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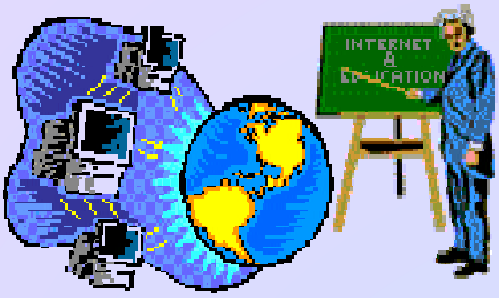

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Journal of Educational Technology & Society

Aims and Scope

Educational Technology & Society is a quarterly journal (January, April, July and October), but the articles will be published as soon as they are ready for publication (benefit of the electronic medium!), so that the issue will be built up and at any moment, one issue of the journal would be available to accept the articles.

Educational Technology & Society seeks academic articles on the issues affecting the developers of educational systems and educators who implement and manage such systems. The articles should discuss the perspectives of both communities and their relation to each other:

- Educators aim to use technology to enhance individual learning as well as to achieve widespread education and expect the technology to blend with their individual approach to instruction. However, most educators are not fully aware of the benefits that may be obtained by proactively harnessing the available technologies and how they might be able to influence further developments through systematic feedback and suggestions.
- Educational system developers and artificial intelligence (AI) researchers are sometimes unaware of the needs and requirements of typical teachers, with a possible exception of those in the computer science domain. In transferring the notion of a 'user' from the human-computer interaction studies and assigning it to the 'student', the educator's role as the 'implementer/ manager/ user' of the technology has been forgotten.

The aim of the journal is to help them better understand each other's role in the overall process of education and how they may support each other. The articles should be original, unpublished, and not in consideration for publication elsewhere at the time of submission to *Educational Technology & Society* and three months thereafter.

The scope of the journal is very broad as can be seen from the following list of topics considered to be within the scope of the journal:

Architectures for Educational Technology Systems, Computer-Mediated Communication, Cooperative/ Collaborative Learning and Environments, Cultural Issues in Educational System development, Didactic/ Pedagogical Issues and Teaching/Learning Strategies, Distance Education/Learning, Distance Learning Systems, Distributed Learning Environments, Educational Multimedia, Evaluation, Human-Computer Interface (HCI) Issues, Hypermedia Systems/ Applications, Intelligent Learning/ Tutoring Environments, Interactive Learning Environments, Learning by Doing, Methodologies for Development of Educational Technology Systems, Multimedia Systems/ Applications, Network-Based Learning Environments, Online Education, Simulations for Learning, Web Based Instruction/ Training

Guidelines for authors

Submissions are invited in the following categories:

- Peer reviewed publications
  a) Full length articles (between 4000 and 7000 words)
  b) Short articles, Critiques and Case studies (up to 3000 words)
- Book reviews
- Software reviews
- Website reviews

All peer review publications will be refereed by at least two international reviewers with expertise in the relevant subject area. Book, Software and Website Reviews will not be reviewed, but the editors reserve the right to refuse or (with the approval of contributors) to edit copy.

- Each peer review submission should have at least following items:
  - title (up to 10 words)
  - complete communication details of all authors
  - an informative abstract (75-200 words) presenting the main points of the paper and the author's conclusions
  - four - five descriptive keywords
  - main body of paper
  - conclusion
  - references
- Submissions should be single spaced.
- Footnotes and endnotes are not accepted, all such information should be included in main text.
- The paragraphs should not be indented. There should be one line space between consecutive paragraphs.
- There should be single space between full stop of previous sentence and first word of next sentence in a paragraph.
- The keywords (just after the abstract) should be separated by **comma**, and each keyword phrase should have initial caps (for example, Internet based system, Distance learning).
- Do not use 'underline' to highlight text. Use '*italic*' instead.

Headings

Articles should be subdivided into unnumbered sections, using short, meaningful sub-headings. Please use only two level headings as far as possible. Use 'Heading 1' and 'Heading 2' styles of your word processor's template to indicate them. If that is not possible, use 12 point bold for first level headings and 10 point bold for second level heading. If you must use third level headings, use 10 point italic for this purpose.

There should be one blank line after each heading and two blank lines before each heading (except when two headings are consecutive, there should be one blank like between them).

Tables

Tables should be included in the text at appropriate places and centered horizontally. Captions (maximum 6 to 8 words each) must be provided for every table (below the table) and must be referenced in the text.

Figures

Figures should be included in the text at appropriate places and centered horizontally. Captions (maximum 6 to 8 words each) must be provided for every figure (below the figure) and must be referenced in the text. The figures must **NOT** be larger than 500 pixels in width.

Please also provide all figures separately (besides embedding them in the text).

References

- All references should be listed in alphabetical order at the end of the article under the heading 'References'.
- All references must be cited in the article using "authors (year)" style e.g. Merrill & Twitchell (1994) or "(authors1, year1; authors2, year2)" style e.g. (Merrill, 1999; Kommers et al., 1997).
- **Do not use numbering style to cite the reference in the text** e.g. "this was done in this way and was found successful [23]."
- It is important to provide complete information in references. Please follow the patterns below:

Journal article

Laszlo, A. & Castro, K. (1995). Technology and values: Interactive learning environments for future generations. *Educational Technology*, 35 (2), 7-13.

Newspaper article

Blunkett, D. (1998). Cash for Competence. *Times Educational Supplement*, July 24, 1998, 15.

Or

Clark, E. (1999). There'll never be enough bandwidth. *Personal Computer World*, July 26, 1999, http://www.vnunet.co.uk/News/88174.

Book (authored or edited)

Brown, S. & McIntyre, D. (1993). *Making sense of Teaching*, Buckingham: Open University.

Chapter in book/proceedings

Malone, T. W. (1984). Toward a theory of intrinsically motivating instruction. In Walker, D. F. & Hess, R. D. (Eds.) *Instructional software: principles and perspectives for design and use*, California: Wadsworth Publishing Company, 68-95.

Internet reference

Fulton, J. C. (1996). *Writing assignment as windows, not walls: enlivening unboundedness through boundaries*, http://leahi.kcc.hawaii.edu/org/tcc-conf96/fulton.html.

Submission procedure

Authors, submitting articles for a particular special issue, should send their submissions to appropriate Guest Editor rather than to the address below. Guest Editors will advise the authors when to submit final version to following address.

Due to the nature of the journal, all submissions should be in electronic form. The editors will acknowledge the receipt of submission as soon as possible.

The preferred formats for submission are Word document and RTF, but editors will try their best for other formats too. For figures, GIF and JPEG (JPG) are the preferred formats. **Authors must supply separate figures** in one of these formats besides embedding in text.

Please provide following details with each submission:

- Author(s) full name(s) including title(s)
- Name of corresponding author
- Job title(s)
- Organisation(s)
- Full contact details of ALL authors including email address, postal address, telephone and fax numbers

The submissions should be sent via email to (Subject: Submission for Educational Technology & Society journal): **kinshuk@inspire.net.nz** or **kinshuk@massey.ac.nz** (only if previous email does not work for any reason)

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A theory for eLearning

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Discussion Schedule:
Discussion: 10 - 19 March 2003
Summing-up: 20 - 21 March 2003

Pre-Discussion Paper

There has been much written about eLearning practice however little attention has been given to eLearning theory. After arguing that a lack of established theory will hinder further development in eLearning, this paper presents ten hypotheses for eLearning in an attempt to focus attention on the underlying principles that apply to eLearning in all situations.

Over twenty years ago, Perraton remarked that "distance education has managed very well without any theory" (1981:13). The same can be said today of eLearning, though whether or not it has 'managed very well' may not be so accurate. Still, the incredible weight of published articles, institutional investment in practice and uptake of Web-based education tools in the past decade testifies that eLearning practice has achieved a momentum that will make it a central part of future education.

However the vast bulk of literature in eLearning is practice-based and is typically presented in a descriptive format. The majority of conference presentations consist of a 'here's what we did and here's the evaluation' format which do little for transferability to other institutions or even other courses. In addition, the body of literature appears fragmented and there are few common terms used consistently. It is unlikely that eLearning practice will continue to evolve unless the theoretical underpinnings of eLearning are explored and debated, providing a wider platform and a common philosophy for eLearning development. There are few examples of academic literature specifically concerned with eLearning theory and unfortunately the use of technology in education has tended to be technology-led rather than theory-led (Ravenscroft 2001). It is well stated by Watson (2001:251) that "the cart has been placed before the horse."

Keegan (1983:3 cited in Holmberg 1997) suggested that theory could serve as a "touch-stone against which decisions – political, financial, educational, social – when they have to be taken, can be taken with confidence". Keegan's comments related to distance education, which now has a firmly established theoretical basis thanks to the efforts of such theorists as Moore and Kearsley, Lockwood, Holmberg, Peters, Rumble, Rowntree and Mason. At present there is no such 'touch-stone' for eLearning and there are few theorists who can be readily identified as authoritative.

If literature is likened to a 'tree of knowledge' about a particular subject the dire need for more eLearning theory becomes clear. Practice based research can be likened to the branches of the tree, those parts that are readily visible and most easily appreciated. Theoretical principles can be likened to the roots; they do not provide any practical things for people like shade or fruit and neither are they aesthetically pleasing. However it is the root system that determines the health of the tree and also the extent to which it can grow. Unless attention is given to eLearning theory, the branches cannot stretch out for fear of toppling the entire structure. Unless attention is given to eLearning theory, eLearning practice cannot develop fully. Without further debate and development in the theoretical underpinnings, we will be left with bonsai eLearning.

The truth of theory's central role in the development of practice is recognized across all fields of activity. As Berger (2000) points out, "we tend to conduct life based on many theories that are below the level of conscious thought and accepted without examination. But, being conscious of theories and subjecting them to examination is essential because they are particularly important to change and learning."

We can only test theories if we have them explicitly stated. The knowledge base of eLearning cannot be expanded with more accounts of how eLearning has been applied to particular courses. Only by further exploring

Nichols, M. (2003). A theory for eLearning. *Educational Technology & Society,* 6(2), 1-10, Available at http://ifets.ieee.org/periodical/6-2/1.html
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what lies beneath the surface of things, by investigating the root system, can we hope to provide eLearning with a more flourishing future.

What is a 'theory'?

A theory can be described as a set of hypotheses that apply to all instances of a particular phenomenon, assisting in decision-making, philosophy of practice and effective implementation through practice. Theory provides a yard stick for evaluating practice, though it in turn may be adjusted by findings from practice that show the theory to be inadequate, as in Khun's (1962) 'scientific revolution'. Theories are therefore at the same time static and firm enough to build on for practitioners and living, dynamic and open to challenge by theorists. As Garrison (2000:3) states, "It is theory that provides a coherent ordering of relevant variables and relationships to guide both practitioners and researchers."

Adjustments to theories might be minor or major. The former occurs when a particular hypothesis is found to have exceptions. The latter occurs when an hypothesis is found to be fundamentally flawed as occurred in physics once Newtonian models, which held sway for two hundred years, were discovered to be inadequate.

Theory can only be effectively communicated if a common set of terms is used and if their meaning is popularly adhered to. The terms below are defined to help provide further clarity to the hypotheses which follow.

Toward a common set of terms

- **Online learning** – this term describes education that occurs only through the Web, that is, it does not consist of any physical learning materials issued to students or actual face to face contact. Purely online learning is essentially the use of eLearning tools in a distance education mode using the Web as the *sole* medium for all student learning and contact.
- **Mixed-mode/blended/resource-based learning** – these terms interchangeably describe an approach to education that combines face to face and distance approaches to education in that an instructor or tutor meets with students (either in a face to face mode or through a technological means) and a resource-base of content materials and learning activities is made available to students. In addition, some eLearning approaches might be used.
- **eLearning** – the use of various technological tools that are either Web-based, Web-distributed or Web-capable for the purposes of education.
- **Learning object** – a digital file or tool that can be reused in eLearning contexts.
- **Learning Management System (LMS)** – a collection of eLearning tools available through a shared administrative interface. A learning management system can be thought of as the platform in which online courses or online components of courses are assembled and used from.
- **Interactive** – there are two types of interactivity, indicative and simulative. Indicative interactivity is typified by the use of button rollovers and site navigation. Clicking a button to start an animation or turn the page is indicative interactivity. Simulative interactivity is interactivity that enables students to learn from their own choices in a way that provides some form of feedback. The ability to select between different Web pages is indicative interactivity; the ability to fly a virtual plane in a realistic virtual environment is simulative interactivity.
- **Pedagogy** – this term is traditionally understood to refer to teacher-oriented instruction, however it is now increasingly used to describe the application of sound education practice (which encompasses so-called 'androgogy'). In the paper below, it is used in the latter sense.

Ten hypotheses for eLearning

What follows is a set of general hypotheses or fundamental principles for eLearning. These are intended to provide a platform for debate.

Hypothesis 1:

eLearning is a means of implementing education that can be applied within varying education models (for example, face to face or distance education) and educational philosophies (for example behaviourism and constructivism).

This principle sets eLearning as a *means* of education as opposed to a *mode* of education. In other words, eLearning involves the use of a number of technological tools that can be applied in various contexts; it is not a distinctive educational system in itself. Therefore eLearning cannot be compared with face to face delivery or distance education because it can be used within either of these models. Instead, eLearning is a means by which these education models can be implemented. This hypothesis is confirmed by institutions such as the Open University, which uses eLearning as an adjunct to its "supported open learning" model (Eisenstadt and Vincent, 2000:xiii).

It is also possible to apply different education philosophies using eLearning. Students can be encouraged to construct their own knowledge using technology tools, and those same tools can also be used to present materials that deliberately lead students to pre-determined conclusions in highly structured ways. The use of technology in education has a significant history. Initially, computers were applied in behaviourist modes in accordance with Skinner's work (Ravenscroft 2001), which emphasized the teacher's control over what is learned and how it is to be learned. More recently, emphasis is on the constructivist use of technologies which provide students with opportunities to construct their own understandings. Skinner's behaviourism, Piaget's cognitive constructivism and Vygotsky's social constructivism can all be facilitated through eLearning. Tam (2000) provides an excellent overview of how technology can be used for constructivist purposes.

However, it is also true that eLearning enables a form of educational convergence, thus:

Hypothesis 2:

eLearning enables unique forms of education that fits within the existing paradigms of face to face and distance education.

This is one of the more exciting aspects of eLearning – it enables new expressions of education that can potentially combine the strengths of face to face and distance forms of education in various ways using various technologies such as bulletin boards. It is acknowledged that eLearning changes the role of the instructor, particularly in online environments (Coppola et al 2002) and in blended modes however it is argued that this represents a more developed form of existing instructional methodologies. The realization of blended courses does not necessitate the creation of a new paradigm of education because blended courses draw on the same theoretical principles that belong to face-to-face and distance courses. Blended learning can be thought of as a new genus, not a new species; it is the result of evolution, not revolution (see for example Nipper 1989 for an account of how technology has resulted in new forms of distance education, and Garrison 2000 and Peters 2000 for an overview of distance education theory and its need to evolve).

The difficulty is what terminology to use in order to refer to these new forms of education. The term *mixed-mode* is commonly used to describe a blend of face to face and distance education that does not necessarily have a high technology component. Some prefer the term *resource-based learning* (Nichols 2001; Ryan et al 2001). Others, particularly in industry-based training, use the term *blended learning*. Weller (2002) provides a helpful framework for categorization of such courses based on the extent to which they are didactic/constructivist and make use of high/low levels of technology. It is clear that the distinction between purely online and partly online is an important one, and that the philosophical framework of a course is also; Weller's framework is to be preferred when categorizing such courses.

Whichever term or categorization is used, the approach can only be used if purposeful education strategies are adopted. This leads to the third hypothesis:

Hypothesis 3:

The choice of eLearning tools should reflect rather than determine the pedagogy of a course; *how* technology is used is more important than *which* technology is used.

If eLearning is a means to education, then it can be applied in accordance with varying pedagogies (see Thorpe 2002). Weller (2002) lists the following as pedagogies:

- Constructivism
- Resource based learning
- Collaborative learning

- Problem based learning
- Narrative based teaching
- Situated learning.

Technology is pedagogically neutral and can therefore be applied quite merrily to all of the pedagogies listed above. It follows then that the poor implementation of technology must reflect poorly implemented pedagogy, or an over-estimation in technology's potential (or a blend of the two). The selection of education approach or philosophy is therefore more important than the selection of the technology itself. If this hypothesis is indeed true, then the responsibility for eLearning failure rests on those who chose the technology tools to use and how they were implemented.

However the reverse is also true. Effective pedagogical decisions can make simple technologies extremely useful. There are multiple examples that illustrate this (such as the Open University's use of the simple online discussion forum CoSy documented by Mason, 1989 and the *Reintroduction of the Wolf* scenario described by Jonassen et al 1997, which makes use of nothing more complicated than linked Web pages), and many communities of practice throughout the globe who collaborate and communicate effectively through simple text-only listservs. These testify to the fact that *how technology is used* is more important than *which technology is used*.

Closely related to this is the next hypothesis.

Hypothesis 4:

eLearning advances primarily through the successful implementation of pedagogical innovation.

As a general rule it will be breakthroughs in teaching practice that will make eLearning more useful and not breakthroughs in technology, though the latter can provide opportunities for the former. As noted by Laurillard (2002), instructional designers should drive eLearning, not technologists. Those who are innovative educators will be those who maximise eLearning and ensure its further development. Reeves (2002) argues that, in the main, technology is not being used innovatively in education. It is both a strength and a weakness that technology can sit quite comfortably within current approaches to education; it is a strength in that we can stay with those educational practices that we are most used to, but this is also its weakness.

Ravenscroft (2001:134) argues that "we cannot truly transform educational practice for the better through using new technologies unless we examine the roles the computer can play in truly stimulating, supporting and favouring innovative learning interactions that are linked to conceptual development and improvements in understanding." Future progress in eLearning will come from a better understanding of the dynamics of teaching and learning and not from more improved or functional technology, though as mentioned the latter does provide opportunities for new, innovative pedagogies to develop.

