beneficial research in Web-based distance education is the use of longitudinal studies. Lockee et al. (1999) pointed out that:

> 'The collection of data over time can provide a more accurate perspective, whether through qualitative case studies rich in descriptive information, or more quantitative time-series analyses, which may demonstrate patterns in certain variables' (p. 39).

An example of this approach is the study conducted by Graham and Scarborough (1999) over two years at Deakin University in Australia. In their empirical study, they compared the potential and benefits of on-line learning to traditional method. Students were allocated to a traditional method group and a FirstClass group. The traditional method involving printed course notes, phone contact with staff, assessment via assignments and final exams. FirstClass provided students with asynchronous and synchronous communication tools and facilitated access to on-line resources and sharing files. Analysis of results was based on overall final exam grades, questionnaires administered over a two-year period and interviews with the staff. The findings showed that although the performance of 60% of on-line students improved in the second year of the programme, compared to traditional method students and access to the lecturer is a great potential benefit of on-line learning, the need to keep up to date with fortnightly exercises reduced the flexibility of on-line distance education. In addition, Graham and Scarborough concluded that measuring learning outcomes using only final grades in evaluating on-line learning systems is limited and fails to recognise the actual benefit of interactive learning, flexibility and collaborative learning activities.

Cost-benefit of Web-based distance education

Few exploratory developmental studies in Web-based distance education have investigated the full direct costs or costs and benefits of Web-based distance education. The aim of these studies is to investigate the several key design elements that should be considered in costing Web-based distance education. Two comprehensive case studies were conducted in this area by Whalen and Wright (1999) and Zlomislic and Bates (1999). The purpose of these studies was to develop a cost-benefit methodology to be considered in analysing and understanding

the costs of Web-based distance education projects.

Whalen and Wright (1999) conducted a case study to analyse and compare the cost and evaluate the effectiveness of training courses provided by Bell Online Institute in Canada. They developed and delivered three courses on four different learning platforms (WebCT, Mentys, Pebblesoft and Centra Symposium). Their methodology divided project costs into fixed capital costs and variable operating costs. According to Whalen and Wright, fixed costs analysis helps to 'determine whether the high fixed costs associated with providing learning in a technology-enabled format are justified in comparison to the costs of traditional classroom' (p.30). These costs include licence fees for learning platform software, costs of hardware (server and clients), costs of course development (including instructional design, the production of text, graphics and multimedia, software development and course testing) and developers' salaries. However, variable costs are the tuition fees, training costs, usability testing costs and travel costs.

The results of cost-benefit analysis showed that although Web-based education seems to have higher fixed costs than the traditional campus, the total cost per student was offset by lower variable costs due to two reasons: the reduction in course delivery time and the potential to deliver courses to a wider range of learners without additional costs. However, to make savings and recover high the fixed costs, Whalen and Wright emphasised the need to consider three variables in developing and delivering on-line costs. These variables are the number of students per course, multimedia objects in the content and the live presence of the instructor during delivery. A sufficient number of students and limited multimedia elements and instructor presence could offset the high total cost of the course. Lastly, Whalen and Wright (1999) argued that this methodology could provide more comprehensive understanding of the cost benefit of on-line learning and be used in conducting future cost-benefit studies of Web-based distance education.

Using a similar, but more generic, methodology, Zlomislic and Bates (1999) developed and applied a cost-benefit model for assessing Web-based learning at the University of British Columbia (UBC). The methodology developed in their study was based on Bates' (1995) ACTIONS model. Cost measures assessed in this study include capital and recurrent costs, production and delivery costs and fixed and variable costs. Benefits include learning outcomes, student/instructor satisfaction, increased access, flexibility and ease of use as well as other 'value added' benefits (e.g. reduce traffic and pollution and the potential of new market). Both quantitative and qualitative techniques were used with a sample of 80 university students. Cost findings revealed that start-up costs were higher than anticipated, students thought the course was worth the money it cost them to take it and on-line courses can be cost effective, especially when marketed internationally.

Regarding benefits, it was found that students were able to access instructors and experts, access to on-line courses was flexible in terms of time and place and students were satisfied with the course materials, the user-friendliness of the design, individualised tutor feedback and peer interaction and development and delivery of courses can be made very quickly (Zlomislic and Bates, 1999). Zlomislic and Bates claimed that this cost-benefit methodology allowed them to take a detailed look at the distance education project, provided an accurate approach of measuring the costs of on-line courses in a real context and could be very useful in conducting future cost-benefit analysis of similar projects.

