Information Systems Education: The Effectiveness Of Using Web Technology

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Abstract

Many universities are incorporating Web technologies into their teaching programmes. A wealth of literature exists on the worth of these technologies for providing an effective teaching and learning environment in general rather than in specific subject areas. This study explores the use of Internet technology to support the learning process in an information systems course. The results of this study indicate student performance has been enhanced through the use of Web technology and they believe Web-based technologies provide an effective learning environment. Further research is needed in this area to corroborate and extend these findings.

Keywords

IS Education, Educational IS, Educational Technology, Innovation in Education, Flexible Delivery

INTRODUCTION

Many universities have increased the use of technology as an alternative to traditional teaching methods particularly Web technologies. At the same time, universities are being pressured to increase the level of flexibility built into their degree programmes. Many universities have adopted a process whereby Web technology is being used to provide more flexibility in their teaching programmes. This paper will present several reasons for implementing change in the teaching and learning environment. Two frameworks for implementing and using computing technology in a teaching-learning environment will be discussed in the first section. An overview of the current research focusing on technology, particularly Internet technology, will be undertaken next. However, while much of this research concentrates on learning outcomes and learning styles, little attention is directly focused on the usefulness of Internet technology in teaching particular subject areas, for example information systems. The final section describes an exploratory study on the use of Internet technology to support the learning process in a second-year information systems course. The study is the first step in determining whether the use of Internet technologies as part of the strategies for teaching information systems is essentially different to other areas.

REASONS FOR CHANGING THE EDUCATIONAL PROCESS

Pressure for change on the way universities have traditionally met the educational demands of the marketplace is increasing. New technologies such as the Internet, are effecting the learning and teaching process (Langlois 1997). While a university's long term prospects will depend on its ability to meet the increasing demands of the marketplace, the fundamental reasons for change must not be forgotten. Collis (1998) offers three compelling reasons, viz. re-affirming principles of high-quality teaching and learning, a changing student population and the diversification of their requirements and lastly, demand for more flexibility in the education process.

The need to periodically evaluate how the principles of high-quality teaching and learning have been implemented is important. Norman (1997) provides a succinct review of the key issues that

have emerged from the extensive base of theory and practice related to education in higher institutions. Learning occurs with the acquisition of information and the student becomes actively engaged in the cognitive process "*since knowledge is constructed and reconstructed through heuristic processes of creative thinking and interaction*" (Norman 1997, p. 51). Norman extends this proposition to include the assessment of student competencies by firstly listening and then providing appropriate feedback on their conclusions. The learning models employed in teaching must become more learner-orientated and process-based (Wright and Cordeaux 1996). The student should be guided into clear modes of thought, self-assessment and reflection (Berge 1997). The teaching and learning environment must provide feedback mechanisms as well as maximising the potential for communication and interaction between students and instructors and among the students themselves (Shabo, *et al.*1997). In addition to these key principles, two student-orientated learning principles should be considered, that is, students want to proceed efficiently through their studies and they probably will not have appropriate study skills or self discipline to do so (Collis and Meeuwsen 1998).

The diverse nature of its student body is a challenge to the University. While personal characteristics of the student population drawn from secondary schools have changed little, they are joined by a cohort that are diverse in their ages, educational backgrounds, work experiences and cultural backgrounds (Langlois 1997). The educational programmes required by today's cohorts are diverse and specific to the student's own circumstances. A standard range of programmes and programme choices is not suitable to this diverse student population. The University has met this challenge by opting to provide a range of programmes that are delivered in a more-flexible format that encompasses the use of Internet technologies.