All of this means that eLearning practitioners need to scan technological developments in the context of the substantial resource base available in the fields of psychology and education. The principles of cognitive development found in such literature is directly relevant to eLearning because, as Horton (in Islam 2002:23) rightly states, "E-learning doesn't change anything about how human beings learn."

Hypothesis 5:

eLearning can be used in two major ways; the presentation of education content, and the facilitation of education processes.

The fundamental applications of eLearning include digital materials storage and distribution (presentation) and synchronous and asynchronous communication, simulative interactivity, multimedia, and access tracking (processes) – each of which is subject to multiple applications of use and innovation.

In other words eLearning can both make information available and play a part in students' self-construction of knowledge (see also Boot and Hodgson, 1987). It is important to note that technology is *not* content, and technology is *not* process; rather, it can be used to provide access to both.

It is important to note that this hypothesis only describes eLearning tools as they are currently available. Further advances in technology will lead to the revision of this particular hypothesis.

Hypothesis 6:

eLearning tools are best made to operate within a carefully selected and optimally integrated course design model.

Practice-based literature is at least clear that the 'build it and they will come' approach does not work with online discussion boards, for example, however making resources and grades available to students online does make them accessible when they otherwise may not be. Beyond these simple enhancements it can be confidently stated that it is not sufficient to simply add eLearning tools on to an existing course if eLearning's true benefits are to be realized (Oliver 1999). Instead, attention must be given to the contribution eLearning can make to learning so that any use of eLearning becomes a seamless component of the overall course design and delivery package.

Research already supports this hypothesis. Clear design is a feature of successful online learning (Swan 2001), and a responsive instructor who facilitates learning and encourages students to explore their learning at a conceptual level is a must for effective conceptual change (Ramsden, 1992). There is evidence that learners require prompting from an instructor for conceptual reflection to occur (Hartley 1998 in Ravenscroft 2001). Oliver (1999) lists content, learner supports and learning activities as the three critical design elements for online teaching and learning. There is general agreement across existing education literature that collaborative dialogue and communication with instructors are major contributors toward successful learning; Nichols (2001) adds further course design considerations (a variety of learning resources, opportunities for reflection and simulative interaction) and proposes a course design framework within which technology can be made to work effectively.

Hypothesis 7:

eLearning tools and techniques should be used only after consideration has been given to online vs offline trade-offs.

This is a very important step that ensures that file sizes are appropriate, students are able to continue their studies if they are away from a computer, the family phone line is not continuously tied up for dial-up Web access, etc. It may be more appropriate to provide certain materials on paper or CD-ROM rather than over the Web in many cases.

In general, the Web is best used for communications such as notices, updates, asynchronous and synchronous discussion, and for content that is frequently updated or only becomes available during the actual course. It is prudent to make other materials such as Word documents, slideshows and relatively static content offline, either on CD-ROM or paper (or both). It is also possible to make video and audio materials available on CD-ROM or tape (or both).

Eventually, when (or if) the wireless revolution takes place and portable digital devices are commonplace and bandwidth is no longer an issue, this hypothesis will still stand – only its practice will need to change.

Hypothesis 8:

Effective eLearning practice considers the ways in which end-users will engage with the learning opportunities provided to them.

Understanding end-user behaviours is an important step toward effective eLearning. The consequences of making materials or learning opportunities available through eLearning should be carefully considered. As an example some institutions do not provide any printed materials, preferring instead to make all things available on a CD-ROM or online. For many students who do not like to read from a screen or cannot take their desktop computers away on holiday with them for the weekend, such a move requires them to print the materials out. Distributing online activities throughout a one hour study session will also require a student studying from home to either frequently dial up to the Internet or else stay online for the entire period; better practice would be to anticipate such activities and instead combine all online activities in one section.

Another consideration here is the question, how do you make the most of online discussion? Understanding some of the characteristics of students using online discussion applications for the first time enables moderators to better plan online discussion activities and exercises (see Salmon, 2000). A consideration of the end-user helps in the construction and execution of eLearning courses.

Hypothesis 9:

The overall aim of education, that is, the development of the learner in the context of a predetermined curriculum or set of learning objectives, does not change when eLearning is applied.

In other words, the curriculum is still king. Hypothesis 1 establishes eLearning as a means; development of the learner in the context of the curriculum is still the end. As put by Idrus (2000), "The tools have change[d], the job hasn't."

eLearning tools can certainly be used to encourage students to further explore topics on their own and take ownership of their learning. It is often desirable to assess things such as bulletin board participation in order to encourage the sharing of ideas online, for example, however caution is required. The curriculum still needs to be the point of reference. If participation in a bulletin board is not relevant to the curriculum, then its use as an assessment tool should be questioned. Overall it is how the students measure against the learning objectives, not whether or not they can use the technology that will determine their success in the workplace. The curriculum, not their use of technology, is the standard.

Hypothesis 10:

Only pedagogical advantages will provide a lasting rationale for implementing eLearning approaches.

As educators we can take no other position. Institutional, societal and political advantages do not automatically lead to better student learning. Eisenstadt and Vincent (2000:xi) reserve the advantages of technology for those applications built on sound pedagogy: "Evidence continues to confirm that the Web, as with other technologies and media, can be successfully exploited provided that the educational need to which it is applied is identified first."

Institutional, social and political expediencies may be helpful to justify eLearning investment, but they are not sufficient on their own. There must also be a conviction that technological tools improve teaching and learning to ensure long-term commitment to their use, and to ensure appropriate implementation.

Conclusion – room to grow

If eLearning is to have an effective future beyond much of the hype and experimentation that reflects much of the existing literature, it is vital that its theoretical underpinnings be made explicit and available for critique. As we practice eLearning, it is essential that we reflect on those transferable principles of our practice that will be of benefit to others. We must research to establish theory not evaluation, principles not practices, pedagogies not applications. Only then will a literature base be developed that can be applied across multiple institutions and education settings.

Ravenscroft (2001:150) remarks that "given that the pace of change of educational technology is unlikely to slow down, the need for relatively more stable and theoretically founded interaction models is becoming increasingly important." The more debate that can take place about eLearning theory, the more prepared practitioners will be as the continuous winds of technology development blow and as institutional, political and social seasons change.

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Post-Discussion Summary

Introduction

Over twenty years ago, Perraton remarked that "distance education has managed very well without any theory" (1981:13). The same can be said today of eLearning, though whether or not it has 'managed very well' may not be so accurate. The vast bulk of literature in eLearning is practice-based and is typically presented in a descriptive format. The majority of conference presentations consist of a 'here's what we did and here's the evaluation' format which do little for transferability to other institutions or even other courses. In addition, the body of literature appears fragmented and there are few common terms used consistently. It is unlikely that eLearning practice will continue to evolve unless the theoretical underpinnings of eLearning are explored and debated, providing a wider platform and a common philosophy for eLearning development.

If literature is likened to a 'tree of knowledge' about a particular subject the dire need for more eLearning theory becomes clear. Practice based research can be likened to the branches of the tree, those parts that are readily visible and most easily appreciated. Theoretical principles can be likened to the roots; they do not provide any practical things for people like shade or fruit and neither are they aesthetically pleasing. However it is the root system that determines the health of the tree and also the extent to which it can grow. Unless attention is given to eLearning theory, the branches cannot stretch out for fear of toppling the entire structure. Unless attention is given to eLearning theory, eLearning practice cannot develop fully. Without further debate and development in the theoretical underpinnings, we will be left with bonsai eLearning.

Discussion centred around ten statements that aimed to set a theoretical foundation for eLearning practice (these were formerly called 'hypotheses' but this was changed as a result of feedback from Peter Twining and Martyn Wild). These statements are described in this summary, along with the comments from IFETS subscribers that helped to further shape them. Unfortunately it is not possible to include all points in this summary; what follows are those points that have significantly led to either the validation or adjustment of the ten statements.

1. *eLearning is a means of implementing education that can be applied within varying education models (for example, face to face or distance education) and educational philosophies (for example behaviourism and constructivism).*

While some seemed to challenge whether or not this statement is needed, it does place eLearning firmly in place within education theory. No argument was produced that the statement requires revision.

2. *eLearning enables unique forms of education that fits within the existing paradigms of face to face and distance education.*

This statement was not explicitly addressed in the discussion however Brent Muirhead, Eric Flescher and William Klemm proposed various keys to online teaching that fitted nicely into either a face to face or distance education context, illustrating the validity of this statement.

3. *Whenever possible the choice of eLearning tools should reflect rather than determine the pedagogy of a course however as a general rule* how *technology is used is more important than* which *technology is used.*

Bev Trayner raised an interesting issue here that has led to the change in wording for this statement. Often the technology that we use in education is based on the designer of the software's pedagogical assumptions.

4. *eLearning advances primarily through the successful implementation of pedagogical innovation.*

A brief exchange between Mary Hall and Derek Chirnside about what an ideal learning management system would be capable of added validity to this statement.

5. *eLearning can be used in two major ways; the presentation of education content, and the facilitation of education processes.*

There was no disagreement with this particular statement.

6. *eLearning tools are best made to operate within a carefully selected and optimally integrated course design model.*

In response to a point raised by Stephen Downes, this statement needs elaboration to make it clear that "open minded and undesigned" learning (serendipitous learning) is not excluded.

7. *eLearning tools and techniques should be used only after consideration has been given to online vs offline trade-offs.*

There were no comments made about this particular statement.

8. *Effective eLearning practice considers the ways in which end-users will engage with the learning opportunities provided to them.*

Dr Eric Flescher mentioned his research into how learners interact with simulations; Eric's research suggests that learners need to be provided with some form of structure if they are to successfully engage with them. This is consistent with this particular statement.

9. *The essential process of education, that is, enabling the learner to achieve planned learning outcomes, does not change when eLearning is applied.*

This statement received the most thorough going over and has also been significantly reworded (with thanks to Bill Williams for the suggested wording). The main change is the removal of the term 'curriculum'. Stephen Downes, Bill Williams and Bronwyn Hegarty raised the concern that a curriculum is outcome oriented whereas learning is process-oriented. This was an interesting avenue of debate that should be continued in a future exchange; of particular interest is the extent to which the 'rules' of institutionalised learning can be significantly challenged simply because we add technology-assisted learning processes into the mix. Mary Hall suggested that the criticisms were valid "when applied to the concept of 'learning', which may be informal, unstructured, spontaneous, without plan or purpose" but that they may not be so strong when the institutional imperative was considered. I am certain that there will be many readers who participated in the debate who might still be unsatisfied with the wording of this statement.

10. *Only pedagogical and access advantages will provide a lasting rationale for implementing eLearning approaches.*

The addition of the words "and access" to this statement are in response to Lora Kaisler who pointed out that eLearning can make learning more convenient (and even possible) for many learners.

Issues for further discussion

As with most interesting discussions more questions are created as potential answers are suggested. Four of the major issues for further discussion are itemised below; each would be worthy of a pre-discussion paper and ensuing exchange.

- Is a separate theory for eLearning necessary? This question was first suggested in Charles Nelson's initial message. Charles was concerned that it was possible to substitute the term 'learning' for eLearning in the pre-discussion paper and have it still make sense. It seems that the best justification for a theory of eLearning is that so many seem to practice eLearning without making reference to the considerable body of education theory that is directly relevant. An eLearning theory can at least point practitioners to education principles. A further question is, what type of theory is needed? David Jones cited a paper by Gregor (2002) who categorises five different types of theory.

- Is technology really different? What is really new in learning because of technology, and what just evolves? This question was prompted by Gary Miller; if technology's use can be likened to having a set of 'power tools' rather than 'hand tools', to what extent do the fundamentals of learning change because we have technology available to us in education?
- Do we really agree on definitions? A number of definitions were proposed in the pre-discussion paper (only one of which was discussed by Derek Chirnside, that of interactivity). There were several comments during the discussion relating to the semantic minefield that is eLearning; terminology is certainly one area of eLearning that needs urgent attention.
- Next, the role of the curriculum was briefly discussed in the comments associated with statement nine but it is worth mentioning again. Is the need for a curriculum over? Is it really a limiting factor for eLearning, or does it add necessary boundaries, enable the awarding of qualifications and a serve as a transparent guide to what is important?

While it is not possible to fully validate each of the statements in this summary paper, they have proven robust thus far and will hopefully be of assistance to those seeking to implement eLearning on a firm theoretical foundation.

References

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Towards a Pattern Language for Learning Management Systems

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Abstract

Learning Management Systems are sophisticated web-based applications that are being engineered today in increasing numbers by numerous institutions and companies that want to get involved in e-learning either for providing services to third parties, or for educating and training their own people. Even though the construction of such systems has been taking place for many years, they are still designed and developed from scratch. The reason is that experience from previous Learning Management Systems, is not codified or documented, resulting in forcing the development teams to 're-invent the wheel'. This paper presents an approach of recording design experience in the form of design patterns for Learning Management Systems and aims at developing a pattern language for these systems.

Keywords

Design Patterns, Pattern Language, Patterns System, Learning Management Systems, e-Learning, Learning Technology Systems

Introduction

Learning Management Systems (LMS) are specialized Learning Technology Systems (IEEE LTSC, 2001a), based on the state-of-the-art Internet and WWW technologies in order to provide education and training following the open and distance learning paradigm. The design and implementation of such systems is not an easy task, since they are complex systems that incorporate a variety of organizational, administrative, instructional and technological components (Moore & Kearsley, 1996; Carlson, 1998). Therefore systematic, disciplined approaches must be devised in order to leverage the complexity and assortment of LMS and achieve overall product quality within specific time and budget limits. One such approach is the use of design patterns, so that these systems will not be designed and implemented from scratch, but based on reusable design experience gained over several years of try-and-error attempts.

Experienced designers know how to solve certain problems because they have seen them appearing repeatedly and have developed design patterns implicitly. These implicit design patterns are in practice what separates the

experienced designer from the novice one. According to (Alexander et al., 1977): "each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over". Patterns are not conceived in a big bang but rather discovered or mined after numerous implementations of the same solution in a given problem, usually by different people. It is more or less a process of reverse-engineering the systems that embed good design in order to make that design explicit, and be able to communicate it to other designers, so that it becomes common practice.

Alexander has also proposed the notion of a *pattern language*, which is a collection of related patterns that captures the whole of the design process and can guide the designer through step-by-step design guidelines. This concept is also known as *system of patterns*, a term introduced in (Buschmann et al., 1996). Even though there are some differences between these terms, they are often used interchangeably to denote a set of related patterns that collaborate inside the boundaries of an application domain (Lyardet et al., 1998).

Patterns are all about reusability, which seems to be the keyword in achieving the economies of scale for building affordable software systems. Reuse in the form of analysis, design, or architectural patterns, is even more important than simple code reuse (Rossi et al., 1997; Ericsson & Penker, 2000). A further advantage that patterns promote is independence of methodologies, methods, processes, models and languages (Buschmann et al., 1996; Rossi et al., 1997; Garzotto et al., 1999; Nanard et al., 1998). In that sense, patterns are a pervasive, horizontal reuse strategy that can illustrate a recurring problem and its solution in a neutral manner. Their field of application is extremely broadened in this sense.

The history of patterns and their proliferation is well known and broadly documented. It all began in the field of building architecture, when Christopher Alexander invented the idea of capturing design guidelines in the form of design patterns (Alexander et al., 1977). The 'Alexandrian' patterns found many followers in the computer science discipline, especially after the so-called 'GOF' book for object-oriented design (Gamma et al., 1994). Some of the fields that have adopted patterns are: software architecture (Buschmann et al., 1996; Schmidt et al., 2000), hypermedia engineering (Rossi et al., 1996), object-oriented analysis (Fowler, 1998), business modeling (Eriksson & Penker, 2000), Human-Computer Interaction (Borchers, 2001), e-business patterns (http://www.ibm.com/framework/patterns) and patterns for specific programming languages such as Java (Cooper, 2000; Alur, 2001). The last years, we have even watched the idea of recording not only patterns but also *anti-patterns* (http://www.antipatterns.com/) (Brown, 1998): what usually goes wrong in software development and how one can avoid these mishaps. This list is certainly not exhaustive but does indicate the paramount importance of patterns and their adoption in a wide array of disciplines.

Several repositories of patterns exist for various disciplines and offer design expertise reuse to the corresponding communities. The object-oriented software community documents the design patterns initiated in (Gamma et al., 1994), in the "PLoP" (Pattern Languages of Programs) series of conferences (http://jerry.cs.uiuc.edu/~plop/) that followed as well as their clones in various parts of the world such as EuroPLoP, KoalaPLoP, SugarLoafPLoP etc. (see http://www.hillside.net/patterns/). The hypermedia community and particularly the ACM-SIGWEB have established their own repository of design patterns that is mostly originated in the official hypermedia design patterns web site (Hypermedia Design Patterns Repository, 2002). The HCI community has also launched a repository of design patterns that are discussed and recorded in workshops, conferences and web sites, like (HCI patterns web site, 2002). On the contrary, the e-learning community even though is aware of patterns and their advantages, has not yet initiated a similar attempt to establish a formal repository of patterns for its own domain.

This paper aims to move research steps towards that direction by proposing an initial set of design patterns for Learning Management Systems. The patterns in this paper are meant to work synergistically and become part of a *pattern language* for Leaning Management Systems. As in other pattern languages proposed, the patterns of this paper are not new and certainly not innovative, they have been incorporated in LMS for years now. Instead the intention of this form of pattern languages is merely to capture design expertise and present it in a comprehensible and usable format (Lyardet et al., 1999). In this way, designers of new or existing LMS, especially inexperienced designers, can take advantage of previous design expertise and save precious time and resources.