Students' perception and performance in online learning

Another common area of research in Web-based distance education is investigation of the effectiveness of online delivery of course materials in students' perception and learning

outcomes, especially in comparison with traditional classroom. Schlough and Bhuripanyo (1998) developed a Web-based instruction programme for graduate students at the University of Wisconsin-Stout. After eight weeks of interaction with the on-line content, the students (n=22) were asked to rate several statements using a five point Likert scale. Students cited organisation, relevance and accuracy of content as strengths of the course and provided positive feedback regarding the effective and attractive design of graphics and illustrations. On the other hand, lower scores were given for navigation and control over the program, instructional format of the course and peer interaction.

In addition, in a comparison between an on-line course and an equivalent course taught in a traditional face-to-face format using a five point Likert scale (1= strongly disagree, 5=strongly agree) Johnson et al. (2000) found that on-line distance education could be designed to be as effective as traditional instruction. The overall mean rating of the traditional class was 3.47 (SD = .60) and the mean rating for the on-line class projects was 3.40 (SD = .61). The results of this study showed student satisfaction with their learning experience to be slightly more positive for students in a traditional course format, although there was no significant difference in the quality of the learning that took place.

More recently, Gagne and Shepherd (2001) have supported the common finding of non-significant differences between Web-based distance education and conventional classes (conventional face-to-face lecture mode) using a well-described true experimental design, with a relatively larger number of students. The same course was delivered in the traditional format and via the Web. According to Gagne and Shepherd, the on-line course allowed students to engage in synchronous (chat) and asynchronous (e-mail and forums) interaction to communicate with the instructor and with each other. They were given their own workspaces where they could exchange files with the instructor and with each other. To enhance comparability, the same text, syllabus, assignments and examinations were used in both classes. Moreover, the same lecturer taught both groups.

Analysis of variance was used to investigate how much the two classes differed from each other and how much the students' demographics (e.g., work experience, academic background, etc.) within the classes differed. The findings indicated that the performance of on-line students was similar to that of those in the on-campus course. Furthermore, Gagne and Shepherd concluded that although students' perceptions of the course were similar, students in the online course indicated that they were less satisfied with the presence of the on-line instructor than the traditional class students.

Non-comparative studies

While the above studies compared the effectiveness of the Web with a traditional class or other media, there are a few non-comparative studies that concern or examine factors that may be related to successful on-line learning and students' satisfaction or how students with different learning styles perform in Web-based distance education. For example, Shih et al. (1998) designed and developed two stand-alone Web-based courses, which they tested on 78 university students. The purpose of this study was to identify relationships among student learning styles, learning strategies, patterns of learning and achievement. An on-line questionnaire including a learning strategies scale, a patterns of learning scale and demographic questions was designed and posted on the Web for this purpose. In addition, students completed a learning styles test. The results of this study indicated that learning styles, patterns of learning toward Web-based instruction and student characteristics did not have an effect on students' achievement.

Also, Jiang and Shrader (2001) conducted an exploratory study to investigate many factors

that might contribute to students' academic achievement and satisfaction with an on-line environment provided by Western Governors University. These factors are pre-assessment results, interaction with the mentor, number of on-line courses taken and demographic profile (e.g., age, gender, age, current position, etc.). Participants in this study were 120 students enrolled in a Master's programme. They learned via direct interaction with on-line course materials and the mentor using e-mail, listservs and threaded discussions. The researchers developed a questionnaire to reveal students' satisfaction with the programme and used the results of pre-assessment and raw count of students' messages. Using correlation analysis and multiple regression analysis, the researchers found that:

1. Students' overall satisfaction was high, with a mean score of 3.18 on the four-point rating scale. They felt most satisfied with the flexibility of time and place provided by the on-line course;

2. Only student-mentor interaction had a significant relation with students' satisfaction and academic progress.

3. The various demographic variables did not bear any significant relationship with satisfaction and academic progress.

Jiang and Shrader found that the more the students communicated with their mentor, the more motivated they were and the more academic help they obtained from their mentor, therefore they progressed faster and were more satisfied with on-line learning.