The eclectic mix of students makes the task of providing educational material within a flexible framework difficult and complex. When considering flexibility, each course planner needs to identify the aspects of the programme that will become flexible. Flexibility is generally understood to mean offering the student some choices in the learning environment so that it can better meet her or his individual needs. Collis (1998) identified several forms of flexibility that were of particular importance to students including location, class times, assignment completion times, course content, amount of communication required and assignments relevant to their workplace. However, Collis also identified several limitations related to the degree and types of flexibility that can be offered. Logistical limitations can arise since an instructor has a finite amount of time in which to interact and communicate with students. Offering flexibility in entry and completion dates may exclude or limit the choice of class times and the amount of interaction with other students and the instructor. Further, limited resources such as budgets may preclude the development and use of interactive web-based exercises. Notwithstanding the above points, Collis regarded flexibility in location, programme structure, types of interaction, forms of communication and study materials were most important for combining the principles of high-quality teaching and learning.

Frameworks that Provide Flexibility in the Education Process

Laurillard (1993) and Newman (1990) have presented two frameworks that allow flexibility to be integrated into the education process. Both frameworks relate to the use of technology in education. In her study, Laurillard attempted to define characteristics of quality multimedia applications for education. She identified four primary aspects of the teaching and learning process, viz. discussion, interaction, adaptation and reflection. The interactions between these aspects are illustrated in Figure 1. Many of the principles for high-quality teaching and learning are evident in Laurillard's model of the ideal learning process. The required flexibility can be incorporated into the model.

Newman (1990) proposed a framework for implementing and using technology in education. The framework has four steps and a prerequisite step that establishes the educational unit's goals:
1) Determining strategies to create an effective teaching and learning environment,

2) Analysing how technology can support the strategies,
3) Investigating new technologies to improve teaching and learning environments, and
4) Proposing avenues for further research.

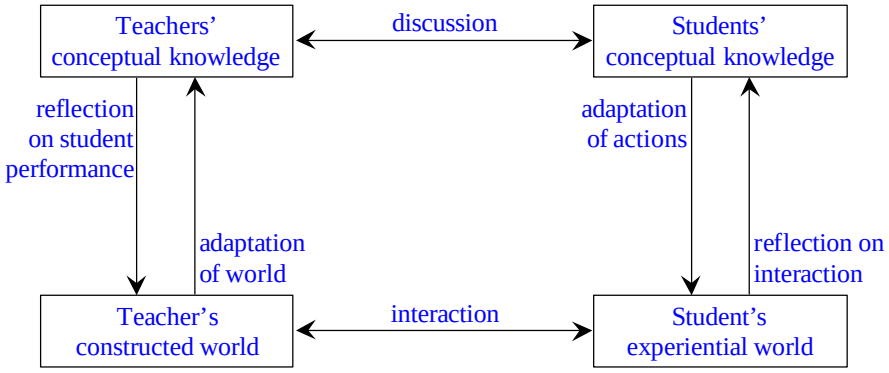

Figure 1: Essential aspects of the ideal-learning process (Source: Laurillard in Phillips (1997, page 23)).

The objective of any learning environment should be to ensure that there are opportunities for learners to develop competencies in the course material being taught. Any subsequent improvements to the learning environment must continue to support this goal. In order to determine how computers can best be applied to support learning, strategies for creating an efficient and effective learning environment must be established. Once the learning strategies have been determined, the technological infrastructure required to support them can be identified. Egbert (1993) identified several strategies for creating an effective learning environment that are applicable to almost any classroom situation. Her strategies are summarised in Table 1.

Strategy # 1	Provide opportunities for learners to interact
Strategy # 2	Provide an authentic audience and opportunities to negotiate meaning
Strategy # 3	Create/Use authentic tasks
Strategy # 4	Promote exposure to and production of rich and varied language
Strategy # 5	Provide learners opportunities to formulate ideas and thoughts
Strategy # 6	Promote intentional cognition
Strategy # 7	Create an atmosphere with optimal stress and anxiety
Strategy # 8	Create a learner-centred classroom

Table 1: Strategies for Creating an Effective Learning Environment (Source: Egbert (1993, page 302)).

The import of these strategies has been summed up by Gaies (1989) when asserting educators must recognise and understand who their students are and where their experience and interests lie. They must also provide opportunities for stimulating learning and fostering interaction and collaboration between the students themselves and the teacher. In this respect, both Laurillard's and Newman's frameworks are complementary.