The structure of this paper is as follows: Section 2 analyses the context of LMS for the application of design patterns by emphasizing on its unique characteristics that affect the definition of the patterns. Section 3 provides the catalog of patterns described according to a specific template. Finally section 4 wraps up with conclusions and ideas for future work.

The context of LMS Design Patterns

Learning Management Systems are in essence hypermedia systems, and as such can take advantage of design patterns in that area, since there is a significant amount of work already completed in that field (Hypermedia Design Patterns Repository, 2002). We strongly encourage the utilization of those patterns for the design and development of the interface, navigation and content of LMS. However in this paper we propose domain-specific patterns in the context of web-based learning that attempt to solve problems particular to LMS and as such, have not been addressed by hypermedia design patterns. It is noted though that the patterns proposed in this paper are related to some of the hypermedia patterns, as it will be shown later. Relevant research work has been conducted in (Lyardet et al., 1998), where the authors propose hypermedia design patterns that can be applied in educational multimedia applications. There is also a repository of patterns in the conventional learning and pedagogical discipline, mainly focused on teacher-based learning (Pedagogical Patterns Project site, 2002).

Learning Management Systems have been widely adopted by institutions and instructional designers in order to fulfill certain needs and requirements in a field of ever increasing demands for effective, fast and pedagogically correct education and training. LMS that are in use today are either commercial products (e.g. WebCT, Blackboard, Intralearn), open-source projects (e.g. FLE, http://fle3.uiah.fi/), or customized software systems that serve the instructional purposes of particular organizations. The users of LMS can been classified into three categories:

- The *learners* that use the system in order to participate through distance (in place and/or time) to the educational process. In fact, the learners are the focal users of LMS, in the sense that these systems are being developed in order to satisfy some of their needs and resolve their problems.
- The *instructors*, being the teachers and their assistants that use the system in order to coach, supervise, assist and evaluate the students (e.g. notify for important issues on an electronic notice board, engage in discussions in electronic fora, communicate and exchange personal messages with students, collect, assess and return deliverables, etc.).
- The *administrators* of the system, who undertake the support of all the other users of the system and safeguard its proper operational status.

According to (McCormack & Jones, 1997), an LMS offers services for satisfying specific instructional needs and/or automating (partially or fully) instructional events. LMS should support the development and execution of four basic tasks via a simple, friendly and uniform user-interface:

- *Information distribution*, e.g. announcing the tips of the day, calendar, glossary, etc.
- *Management of learning material*, e.g. customisation of the user interface to the needs of the instructor, updating the learning material, etc.
- *Offer of Multiple communication facilities*, e.g. asynchronous and synchronous communication.
- *Class management*, e.g. on-line marking of students' assessments, tracking learners' participation, management of learners profiles, etc.

If we consider these basic tasks as problems that designers of LMS have to solve, we can find the appropriate patterns in existing LMS that illustrate the solution to these problems. The methodology used in this paper for 'pattern mining' is governed by such a philosophy. In particular, we first analyzed the above basic tasks into more detailed features and then tried to discover these features in a number of real LMS that are broadly used. If these features were indeed found in at least three or four LMS, then these features were considered widely adopted and applicable and were therefore regarded as LMS design patterns. The set of LMS that we used to mine the patterns is shown in Table 1. The next step was to describe them in a suitable format in a similar way to patterns of other domains.

Name	Company	URL
WebCT	WebCT, Inc	http://www.webct.com
CoSE	Staffordshire University	http://www.staffs.ac.uk/COSE
LearningSpace	Lotus	http://www.lotus.com/home.nsf/welcome/learnspace/
BlackBoard	Blackboard	http://www.blackboard.com
TopClass	WBT Systems	http://www.wbtsystems.com
VirtualU	Virtual Learning Environments	http://www.vlei.com
FirstClass	Centrinity	http://www.firstclass.com
Zebu	Centrinity	http://www.mc2learning.com
Learnlinc	Mentergy	http://learnlinc.com
Intralearn	Intralearn	http://www.intralearn.com
Saba	Saba Software	http://www.saba.com

FLE	UIAH Media Lab	http://fle3.uiah.fi
Convene	Convene	http://www.convene.com
Gentle WBT	Hyperwave AG	http://wbt-2.iicm.edu

Table 1. LMS that were searched for patterns

As eloquently stated in (Gamma et al., 1994), it is more difficult to describe patterns than to actually find them. Almost all of the approaches that have proposed patterns in a subject field, have also suggested a novel way of describing and cataloging them. Our suggestion for a pattern description format is a variation of the Alexandrian template that contains the following fields:

i. **Name** – a unique name to distinguish the pattern and uniquely refer to it.
ii. **Problem** – a brief description of the design problem at hand.
iii. **Motivation** – an explanation of the origins of the problem, probably with an example for better communicating it. It may also contain the context of the particular problem if it is necessary in order to make it more comprehensible.
iv. **Solution** – a description of the solution proposed by this pattern that addresses the problem and motivation stated earlier.
v. **User category** – one of the three categories of LMS users defined above.
vi. **Known uses** – examples of the pattern in real LMS. This is an important attribute of a pattern since it is claimed that a proposed pattern gets accepted by the corresponding pattern community, only if there have been two or three examples of its use by someone other than the one who suggested the pattern (Buschmann et al., 1996).
vii. **Related Patterns** – other patterns that are related to this one in some way. It is noted that the patterns proposed in this paper, except for being related to each other, are also related to hypermedia design patterns.

The Alexandrian format is a rather abstract way of describing patterns, as it does not delve into implementation details, but rather expresses a generic solution. On the contrary, the GOF format is very complete and provides straightforward guidelines for implementing the patterns into software. The reason for choosing the Alexandrian format rather than the GOF format, was that the patterns found in Learning Management Systems do not contain many implementation details, but are rather generic and abstract and can be implemented in several different ways. In addition we do not wish to deal with implementation issues because the technologies are changing too fast and if we attempt to propose specific technologies, they will soon become obsolete. The same practice is used in the hypermedia patterns (Rossi et al., 1997; Garrido et al., 1997; Rossi et al., 1999; Garzotto et al., 1999), as well as the HCI patterns (HCI patterns web site, 2002). The next section shows the application of this format for a number of LMS design patterns.

Catalog Of Patterns

Personalization

i. **Problem:** how can the different courses that users are involved in, be organized, so that each user is presented with her/his own personalized set of courses?
ii. **Motivation:** Users of a Learning Management System are involved in a number of courses, depending on the specific academic program they are involved in and their particular position. For example the student of a virtual university for an undergraduate degree, is usually enrolled in 4-8 courses per semester. Correspondingly a professor in a virtual university might teach two to four courses. Also people that act as tutors or teaching assistants of undergraduate courses, might themselves be students of post-graduate courses. All these users may access the courses they attend, teach or provide teaching assistantship to, in varied ways. They may choose for example a specific course from a set of courses, and according to their login information, they will have the corresponding rights and privileges. Another way is to categorize the access pages of different users and let, for example, instructors go to the instructors' access page and choose the courses they teach from a list of all the courses being taught. The problem with such approaches is that users have to trace the individual courses they are interested in through intermediate pages according to their role. Also they are presented with information that is irrelevant to them, for example they see all the courses that are being taught and not the ones that are of immediate interest to them. Another problem is that if they have different roles in different courses, they have to follow different access structures.
iii. **Solution:** Provide a personalization service for all the users, that customizes their home page according to a unique account. Through this service all users should enter the system through an initial login page, and once they are authenticated, they should be presented with all the courses they are involved in, irrelevantly

to what their roles are in those courses. These personalization engines are usually named with the prefix 'my-', similarly to ones in common web sites, e.g. 'mySun' in http://mysun.sun.com/.

iv. **User category:** All users.

v. **Known uses:** WebCT and BlackBoard offer such personalization services called myWebCT and myBlackBoard.

vi. **Related Patterns:** Registration-authentication-access control, Course announcements, Information distribution.

Course announcements

i. **Problem:** Given a sizeable LMS with numerous courses and users, how can the users see the announcements about courses that are of interest to them?

ii. **Motivation:** In large LMS, users are involved with a number of courses and it is of paramount importance for them to see the announcements about courses that concern for example project delivery deadlines, on-line test dates, on-line lecture dates etc. This information must be visible in a place where the user is certain to see it independently of the task she/he wishes to perform when entering the LMS. For example if there is an important announcement about a mathematics course and the student only accesses the LMS to read her/his e-mail or access another course, she/he should also be able to see that announcement.

iii. **Solution:** Structure the initial page of the LMS so that the user as soon as she/he logs into the system, she/he will be able to see the announcements that are of relevance to the courses she/he is involved in. The announcements mechanism should also keep track of the announcements the user has already seen and properly flag the new ones.

iv. **User category:** All users

v. **Known uses:** WebCT and BlackBoard have embedded such a mechanism in the "my" personalization engines, that inform all users of the announcements that relate to the courses they are involved in.

vi. **Related Patterns:** Personalization, Student Assignments Management, Information distribution. This pattern is also related to the News hypermedia design pattern described in (Rossi et al., 1999), which describes the same mechanism for providing the latest news about a particular company in commercial web sites.

Pervasive references

i. **Problem:** How can users have access to various tools of the LMS from parts not directly related to them?

ii. **Motivation:** Learners that are studying the learning resources need to jump from one resource to the other seamlessly, even when the two resources are not directly related. For example learners reading the electronic book, often need to look up terms they come across in the dictionary or glossary. Or when learners are doing a self-assessment exercise and get stuck in a problem, they need to post a question in the discussion forum or find a colleague to chat about it. Even though this problem is more evident with learners, it applies quite equally to the other LMS user categories. For example when the instructor is adding an announcement about a new project assignment being posted, he/she also wants to do some file management in order to upload the files in the appropriate place.

iii. **Solution:** Define a set of pervasive references that are constantly visible from within an environment that is indirectly related to them. This is usually implemented with a toolbar that is placed on top or at the left of the page and users can contains all the tools that users may want to access during another task. It is also common practice to be able to customize this toolbar so that it will match one's preferences.

iv. **User category:** All users.

v. **Known uses:** All the LMS that were examined have incorporated the ability to add such pervasive references.

vi. **Related Patterns:** all the other patterns are related to Pervasive References since all the tools described by the patterns can act as pervasive references. This pattern is also related to the Landmark hypermedia design pattern described in (Rossi et al., 1999), which describes the same mechanism for providing easy access to different though unrelated subsystems in a hypermedia application.

Study toolkit

i. **Problem:** how can the learners be assisted in studying the learning resources instead of being limited to reading simple HTML pages?

ii. **Motivation:** There are many facets to this problem. A first one is that most learners find it difficult to study on-line material because they are used to particular methods of studying paper-based courseware and can't get accustomed to reading from the screen passively. When reading paper-based material, learners usually underline or highlight words or phrases, place bookmarks on particular pages, make annotations on the side etc. These functions obviously can't be performed on a plain web page and they need to be incorporated as an explicit service of the LMS. Another facet of this problem is that learners can't remain connected to the server for many hours for financial reasons (e.g. connection through a dial-up modem) or because they have problems with their connection (limited bandwidth, server down, network congestion). In this case the learners need to download the learning material, store it locally on their computer and use it whenever they want to. Of course this is not a simple download problem, since the learning material may be comprised of numerous pages, linked implicitly through the LMS navigational mechanisms, may have an LMS-made table of contents etc. Finally another facet of this problem is that learners do not want to do on-line studying at all and would rather print the material and read it from paper. Once again this is not a simple download problem, as described earlier.
iii. **Solution:** Provide a study toolkit for the learners to use, which will facilitate them in studying the courseware according to their own preferences. Offer them a set of tools for creating annotations on the text, putting bookmarks on point of interest etc. Also provide them with a tool that 'compiles' the learning material in such a format that can be downloaded and stored locally, and another format that is printable.
iv. **User category:** Learners.
v. **Known uses:** WebCT, VirtualU, Blackboard, CoSE, Intralearn, TopClass, LearnLinc, FirstClass and LearningSpace provide the ability to set bookmarks, while CoSE, Intralearn, FirstClass and LearningSpace provide annotation tools. WebCT and BlackBoard provide the tools for 'compiling' the learning content in a downloadable and printable format.
vi. **Related Patterns:** E-book delivery, Glossary.

Searching

i. **Problem:** How can the users search through the learning resources and find something, effectively and without wasting too much time in irrelevant pages?
ii. **Motivation:** There are cases where the learning resources are numerous and diverse, resulting in the students spending much time and effort in trying to locate them. Browsing through the resources is therefore not the most effective way to find what one is looking for, in an educational context. Also the learners are often overburdened with information resulting in a cognitive overload in expense of the learning process.
iii. **Solution:** LMS should have the provision of incorporating search engines such as the ones found in generic web sites. These search engines though are differentiated from common web site search engines, in that they are specialized in learning resources and therefore can be smarter than common search engines. That can be achieved by adding contextual semantic information for learning resources in the form of *learning object metadata*, which describe relevant characteristics of learning objects in order to facilitate search, evaluation, acquisition, and use of learning objects, for instance by learners or instructors (IEEE LTSC, 2001b). There are several metadata standards (e.g. IEEE LTSC, IMS, Ariadne) that can be adopted by LMS so that these descriptions of learning resources can be formalized and even exchanged between them.
iv. **User category:** learners and instructors.
v. **Known uses:** Search engines that facilitate searching in the learning content are offered by WebCT, COSE, Intralearn and TopClass. None of them so far has adopted an international standard for learning object metadata, but some LMS have announced that they plan to do so. However COSE, TopClass, LearnLinc, Saba and LearningSpace support proprietary metadata formats to enable searching of learning resources.
vi. **Related Patterns:** Searching can apply to all learning resources, therefore this pattern is related to E-book delivery, Glossary, Course announcements. The patterns 'Selectable Search Space', 'Selectable Keywords', 'Structured Answer', 'Selectable Search Engine' and 'Simple Search Interface' (Lyardet et al., 1999) are relevant for providing guidelines on how to make effective search engines for Web Information Systems.

Course Creation and Customization

i. **Problem:** How can the instructors be assisted in building on-line courses in LMS so that some of the tasks they need to perform can be automated?
ii. **Motivation:** LMS need to make the job of instructors easier by providing them with easy-to-use tools for creating, and customizing their courses so that they won't have to be experienced in using the LMS, neither will they have to spend too much time and effort in performing those tasks. This way, courses will not be

created from scratch, but instead instructors will reuse some design templates and easily perform generic activities and let the LMS take care of the details. For example if an instructor already has a course named 'Software Engineering: Part I' and wants to create another one for the course 'Software Engineering: Part II' that has roughly the same structure and format, she/he should not create it form scratch. Instead she/he should be able to build the new course by using the old one as a template. Also instructors should not have to perform low-level activities to customize their course but the LMS should provide the appropriate tools. For example if the instructor wants to change the background image of the course's home page she/he should not change the corresponding HTML tag, but instead set it visually through an LMS tool. Finally courses have to be initialized in the beginning of every semester in an automatic way by resetting student accounts, deleting the old announcements, reconfiguring the calendar, cleaning the old file folders etc.

iii. **Solution:** Provide the instructors with appropriate tools for creating a course and customizing it according to their preferences. The creation of courses should be based on design templates with pre-set interfaces, content structure and features or based on existing courses. Instructors should also be equipped with tools to reset the courses on every semester and easily manage the appearance, structure and features of their courses, doing as few things manually as possible.

iv. **User category:** Administrators and Instructors.

v. **Known uses:** WebCT, VirtualU, Blackboard, Intralearn, TopClass, LearnLinc, FirstClass, Convene and LearningSpace provide templates for course creation as well as tools for customizing the various courses characteristics.

vi. **Related Patterns:** Personalization, Course Initialization.

Student tracking

i. **Problem:** How can the instructors track the students' progress while they interact with the LMS 's various features? How can the students be informed of what activities they have already performed in a course?

ii. **Motivation:** In the traditional classroom, instructors watch the students' progress, monitor their various activities, evaluate them and coach them so that they learn as effectively as possible. In the virtual world of LMS, instructors do not have a physical interaction with the students and thus cannot observe them and supervise their learning. For example the instructors do not know whether the students have studied the appropriate learning resources, practiced the on-line exercises, collaborated with their colleagues in their projects, or read the announcements for a course. On the other hand, in large and multifaceted courses, the students do not know which parts of the LMS they have already seen, what remains to be done etc.

iii. **Solution:** Keep records of the students' activities in terms of which parts of the course they have visited and how long they have spent in them, what tools they have used, and maintain files of the conversations that took place in chat rooms, discussion fora etc. Provide the instructor with a tool for observing these records and facilitate him/her in assessing the various activities that students perform, for example by presenting him with statistics about the students' actions. On the students' side, these LMS services can also provide the students with a log of their personal history so that they know where they have already gone and what remains to be seen.

iv. **User category:** Instructors and learners.

v. **Known uses:** WebCT, Blackboard, Intralearn, Saba, FirstClass, Convene and LearningSpace provide tools for tracking the progress of students. On the other hand WebCT, VirtualU, Blackboard, Intralearn, Saba, FirstClass and LearningSpace provide tools for informing students of their own study progress.

vi. **Related Patterns:** E-book delivery, Glossary, Management of on-line questionnaires, Student Assignments Management, Student group management.