One final interesting study was conducted by Carey (2001) to examine the effect of practice tests and feedback strategies on academic achievement and motivation in Web-based instruction. Forty-five undergraduate students enrolled in a Web-based assessment for teachers course participated in the study. All practice tests and feedback were contained within the Web site and there were a total of 42 practice tests embedded in the instruction. To create the two different practice test strategies, Carey divided the course Web site into two separate models. In the first model, questions related to the current instruction were presented, and students were directed to answer the questions using their own paper. They were then directed to check their answers against the feedback by scrolling down the web page. However, students were not forced to answer questions in order to receive feedback. In the second model, students took the practice tests using a test administration program, and they submitted their answers for the grading program. The program returned information about whether each item was correct or incorrect, as well as the total percentage of correct scores. Students were not forced to take the practice tests to continue through the instruction; but they could access feedback only by answering the questions.

The students were randomly assigned to either the self-scored or the computer-scored testing and feedback strategy. The findings showed that:

1. The computer-scored practice test group performed significantly better than the self-scored practice test group on both the midterm and the final examinations. In addition, the students in the self-scored group achieved at relatively the same levels on both the midterm and final examinations, while the students in the computer-scored practice group improved their achievement level between the midterm and the final.

2. The two groups were not significantly different in their ratings of their attention to practice and feedback materials.

3. There were no significant differences in the two groups' ratings of their confidence in performing course objectives or their satisfaction with their efforts during the course.

Carey argued that students' performances improved and were supported by the enhanced perception of the relevance of the practice and feedback, because students provided their own structure in the course and created their own interpersonal dialogue. He recommended that 'research should continue in strategies for narrowing the transactional distance for less mature learners'.

Summary of current research in on-line distance education

The above review of literature shows that developmental studies take one of three forms defined by Richy and Nelson (1996). These forms are:

1. Performing instructional design, development, evaluation activities and studying the process of distance education at the same time;

2. Investigating the impact of someone else's instructional design and development; and

3. Studying the instructional design, development and evaluation process as a whole, or a particular component (Richy and Nelson, 1996).

In evaluation studies, it was found that both the internal efficiency and the operational efficiency of the programme, as defined by Lam and Paulet (1991), are considered. Internal efficiency refers to 'the learners' achievements, the number of learners who successfully complete the courses or programs, and perhaps, the degree of satisfaction with the learning experience' (Lam and Paulet, 1991, p. 54), while operational efficiency refers to whether the revenue to the institution is sufficient to allow it to continue to offer the same programme for a long time or not.

In both developmental and evaluation studies, a research design was implemented to obtain and analyse research data (e.g., true or quasi-experimental, quantitative or qualitative, etc.). In addition, evaluation measurements, such learning outcomes, students' overall satisfaction, costs and benefits of the system, media attributes, implementation issues and factors associated with students' achievement and perception were implemented to examine the effectiveness of the Web in distance education.

In almost all of the above developmental and evaluation studies, first, on-line students performed as well as students in traditional classrooms and had the same attitudes toward the course. However, some factors might influence students' performance and perception. These include gender, age, academic experience, computer skills, student-instructor interaction and motivation. Second, research emphasised the role of the human contact in motivating and enriching students' experience. Third, although these studies pointed to increased interest and motivation to learn via the Web, they did not indicate:

1. the quality of student-student and student-tutor interaction and how they can affect students' performance;

2. the quality and ease of access to Web resources;

3. the potential of branching and user-interface capabilities of the Web (Smith and Dillon, 1999);

4. the best ways of integrating asynchronous interaction with the on-line learning; and

5. the technical support needed to deal with and learn via the Internet.

Moreover, in all these studies, participants were mature learners (undergraduate, graduate or

higher education learners) and no study investigated the Web-based distance education process with younger or school students. Therefore, further research is required to investigate approaches for designing and implementation of on-line learning for younger learners using appropriate learning theories and instructional design approaches.

Lastly, although most of the studies reviewed in this section were comparison studies, which have been criticised recently (Lockee et al, 1999), such studies could play an important role in providing distance educators with extensive experience in designing and implementation of the Web and the factors that could affect learning in a variety of settings, 'but only if those factors are adequately defined' (Smith and Dillon, 1999, p.20).

Frameworks for evaluation of distance education technologies

The lack of evidence of the quality and the cost-effectiveness of on-line learning, inadequate information about the factors that may contribute to students' academic success and satisfaction with on-line learning, in conjunction with the long history of contradictory results of distance education technologies, may lead to inappropriate and costly educational and policy mistakes (Clark and Salmon, 1986). Therefore, the need is emphasised to clarify and evaluate the effects of using the Web in teaching students at a distance using a comprehensive approach and a multi-level evaluation framework (Clark, 1994).