Providing Effective Teaching and Learning Environments via Internet Technology

A teaching and learning environment that incorporates Internet technologies, such as hypermedia, chat rooms and bulletin boards, can be considered as beneficial. Hypermedia can provide opportunities for interaction and negotiation amongst learners by supporting real-time interaction

in many ways (Strategies 1 & 2). Hypermedia can not only provide task-content, it is able to focus on task-processes, so users can create and use tasks that have practical applications, thus increasing knowledge (Strategies 3 & 6). Hypermedia can expose learners to a rich and varied language via a range of real-life tasks and information from other applications (Strategy # 4). Time spent on tasks is enhanced as learners can view and reply to ideas input by other students during chat sessions (Strategy # 5). Hypermedia permits students to work at their own pace and in their preferred manner thereby increasing participant comfort levels and reducing stress and anxiety (Strategy # 7). Control of the hypermedia learning environment is given to the learners (Strategy # 8).

However, several potential disadvantages can occur. Constrained social interactions may diminish outcomes and attainment of lesson goals (Strategy # 1) and reduce participation (Strategies 2 & 7). Applications of real tasks may be discarded due to a student's lack of creativity or failure to perceive external relevance (Strategy # 3). Increased comfort may promote using informal or common language not a rich and meaningful one (Strategies 4 & 7). Learners may not fully comprehend comments due to time constraints or the inability to obtain adequate feedback (Strategies 5 & 6). Learners, hesitant in taking control may resort to more traditional delivery methods (Strategy # 8). Many of these disadvantages can be minimised or overcome with appropriate planning and lesson structuring. Hence, Internet technologies can be regarded as a suitable technology for creating effective teaching and learning environments. Empirical research, the last step in Newman's framework, must be conducted to learn, amongst other things, whether this contention is supported.

RESEARCH USING INTERNET TECHNOLOGIES FOR EUCATION

A plethora of research exists on the use of Internet technologies for teaching and learning settings. Several researchers have undertaken reviews of the literature in an attempt to provide some structure and synthesize the research findings (for example see, Landauer 1995; Chen and Rada 1996; Dillon and Gabbard 1998). Much of the work does not have any scientific rigour and provide little support for the claims made (McKnight, *et al*. 1996, Dillon 1996). Landauer (1995) reported that he could find only a handful of studies that met minimally acceptable scientific rigour notwithstanding the numerous published reports in this area. Chen and Rada (1996) found 18 experimental studies of note. Analyses conducted in both studies revealed little advantage for web technologies over other media in general information tasks. The more recent analysis conducted by Dillon and Gabbard (1998) extended Landauer's work into the learning domain and attempted to provide a baseline review of experimental findings on the quantitative effects of hypertext/hypermedia on learning outcome. Research in associated areas, such as hypermedia interface design and development of hypermedia applications, were not considered. Further, the studies that reported only qualitative learner/instructor responses were excluded.

Dillon and Gabbard (1998) categorised the research into three distinct themes: comprehension of presented material, learner control over presentation of material and individual differences in learning style. Each of these themes will be discussed further in the following sections.

Summary of Literature on Comprehension

The comprehension measures used in the various research studies seek to determine the extent to which hypermedia is responsible for the students' gain in knowledge. This is primarily due to hypermedia being able to support structured access to presentation materials, manipulate the required information rapidly and the high degree of control the learner has over the environment. Dillon and Gabbard concluded that as a host of comprehension measures were used in the studies analysed, comparisons were difficult to undertake. The different methods employed further compounded the analysis, for example, material presented using hypertext was compared to those using paper or the comparison was between different hypermedia structures. In the majority of studies analysed, only a small number of students (<20) were selected and the task involved was quite specific. Their main conclusion was that no significant increase in comprehension was due

to the use of multimedia as compared to use of paper. Three of the papers analysed by Dillon and Gabbard examined the various hypermedia forms and their impact on student learning. No overall conclusions were drawn as they regarded the research base to be too small.