Course Initialization

i. **Problem:** How can the administrator of the LMS initialize the courses properly so that they are ready for instructors to customize?

ii. **Motivation:** LMS are complex Web-based systems, usually supporting a large varying number of courses. There is a need for a central maintenance of newly created courses, the proper initialization of technical settings concerning security, performance, physical deployment of the course into the system, the assignment of proper user roles, the integration of previously available information into the new course.

iii. **Solution:** Provide a tool for the creation of a new course to the administrators of the LMS. Provide a set of templates for the new course. After the completion of the setup procedure, accredited course instructors can modify the newly created course according to their needs.

iv. **User category:** Administrator

v. **Known uses:** FLE, BlackBoard and WebCT provide tools to their administrators for the creation of new courses.
vi. **Related Patterns:** Course Creation and Customization, Course backup – restore**.**

Course backup – restore

i. **Problem:** How can the LMS prevent the loss of data after system failure?
ii. **Motivation:** LMS are mission critical systems in the context of educational organizations. They contain valuable information in the form of student data, course and information material. Possible system crashes or other failures can cause the loss of such information, leading the whole learning process in an invalid state.
iii. **Solution:** Make available tools for the backup and restoration of courses to Administrators and encourage them, though the appropriate documentation, to take backups on a regular basis.
iv. **User category:** Administrator
v. **Known uses:** Virtual-U provides both command-line and web-based tools for backup and restore of courses. WebCT, Intralearn and Convene provide a web-based tool for the backup – restore of courses. In addition WebCT suggests the use of separate archiving tools in order to take system-level backups.
vi. **Related Patterns:** Course Initialization.

E-book delivery

i. **Problem:** How can the instructors be provided with an easy and consistent way of creating and structuring electronic course books using hypermedia content?
ii. **Motivation:** No matter what the learning theory and instructional design strategy is adopted by the Instructors or Institutions, the dissemination of learning content in the form of a set of web pages delivered over the web is common in every web-based system facilitating learning processes. The learning content must be structured, have consistent style and layout and provide a uniform and self explanatory user interface metaphors allowing its users (Students) to easily navigate into the hypertext.
iii. **Solution:** Develop a run-time system for the dynamic structure and delivery of the learning content. Provide course Instructors with appropriate tools for structuring the learning content into aggregated logical sets of web pages (i.e. chapters) in a hierarchical manner. These web pages can be uploaded to the system or created from scratch. Present the content to Students preserving its structure.
iv. **User category:** Instructor**.**
v. **Known uses:** WebCT, Blackboard, VirtualU, COSE, Intralearn, TopClass, LearnLinc, FirstClass, and LearningSpace provide instructors with tools for the creation and management of an electronic book.
vi. **Related Patterns:** Glossary, web page editing, Study toolkit, Searching.

Glossary

i. **Problem:** How can the students be provided with definitions or explanations of terms that appear inside the learning material?
ii. **Motivation:** During the study of a specific topic, certain terms need to be defined or explained. These terms usually appear for the first time, or are of specific importance for the comprehension of a specific learning topic and the achievement of its learning goals.
iii. **Solution:** Develop a mechanism for assigning definitions or explanations to properly inserted terms. The set of these terms constitutes a glossary related to a specific course. This mechanism may support:
    a. An alphabetical index containing the terms of the glossary.
    b. Automatic creation of links to the explanation of the terms appearing in the learning content, wherever possible through a pop-up window.
iv. **User category:** Instructor
v. **Known uses:** WebCT, Blackboard, VirtualU and IntraLearn provide tools for the creation and maintenance of a glossary in courses.
vi. **Related Patterns:** e-book delivery, Searching.

Web page editing

i. **Problem:** How can the hypertext learning content be created or modified in-place?
ii. **Motivation:** Although the learning content integrated into an LMS is usually created by means of specialized development tools, there is a need for adding new web pages or modifying existing ones. These features must be accessible to authorized users (Instructors) over a web-based user interface.
iii. **Solution:** Develop a web-based tool for the creation of web pages or the modification of existing ones. Provide templates or wizards for the creation of new pages and /or an HTML editor.
iv. **User category:** Instructor
v. **Known uses:** WebCT, COSE and FirstClass permit the editing of web pages via a simple web-based HTML editing tool. Zebu provides a web-based user interface for the creation of learning material based on templates and without the need to write HTML code. COSE and FirstClass offer wizards to automate the process of content authoring.
vi. **Related Patterns:** e-book delivery.

Registration-authentication-access control

i. **Problem:** How can all the different users' access rights and privileges be effectively managed?
ii. **Motivation:** LMS are large, multi-user systems accessible via the World Wide Web. Due to security, privacy, financial and institutional policy reasons, user access to the resources of on line courses must be restricted to authorized users only. Additionally, user roles vary from guests, granted limited access rights, to administrators with full permissions over the entire system. Consequently, systems must assign specific rights to the various systems resources according to the role of each user.
iii. **Solution:** Provide a standard registration mechanism for every user of the system. Users may register themselves through a web interface or submit a request for registration to the System Administrator. Every user has a specific role in the system: Student, Instructor and Teaching Assistant. This role may be different for different courses in the same system. Develop a database with user data and provide a mechanism for user authentication.
iv. **User category:** All users
v. **Known uses:** All LMS provide some authentication mechanism and define separate roles of users.
vi. **Related Patterns:** Course grouping, Personalization

Management of on-line questionnaires

i. **Problem:** How can web-based quizzes be created, delivered and graded?
ii. **Motivation:** The administration of on-line tests for the assessment of students is a common task for the majority of LMS. The creation and delivery of questions and tests over the Web is a complicated task due to the interactive, sophisticated nature of the web-based questionnaires.
iii. **Solution:** Provide a mechanism for the creation of on-line questions: closed-end questions with predefined answers, that are able to be automatically graded and open-end questions, that need to be graded by an instructor. Allow the Instructors that create the questions, to be able to allocate a grade to each question. Also give them the ability to announce the schedule of on-line tests so that students are informed in time. Develop a run-time system for the delivery of the tests at the time scheduled, the automatic grading of closed-end questions, the automatic submission of answers to open-end questions to the Instructors and the storage of the results into the students' records. In case of self-assessment questionnaires, assign particular questions to learning units where the student should check the knowledge she/he is supposed to have obtained. The run-time system should make these questions available to the students whenever they access the particular learning units.
iv. **User category:** Instructor, Learner.
v. **Known uses: A**ll LMS that were reviewed have some mechanism for on-line questionnaires.
vi. **Related Patterns:** Assignments management, Student tracking

Student group management

i. **Problem:** How should groups of students be created and managed, and how can projects be assigned to these groups?
ii. **Motivation:** One of the most complicated tasks of both traditional and on-line courses is the management of groups of students. Students must be grouped in working teams, their progress should be tracked during the

project time, and ways of communication between the members of the group and the supervising instructor must be established. In addition there must be some repository for the artifacts of the projects assigned to these groups and a mechanism for grading the students.

iii. **Solution:** Provide a tool for the creation of groups of students. The groups can be created either manually, by the instructors, or automatically by the system. The tool should also provide the ability to assign projects to groups, and, optionally, allocate space for the project deliverables, as well as provide a mechanism for the easy upload of these deliverables from group members. The communication between the members of the group should be established through asynchronous (e-mail, discussion forums) or synchronous (chat, video conference) mechanisms. The system should permit the supervisor of each project to participate in the communication sessions between the members of the groups, to track their progress by reviewing the artifacts of the project and to grade each student at the end of the project.

iv. **User category:** Learner, Instructor.

v. **Known uses:** Blackboard, CoSE, FirstClass, Convene, LearningSpace and WebCT provide tools for the creation and the management of workgroups of students. Gentle WBT has a tool for the definition of working groups, which is available to all types of users.

vi. **Related Patterns:** Student Assignments Management, Asynchronous collaborative learning, Synchronous collaborative learning, Student tracking

Student Assignments Management

i. **Problem:** How to create on-line assignments for students?

ii. **Motivation:** Assigning questions and exercises to students is a common practice for instructors. In the context of a web-based LMS certain matters have to be resolved: How to communicate issues concerning the assignments to students, how to grade students, etc.

iii. **Solution:** Provide a tool for instructors to manage assignments. An instructor can define an assignment adding the following entries: The title of the assignment, a description, links to on-line resources, start and due date. Students are notified for the assignment and prepare their documents for submission. The documents can be sent to the instructor via e-mail.

iv. **User category:** Instructor, Learner.

v. **Known uses:** Virtual-U, WebCT, COSE, Intralearn, Saba, Blackboard, FirstClass, Convene and LearningSpace provide tools for assignments management.

vi. **Related Patterns:** Asynchronous collaborative learning, Synchronous collaborative learning, Announcements, Student tracking. This pattern is also related to the Student Group Management Pattern in the sense that they both facilitate a problem-based instructional approach. The main difference between the two is that while in the former, assignments are disseminated to the whole class and require personal work of each individual student, in the latter, groups are created in order to encourage the collaboration of students along with the supervision of an instructor.

Asynchronous collaborative learning

i. **Problem:** How to allow and facilitate learners and instructors to asynchronously collaborate and interact, to engage learners in problem-solving and critical thinking about issues in a domain, to be able both to mentor and to assess these interactions?

ii. **Motivation:** When students work together they learn from one another and extend their interaction and learning outside of class. Busy schedules and commuting students often make group work difficult to coordinate. When properly applied, technology can eliminate these barriers to collaboration. The main goals for asynchronous collaboration are:
   - providing a comfortable setting for contribution by all group members
   - enabling convenient collaboration without restrictions of time or place
   - archiving learners and instructors exchanges

iii. **Solution:** Asynchronous computer mediated communications (ACMC) can effectively and efficiently support the asynchronous collaborative learning process, due to the fact that they offer flexibility in the use of time as well as space. The most common type of ACMC is the asynchronous text-based communication, such as e-mail, mailing lists, web-based discussion fora.

iv. **User category:** Learners and instructors

v. **Known uses:** All LMS provide both customized e-mail client-servers and discussion fora. Most of them offer tools for creating group mailing lists.

vi. **Related Patterns:** Personalization, Synchronous collaborative learning, Student group management, Student Assignments Management, Announcements, Information distribution Synchronous collaborative learning.

Synchronous collaborative learning

i. **Problem:** How to allow and facilitate learners and instructors to synchronously interact, collaborate and co-operate with peers?
ii. **Motivation:** Synchronous collaborative learning is a computer-mediated effort that simulates face-to-face interaction. Since body language and facial expressions cannot be conveyed through asynchronous communication, real-time communication allows contributions participation, sharing information and social dialogue at a distributed environment. The main advantages of synchronous multimedia communication are:
   - "Next best thing to being present at a lecture hall"
   - Very visual medium; students and teachers can begin to relate to one another.
   - Good for distance education novices for developing a "learning community"
iii. **Solution:** Synchronous multimedia communication tools make it possible for learners and instructors at different sites to partake in the same conference at the same time through the "magic" of two-way audio and two-way compressed video. Examples of types of synchronous communication include:
   - text-based Internet chats
   - instant messaging
   - audio & video conferencing
   - virtual whiteboard applications
   - shared applications
iv. **User category:** Learners and instructors
v. **Known uses:** All LMS provide some sort of chat or conferencing service.
vi. **Related Patterns:** Asynchronous collaborative learning, Student group management, Student Assignments Management

Online support

i. **Problem:** where can LMS users find information about the features of an LMS, solutions to problems about the utilization of the system, the navigation, etc.?
ii. **Motivation:** When an LMS is easy to use, then help is not really needed. However, users need many types of online assistance such as quick reference for achieving a task, (i.e. task-specific help), complete documentation for better understanding of the system, tutorials, etc. Online support should have the following requirements:
   - availability
   - access at any time, at the same time
   - accuracy and completeness
   - correct coverage of the whole system
   - consistency on content, terminology, and style
iii. **Solution:** Online support is provided by LMS either by online documentation, online tutorials and frequently asked questions. It can be categorized as follows: a) quick reference (mostly used as a reminder), task-specific help (for achieving a task), full explanation (for better understanding of the system) and tutorial. In principle, online support/help systems:
   - are hyper-documents
   - allow navigation to topics via auto created contents and index of topics
   - save history of shown topics
   - support interactive showing

   In fewer systems LMS creators adapt the help system to the user. Such “adaptive help systems” are similar to general adaptive user interfaces, monitor user activity (e.g., preferences, mistakes, etc.), and build model of users so that the LMS can actively initiate help.
iv. **User category:** All users
v. **Known uses:** WebCT, VirtualU, Blackboard, Intralearn, TopClass, Learnlinc and LearningSpace provide on-line help to their users. In addition some of them provide “help lines”. For example, Ask Dr. C is a question-and-answer service moderated by a dedicated, international community of experienced WebCT users, who accept any question about WebCT.

vi. **Related Patterns:** all the other patterns are related to Online Support since all the tools described by the patterns should be supported by some kind of help.

Information distribution

i. **Problem:** How to allow users to view and share events with other users about education-related events?
ii. **Motivation**: Users need mechanisms that can provide either private or public (centralized) access to current and past information about instructional events, meetings, etc. Such mechanisms should be used for:
   - Planning future events (e.g. mid-tem examination)
   - Checking dates when planning events to avoid scheduling conflicts (e.g. attendance at a meeting)
   - Checking the archive of events
   - Searching for types of events using keywords or text matches
iii. **Solution:** Some LMS incorporate calendar systems that hold a number of features, enabling the user to publish events and customize the calendar according to his/her needs and preferences. Such features are:
   - View calendar in Day/Week/Month view
   - Navigation: go to today; go to specific date; go to next Day/Week/Month
   - Add/Edit/Delete Events
   - Date and Time picker components
   - Repeating events
   - User-defined categories for events
   - Search for events by title and description
   - Event alarms; notification on desktop, email, or text pager
   - Send event invitation by email
iv. **User category:** Instructor, Learner.
v. **Known uses:** Blackboard, WebCT, VirtualU, Intralearn, Convene and LearningSpace have a calendar tool that enables either private or public event announcements, which can be linked to their personalization services.
vi. **Related Patterns:** Personalisation, Asynchronous collaboration learning, Announcements.

Conclusions and future work

This paper has attempted to initiate the establishment of a pattern language for Learning Management Systems. We believe that such a pattern language can have the following advantages for designers of Learning Management Systems:

- Reduced time and cost of designing and developing LMS.
- Increased software qualities of LMS and especially in the usability sector.
- Increased pedagogical quality of LMS and especially learning effectiveness.

Future work is concerned with establishing an initiative for constructing a repository of design patterns for Learning Management Systems in order to attract more researchers into depositing their own patterns. That would strengthen the pattern language and offer a wealthy pool of patterns, so that inexperienced designers of LMS could base their work on a sound and systematic basis. Furthermore, an experimental LMS is already being constructed that incorporates the patterns proposed in this paper. The aim is to illustrate the actual implementation of these patterns by showing the implementation details and offering a complete description of the patterns using a GOF-like description template. Finally we intent to expand the application domain of patterns to the general context of e-learning that will include the design of web-based learning content, as well as the organization of the human actors that participate in such systems. That would result in a holistic approach of documenting the design expertise of instructional design in web-based instructional systems by capturing all of their subsystems.

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Uncovering the Provisos behind Flexible Learning

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Abstract

In this paper we argue that flexible learning, as is prevailing among Australasian higher education institutions in recent years, is not without a price. Through a review of literature, we try to uncover provisos underpinning flexible learning. That is, all flexibilities come with provisos, pre-conditions, and commitments (or even inflexibilities). In order to make one aspect of the instruction flexible, usually other aspects have to be made more structured. Eight aspects of flexibility are analysed and discussed. We conclude this paper with a call for more rigorous investigations into issues related to flexible learning.

Keywords

Flexible learning, Cost-effectiveness, Proviso, Flexibility

Introduction

In this paper we argue that flexible learning, as is prevailing among Australasian higher education institutions in recent years, is not without a price. Through a review of literature, we try to uncover provisos underpinning flexible learning. That is, all flexibilities come with provisos, pre-conditions, and commitments (or even inflexibilities). In order to make one aspect of the instruction flexible, usually other aspects have to be made more structured.

A commonly accepted definition of flexible learning is that an institution provides students with flexible access to learning experiences in terms of at least one of the following: *time*, *place*, *pace*, *learning style*, *content*, *assessment* and *pathways* (e.g., Macquarie University, 2001; Browne, 1999; Ling, et al, 2001). This definition is based on the view that learning requires the active engagement of students; and that students should be more independent and more responsible for their own learning. That is, flexible learning tends to be student-centred, rather than teacher-centred. Other characteristics of flexible learning include: students' collaboration with peers and/or practitioners in the field, provision of ample resources, the learning experience being context sensitive, and greater emphasis on generic skills (e.g. thinking, meta-cognitive, problem-solving), and the shift of the teacher's role from a source of knowledge to a facilitator throughout the students' journey in learning (e.g., Bridgland & Blanchard, 2001; George & Luke, 1995; University of Sydney, 1999).

The term flexible learning, in some documents, is loosely used and sometimes may be referred to as distance education, open learning, e-learning, technology-based learning, and more recently blended learning. In this paper, flexible learning is taken as a broad concept, which encompasses aspects and features of most of these terms.

Flexible learning can be translated into different levels in implementation. For example, it could focus mainly on using a technologically driven e-learning environment to make learning flexible (Waikato University). It could mainly focus on flexible delivery, which includes various types of mediated instruction including print, audio-visual, computer assisted or online delivery as well as traditional instructional formats such as lectures and tutorials (University of Wollongong, 2000). Flexibility can be considered in terms of course structure, course content, teaching and learning methods, interactions between the teacher and the students, and assessment method (Monash University). Macquarie University (2001) has adopted flexible learning as a university-wide endeavour. The Centre for Flexible Learning was established to coordinate and implement such efforts. A total of 31 staff members are working in the Centre for Flexible Learning. This Centre is set up in addition to the

Centre for Professional Development (11 members) and the Centre for Open Learning (30 members), the distance education "arm" of the University.