Previous studies in distance education and on-line learning claimed that evaluation of on-line learning needs to provide information about students' reactions to both instructional (e.g., interactivity, quality of teaching, quality of resources, etc.) and technical aspects (e.g., speed, ease of use, ease of access, etc.) of the medium and technology, with an indication of students' achievement of learning objectives and the cost-benefit/savings of implementing the new programme (Fulford and Zhang, 1993; Bates, 1995; Clark, 1994; Thorpe, 1998; Lockee et al., 1999; Whalen and Wright, 1999; Jung and Rha, 2000).

Smith and Dillon (1999), for example, proposed a framework for defining and comparing the variables of alternative distance education technologies. The importance of this model is that it was originally proposed to compare between distance education and classroom learning. In addition, it considers recent attributes (e.g., types of interaction, bandwidth and system interface), which make it more suitable when attributes of interactive technology (like the WWW) are considered. These variables are categorised into three groups: realism/bandwidth, feedback/interactivity and branching/interface (Table 2).

Table 2. Analysis of media attributes (adapted from: Smith and Dillon, 1999)

Category	Media	Attributes
Realism/Bandwidth	Images, motions, films and Video-conferencing	- Provide high realistic symbols and images - Richer and immediate learning experience - Support and activate cognitive processing
Feedback/Interactivity	Telephone, e-mail and discussion boards	- Correct misunderstanding and reinforce correct learning - Enhance meaning - Promote high-order learning (e.g., problem solving) - Motivate learners
Branching/Interface	Interactive CD-ROMs and the WWW	- Provide individual instruction - Offers immediate educational experience - Learners gain greater control over content - Increase learner autonomy

Realism is the concept that reflects the relative concreteness of a medium and bandwidth refers to how much information can be sent from site to site. Feedback indicates to the possibility of asking and answering questions and interactivity, fundamentally involves two-way communication, indicates the opportunity for dialogue between the tutor and students and among students themselves. Branching is a characteristic of instruction in which the sequence of instruction is determined by prior response and interface refers to seamless access to multiple information resources.

In addition, Bates (1995) suggested a generic framework called the ACTIONS model (Access, Costs, Teaching and learning functions, Interactivity and user-friendliness, Organisational issues, Novelty and Speed) to help in analysing and selecting the appropriate distance education technology.

Table 3. Bates' ACTIONS model for evaluation of distance education technologies

Features	Questions
Access	- How accessible is a particular technology for learners? - How flexible is it for a particular target group?
Costs	- What is the cost structure of each technology? - What is the unit cost per learner?
Teaching and learning	- What kinds of learning are needed? - What instructional approaches will best meet these needs? - What are the best technologies for supporting this teaching and learning?
Interactivity and User-friendliness	- What kind of interaction does this technology enable? - How easy is it to use?
Organisational issues	- What are the organisational requirements, and the barriers to be removed, before this technology can be used successfully? - What changes in organisation need to be made?
Novelty	- How new is this technology?
Speed	- How quickly can a course be mounted with this technology? - How quickly can materials be changed?

In terms of on-line distance education, access is the first criterion considered in deciding whether the technology, learning resources, the tutor and peers are accessible by students at a distance or not. Based on the ACTIONS model, three major factors influence access to Web-based instruction: demographics, standardisation and accessibility. Demographics refers to the availability of computers and Internet connection needed to access the Internet. Standardisation refers to the compatibility of the Web design with students' hardware and software. Accessibility refers to the ease of access to Web resources, the on-line tutor and peers within the on-line class.

In addition, the main assumption that encourages distance educators to use a new technology like the Internet is to reach a wide population of learners with significant cost savings (Inglis et al. 1999). However, the analysis of the cost structure and cost relationships of Web-based learning environments may show that it is not possible to conclude that shifting to the Internet is always less costly than other approaches (e.g., print and CD-ROMs). The costs resulting from using the Internet to deliver instruction are affected by many design and implementation-related factors, such as the purpose of the distance education programme, the objectives of learning, the pedagogical approach, the quality of learning materials, the lifetime of the course and enrolments (Hülsmann, 2000; Sadik, 2002)

Also, there are various quality criteria to be considered in the instructional and interactive features of on-line learning. These features are the quality of course materials (layout, graphics, presentations, etc.), the quality of course content (accuracy, comprehensiveness, etc.) and the quality of instructional design (teaching approach, activities, learning outcomes, etc.). For example, in terms of the quality of course content and materials, research indicated that a flexible learning sequence and rich course information are important features that should be considered in designing on-line materials. The organisation of the course content into logically segmented and small chunks of content, in particular, was found to make it easy to follow and manage learning (Sadik, 2002).