Summary of Literature on Learner Control

One of the advantages of hypertext and hypermedia is its ability to place control over the learning environment with the student. Many researchers have alleged that the enhanced level of control learners have over their environment has had positive effects on their learning. Dillon and Gabbard analysed the research studies that investigated the impact of manipulating learner control. They regarded learner control as being difficult to measure and questioned the validity of the operationalisation of the some of the control variables used. While there are many ways to manipulate control, most researchers employed selectable links and paths as the control variable. The evidence provided bymost of the research indicates that the ability of learners to control the environment does not significantly impact learning outcomes except for learners with a high-level of prior knowledge.

Summary of Literature on Learning Style

Research attention has also been focused on the personal characteristics of the learner, particularly level of prior knowledge and experience with technology as well as learning styles (the learner's distinct approach to learning). Dillon and Gabbard, in evaluating the findings of the research investigating the impact of prior knowledge, concluded that it contributes to, but did not fully explain the differences in learner performance. Attention was focused on learning style because it can be considered independent of learner ability. Learning style has been the focus of a large body of research, however, there does not seem to be any consensus on which measure is appropriate. Learning styles reflect the learner's position on a continuum of traits such as holistic and analytic, verbal and spatial, reflective and impulsive or exploratory and passive. Several measures have been proposed: Field independence/field dependence construct; Passive versus active learners; Deep versus shallow processors. Dillon and Gabbard used these three categorisations in their analysis of the literature. Their overall conclusion was that learning styles offer an advance on other variables in explaining the difference in learner performance when using hypermedia. They concluded that low-ability learners could be supported more effectively using hypermedia learning environments. High-ability learners will out perform low-ability learners regardless of the presentation medium chosen.

Overall Conclusions from Literature

In summary, the use of hypermedia does not lead directly to significant gains in comprehension, nor do media characteristics or interface features impact gains. The third line of research, learning styles and other learner characteristics offer more hope when explaining gains in learner performance. However, there is considerable debate in the literature as to measures of learning style and in what instances they are relevant. One interesting point to be revealed in the literature is that low-ability learners or low-achievers benefit from the use of hypermedia and that the high-ability learners are seemingly indifferent. This would tend to suggest that hypermedia learning environments should be designed to support low-ability students rather than high-ability learners or at some point between the two extremes. While the research tends to support the contention that web technologies have potential for supporting an effective teaching and learning environment, its use must be carefully balanced against the desired learning outcomes. Gaies (1989) assertion that educators must recognise and understand who their students are and where their experience and interests lie has been largely ignored. Much of the research has focused on gains and performance improvement through the use of hypermedia, but little attention has been focused on the use of this technology for specific learning areas such as information systems. In an attempt to address this issue, this initial study explores user perceptions of the technology when used to teach a second-year information systems course.

THE STUDY

This section explains the methodology used in this exploratory study. The research question and propositions are examined and then the teaching and learning environment is explained in some detail. The undergraduate level course, *Information Systems Analysis*, was selected for this study. Characteristics of the students participating in the study are identified next. The following section explains the procedure used along with the various measurement instruments.

Research Question and Propositions

The research question of import was:

Do Internet technologies provide an effective teaching-learning environment for students studying information systems?

The proposition to be investigated is:

P1: The use of Internet technologies is an effective teaching-learning strategy for courses delivering information systems content.

Teaching and Learning Environment

Information Systems Analysis (ISA), a second year course within the Information systems major, was designed to run in a flexible mode to allow students greater choice of access, communication methods and presentation format. The course uses a conceptual framework that organises the knowledge and skills needed by management students into five key modules, each having several topics. Table 2 identifies the topics within each of the modules. The structure of the material closely follows the phases of the systems development life cycle (SDLC) – the primary analysis and development approach covered in this course.