In Australia, Ling et al (2001) surveyed 10 universities and identified 6 models of flexible provision of higher education:

1. Moving time and/or place to suit the learner
   (e.g., provision in the workplace or regional campuses, study centres, or summer school)
2. Removing fixed time and place constraints
   (e.g., off-campus programmes utilising print or digital tuition materials)
3. Removing entry requirements
   (e.g., no academic entry requirement or recognise and give credit for prior learning)
4. Providing alternative entry and exit points appropriate to the learner
   (e.g., courses that articulate with TAFE studies providing advanced standing in the higher education course; programs that provide alternate exit points)
5. Accommodating learning style, pace and collaboration preferences
   (e.g., programmes offered in full or in part in more than one mode; programmes with flexible time schedules; courses that permit but do not require collaboration)
6. Accommodating content and assessment preferences
   (e.g., modularised content allowing choice in construction of a programme; problem-based learning allowing some selection of content; alternative assessment tasks)

Most of the universities surveyed by Ling et al are situated in rural areas and are predominantly distance education institutions or traditional campus-based universities with existing infrastructure to support the provision of education in alternative ways.

The Tug Between Learning- and Cost- Effectiveness

A search of the literature on flexible learning has been disappointing because not many studies directly address effectiveness issues related to flexible learning. Of the few papers found, most of them are based on conceptual analysis or anecdote. A closer examination of these papers showed that most of them converge on two common questions set forth by institutions.

First, is flexible learning an effective way to learn? It seems that most papers advocate flexible learning at the philosophical and theoretical level (e.g., Takala, Hawk & Rammos, 2001) or describe how flexible learning is implemented in its respective local context at the institution (e.g., Bridgland & Blanchard, 2001; Munan, George & McCausland, 2000). There is little reference to student learning or the quality of the learning experience. There are some attempts to measure the success of flexible learning by so-called performance indicators. However, most of these are indicators of flexibility or satisfaction, which are loosely related to learning. For example, the University of South Australia uses the Graduate Course Experience Questionnaire as a key performance indicator for its success in teaching and learning (Munan, George & McCausland, 2000). This questionnaire asks about how much students enjoyed the learning experience, but not about the quality of that experience. An elaborate study commissioned by the Australian Ministry of Education on flexible provision of higher education uses student completion and attrition rates or student satisfaction as the indicator for "student outcome" (Ling et al, 2001). Bell et al (2001) studied how making time and place of learning flexible affects student learning. They were disappointed to find that flexibility reduced students' motivation and that the students tended to defer their study because they could do it at a later time. The above examples provide only weak evidence that if students are empowered with flexible access to learning, they will actually learn better.

Second, can flexible learning reduce the overall cost in the long term and is a commitment to flexible learning more cost-effective to the institution? Some reports claim cost-effectiveness. However, very few of them are backed up by research or cost analysis. Even though Ling et al. (2001) concluded from their survey that flexible provision tends to make only marginal additional demand on infrastructure costs, it is only confined to institutions with established off-campus or multi-modal arrangements and with arrangements to allow for design and development demands. Ling also pointed out that the surveyed institutions do not normally consider the additional demands on academic staff time. In fact, these demands are satisfied in part at the cost of time spent on research and in part by staff working longer hours (Ling et al., 2001). Johnstone & Poulin (2002) contend that people costs outweigh technology costs when implementing technology-mediated learning. Johnstone & Poulin (2002) also argue that the best solution may not always be the cheapest one. An elaborate cost analysis conducted at the Macquarie University (Ling, Inglish & Webster, 2002) shows that while the total cost based on

traditional face-to-face instruction is A$30,000 per course per year, the proposed flexible learning format (face-to-face supported by flexible delivery), costs A$70,000 if it is run as a 1 year project or A$61,000 per year if the project spans over 3 years, more than twice the cost of the conventional way! In order to sustain the viability of flexible learning, it seems that the flexible learning initiative must be able to attract and "serve" more students in order to justify its existence financially.

In short, there are clear indications that to make learning more flexible, more resources and supports must be in place. However, there is weak evidence (regardless of how theoretically sound it is) suggesting its learning effectiveness. There is also a seeming tension between learning effectiveness and cost-effectiveness. Clearly, more research studies are needed.

Uncovering the Provisos

It becomes a concern from the above brief review that flexibility in many cases seems to become an end, rather than a means to the pursuit of quality learning. The performance indicators (e.g., how many courses are conducted flexibly) typify this kind of ideology. In many ways, flexibility is presumed good and inflexibility bad. Instead of taking that presumption, in this paper, we suggest that flexibility is but one way to approach learning. Its merit cannot be taken for granted and needs further examination. In fact, we contend that all flexibilities come with provisos, pre-conditions, and commitments (or even inflexibilities). An informal meeting with a Flexible Learning team reinforces this conception of provisos. The teaching team commented that their off-campus students were experiencing difficulties when they first tried to make the course content more flexible. One source of difficulty is the lack of a clear structure. This is partly because students progressed at different paces and there were few opportunities for peer interactions. The teaching team later found that spelling out clearly the course content including learning activities, guiding question and assessment components at the beginning of a course greatly reduced the difficulty. The course material pack (which also includes an audio tape) helps students to structure and plan their learning. It also ensures that all students have access to reading materials so that they may participate in discussion more effectively. This course material pack, however, limits the possibility for the teaching team to make formative adjustments to the course based on emergent opportunities. The above example shows that to make some aspects of the learning flexible, some other aspects may have to be pre-determined (and thus made inflexible).

This naturally leads to the following attempt to analyse the provisos underpinning various aspects of flexibility. We did not adopt the model emerging from the study by Ling et al (2001) because their proposed items are not independent from one another. For example, removing fixed time and place constraints could also imply moving time and/or place to suit the learner; providing alternative entry and exit points could also include removing entry requirements. We use the type of flexibility and the instructional media involved as independent variables for our analysis. Table 1 illustrates our attempt to unpack the analysis process.

Aspect of flexibility	Educational benefits when provisos met	Issues	Provisos	Demands on additional resources
Flexible place, same time (Synchronous), text-based (e.g., Chat)	Sense of social presence	Mainly for socialisation, not instruction Lack of sense of immediacy Inability to handle multiple chats well Hindrance to communication Only feasible with small groups	Typing skill Technological infrastructure	Tech: * Time: ** Dsgn: * Admn: *
Flexible place, same time (Synchronous), (AV-based conferencing)	Same as or less than face-to-face	More limited interaction than f2f instruction Still need to report to a fixed broadcast station	Technological infrastructure Technical support	Tech: *** Time: ** Dsgn: * Admn: **
Flexible place, flexible time (Asynchronous) without	Opportunity for self-directed learning	No teacher interaction with students	Student access to learning materials Student motivation Clearly defined course	Tech: * Time: * Dsgn: *** Admn: *

interaction with others			content or structure	
Flexible place, flexible time (Asynchronous) with opportunities to interact	Engage students in in-depth discussion and reflection	Difficult to consult or clarify quickly Difficult to make quick decisions	Technological infrastructure Student access to learning materials Student motivation Clearly defined course content or structure	Tech: * Time: *** Dsgn: *** Admn: *
Flexible pace (starting/exit points)	Providing alternatives for motivated students	Limited student collaboration Lack of sense of community Only feasible with small groups Staff workload	Student motivation Ample staff support	Tech: * Time: *** Dsgn: * Admn: *
Flexible style (e.g., courses offered in different modes)	Catering for individual needs	Staff workload	Ample staff support Available supporting team	Tech: *** Time: *** Dsgn: *** Admn: *
Flexible course level pathway (e.g., content and assessment)	Catering for individual needs	Staff workload Limited student collaboration Lack of sense of community Only feasible with small groups	Modularisation of a course	Tech: * Time: *** Dsgn: * Admn: *
Flexible pathway (Degree components)	Catering for individual needs	Administrative support Policies (e.g., accreditation & cross-accreditation) Financial arrangements	Quality assurance Credibility Academic advisors	Tech: * Time: * Dsgn: * Admn: ***

Tech: Technology Dsgn: Instructional design support
Time: Staff time Admn: Administrative support
* low ** moderate *** high (indicative)

Table 1. An analysis of provisos and benefits of flexible learning

Flexible place, same time (synchronous), text-based. Students in the synchronous approach gain access to the instruction from different places but at the same time. The most common example of a *text-based* approach is the employment of Chat sessions in the instructional activity. Participants could type a short text message and send it to the Chat server. This message will then appear in every participant's monitor. The interaction takes place in almost real time. Studies found that chat sessions are more often used by participants for socialisation purposes. Furthermore, the sense of immediacy that is usually experienced in face-to-face discussion is taken away due to the slowness of typing. Consequently, the flow of communication in hindered. Chat is also limited in handling multiple topics because messages coming from different participants interweave with one another. It requires extra effort in composing messages to make sure which previous message the current message is referring to. Chat sessions must be carefully structured to ensure their instructional value. Typing skills must be a pre-condition for all participants. In other words, this text-based synchronous approach may preclude people with poor typing skills from the learning activity.

Flexible place, same time (synchronous), AV-based. Another synchronous approach to *flexible place* is AV-based (e.g., video or audio-conferencing). Because participants can communicate orally, the typing skill pre-condition as imposed by the text-based approach is overcome. However, technological infrastructure must be in place for this approach to be successful. Video conferencing equipment is still expensive at this stage and the communication is seldom without problems. Therefore, technical support on site when the learning activity is taking place is also essential. The interaction among participants is limited due to the camera position. One must be within the camera "range" to show up on the screen. Eye contact is gone. What is gained using videoconference is the capability to display visual resources for instruction or discussion. Flexibility, which the AV-based synchronous approach provides, is very much limited, because participants still have to report to a fixed studio with the conferencing facility.

Flexible place, flexible time (asynchronous) without interaction with other students. The *asynchronous* approach refers to learning taking place at a flexible time and thus naturally implies learning occurring at a flexible place. This approach usually involves the use of print materials or interactive multimedia on CDs. If there is no

provision for students to interact with others, the design will become distance education in the traditional sense that students receive course materials and study on their own. The advantage of this approach is that it is very flexible and provides students with ample opportunity for self-directed learning. However, because of the lack of interaction with the teacher and other students, success relies heavily on individuals being very motivated. Course materials must be structured very clearly to enable student learning. Much instructional design effort is therefore needed.

Flexible place, flexible time (asynchronous) with opportunities to interact. In addition to the provision of course materials, there can be provision for interactions between the teacher and students or among students. Usually, the interaction is by means of the Internet and its text-based discussion or e-mail functions. This approach is generally more flexible than the synchronous approach, but raises different issues. For example, it does not permit real time consultation and thus students are not able to get something clarified quickly. This, at times, could become frustrating, because "one simple clarification in time could save nine unnecessary misinterpretations". Students and lecturers always have to wait for the majority to come online before a decision can be made. So, teachers may only "fine tune" the course to a very limited extent. Consequently, the course content and structure must be very clearly spelt out before the commencement of a course, that is, "inflexible" content and structures. In addition, teachers need to make sure all students have access to the learning materials (the issue of digital divide); and the success of this approach is also heavily dependent on motivated students.

Flexible pace (starting/exit points). In terms of flexibility in learning *pace*, this usually refers to situations where students can start a course at a flexible time of the year and can pace themselves through the course accordingly. Usually, Masters and Ph.D. dissertations operate under this model. Issues related to this approach include the very limited opportunity for students to collaborate and the lack of sense of a learning community because of the limited interaction with peers. Students also need to be strongly motivated to finish the course requirements. Because this approach is highly individualised, the demand on faculty time and efforts is tremendous. Therefore, scalability is an issue. It may not be a realistic expectation for this approach to work equally well with a large number of students.

Flexible style (courses offered in different modes). Flexible style means the course is offered in different modes. For example, not only does the lecturer give lectures, but course materials are also structured into multimedia CD-ROM to allow for student revision. Not only materials are presented in print format, but also are they in audio, video or digital formats. The advantage of this flexible style is that the instruction caters for individual needs and learning styles. However, since it is offered in different modes, it is equivalent to offering different courses and the demands on staff time, instructional design and technical support are very high.

Flexible course level pathway (content and assessment). A flexible pathway at the course level means students have choice over the combination and the sequence of the content to be learned. This can sometimes also imply choice over assessment modes. The advantages and disadvantages are similar to flexible pace. In addition, the course must be modularised to enable the flexible pathway. This is sometimes not feasible for subjects that are highly integrative in nature.

Flexible pathway (degree components). A flexible pathway at the degree conferment level involves flexible recognition of students' prior learning and working experience and potential to study higher level or alternative courses. The major advantage is again in catering for individual needs. However, this imposes challenges in terms of quality assurance and accreditation of what is learned. It also requires major changes to existing policies such as accreditation and cross-accreditation mechanisms and imposes administrative complexity on the financial arrangements. Sufficient academic advisors are also essential.

From the above analysis, it can be seen that every form of flexibility comes with provisos before we can begin to enjoy the educational benefits of flexible learning. The tug between learning- and cost- effectiveness is also quite evident. Issues related to each type of flexibility warrant further investigation.

Summary

The discussion in this paper can be summarised into the following points:

- Flexible learning means that students have flexible access to learning experiences in terms of at least one of the following: *time*, *place*, *pace*, *learning style*, *content*, *assessment* and *pathways;*

- There is clear evidence that flexible learning in most forms requires additional resources: *staff time* and *instructional design, technical*, and *administrative supports*;
- There is weak evidence that making learning flexible will enhance learning;
- Flexibility comes with provisos. By making one aspect of learning flexible, other aspects may have to be more structured (or inflexible);
- Flexibility may not necessarily promote learning, whereas inflexibility may not necessarily inhibit learning;
- E-learning can be flexible or inflexible depending on how the instruction is designed;
- Flexible learning should be seen as a means not an end to quality learning.

It follows that flexibility is one of the tools that higher education institutions may use to meet their goal (charter obligation) of providing high quality learning to their students. Education institutions may wish to use flexibility in order to achieve such things as increasing student numbers, making courses more easily available to students, and enabling campus bound students to manage their time more flexibly. Should any instituions wish to increase flexibility, it will need to consider the implications in terms of resources and expertise to ensure that its primary goal of providing quality high level education can be met.

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An Evaluation Instrument for Hypermedia Courseware

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Abstract

This paper presents an evaluation instrument for hypermedia courseware. Its design is based on an evaluation framework developed from the integration of a number of important issues emerged from research on instructional design and system evaluation the past fifteen years and is concerned with both social and practical acceptability of hypermedia courseware. The term social acceptability is related with the social basis of an educational system. Practical acceptability is examined through the evaluation of the following sectors: content, presentation and organization of the content, technical support and update processes and finally, the evaluation of learning. All sectors are equally important, as hypermedia courseware has to be simultaneously pedagogically and technically sound. The paper first discusses other evaluation efforts; next it introduces the evaluation framework and finally presents the evaluation instrument and suggests ways for the analysis of the results.

Keywords

Evaluation criteria, Evaluation instrument, Hypermedia courseware

Introduction

The number of products from the educational software industry has significantly increased the last decade and in particular there are numerous hypermedia courseware available in the market on almost any educational subject. (Courseware is a relatively recent appellation for Computer Based Learning, which refers to the use of computers for the delivery of instruction in an interactive mode.) The reason for that increase is closely related to the basic policy assumption that the educational system should serve the overall target of 'information society for all'. Schools should prepare students to use actively new information and communication technologies (ICTs) taking advantage of the life-learning process that these technologies support. As a result in most countries all curriculum are under continuous development adopting ICTs in teaching and learning.

Nowadays, hypermedia systems provide the necessary technology for highly interactive and potentially adaptive learning environments. Yet, in many cases authors of educational hypermedia are often tempted to impress rather than educate the user. As often stated, the failure of so many instructional programs has been the result of an emphasis solely on content, with little regard for principles of instructional design to produce effective, efficient, and appealing instruction. If hypermedia is not well designed, they will create difficulties for users, such as memory overload and divided attention, or they will fail to suit the variety of ways that people work together or alone (Preece, 1993).

The media and learning debate has carried on for several decades. In 1983, Richard Clark reviewed the research to that date on media-delivered education and concluded that instructional designers gain no learning benefits from employing a specific medium to deliver instruction (Clark, 1983). He claimed that any performance or time saving gains researchers observe is the result of uncontrolled instructional methods or novelty. In 1994 re-addressed the conclusions from his 1983 work by reviewing more recent studies (Clark, 1994). Kozma responded to Clark by arguing that media have an important role in learning as they can provide certain representations or model cognitive operations that are salient to a learning task, often ones that learners cannot or do not perform for themselves (Kozma, 1991). Some students will learn a task regardless of the delivery device. For others, though, Kozma argues that a careful use of media will enable learners to take advantage of its strengths to construct knowledge.

Despite the intricacies of the debate, in the early 1980s, several meta-analyses related to the effects of computers on learning were published by Kulik and his associates at the University of Michigan (Kulik, Kulik & Cohen, 1980; Kulik & Kulik, 1987; Kulik & Kulik, 1991) which has proven that computer-based instruction made small but significant contributions to the course achievement of all level students. Moreover, a meta-analysis on the effects of hypermedia versus traditional instruction on student's achievement on thirty five different empirical studies published from 1986 to 1997 showed that the effects of using hypermedia in instruction are positive and greater than the traditional instruction (Liao, 1997). Taking also into consideration cost-effectiveness and access issues regarding hypermedia versus traditional instruction, it can be argued that hypermedia courseware can be seen as an effective learning tool. However, instructional designers must carefully design hypermedia contents to take full advantage of them. Moreover, it can be argued that one of the main reasons for the lack of high quality of hypermedia courseware is that often research cannot keep pace with the advances of technology and as a result existing evaluation methods are often inadequate. Therefore, the development of evaluation criteria is very important for employing hypermedia courseware to best effect.

Background

Systematic evaluation of computer-based education (CBE) in all its various forms often falls behind development efforts (Flagg, 1990). There are several reasons for this lack of evaluation. Producers of CBE products are often invest more money in marketing CBE than in evaluating them. Moreover, consumers of technological innovations for education seem to assume that because these innovations are advertised as effective, they are effective. Also, evaluation of CBE has often been reduced to a number of indicators wherein the value of CBE is represented by the amount of money spent on hardware and software, the ratio of students to computers etc. (Becker, 1992). Another reason for the lack of the evaluation of CBE is the inadequate utility of the evaluations that have been previously conducted. Evaluation reports are usually presented in the format of social science research reports, "format that is almost useless for most educators" (Scriven, 1993).