Directions for future research

The above frameworks point out avenues for future research in design, development and evaluation of Web-based distance education programmes. First, although there is no doubt

that the on-line learning environment and the traditional classroom are not equal in the nature of their educational experience, it is important to employ a variety of technologies to help students achieve 'equivalent' learning outcomes (Simonson, 2000). Simonson, Schlosser and Hanson (1999) argued that the more equivalent the distance education environment and traditional classroom, the more equivalent the outcomes of the learning experience.

In addition, according to Smith and Dillon (1999), it is not sufficient to conclude that a distance education programme is as effective as the traditional classroom. The attributes of the on-line environment (e.g., interactivity, immediate feedback, accessibility, ease of use, navigation, active engagement, user-friendliness, etc.) should be described and their instructional roles should be defined to understand how the attributes of the medium were employed to support learning. In addition, there are various quality criteria to be considered in the instructional features of on-line learning. These features are the quality of course materials (layout, graphics, presentations, etc.), the quality of course content (accuracy, comprehensiveness, etc.) and the quality of instructional design (teaching approach, activities, learning outcomes, etc.).

Therefore, more research is needed to compare and investigate how different approaches for the design and development of user-friendly interfaces, interactive, easy to use and accessible learning tutorials, quality course content and learning based on sound theories can affect students' learning and satisfaction with the program and reduce the on-line time spent in study. For example, there is a need to study how tutorial layout, navigation aids, and interactive multimedia components can be designed and organised in a navigation hierarchy of hyperlinks (e.g., sequencing design, exploration design, indexed design, etc.) to facilitate the following and control of course information. In addition, research is needed to investigate the relationship between the use of interactive functions and actual learning and the connection between learner's perceptions and usage of interactive functions and their overall satisfaction with on-line learning systems (Chou, 2003)

The importance of this type of research is that it can provide a generic framework to develop authoring systems that offer comprehensive approaches and tools to assist educators to establish their own standard tutorials in less time and with lower costs. Although current authoring systems (such as ToolBook Instructor) provide effective templates and tools for educators to develop course materials to be distributed off-line (using CD-ROMs), these systems and other on-line management platforms (such as Blackboard and WebCT) are limited and poor in their functions to develop on-line tutorials and cannot help developers to create on-line tutorials based on sound learning principles or pedagogy. The new authoring systems should be easy to learn and use by educators, who have not adequate technical and pedagogical skills to design their own tutorials from scratch. They should help developers by suggesting appropriate lesson content and materials to be added and flexible enough to take advantage of the new interactive capabilities and rich resources available on the Web.

Second, the costs resulting from using the Internet to deliver instruction are affected by many design and implementation-related factors, such as the purpose of the distance education programme, the objectives of learning, the pedagogical approach, the quality of learning materials, the lifetime of the course and enrolments (Sadik, 2001).

To realise the effect of these factors, three types of costs should be investigated: capital infrastructure costs, course materials design and development costs, and delivery and support costs. However, whereas it may be possible to estimate and compare the development and delivery costs of on-line learning, it might be unrealistic to compare between the capital infrastructure costs of establishing a virtual classroom and those of the traditional classroom

or other media, since each system has its own cost structure and lifetime.

For example, whereas on-line learning requires a substantial investment in training staff and purchasing and installing network infrastructure, servers, connection and programs, print and audiocassette programmes may require less investment in infrastructure to be established. However, the costs of establishing on-line learning environment could be dramatically offset when compared to the overhead costs of traditional classroom infrastructure and labour.

In addition, two major factors influence the development and support costs of on-line learning need to be investigated. These factors are the quality of on-line materials and the instructional design of the programme. Multimedia objects and interactive segments (e.g., input forms, interactive maps, etc.), for example, are usually incorporated into the learning materials to enhance the quality of learning and improve students' performance. These quality materials need more planning and programming time than simple textual materials, and require sophisticated production tools and skilful Web developers to develop and maintain them.