Module One – Systems Planning Introduction Information Systems Analysis Data/Process Oriented Approaches Systems Development Life Cycle Systems Planning Problem Definition Information Gathering Determining Feasibility Project Scope Project Management	**Module Three – Systems Design** File and Database Design Entity Relationship Diagrams Normalisation Input and Output Design Systems Architecture
Module Two – Systems Analysis Determining Requirements Analysing Requirements Structured Analysis Tools Evaluating Alternative Strategies	**Module Four – Systems Implementation & Operation** Systems Implementation Application Development Installation and Evaluation Systems Management Support Activities Organisational Issues
	Module Five – Other Approaches Business Process Reengineering Analysis of Existing Information Systems

Table 2: Structure of the Content for the Course Information Systems Analysis

Teaching and learning activities were structured around two types of formal class, lectures (large group) and workshops (small groups). This approach provides opportunities for interaction and negotiation amongst learners by supporting real-time interaction (Strategies 1 & 2 in Table 1). Further it exposes students to a rich and varied language as well as promoting intentional cognition (Strategies 4 & 6 respectively). A web site was also provided for student use and learning, and it was set up on the University's Intranet via a network of Pentium desktop computers (Strategies 7 & 8). The workstations were located across the campus in computer laboratories, study centres and library. Students were able to access e-mail and the World Wide

Web. The web presence was established to support the student-centred learning approach and the site contained:

- course details – an overview of the course, learning objectives, and topic materials organised in a modular format as well as contact details for the teaching staff;
- assessment details and relevant supporting documentation as well as notes on how each topic applied to the assessment items;
- study materials including, workshop exercises, group activities and self assessment quizzes that provided the students with immediate feedback;
- resources including lecture summaries in PowerPoint format, links to useful web sites and a readings list with links to resources that were available on the textbook's companion web site;
- Frequently Asked Questions (FAQs) facility where the answers to common questions asked by the students were provided;
- Forum or chat facility through which students could interact with each other, and the teaching staff, to exchange ideas and seek help on any problems they may have encountered; and
- Notice Board on which the lecturer could announce events of interest, the availability of assessment material and concept tests, and provide feedback on assessment items.

The home page for ISA is divided into two distinct sections. The left–hand side of the screen provided an index of the site's contents. It is standard across all courses taught on the campus, although the options may differ according to the requirements of the course. The right-hand side provided access to the modules and the various topics as well as the resources and other relevant information about the course. To access the topics, the relevant module was clicked and then the desired topic. Once the student entered the module, any of that module's topics could be selected, as could any of the learning activities set for each topic. Learning materials were organised in a hierarchical structure with the same layout and format used for each topic. Students were able to access the site from outside the university so they could undertake learning activities at their own convenience (Strategies 1, 2, 7 & 8).

Students were provided, as a printed version, some of the study material available on the web site. The provision of a hard copy of this material ensured those students who preferred not to use the technology extensively were not disadvantaged (Strategies 7 & 8). The study guide contained a course overview, general assessment details, seminar (lecture) schedule, workshop schedule and outline, as well as the weekly workshop activities for the first half of the semester. The weekly activities for the remaining workshops were provided later in the semester. As part of the teaching strategy and to provide students with a sense of ownership and control, they formed informal study groups of 4-5 (Strategies 1, 2, 3, 5 & 7). Students were able to interact with other group members to discuss course material, exercises, events and assessment items.

While the Web site is capable of providing a degree of independence and control for the students, they were also able to discuss and analyse study materials and assessment items during workshops (Strategies 3, 4, 5, 6 & 7). These workshops were run on a regular basis, and although attendance was optional, they permitted students to interact with the teaching staff in a small group context (Strategies 1 & 8). Students were set exercises that could be completed in their own time and if problems or questions were encountered, these were then handled most effectively during the workshop sessions (Strategies 1, 2, 3, 5 & 6). The more difficult concepts within the course were illustrated through interactive examples delivered via the Web site (Strategies 6 & 7). The workshop exercises were structured to ensure appropriate coverage of the theoretical aspects of each topic in the first instance, and then the application of the theory to case examples in the second. That is, Laurillard's approach (1993) as applied to the course ensured students could discuss issues and interact with the teaching staff as well as other students. The students adapted the theoretical concepts when determining the solution to case study problems. The class then discussed these solutions and feedback from the teaching staff was provided.