However, besides the general trend, there are some important evaluation studies that either focus only on interface design or there are broader and focus on the pedagogical value of hypermedia systems as well. For example, heuristic evaluation suggested by Nielsen (Nielsen and Molich, 1990; Nielsen 1994) is looking at the usability problems in a user interface while Reeves (Reeves, 1992; Reeves and Harmon, 1994) pedagogical dimensions are used as criteria for evaluating different forms of computer-based education.

Heuristic evaluation is a usability engineering method for finding the usability problems in a user interface design so that they can be attended to as part of an iterative design process. Heuristic evaluation involves having a small set of evaluators examine the interface and judge its compliance with recognized usability principles (the 'heuristics'). The ten Usability Heuristics defined by Nielsen are: Visibility of system status; Match between system and the real world; User control and freedom; Consistency and standards; Error prevention; Recognition rather than recall; Flexibility and efficiency of use; Aesthetic and minimalist design; Help users recognize, diagnose, and recover from errors; Help and documentation.

Reeves, on the other hand, proposes fourteen pedagogical dimensions of computer-based education that can be used to compare one form of CBE with another or to compare different implementations of the same form of CBE. Each dimension is based on some aspect of learning theory or learning concept that can be used as criteria for evaluating different forms of computer-based education. These pedagogical dimensions are as follows: epistemology; pedagogical philosophy; underlying psychology; goal orientation; experiential value; teacher role; program flexibility; value of errors; motivation; accommodation of individual differences; learner control; user activity; cooperative learning; cultural sensitivity (Reeves, 1992; Reeves & Harmon, 1994).

Another important study is the 'conversational framework' for use in the analysis of teaching media developed by Laurillard (1993). Laurillard suggests that teaching media can be divided into four categories: discursive, adaptive, interactive and reflective. Discursive media should allow student and teacher to exchange views freely. Students must be able to act on, generate and receive feedback appropriate to the topic goal whilst the teacher must be able to reflect upon the student's actions and descriptions in order to adjust their own descriptions, making them more accessible for the student. Adaptive media allows the teacher to use the relation between his/her and the student's understanding to determine topic goals for the continuing session. Interactive media enables students, acting to achieve topic goals, to receive meaningful intrinsic feedback. Finally, reflective media facilitates teacher support for the process by which students link feedback on their actions to the topic goal. This list of required media characteristics was designed by Laurillard to encompass a complete specification of what is required of a learning situation. The 'conversational framework' incorporates all four categories of media.

Adaptation and reflection are internal to both teacher and student. The two levels in their dialogue: discursive and interactive are external processes transmitted over the media. Several other studies are based on the 'conversational framework' such as a framework for pedagogical evaluation of virtual learning environments (Britain & Liber, 1999) and evaluation of computer-supported collaborative learning (Crawley, 2002).

Besides the above evaluation studies there are also studies with a narrower centre of attention. For example the South Carolina Statewide Systemic Initiative developed an evaluation instrument for instructional material in mathematics; the Children's Software Review (1998) developed an evaluation instrument for children's Internet site; Biner (2002) created a web course evaluation questionnaire; Southern Regional Educational Board (2002) developed criteria for evaluating computer courseware; Beaudin and Quick (1996) formed an evaluation instrument for instructional video; etc.

It is also worth mentioning the standardization efforts of several organizations, such as the IMS Global Learning Consortium (IMS, 2001) and the International Standardization Organisation (ISO). IMS focus on interoperability - defining the technical specifications and supporting the incorporation of specifications into products and services worldwide. The ISO set up an ISO/IEC JTC1 SC36 sub-committee (ISO/IEC JTC1 SC36, 2001) "Standards for Information Technology for Learning, Education and Training". Again the focus here is interoperability and reusability of resources and tools. In addition, Europe has a number of bodies aiming on standardization of learning resources, such as the Alliance of Remote Instructional Authoring and Distribution Networks for Europe Foundation (ARIADNE, 2001) and the European Committee for Standardization: Information Society Standardization System (CEN/ISSS, 2001).

As shown, despite the fact that systematic evaluation of computer-based education (CBE) often falls behind development efforts there are several evaluation studies. However, some of the evaluation models described above require background knowledge on instructional technology, while the latter references have a very specific target (e.g. instructional material for mathematics, for children etc.). However, with the growth in the use of learning technologies and the availability of hypermedia courseware, an increasing number of teachers with no particular knowledge on instructional technology want to use such courseware in their teaching. The authors of this paper are attempting to provide an evaluation instrument for hypermedia courseware based on an evaluation framework, that can also address teachers with no particular knowledge on instructional technology, as a structured way of assisting them to initially assess a new piece of courseware that want to use in their teaching. Next, the evaluation framework is discussed.

Evaluation Framework

The efficiency of hypermedia courseware depends on many issues. In order to build the evaluation instrument the authors attempted to integrate in a framework a number of important issues emerged from research on instructional design and system evaluation the past fifteen years, and which should be considered from evaluators of hypermedia courseware (H.C.) that delivers mainly content knowledge (Georgiadou & Economides, 2000). It has to be acknowledged that this framework is relatively limited as there are numerous articles in the literature on instructional design and system evaluation. However, the authors, in order to develop the framework, tried to review a large number of them and then to focus on the most often cited authors and articles. Moreover, the framework is not rigid and therefore new parts could be added or existing ones could be altered as research advances in the area of educational hypermedia.

This framework is concerned with both social and practical acceptability of hypermedia courseware, based on Nielsen's idea that "the overall acceptability of a computer system is a combination of its social and practical acceptability" (Nielsen, 1990). The term social acceptability is related with the social basis of an educational system. In cases when the basis is teacher-centred, then the software that provides high levels of learner control and undermines the teacher's authority is possibly socially unacceptable. On the other hand, when the basis is student-centred, then a courseware that limits the student's potential for independent discovery is socially unacceptable. Moreover, as an example, whereas constructivist pedagogy advocates persistent questioning on the part of learners, questions, especially 'why?' questions, are inappropriate in cultures such as the Torres Strait Islanders of Australia. Although computer-based education may not be able to adapt to every cultural norm, they should be designed to be as culturally sensitive as possible (Powell, 1993).

Given that a piece of hypermedia courseware is socially acceptable, its practical acceptability is examined through the evaluation of the following four sectors: a) content, b) presentation and organization of the content, c) technical support and update processes and finally, d) the evaluation of learning. All sectors are equally

important, as hypermedia courseware has to be simultaneously pedagogically and technically sound. Moreover, each sector includes a number of criteria that are incorporated in the evaluation instrument, which should be met in a satisfactory level, in order to characterize a piece of hypermedia courseware of high quality. Furthermore, cost-effectiveness should always be examined when similar products seem to have the same educational value. Figure 1 presents in a diagram the sectors included in the framework and the factors that are associated with them.

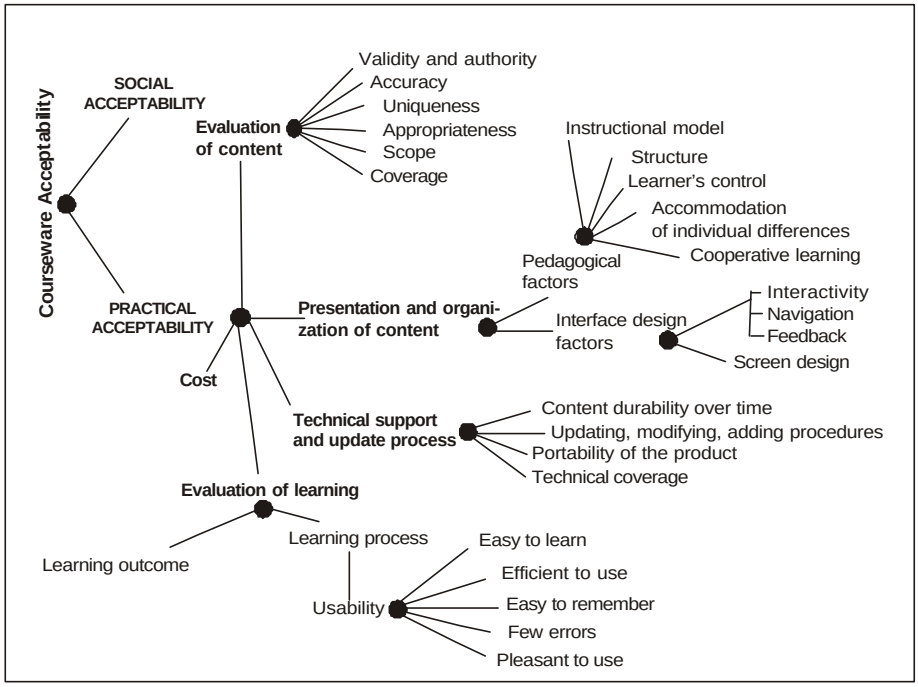

Figure 1. Diagram of the Evaluation Framework

Before we proceed to present the evaluation instrument it is necessary to discuss the underlying theory of the criteria used for the 'presentation and organization of the content' and the 'evaluation of learning' sectors. It is not necessary to do the same regarding the criteria for the evaluation of 'content' and those for the 'technical support and update processes' as the relevant items included in the evaluation instrument that are based on guidelines available in the literature (ANSI Standards Committee on Dental Informatics, 2002; Southern Regional Educational Board, 2002) are self-explanatory.

Presentation and Organization of the Content

The factors associated with this sector are the pedagogical ones that are concerned with learning and instructional design theories and the interface design factor.

Pedagogical Factor: This is a complicated factor as there are different beliefs of how humans learn. However, cognitive theories stress that learning is an active, constructive, cumulative, self-regulated process in which the learner plays a critical role. Moreover, current instructional theory focusing on learner-centred approaches depends on information access and learning environments that encourage free interaction with information. The agreement with the principles of an instructional design theory depends heavily on the subject matter. In addition, teachers' beliefs is of great importance, especially in cases when the hypermedia courseware is part of the curriculum.

Nevertheless, the two core elements that are important in all educational settings are 'motivation' and 'structure', which largely define the instructional nature of an information environment. A typical way to motivate the learner is to inform him/her what will s/he achieve at the end of the instruction by stating the aims and objectives (Gagné, Briggs, Wager, 1988). As far as the structure of the hypermedia courseware is concerned, that is how to organise instructional information, this again depends on the subject matter. However, in cases when the instructor wants to permit the learners to advance, review, see examples, repeat the unit, or escape to explore

another unit, Jonassen (1992) suggest the network type or structured hypermedia as most appropriate. Structured hypermedia consists of sets of nodes, each set accessible from any other set. The node sets can be structured in any number of ways, such as node-link, hierarchical, network, depending on the nature of the processing the designer wants to elicit from the user. The structure of each node set with the various options available within each set needs to be conveyed on every screen. Another method for structuring the node sets is to combine related concepts, tie them together in an introductory block, and then permit access within the set only to concepts contained within the set.

In hypermedia learning systems another important element is 'learner's control', which is primary in the design of interactive learning as it allows students to tailor the learning experience to their own individual needs. However, there are dangers in surrendering too much control to the user, as low-ability students may get confused when control depends on a wide range of options (Gray, 1989; Litchfield, 1993). The high level of learner control may result in disorientation and distraction. The amount and type of learner control depends on the learner characteristics (age and cognitive capabilities), content, and the nature of the learning task (Poncelet & Proctor, 1993). Content that must be mastered and unfamiliar tasks often requires more program control, compared to content with no qualified mastery levels or familiar learning tasks. Learner control is more appropriate than program control when learners are more capable and are familiar with the learning task. Moreover, advisement is provided to assist learners in making decisions and control is used consistently within a lesson (Ross & Morrison, 1989). In general, the more control is given to the learners, the more feedback about their decisions should be given (Mcateer & Shaw, 1995).

Moreover, the issues of 'accommodation of individual differences', and 'cooperative learning' are highly important in the effectiveness of hypermedia-based learning. In most education contexts learners are not homogeneous in terms of prerequisite knowledge, motivation, experience, learning styles and cognitive styles. Also evidence suggests that when hypermedia-learning systems are structured to allow cooperation, learners benefit both instructionally and socially.

Interface Design Factor: *Interactivity - Navigation - Feedback*: Interactivity in instruction comprises the nature of the activity performed by the technology and the learner, as well as the ability of the technology to adapt the events of instruction in order to make that interaction more meaningful (Reigeluth, 1987). It is important to design as much meaningful interactivity as possible into instructional software (Orr, Golas, & Yao, 1994). The amount of navigational assistance needed is a function of the size of the knowledge base, the usefulness of navigational aids that are already part of the authoring software, and the types of links the software allows (Locatis, Letourneau & Banvard, 1989). Guidelines for increased interactivity were produced from researchers (Shneiderman & Kearsley, 1989; Tessmer, Jonassen & Caverly, 1989) and are used in the instrument as evaluation items in the relevant section.

The basic factors that can determine the effectiveness of feedback are the type and frequency of feedback given and the delay between feedback and instruction (Jonassen & Hannum, 1987). Feedback is closely related with the issue of interaction, as action without feedback is completely unproductive for a learner. Laurillard (1993) identifies two types of feedback, 'intrinsic' and 'extrinsic'. *Intrinsic* feedback is what is given as a natural consequence of an action. To illustrate the concept of *intrinsic* feedback Laurillard uses examples of a child's actions while playing with water as the physical world responds to the child's actions of filling, pouring, etc. On the other hand *extrinsic* feedback does not occur within a situation but as an external comment on it: right or wrong. She suggests that extrinsic feedback is not a necessary consequence of the action, and therefore is not expressed in the world of the action itself, but at the level of the description of the action. In computer-based instruction, however, the *intrinsic* feedback relates to navigation and interactivity with the instructional program, and the *extrinsic* feedback relates to the feedback on user's performance. Schimmel (1988) identifies three types of extrinsic feedback: (a) Confirmation feedback that simply confirms whether a learner's answer is correct or incorrect; (b) Correct response feedback that presents the correct answer; (c) Explanatory feedback, such as a step-by-step solution to an incorrectly answered question. Many actions require more extended *extrinsic* feedback than confirmation feedback. Simple answers such as right or wrong cannot provide any information about how learners should correct their performance. A more helpful form of extrinsic feedback would give the learner information about how to adapt and correct their performance, such as correct response and explanation feedback.

'**Screen design'** is also an important evaluation factor. Different screen elements should be used to present stimulating information that will motivate and assist the learners in retaining and recalling the information. The psychological limitations to consider when designing hypermedia learning systems include: (a) Memory load: i.e. how many different control icons is it reasonable for learners to remember at any one time? (b) Perception:

i.e. what colours and fonts provide the best readability?, and (c) Attention: i.e. how can the users' attention be drawn to information that is relevant, when there is a lot of different information on the screen? (Preece, 1993). A large number of screen design guidelines produced from several researchers on educational technology exist in the literature and the relevant items on the evaluation instrument are based on these (Morris, Owen & Fraser, 1994; Cox & Walker, 1993; Clarke, 1992; Mcateer & Shaw, 1995).

Evaluation Of Learning

Marchionini (1990) argued that the interactivity of hypermedia systems provides learners with access to vast amount of information in varied forms, control over the process of learning, and the potential for collaboration with the system and other people. Such empowerment of learners forces evaluators of learning to adopt a broad-based set of methods and criteria to accommodate 'self-directed' learning. He proposes a 'multi-faceted' approach to the evaluation of hypermedia based learning that address both the outcomes and the processes of learning.

The *learning outcomes* are evaluated through performance tests typically used to judge the quality and the quantity of learning, which usually have the form of 'pre-tests' used to determine learning outcomes prior to the intervention and 'immediate' and 'delayed post-tests' to examine learning outcomes after the intervention. The *learning process* refers to the usability of a product and should be evaluated by observing and measuring the end-users attitudes. Usability is usually associated with five parameters (Nielsen, 1990): (1) Easy to learn: Users can quickly get some work done with the system, (2) Efficient to use: Once the user has learnt the system, a high level of productivity is possible, (3) Easy to remember: The casual user is able to return to using the system after some period without having to learn everything all over, (4) Few errors: Users do not make many errors during the use of the system or if they do so they can easily recover them, and (5) Pleasant to use: Users are subjectively satisfied by using the system.

Evaluation Instrument

The criteria selected from the literature for every sector of the evaluation framework were used as the basis for the design of the initial version of the evaluation instrument. This initial version was disseminated for comments to academics, postgraduate students and researchers in the field of educational technology at the University of Macedonia, Greece. This effort was under a project run for two years (2000-2001) by the University of Macedonia called EPENDISI that aimed to train secondary schoolteachers in the use of ICTs in the classroom and also to build a database that contains information and resources on several evaluated educational software on almost all secondary school subjects. Taking into consideration the comments provided the instrument was revised and its final form is presented here.

The instrument has the form of a suitability scale questionnaire with five points; where figure (1) is assigned to strongly agree and figure (5) to strongly disagree. The scale also includes the figure (0) for those items in the questionnaire that cannot be evaluated, as they do not apply during the evaluation of particular hypermedia courseware. One hundred and twenty four items are included in the instrument and they cover both cases of stand-alone and web-based hypermedia courseware. The one hundred items refer to both stand-alone and web-based ones and the extra 24 items refer only to web-based ones, as these applications have some distinct characteristics regarding screen design and technical support and update processes. However, the instrument does not include items regarding the Social Acceptability because the criteria for such an evaluation cannot have universal application, as different educational systems have different beliefs on what is socially acceptable or unacceptable; therefore these criteria should be determined every time from the evaluators of each educational system.

The different sections of the instrument and the items included are presented next. It has to be noted at this point that the numeration of the items continues from each previous section in order to be more helpful to potential evaluators.