However, the results of research showed that it may be incorrect to believe that the use of interactive multimedia technology is able to enhance student learning (e.g., Whittington, 1987; Clark, 1994; Spencer, 1999; Joy and Garcia, 2000). Spencer (1996) reviewed the effectiveness of media attributes in student performance and indicated that, overall, audio or visual media (e.g., radio, films and television), which require expensive equipment, much time to develop and maintain, and skilful producers, may not automatically improve student performance when compared with other static and low cost media (e.g., textbooks and filmstrips). The information provided by these media 'is often too much, in quantity or speed of delivery, and the student perceives only a fraction of it, and understands even less' (Spencer, 1999).

However, in the case that a high quality and sophisticated presentation is required, research is needed to prove that on-line learning is more reliable and efficient than inexpensive and easy-to-deliver CD-ROMs. The significant recurrent costs of Web server maintenance, Internet connection, administering students online and technical support may eliminate any cost savings that can be made, from using the Internet. In CD-ROM delivery, the ratio of fixed costs to variable costs is quite high, since the costs of delivery are much less than the development costs. This high ratio allows the potential for economies of scale to be well exploited (Inglis et al., 1999).

Moreover, since offering distance students the opportunity for dialogue with the tutor is critical for social and academic support and reducing drop-put rates (Simpson, 2000), the implementation of synchronous and asynchronous student-tutor interaction approaches should be investigated with care. The first approach requires fast and expensive connection and highly-paid staff to arrange, moderate and conduct live discussions throughout the course. However, the second approach (asynchronous) requires much time and also highly paid staff for planning students' activities and quality materials to support asynchronous learning. This raises the questions of how many students can be handled per course or per hour and how these hours can be reduced without affecting the quality of learning (Rumble, 2001).

Third, research is needed to investigate how the amount and type of instructor involvement can affect the amount and type of student learning and participation (Angeli, Valanides and Bonk, 2003). In other words, there is a need to investigate the relationship between the presence of the on-line tutor at different levels and the quality of the distance education programme (including, learning outcomes, student satisfaction, cost saving, etc.). Examples of tutor presence approaches in on-line learning environments are the 'initial approach', 'act of

distance tutoring' and 'reflection about the process underway' (Trentin, 2000). The purposes of these approaches varied between 'breaking the ice' (low-level) between the student and the tutor to offer permanent support via conferencing throughout the course (high-level).

In this case, a question like 'do instructors with high/minimal course presence generate high/low levels of student satisfaction and success?' can be introduced. At the same time, since it was found that the higher levels of tutor presence or involvement are more costly than lower levels, there is a need to find alternative approaches that can be used to substitute or, at least, complement the tutor's roles in on-line learning environments. In addition, there is a need to study how much should be invested in tutor interaction to guarantee a high, or at least acceptable level of quality of on-line learning.

Third, although peer interaction may have not a direct impact on students' achievement, research indicated that high levels of peer interaction may be an important resource for learning and contribute to student performance (Moore, 1989; Anderson and Garrison, 1995). 'Asynchronous communication technologies (e.g., bulletin boards) permit time for learners to reflect, which is an essential step in building meaning and knowledge' (Miller and Miller, 2000, p. 164). Therefore, many issues and questions related to peer-interaction need more investigation. For example, while many different interaction tools are available, little research has been done to identify the interaction strategies that most contribute to student academic success. In this regard, many questions need to be answered. These questions may concern the ways of improving student-peers interaction and enhancing the quality of on-line learning, the social and cognitive factors affecting this quality and what interaction tools are needed to achieve learning objectives.

Lastly, although the literature addresses many academic advantages and cost-benefits of implementing on-line learning and how successful learning can be achieved, there is little information about students' non-academic needs (e.g., social and emotional needs) and how non-tutorial support can be provided for on-line students at a distance. This may include, advising and giving feedback on non-academic skills to promote study and developing leadership. Therefore, there is a need for future research to address this gap in the literature and explore the non-academic needs of on-line distance learners.

Conclusion

The above review of research in on-line learning shows that the Web support interactive, cost-effective, easy to access and user-friendly learning. However, Web-based distance instruction can be done well or poorly. Developers should investigate these different types of learning and the factors related in designing for learning. Research is needed to help in identifying the strengths and weaknesses of the Web in delivery of instruction, comparing students' perceptions and learning styles towards elements of Web-based distance education and identifying programme-related factors that are conducive for successful and less costly on-line learning.