Students had access to teaching staff outside formal class times at regular set times and at other times by appointment (Strategies 5, 6, 7 & 8). E-mail access could be gained at any time and staff would respond usually with 24-hour period (Strategies 4, 6 & 7). The students were

provided with a forum or chat facility through which they could exchange ideas and provoke creative thought (Strategies 2 & 6); however, they preferred to use their informal study groups. The electronic noticeboard was used as a means of communication, motivation and providing feedback on assessment items (Strategies 5 & 6). Since students were able to download topic summaries from the web site, the focus of the lectures was in providing appropriate examples of how the theory was applied in the business environment (Strategies 3, 4 & 5) rather than disseminating information.

The only element in the course that was outside the student's control was the assessment items and the dates on which they were due. The course was assessed in two ways, by concept tests delivered via the Web and a three-part group project. Students had access to self-assessment quizzes to test their understanding of each topic in the course. The three assessable concept tests examined the student's comprehension of the theoretical concepts. The questions for the assessable tests were drawn from the quiz question banks (Strategies 5 & 7). The students were able to undertake all of the concept tests at a time and location convenient for them provided it was before the test's withdrawal date (Strategies 7 & 8). The project material was drawn from a real world business application and required the students to apply the theory and skill developed during their studies (Strategies 3, 5 & 8). Representatives from the business presented an overview of their desired information system application. Students were able to ask the representative questions on the project at that time, and any subsequent questions were answered via e-mail (Strategies 5 & 8). By using a real world example for their assessment, students had to adapt the theoretical constructs to suit an actual problem environment. These activities provided another level of complexity to the learning approach – Laurillard 's approach - used in the workshops. Further, by submitting the project in three parts, students could gain feedback on their solution and incorporate that feedback into their next submission (Strategies 5, 7 & 8). The timing of the Concept Tests and the submission dates for the Progressive Project ensured students gained feedback on their understanding of the theoretical concepts before they were required to submit the corresponding part of the progressive project.

Procedure

The effectiveness of the Teaching and Learning approach was evaluated by comparing the performance of the 38 students enrolled in the course with their performance in previous courses. Just under half of the students were female (17), while only nine were over 25 years of age. All students were in their second year of full-time study in a Management degree and had completed two information systems courses. Two measures of performance were taken: the differential between performance on Concept Tests and the Progressive Project and the improvement on Project over three Information Systems courses. The three courses were: the first year introductory information systems course called Business Systems (BSys), another second year course, Computer Systems Concepts (CSC) and Information Systems Analysis (ISA). Both of the second year courses had similar assessment structures although the weight assigned to each item was slightly different. The assessment structure for the first year course was different, however, it did include a case analysis that required students to analyse a problem and recommend a viable solution.

Effectiveness was also considered from the student perspective. As such, 21 of the 38 students studying ISA participated in a survey to elicit their opinions of the use of the Web technology as an effective teaching and learning strategy. Just under half of these students were female (9), and all but two of the mature aged students (7) participated in the survey. Participation in the survey was entirely voluntary on the part of the student. A survey instrument was developed and provided to the students. The first section contained questions on personal characteristics while the second evaluated their experience with computing technology and flexible learning. The third section contained questions relating to the various instruments employed to measure student perceptions. The final section contained three open-ended questions.

Two survey instruments were drawn from the research literature. The first instrument was "Microcomputer Playfulness Measure", which describes "*an individual's tendency to interact spontaneously, inventively and imaginatively*" with a computer (Webster and Martocchio 1992, p. 201). It has been demonstrated that microcomputer playfulness relates positively to learning. The instrument was selected as an alternative to learning style in an attempt to circumvent the current debate on learning styles. A second instrument – end-user computing satisfaction (Doll and Torkzadeh 1988) – was selected to describe the student's (user's) satisfaction with the web technology. It can be argued that students are in effect end-users and as such, the instrument is an appropriate choice. Both these instruments have been tested and validated in the literature.