?. Evaluation of the content

1. The content is reliable	0 1 2 3 4 5
2. The origin of information is known	0 1 2 3 4 5

3. The authors and the publishers are reputable	0 1 2 3 4 5
4. Balanced presentation of information	0 1 2 3 4 5
5. Bias-free viewpoints and images	0 1 2 3 4 5
6. Balanced representation of cultural, ethnic and racial groups	0 1 2 3 4 5
7. Correct use of grammar	0 1 2 3 4 5
8. Current and error-free information	0 1 2 3 4 5
9. Concepts and vocabulary relevant to learners' abilities	0 1 2 3 4 5
10. Information relevant to age group curriculum	0 1 2 3 4 5
11. Information of sufficient scope and depth	0 1 2 3 4 5
12. Logical progression of topics	0 1 2 3 4 5
13. Variety of activities, with options for increasing complexity.	0 1 2 3 4 5

?. Organization and Presentation of the Content

?.1 Pedagogical Parameters

?.1.1. Instructional Theories – Curriculum

14. The design of the hypermedia courseware is based on reliable learning and instructional theories and is directly related with the content of the curriculum.	0 1 2 3 4 5
15. The application of the hypermedia courseware is possible in various topics of the curriculum	0 1 2 3 4 5
16. The application of the hypermedia courseware is possible on issues related with the curriculum	0 1 2 3 4 5
17. The hypermedia courseware can be used by learners alone, without the need of other instructional objects (i.e. book)	0 1 2 3 4 5

?.1.2. Structure

18. The content is structured in a clear and understandable manner	0 1 2 3 4 5
19. The structure allows learners to move around freely in different units	0 1 2 3 4 5
20. The structure of the H.C. permits learners to advance, review, see examples, repeat the unit, or escape to explore another unit	0 1 2 3 4 5

?.1.3. Learners Control

21. Learner's control corresponds to learners' age	0 1 2 3 4 5
22. Learner's control corresponds to learners' cognitive capabilities	0 1 2 3 4 5
23. The quantity of learner's control corresponds with the feedback given from the H.C.	0 1 2 3 4 5

?.1.4. Adaptivity

24. The H.C. considers the individual differences of the learners	0 1 2 3 4 5
25. The H.C. considers the different learning styles	0 1 2 3 4 5
26. The H.C. considers different background knowledge of the learners	0 1 2 3 4 5
27. The H.C. considers the different motivation of the learners	0 1 2 3 4 5
28. The H.C. considers the different learning experience	0 1 2 3 4 5
29. The H.C. contains understanding assignments	0 1 2 3 4 5
30. The H.C. contains assignments that develop the critical ability	0 1 2 3 4 5
31. The H.C. facilitates learning by doing	0 1 2 3 4 5
32. The H.C. permits learners to change the basic configurations	0 1 2 3 4 5
33. The H.C. offers the ability to change the level of difficulty	0 1 2 3 4 5
34. The H.C. allows learners to work on their own pace	0 1 2 3 4 5

?.1.5. Collaborative learning

35. The H.C. promotes collaborative learning	0 1 2 3 4 5
36. The H.C. contains assignments that can be executed by a group of learners	0 1 2 3 4 5
37. The H.C. encourages discussion and collaboration among learners	0 1 2 3 4 5

?2. Design Factors

?.2.1 Interactivity - Navigation - Feedback

?.2.1.1. Interactivity

38. The interactivity of the H.C. is according to the maturity of the students	0 1 2 3 4 5
39. The H.C. provides opportunities for interaction at least every three or four screens	0 1 2 3 4 5
40. The content is chunked into small segments and includes build in questions, reviews, and summaries for each segment	0 1 2 3 4 5
41. The H.C. poses frequently questions to the users that do not interrupt the learning process	0 1 2 3 4 5
42. The H.C. ask students to apply what they have learnt rather than memorise it	0 1 2 3 4 5
43. The H.C. uses rhetorical questions during instruction to get students to think the content	0 1 2 3 4 5
44. The H.C. allows learners to discover information through active exploration	0 1 2 3 4 5

?.2.1.2. Navigation

The H.C. includes:

45. Help key to get procedural information	0 1 2 3 4 5
46. Answer key for answering a question	0 1 2 3 4 5
47. Glossary key for seeing the definition of any term	0 1 2 3 4 5
48. Objective key for reviewing the course's objectives	0 1 2 3 4 5
49. Content map key for seeing a list of options available	0 1 2 3 4 5
50. Summary and review key for reviewing whole or parts of the lesson	0 1 2 3 4 5
51. Menu key for returning to the main page	0 1 2 3 4 5
52. Exit key, for exiting the program	0 1 2 3 4 5
53. Comment key for recording a learner's comment	0 1 2 3 4 5
54. Example key for seeing examples of an idea	0 1 2 3 4 5
55. Key for moving forward or backward in a lesson	0 1 2 3 4 5
56. Key for accessing the next lesson in a sequence	0 1 2 3 4 5

?.2.1.3. Feedback

57. The H.C. provides feedback immediately after a response	0 1 2 3 4 5
58. The placement of feedback is varied according to the level of objectives. (Provide feedback after each response for lower level objectives, and at the end of the session for the higher level ones)	0 1 2 3 4 5
59. The H.C. provides feedback to verify the correctness of a response	0 1 2 3 4 5
60. For incorrect responses, information is given to the student about how to correct their answers, or hints to try again	0 1 2 3 4 5
61. The H.C. allows students to print out their feedback	0 1 2 3 4 5
62. The H.C. allows students to check their performance	0 1 2 3 4 5
63. The H.C. allows students to measure the time they consume in a certain on-line assignment	0 1 2 3 4 5

?.2.2 Screen Design

64. Screens are designed in a clear and understandable manner	0 1 2 3 4 5
65. The presentation of information can captivate the attention of students	0 1 2 3 4 5
66. The presentation of information can stimulate recall	0 1 2 3 4 5
67. The design does not overload student's memory	0 1 2 3 4 5
68. The use of space is according to the principles of screen design	0 1 2 3 4 5
69. The design uses proper fonts in terms of style and size	0 1 2 3 4 5
70. The use of text follows the principles of readability	0 1 2 3 4 5
71. The color of the text follows the principles of readability	0 1 2 3 4 5
72. The number of colors in each screen is no more than six	0 1 2 3 4 5
73. There is consistency in the functional use of colors	0 1 2 3 4 5
74. The quality of the text, images, graphics and video is good	0 1 2 3 4 5
75. Presented pictures are relevant to the information included in the text	0 1 2 3 4 5
76. The use of graphics support meaningfully the text provided	0 1 2 3 4 5
77. A high contrast between graphics and background is retained.	0 1 2 3 4 5
78. There is only one moving image (animation and/or video) each time on the same screen	0 1 2 3 4 5
79. Video enhance the presentation of information	0 1 2 3 4 5
80. Sound is of good quality and enhances the presentation of information	0 1 2 3 4 5
81. Sound is an alternative means of presenting information and not a necessity (except for music and language courses)	0 1 2 3 4 5
82. The integration of presentation means is well coordinated	0 1 2 3 4 5

C. Technical Support and Update Process

83. The content has durability over time	0 1 2 3 4 5
84. The content can be updated and/or modified with new knowledge that will appear soon after the purchase of the courseware	0 1 2 3 4 5
85. Technical coverage is offered from the production company	0 1 2 3 4 5
86. The courseware can be used in different platforms	0 1 2 3 4 5
87. Documentation exist regarding technical requirements for software and hardware needed	0 1 2 3 4 5
88. There are instructions for the installation and use of the courseware	0 1 2 3 4 5
89. There is a review of the courseware's contents for use by the instructor	0 1 2 3 4 5
90. Documentation exists regarding the use of the courseware in the classroom with teaching plans and related activities	0 1 2 3 4 5
91. The updating, modifying and adding procedures are relatively easy for the average user	0 1 2 3 4 5
92. The H.C. provides printing capabilities	0 1 2 3 4 5
93. The H.C. allows to keep (save) every step of the activities	0 1 2 3 4 5

D. Evaluation of learning

D.1 The process of learning

94. The H.C. is easy to learn; the user can quickly get some work done with it	0 1 2 3 4 5
95. The H.C. is efficient to use; once the user has learnt it, a high level of productivity is possible	0 1 2 3 4 5
96. The H.C. is easy to remember; the casual user is able to return to using it after some period without having to learn everything all over	0 1 2 3 4 5
97. The structure of the H.C. is comprehensive and the average performance learners can easily follow it	0 1 2 3 4 5
98. Users do not make many errors during the use of the H.C. or if they do so they can easily recover them	0 1 2 3 4 5
99. Users are subjectively satisfied by using the H.C	0 1 2 3 4 5

100. Users find the H.C. interesting	0 1 2 3 4 5

In cases when the hypermedia courseware is web-based then additionally the following items are examined as well for the Screen Design section.

1. The speed of the program (download) is satisfactory	0 1 2 3 4 5
2. Horizontal scrolling bars are not used	0 1 2 3 4 5
3. The hypermedia courseware includes local links in order to facilitate navigation	0 1 2 3 4 5
4. ?he H.C. is flexible and allows students to access all its contents	0 1 2 3 4 5
5. The first page is understandable	0 1 2 3 4 5
6. The H.C. in general has a distinct and easily recognized character	0 1 2 3 4 5
7. The information is organized into small and functional units	0 1 2 3 4 5
8. The H.C. includes alternative ways of presentation (e.g. with or without graphics)	0 1 2 3 4 5
9. The H.C. includes content map	0 1 2 3 4 5
10. The H.C. includes search engine	0 1 2 3 4 5
11. The main navigation tools are always on display to increase speed of use and save from backtracking	0 1 2 3 4 5
12. The way that the navigation tools work is easily understandable from the students	0 1 2 3 4 5
13. Each learning unit is presented under the same design principles (consistency)	0 1 2 3 4 5
14. External links are loaded in a separate window	0 1 2 3 4 5
15. The H.C. includes synchronous communication channels	0 1 2 3 4 5
16. The H.C. includes asynchronous communication channels	0 1 2 3 4 5

Moreover, for web-based hypermedia courseware the following items need examination for Technical Support and Update Process section.

17. The H.C. includes information regarding how often is updated	0 1 2 3 4 5
18. The H.C. includes information regarding its latest update	0 1 2 3 4 5
19. The links are stable	0 1 2 3 4 5
20. The frequency of malfunction is rare	0 1 2 3 4 5
21. The courseware includes mirror sites	0 1 2 3 4 5
22. The content is updated regularly	0 1 2 3 4 5
23. The management and the maintenance of the site is satisfactory	0 1 2 3 4 5
24. The H.C. includes archives from previous editions	0 1 2 3 4 5

Evaluation Process and Analysis of the Results

As shown from the items included in the instrument, during the evaluation of a hypermedia courseware application a number of people should be involved, i.e. content experts, instructional technologists, educators and interface designers. However, the items are quite straightforward and as a result the instrument can be used from educators with no particular knowledge on instructional technology, as a structured way of assisting them during the initial evaluation of a new piece of courseware that want to use in their teaching. After this initial stage, an evaluation with the students is required in order for educators to have a better understanding of the courseware's value and potential.

In order to analyse the results the evaluators have to consider that not all the factors have the same weight; and content is the most important of all. If the content does not meet the educator's criteria then there is no need to further evaluate the organization and the presentation of the educational material. However, to have an overall idea regarding the value of the courseware at the end of the evaluation process for a particular courseware the sum of the score in all items - except those resulted from the evaluation of the content - and its comparison with the total sum, that is the maximum of the marks in all items is required. Therefore, by excluding the 13 items for the evaluation of content the total sum for stand-alone applications is 435 (87*5) and 555 (111*5) for web-based ones (Table 1). These two figures need alteration in the case that not all the items were used during the evaluation, as some of them could not find application in certain pieces of hypermedia courseware. For example, if only 80 items are used then the total sum is 400 (80*5).

Stand-alone		Web-based	
Total sum	*Score*	*Total sum*	*Score*
435		555	

Table 1. Assessment table for all the items of the evaluation instrument

When evaluating two or more courseware on the same subject, then the above figures can be a useful starting point in determining the most appropriate one. Yet, the most important part of the evaluation is the examination of the scores resulted from the evaluation of the four different sectors separately: a) content, b) presentation and organization of the content, c) technical support and update processes and finally, d) the evaluation of learning. The examination of these scores is important in order to secure the case that an application is technically sound but does not have a pedagogical value and vice versa. Table 2 can be used to compare the results.

	Assessment of the Different Sectors			
	Stand-alone		Web-based	
	Total sum	*Score*	*Total sum*	*Score*
A. Content	65		65	
?. Organisation and Presentation of the content	340		420	
B1. Pedagogical Parameters	120		120	
B2. Design factors	225		305	
C. Technical Support and Update Process	55		95	
D. Evaluation of learning	35		35	

Table 2. Assessment table for the different sectors of the evaluation instrument

It has to be mentioned that in order to ensure high quality of hypermedia courseware the evaluators' team (or the teacher) potentially could agree on some standards and set a threshold to the comparison of the results. For example, if the score resulted from the evaluation of an application is not equal with the two thirds of the total sum in all sectors then the application cannot be used for teaching and learning.

Summary

This paper presented an evaluation instrument for hypermedia courseware that is designed according to an evaluation framework developed from the integration of a number of important issues emerged from research on instructional design and system evaluation the past fifteen years and is concerned with both social and practical acceptability of hypermedia courseware. One hundred and twenty four items are included in the instrument that has the form of a suitability scale questionnaire that are concerned with the evaluation of four main sectors: a) content, b) presentation and organization of the content, c) technical support and update processes and finally, d) the evaluation of learning.

Postgraduate students and secondary schoolteachers in the University of Macedonia, Greece, used the instrument during 2001, in order to evaluate hypermedia courseware on almost all secondary school subjects of the Greek curriculum. This effort was under a project run for two years (2000-2001) by the University of Macedonia, Greece called EPENDISI that aimed to train secondary schoolteachers in the use of ICTs in the classroom and also to build a database that contains information and resources on several evaluated educational software on secondary school subjects. During the evaluation period users of the instrument express their opinion on the instrument itself during debriefing sessions. In general, they agreed that it was easy to use as most of the items included are clear-cut and also the analysis of the results was a simple process that gives relatively quickly an overall idea of a particular courseware's value. Moreover, secondary schoolteachers stated that the first time they used the instrument they felt a bit frustrated as they had little knowledge on instructional design and they usually were consumers of the product rather than evaluators. However, after using the instrument for more than three times they had a better understanding of instructional design and system's evaluation and as a result they felt comfortable with the evaluation process. However, most of the instrument users stated that in order to determine the real value of a particular courseware evaluation with the end-users (i.e. students) is essential.

As research progresses in the field of hypermedia courseware evaluation new items can be added to the presented instrument. Therefore, it is a flexible tool that could be easily adapted in an educational environment and its improvement could be an ongoing process.

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Students' attitudes toward the use of the Internet for learning: A study at a university in Malaysia

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Abstract

This study investigated the success of a technology and Internet-enriched teaching and learning environment in molding positive attitudes among students toward using the Internet for learning at a university in Malaysia. Students were provided with computers facilities, required to complete two compulsory generic courses in information technology, and the lecturers actively encouraged the use of information technology, in particular, the Internet in the teaching and learning processes. Results from the study indicated that students had positive attitudes toward using the Internet as a learning tool, adequate basic knowledge of the Internet, and viewed the learning environment as supportive of using the Internet for learning. Students with better basic Internet skills and who viewed the learning environment as promoting the use of the Internet favored using the Internet for learning. The university achieved its objectives of promoting the use of the Internet for teaching and learning purposes. As the university begins to offer Web-based courses, the generic courses in information technology should likewise be redesigned to introduce the concepts of Web-based learning environments. These courses should in fact be conducted as Web-based courses to prepare the students to learn in these learning environments.

Keywords

Internet-based learning, Web-based course, Technology-based learning, Attitudes toward the Internet

Introduction

The use of the Internet for teaching and learning purposes has received increasing attention over the recent years. Mitra and Steffensmeier (2000) concluded that a networked learning institution where students have easy access to computers could foster positive attitudes toward the use of computers in teaching and learning. They found that a computer-enriched learning environment was positively correlated with students' attitudes toward computers in general, and the role of computers in facilitating teaching and learning. Liu, Macmillan, and Timmons (1998) perceived integrating computers into a learning system as a complex instructional system in which student learning is impacted by lecturers, students, administrative and technical staff, computer hardware and software resources, and the computer laboratory and classroom settings. They reported that students' with positive attitudes toward using computers also have positive attitudes toward using computers for their learning.

In Universiti Malaysia Sarawak, students are encouraged to internalise the use of technology in their campus activities through the provision of up-to-date computer facilities and generic information technology courses, which were compulsory for all students. Lecturers were also encouraged to use information technology and in particular, the Internet in their instructional practices. The premise is that through constant interaction with information technology and a sound foundation in information technology, students will build up positive attitudes towards computer, thus promoting the use of information technology in all aspects of life.

The integration of information technology in the learning environment at Universiti Malaysia Sarawak started with the inception of the university (Universiti Malaysia Sarawak Annual Report, 1995, pp. 6-7). Universiti Malaysia Sarawak Annual Report 1996, stated that "... we have shown that our emphasis on technology ..... has given a feature of distinction in undergraduate curricular design.... Our pioneer students, at last, fully appreciated the Generic Development Program, for they found that their ability to communicate, their competence in information technology and their confidence and flexibility were at time more important than their own grounding in the core course" (Universiti Malaysia Sarawak Annual Report, 1996, pp.4-5). Two compulsory courses in information technology are included in the Generic Development Program to inculcate the information technology culture among the undergraduates. Universiti Malaysia Sarawak has continuously reinforced importance of information technology and the Internet to prepare students for a knowledge-based society (Universiti Malaysia Sarawak Annual Report, 1998, pp. 2-3; 1999, p.2).