References

Anderson, D. & Garrison, R. (1995). Transactional issues in distance education: The impact of design in audio-teleconferencing, the American Journal of Distance Education, 9(2), 27-45.

Angeli, C., Valanides, N. and Bonk, C. (2003). Communication in a web-based conferencing system: the quality of computer-mediated interactions, British Journal of Educational Technology, 34(1), 31-43.

Atkinson, R. (1992). Video conferencing by ISDN for distance and multi campus education, Report to the Department of Employment, Education and Training on a National Priority

(Reserve) Fund Grant, Perth, Murdoch University External Studies Unit.

Bates, A. (1995). Technology, Open Learning and Distance Education, London, Routledge.

Carey, L. (2001). Effects on Achievement and Academic Motivation of Computer-Scored Versus Self-Scored Practice Tests in Web-Based Distance Learning, Program Area Design and Development, paper presented at the Association for Educational Communications and Technology Annual Conference, Atlanta, GA, November 8-10.

Chen, Y. (2001). Dimensions of transactional distance in the world wide web learning environment: A factor analysis, British Journal of Educational Technology, 32(4), 459-470.

Chou, C. (2003). Interactivity and interactive functions in web-based learning systems: a technical framework for designers, British Journal of Educational Technology, 34(3), 265–279.

Clark, R. (1994). Media will never influence learning, Educational Technology Research and Development, 42(2), 21-29.

Clark, R. & Salmon, G. (1986). Media in Teaching, In Wittrock, M. (Ed.) Handbook or Research on Teaching, 3rd Ed., New York, Macmillan.

Foley, G. & Schuck, S.(1998). Web-based conferencing: Pedagogical asset or constraint?, Australian Journal of Educational Technology, 14(2), 122-140.

Fulford, C. & Zhang, S. (1993). Perceptions of Interaction: The Critical Predictor in Distance Education, the American Journal of Distance Education, 7(3), 8-20

Gagne, M. & Shepherd, M. (2001). Distance Learning in Accounting: A Comparison Between a Distance and Traditional Graduate Accounting Class, T.H.E. Journal, 28(9), Retrieved June 23, 2002 from http://www.thejournal.com/magazine/vault/A3433.cfm

Graham, M. & Scarborough, H. (1999). Computer mediated communication and collaborative learning in an undergraduate distance education environment, Australian Journal of Educational Technology, 15(1), 20-46.

Graham, M. & Scarborough, H. (1999). Computer mediated communication and collaborative learning in an undergraduate distance education environment, Australian Journal of Educational Technology, 15(1), 20-46.

Harris, R. (1999). Computer-conferencing issues in higher education, Innovations in Education and Training International, 36(1), 80-91.

Heath, M. (1997). The Design, development, and implementation of a virtual online classroom, unpublished Ph.D. dissertation, Faculty of the College of education, University of Houston.

Hülsmann, T. (2000). The Costs of Open Learning: A Handbook, Oldenburg, Bibliothecks-und Informationssystem der Carl von Ossietsky Universität Oldenburg.

Inglis, A. (1999). Looking back, looking forward: celebrating a quarter century of serving distance education 'down under', Distance Education, 20(1), 7-29.

Inglis, A. et al. (1999). Delivering Digitally: Managing Transition to the Knowledge Media, London, Kogan Page.

Jiang, M. & Shrader, V. (2001). Building a revolutionary way of learning: A study of a competency-based on-line environment, paper presented at the 82nd Annual Meeting of the American Educational Research Association, April 10-14, Seattle.

Joy, E. and Garcia, F. (2000). Measuring Learning Effectiveness: A New Look at No-Significant-Difference Findings, Journal of Asynchronous Learning Networks, 4(1), Retrieved February 22, 2001 from http://www.aln.org/alnweb/journal/Vol4_issue1/joygarcia.htm

Jung, I. (2000). Internet-Based Distance Education Bibliography: 1997-1999, the American Center for the Study of Distance Education (ACSDE), Retrieved September 16, 2001 from http://www.ed.psu.edu/acsde/annbib/partaevaluation.asp

Jung, I. & Rha, I. (2000). Effectiveness and cost-effectiveness of on-line education: A review of the literature, Educational Technology, 40(4), 57-60.