RESULTS

In this section, results of analyses of the data are described and discussed. The first section discusses student performance while the second focuses on student perceptions of the teaching and learning environment. The final section provides a description of the efficiencies created through the use of the teaching approach.

Student Performance

Student performance in ISA was compared with their performance in previous courses. As the assessment items in the different courses carried different weights, percentages of the item total were used instead of the students' raw scores. The first set of performance indicators measures the difference between the Progressive Project and the Concept Tests within each of two second-year courses. The second set of indicators focuses only on the Project and depicts the improvement in performance from the first year course to the second year courses and the difference between the second year courses. The means, standard deviation and range of percentages for each performance indicator are shown in Table 3.

Performance Indicator	Project percentage less Concept Test percentage		Project percentage - differences between courses		
Course(s)	CSC	ISA	CSC-BSys	ISA-BSys	ISA-CSC
Average	-9.0%	10.8%	-0.2%	18.3%	18.2%
Std Deviation	12.0%	9.5%	22.6%	19.4%	24.9%
N=	35	37	38	38	38
Range Min	-41.7%	-11.7%	-60.8%	-17.7%	-18.6%
Range Max	18.7%	26.3%	36.3%	57.3%	91.4%

Table 3: Indicators of Student Performance

A simple comparison of the differential between the Progressive Project and the Concept Test show a distinct improvement from CSC to ISA. Both courses had similar assessment structures and workshop contact time and were taught by the same staff. They differed slightly in terms of the number of seminars – CSC had three while ISA had five. The major difference was in the style of the Web site and the teaching approach. The site for CSC consisted predominantly of textual summaries of the course material, it had no support materials available, no interactive examples, no quizzes and no checklists. The CSC teaching approach was less integrated, relying more on the student's self-discipline and ability to complete required activities on their own. The differences evident in student performance can be attributed to the cohesive teaching and learning approach used in ISA. The Project used as one assessment item in the first year course was used as a base from which to make comparisons. When comparing the first year case analysis to ISA's Progressive Project an improvement in scores is seen. Similarly, an improvement is noted in the Progressive Project in ISA from that of CSC. Again, this improvement can be attributed to the teaching and learning approach. However, the differences noted in the absolute scores must be analysed further to determine whether they are statistically significant.

Student Perceptions of Teaching and Learning Approach

The results of analyses of the data on student perceptions are discussed below. The second section of the questionnaire focused on the student's experience with computing and flexible learning. All questions on the course were evaluated using a 7-point Likert-type scale. The scale range, means and standard deviations of Section B questions are shown in Table 4. Only two students rated their computing skills as below average (3). However, no student considered himself or herself as a *Wizard*. It was interesting to note that only one of the two students, who rated their computer skills as below average, had a low level of playfulness (20). Only one other student had a low level of playfulness (16) - she had rated her skills as average (4). The range of scores for the remaining students was 28-45 (the highest possible score is 49). It would appear that the majority of students can be regarded as playful and therefore more likely to explore the web site. Webster and Martocchio (1992) also consider that users with a high level of playfulness are more motivated and are better able to react to new technologies.

Question 11 asks the student to indicate their feelings about using web technology for learning. Only two students were indifferent (4) while one was somewhat hesitant (3). It is interesting to note that the two who were indifferent, rated their computing skills at 4 and their level of playfulness was 28 and 32. The student who was somewhat hesitant rated her skills at 5 and her level of playfulness was 33. Only one student regarded flexible delivery as being ineffective for presenting teaching and learning materials and he was also dissatisfied with the approach. His level of skill and playfulness was 6 and 38 respectively. One student did not respond to these two questions. Two other students while being neutral towards the effectiveness of the technology for their learning were somewhat dissatisfied with the approach. One of these had a playfulness level of 16 while the other was scored at 40. However, most regarded the technology as effective for their learning purposes and were satisfied with the approach.

#	Question.	Scale range 1	4	7	Mean	SD
7.	How would you rate your computing skills?	Meagre	Average	Wizard	4.6	0.8
8.	Microcomputer Playfulness Measure	-	-	-	33.6	7.4
11.	How would you describe your feelings about using web technology for learning purposes?	Hesitant	Indifferent	Excited	5.7	1.1
12.	How would you rate the effectiveness of flexible delivery for your learning purposes?	Not Very effective	Neutral	Very effective	5.2	1.4
13.	Overall, how satisfied are you with flexible delivery as a means of presenting teaching and learning materials?	Very dissatisfied	Satisfied	Very satisfied	5.0	1.2
14.	I like to use computers for learning.	Not at all	- -	To a very great extent	5.1	1.2
15-25.	End-user Computing Satisfaction Measure	Not at all	- -	To a very great extent	5.6	1.1
33.	My level of usage of the web site was:	Infrequent	-	Frequent	5.2	9.5
34.	My use of the web site was:	Sporadic	-	Regular	5.6	1.1

Table 4: Questionnaire Results

Questions 15 to 25 were summed to form the end-user computing satisfaction measure (Doll and Torkzadeh 1988). The highest possible score is 77 as a 7-point Likert type scale ranging from Not at all satisfied (1) to Satisfied to a very great extent (7) was employed. The scores ranged from 41-77 indicating that all students were satisfied. This result supports the observations on the single satisfaction question discussed earlier. It is interesting to note that of the three students least satisfied on the single question only one had a lower satisfaction score (that is, their scores

were 41, 55 and 64). The student who did not respond to the single question scored 55 on the satisfaction measure.

All of the students who were not satisfied or who regarded the approach as less than effective all liked to use computers in their learning. All but four students used the site on a frequent basis. Three students rated their usage of the web site at 4 and one at 3. These same four students were also irregular users as were two other students. Only one of the four was dissatisfied with the approach and regarded the technology as being somewhat ineffective.

Efficiencies Created Through the Use of Web Technologies

While not the focus of this research, efficiencies were evident from two perspectives: the students and the teaching staff. The development of the web site required a large amount of time and effort by the lecturer and the flexible learning support staff. However, the expenditure of effort will be recouped when the course is presented again using the same format. Since the topic summaries were provided on the web site, the lecturer was able to focus on applications of theory in business environment rather than on disseminating information. Consequently, more interactions with the students as a large group were possible. Additional notes included on the web site provided guidance on how the topic material applied to the assessment items. Further, the FAQs were used to provide answers to common questions asked by students. These additional notes and FAQs enabled the teaching staff to provide guidance to those students who could not attend the regularly scheduled classes or who sought immediate clarification of problems they had encountered. E-mail communication reduced the need for extensive face-to-face student contact. Overall, the teaching staff could focus on motivating the students and providing feedback on their solution to the actual business problem. The modular structure of the course and the progressive nature of the assessment items provided efficiencies to the students. That is, they were able to study and submit assessment on each module before moving on to the next. Once a module had been completed, students did not need to return to it unless the feedback on the assessment item indicated they had not fully understood the concepts it covered. Efficiencies were also evident in that they could choose how much material to study at any one time and where that study was undertaken.

CONCLUSIONS

This study is the first step in determining whether the use of Internet technologies for teaching and learning information systems content is essentially different to other areas. Student performance has been enhanced through the use of this teaching and learning environment. However, further analyses for different student cohorts and over longer time periods are required and are being undertaken. The student's perception of flexible delivery employing Web technologies is positive. Students appear to be well satisfied with the delivery method and their interaction with it. This contention is supported by the favourable responses to the open-ended questions in the questionnaires. This evidence suggests that the use of web technologies is an appropriate strategy for providing an effective learning environment for students. However, further research is required to determine the strength or significance of that support. Data analyses are currently being conducted to ascertain whether any statistical significance exists between student perceptions of the technology as a teaching and learning environment and their performance. Nevertheless, it is clear that students are satisfied with web technologies that support teaching and learning environments.

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