Lam, Y. & Paulet, R. (1991). Beyond cost-effective analysis of distance education, MCGill Journal of Education, 26(1), 53-64.

Lockee, B. et al. (1999). No comparison: Distance Education Finds a New User for 'No Significant Difference', Educational Technology Research and Development, 47(3), 33-42.

Mcmillan, W. (1997). The effect of Computer-mediated discussion on Learning for the non-traditional high education student, unpublished Ph.D. dissertation, the Graduate School of Wayne State University, Michigan.

Miller, S. & Miller, K. (2000). Theoretical and practical considerations in the design of Web-based instruction, In Abbey, B., Instructional and Cognitive Impacts of Web-Based Education, London, Idea Group Publishing.

Moore, G. (1989). Three types of interaction, Editorial, the American journal of Distance Education, 3(2), 1-6.

Richy, R. & Nelson, W. (1996). Developmental research, In Jonassen, D. (Ed.) Handbook of Research for Educational Communication and Technology, Simon & Schuster MaCmillan, New York.

Rumble, G. (2001). The Costs and Costing of Networked Learning, Journal of Asynchronous Learning Networks, 5(2), Retrieved July 9, 2002 from http://www.aln.org/alnweb/journal/Vol5_issue2/Rumble/Rumble.htm

Sadik, A. (2001). Evaluation of a Web-based learning environment for teaching students at a distance, paper presented at CAL 2001 Conference, April 2-4, University of Warwick, UK

Sadik, A. (2002). The Design, Implementation and Evaluation of a Web-Based Learning Environment for Distance Education, unpublished Ph.D. dissertation, Institute for Learning, University of Hull, UK.

Schlough, S. & Bhuripanyo, S. (1998). The Development and Evaluation of the Internet Delivery of the Course 'Task Analysis', SITE 98: Society for Information Technology & Teacher, Proceedings of the Education International Conference, March 10-14, Washington, DC.

Shih, C. et al. (1998). Learning Strategies and Other Factors influencing Achievement via Web Courses, Distance Learning' 98, proceedings of the Annual Conference on Distance Teaching & Learning, August 5-7, Madison WI.

Simonson, M., Schlosser, C. & Hanson, D. (1999) Theory and distance education: A new discussion, the American Journal of Distance Education, 13(3), 60–75.

Simonson, M. (2000). Making decisions: The use of electronic technology in online classrooms, In Weiss, R., Knowlton, D. & Speck, B. (Eds.). New Directions for Teaching and Learning:

Principles of Effective Teaching in the Online Classroom, San Francisco, Jossey-Bass Inc.

Simpson, O. (2000). Supporting Students in Open and Distance Learning, Open and Distance Learning Series, London, Kogan Page.

Smith, P. & Dillon, C. (1999). Comparing distance learning and classroom learning: Conceptual considerations, the American Journal of Distance Education, 13(2), 6-23.

Spector, J. & Davidsen, P. (2000). Designing technology-enhanced learning environments, In Abbey, B., Instructional and Cognitive Impacts of Web-Based Education, London, Idea Group Publishing.

Spencer, K. (1999). Educational Technology – An Unstoppable Force: a selective review of research into the effectiveness of educational media, Educational Technology & Society, 2(4), Retrieved January 2001 from http://ifets.ieee.org/periodical/vol_4_99/spencer.html

Thorpe, M. (1998). Assessment and 'third generation' distance education, Distance Education, 19(2), 265-84.

Trentin, G. (2000). The Quality-Interactivity Relationship in Distance Education, Educational Technology, 40(1), 17-27.

Weston, T. & Barker, L. (2001). Designing, implementing, and evaluating Web-based learning modules for university students, Educational Technology, 41(4), 15-22.

Whalen, T. & Wright, D. (1999). Methodology for cost-benefit analysis of Web-based tele-learning: Case study of the Bell Online Institute, the American Journal of Distance Education, 13(1), 24-44.

Whittington, N. (1987). Is Instructional Television Educationally Effective? A Research Review, the American Journal of Distance Education, 1(1), pp. 47-57.

Zlomislic, S. & Bates, T. (1999). Assessing the costs and Benefits of Technology: A Case study from the University of British Columbia, NCE-Telelearning, Retrieved February 19, 2002 from http://det.cstudies.ubc.ca/detsite/framewhat-index.html

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