Purposes of the Study

This study aimed to answer the following questions:

- What were the students' attitudes toward using the information technologies, in particular, the Internet in their learning tasks?
- What were the relationships between students' basic skills and knowledge in the Internet obtained through these generic courses and their attitudes toward using the Internet for learning?
- Did the learning environment in Universiti Malaysia Sarawak have a positive impact on the students' perceptions of using the Internet as a learning tool?

Sample

The sample of this study consisted of 88 second-year undergraduate students randomly selected from all the second year students enrolled in the five faculties (Faculty of Cognitive Sciences and Human Development, Faculty of Medicine and Health Sciences, Faculty of Resource Sciences and Technology, Faculty of Engineering, and Faculty of Information Technology) at Universiti Malaysia Sarawak.

Research Instrument

The research instrument in this study was a questionnaire divided into four sections. The first section of the questionnaire collected the students' demographic variables, namely gender, race, faculty, and CGPA.

The remaining three sections of the questionnaire consisted of Likert-type statements, each with five choices of response from "strongly disagree" to "strongly agree". The second section of the questionnaire measured the students' basic knowledge and skills of the Internet. Sample statements for this section were "I can search for resources and information through the Internet", "I can use Netscape Navigator, Internet Explorer, or other Internet Browsers", and "I can seek information using search engines such as Infoseek, Yahoo, and Excite". There were a total of seven statements in this section.

The third section of the questionnaire measured the students' perceptions of the learning environment at University Malaysia Sarawak. Specifically the students were asked whether the learning environment facilitated the use of the Internet for learning purposes. Sample statements for this section were "The lecturers regularly ask students to explore related resources from the Internet", "The students are exposed to the Internet and how it functions", and "I can access the Internet from various locations in the University". There were a total of seven statements in this section.

The fourth section of the questionnaire measured the students' attitudes toward the use of the Internet for learning. Sample statements for this section were "Every student should know how to use the Internet", "Learning through the Internet is an effective way to obtain information and knowledge", and "I can learn effectively in most subjects through the Internet". There were a total of seven statements in this section.

The last three sections of the questionnaire reported a Cronbach alpha value of 0.91 during the pilot testing of the questionnaire to a sample of 40 students.

Results

Students' attitudes toward using the Internet for learning

There were seven statements measuring students' attitudes toward using the Internet for learning. For each statement the responses were coded 1 for "strongly disagree" to 5 for "strongly agree". Thus the scores for each student on the seven statements ranges from 7 to 35. Scores from 6.5-17.5, 17.5-26.5, and 26.5-35.5 were classified as having "negative", neutral", and "positive" attitudes toward using the Internet for learning purposes. Most of the students had positive attitudes toward using the Internet for learning. The distribution of the students' overall scores and attitudes is shown in Table 1.

Scores	Attitudes	Frequency
6.5-17.5	Negative	7
17.5-26.5	Neutral	4
26.5-35.5	Positive	77

Table 1. Students' attitudes toward using the Internet for learning

Results from independent t-test and One-Way ANOVA analyses indicated that there were no significant differences in the students' attitudes toward the use of the Internet for learning based on gender (t=0.263, df=86, p=0.793), ethnic race (F=0.373, df=4/83, p=0.827), and CGPA (F=0.137, df=4/83, p=0.991). However, significant differences were detected for the students' attitudes on using the Internet for learning based on their field of study (F=4.143, p=0.004). Students from the Faculty of Information Technology (mean scores=28.7), Faculty of Engineering (mean scores=28.0), and Faculty of Resource Science and Technology (mean scores=27.3) had significantly more positive attitudes toward using the Internet for learning purposes compared to students studying at the Faculty of Cognitive Sciences and Human Development (mean scores=23.8) with p-value < 0.05.

Relationships between students' basic knowledge of the Internet with their attitudes toward the use of the Internet for learning

There was seven statements measuring students' basic knowledge of the Internet. For each statement the responses were coded 1 for "strongly disagree" to 5 for "strongly agree". Thus the scores for each student on the seven statements ranges from 7 to 35. Scores from 6.5-17.5, 17.5-26.5, and 26.5-35.5 were classified as having "poor", average", and "good" basic knowledge of the Internet. Most of the students had good basic knowledge of the Internet. Distribution of the students' overall scores and basic knowledge and skills on the Internet is shown in Table 2.

Scores	Attitudes	Frequency
6.5-17.5	Poor	3
17.5-26.5	Average	8
26.5-35.5	Good	77

Table 2. Students' basic knowledge of the Internet

Students' total scores on the seven statements measuring their basic knowledge of the Internet were correlated with their total scores on the seven statements measuring their attitudes toward the use of the Internet for learning. The Pearson, r, value was 0.582, with p-value < 0.0005. There was a significant relationship between the two variables. Students who were better acquainted with the Internet had more positive attitudes toward the use of the Internet for learning purposes.

Relationships between students' perceptions of the learning environment with their attitudes toward the use of the Internet for learning

There were seven statements measuring students' perceptions of the Universiti Malaysia Sarawak's learning environment with reference to promoting the use of the Internet for assisting the learning process. For each statement the responses were coded 1 for "strongly disagree" to 5 for "strongly agree". Thus the scores for each student on the seven statements ranges from 7 to 35. Scores from 6.5-17.5, 17.5-26.5, and 26.5-35.5 were

classified as students perceiving the learning environment in the university "did not facilitate", "neutral", and "facilitated" the use of the Internet for learning. Most of the students agreed that the learning environment in the university encouraged students to use the Internet in their learning tasks. Distribution of the students' overall scores and their perceptions of the learning environment are shown in Table 3.

Scores	Attitudes	Frequency
6.5-17.5	Did not facilitate	10
17.5-26.5	Neutral	13
26.5-35.5	Facilitated	65

Table 3. Students' perceptions of the University Malaysia Sarawak's learning environment

Students' total scores on the seven statements measuring their perceptions of the university's learning environment were correlated with their total scores on the seven statements measuring their attitudes toward the use of the Internet for learning. The Pearson, r, value was 0.398, with p-value < 0.0005. There was a significant relationship between the two variables. Students who felt that the learning environment in the university promoted the use of the Internet had more positive attitudes toward the use of the Internet for learning.

Discussions

This study revealed that generally students at Universiti Malaysia Sarawak had positive attitudes towards learning using the Internet. This perception was not race or gender specific. It was also not related to students' scholastic ability. However students from the Faculty of Information Technology, Faculty of Engineering, and Faculty of Resource Sciences and Technology had more positive attitudes compared to students from the other two faculties. This could be because the students in these two faculties were more exposed and had more opportunities to use the Internet for course related activities.

The students generally had the basic skills in using the Internet and perceived the learning environment in the university encouraged them to use the Internet as learning tool. The students' basic skills in the Internet and their perceptions of the learning environment were related to their use of the Internet to supplement their learning requirements. Students with better basic skills in the Internet and perceived the learning environment to be supportive of using the Internet for their learning tasks generally had better attitudes toward using the Internet to improve their studies. These findings were in agreement with those reported by Mitra and Steffensmeier (2000) and Liu, Macmillan, and Timmons (1998).

Thus Universiti Malaysia Sarawak's efforts to promote and to encourage the lecturers and students to make use of the technology, in particular the Internet to support the learning activities were quite successful. The learning environment actively encouraged the use of the Internet for learning and teaching. The generic courses were achieving its' targets of providing the basic skills for using technology and the Internet and further inculcate the habit of using the Internet during their study at the university. However, as the university moves to the next phase of using the Internet for learning purposes, by implementing Web-assisted and Web-based learning courses, the generic Information Technology courses should likewise be implemented in Web-assisted or Web-based format (Hong, Lai, Holton, 2001; Scagnoli, 2001). This format of learning places less emphasis on face-to-face lectures and more on learning partially or totally on the Web. Thus it is important that students were exposed to this type of learning so that they could benefit from Web-assisted and Web-based courses conducted in their field of specialization by the various faculties.

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Technology Acceptance and Social Networking in Distance Learning

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Abstract

This study examines the use of integrated communication and engineering design tools in a distributed learning environment. We examined students' attitudes toward the technology using two different approaches. First, we utilized the technology acceptance model to investigate the attitude formation process. Then, to investigate how attitudes changed over time, we applied social information processing model using social network analysis method. Using the technology acceptance model, we were able to demonstrate that students' initial expectation affected the perceptions of, attitudes toward, and use of the system. With social network analysis, we found that one's attitude change was significantly influenced by other students' attitude changes. We discussed the uniqueness of distance learning environments in the context of social influence research and how studies of distance learning could contribute to the research on the social influence of technology use.

Keywords

Technology acceptance model, Social influence, Network analysis, Attitude, Distance learning

Introduction

Advances in computing and information technology are changing the way people meet and communicate. People can meet, talk, and work together outside traditional meeting and office spaces. The introduction of software designed to help people schedule meetings and facilitate decision or learning processes is weakening geographical constraints and changing interpersonal communication dynamics. Information technology is also dramatically affecting the way people teach and learn (DeLacey & Leonard, 2002; Radcliffe, 2002; Starr, 1997). As new information technologies infiltrate workplaces, home, and classrooms, research on user acceptance of new technologies has started to receive much attention from professionals as well as academic researchers. Developers and software industries are beginning to realize that lack of user acceptance of technology can lead to loss of money and resources.

User acceptance is defined as "the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support" (Dillon & Morris, 1996, p.4). Although this definition focuses on planned and intended uses of technology, studies report that individual perceptions of information technologies are likely to be influenced by the objective characteristics of technology, as well as interaction with other users. For example, the extent to which one evaluates new technology as useful, s/he is likely to use it. At the same time, her/his perception of the system is influenced by the way people around her/him evaluate and use the system (Rogers, 1986; Trevino, Lengel, and Daft, 1987).

Studies on information technology continuously report that user attitudes are important factors affecting the success of the system (Burkhardt, 1994; Davis, 1989; Garcia, 2001; Lucas, 1981; Rice & Adyn, 1991). For the past several decades, many definitions of attitude have been proposed. However, all theories consider attitude to be a relationship between a person and an object (Woelfel, 1995). In the context of information technologies, there have been two distinctive approaches to the study of attitude- the technology acceptance model (TAM) and the social information processing model (SIPM). While the TAM suggests users formulate a positive attitude toward the technology when they perceive the technology to be useful and easy to use (Davis, 1989), the SIPM assumes that attitudes toward technology are influenced by opinions, information, and behaviors of salient others (Salancik and Pfeffer, 1978).

The purpose of this study is to examine factors affecting user acceptance of new collaboration technology in a distance learning (DL) class. Specifically, this study investigates how students' attitudes toward a new system form and change. One key factor to successful DL is seamlessly integrating the resources and technology introduced to the class. The United States Distance Learning Association (USDLA) defines DL as the delivery of education or training through electronically mediated instruction including satellite, video, audio graphic, computer, multimedia technology and other forms of learning at a distance. As such, the fundamental function of DL is delivering resources to students with the help of electronic technology. Hence, there is no doubt that information technology plays an essential role in DL environments. However, we have more questions than answers about the determinants of the use and acceptance of collaborative technology (Constant, Sproull, and Keisler, 1996). We believe that theories such as the TAM and SIPM can help us understand how students form attitudes and use technologies in DL environments (Segrest, Domke-Damonte, Miles, and Anthony, 1998).

Although the TAM and SIPM have been extensively tested and validated in areas other than education, we believe that applying the models to the study of DL can offer unique benefits. While the TAM can shed light on the way students form attitudes based on the characteristics of technologies, the SIPM can explain how attitudes are influenced by other users and change over time. Because interactions with remote classmates are limited by the capability of the technology being used for the class, the way students are affected by others should be different from effects in other environments, such as face-to-face. During the past several decades, many studies assessed and tested the SIPM in various settings. However, it is difficult to find research conducted in mediated environments. This study offers an opportunity to assess the validity and usefulness of the SIPM in a mediated environment. In the following sections, the TAM and SIPM will be introduced in greater detail, and the research questions of this study will be presented.

Technology Acceptance Model

In studying user acceptance and use of technology, the TAM is one of the most cited models. According to the TAM, 'perceived usefulness (PU)' and 'perceived ease of use (PEoU)' are primary motivational factors for accepting and using new technologies. PU is the degree to which a person believes that use of technology will produce better outcomes (Davis, 1989). 'Useful' refers to 'capable of being used advantageously.' In contrast,

PEoU is the perception about the degree of effort needed to use a particular system. In this case, 'ease' is conceptualized as 'freedom from difficulty or great effort.'

According to the TAM, if a user perceives a specific technology as useful, s/he will believe in a positive use-performance relationship. Since effort is a finite resource, a user is likely to accept an application when s/he perceives it as easier to use than another (Rander and Rothchild, 1975). As a consequence, educational technology with a high level of PU and PEoU is more likely to induce positive perceptions. The relation between PU and PEoU is that PU mediates the effect of PEoU on attitude and intended use (Moon & Kim, 2001). In other words, while PU has direct impacts on attitude and use, PEoU influences attitude and use indirectly through PU. Based on these prior findings, we hypothesize the following.

H1: In a DL environment, PEoU will have indirect effects on attitude and use.
H2a: In a DL environment, PU will have direct effects on attitude.
H2b: In a DL environment, PU will have direct effects on technology use.
H3: In a DL environment, positive attitudes towards technology will lead to increase of technology use.

Extension of the TAM

Expectation

Previous research has continuously reported that the TAM was very useful in predicting and explaining technology use in various situations (Dillon and Morris, 1996). However, Davis (1989) argued that research should explore other variables that could affect PU, PEoU, and use. Dishaw and Strong (1999) noted that one of TAM's weaknesses is its lack of explicit inclusion of external variables. As an extension of the TAM, they suggested a model including the relation between task-technology fit and PU/PEoU. They found the extended TAM explained the variance of the dependent variable better than the original TAM.

In fact, many scholars have proposed various extended TAMs. For instance, Moon and Kim (2001) suggested a model where perceived playfulness was described as one of the antecedents of attitude toward Web surfing. They noted that most prior TAM research had focused only on extrinsic motivation, not on intrinsic motivation. According to Deci (1975), extrinsic motivation refers to the performance of an activity. Extrinsic motivation is perceived to help achieve valued outcomes that are distinct from the activity itself, such as improving job performance, pay, etc. Intrinsic motivation refers to the performance of an activity for no reason other than the process of performing it. In the case of technology acceptance studies, PU is an example of extrinsic motivation, while perceived fun, playfulness, and enjoyment are examples of intrinsic motivation. Davis, Babozzi, and Warshaw (1992) found that perceived enjoyment was significantly related to PEoU.

Similarly, Bandura (1982) distinguished self-efficacy judgments from outcome judgments in his social cognitive theory. Outcome judgments indicate the extent to which successful behavior is linked to valued outcomes. Applying Bandura's arguments to the TAM, Compeau, Higgins, and Huff (1999) proposed a model where performance outcome expectations and personal outcome expectations were related to technology use. Based on these studies, we decided to include two dimensions of expectation in the TAM. Similar to extrinsic motivation and intrinsic motivation, we conceptualized performance expectation as the expectation about individuals' performance gains from using the technology, and social expectation as the expectation about social and entertainment experiences from using the technology. As extrinsic motivation is related to usefulness and intrinsic motivation to PEoU, we hypothesized that performance expectation will influence PU and social expectation would impact PEoU.

H4a: Performance expectation will have positive influences on PU.
H4b: Social expectation will have positive influences on PEoU.

Satisfaction

Although a large number of studies have been conducted to evaluate user satisfaction regarding the use of systems, it is surprisingly difficult to find TAM studies that explicitly considered user satisfaction. Most studies simply assume that user satisfaction could be manifested by acceptance and use of technology, neglecting satisfaction as an outcome variable. Since one of our research goals is to evaluate factors affecting satisfaction with the distant learning class, we decided to measure students' satisfaction with the DL class explicitly. In a

distant learning class, communications with remote class members occur electronically and thus the quality of communication tends to be influenced by the technological system used. As such, we expected that students' attitudes and technology use would affect the satisfaction with the DL class. Hence, we developed the hypotheses below. Figure 1 summarizes research hypotheses proposed in this section.

H5a: Attitudes will affect satisfaction with the DL class.
H5b: Technology use will affect satisfaction with the DL class.

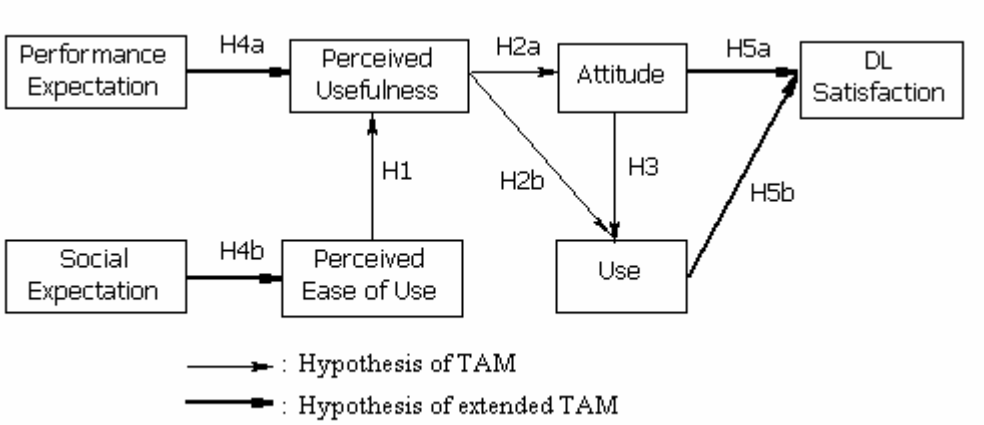

Figure 1. TAM and Research Hypotheses

Social Information Processing and Social Influence Model

A consistent finding from prior research on technology use is that user attitude toward new technology is the key factor for successful deployment. Findings suggest that attitude formation is influenced by the objective characteristics of the system, the extent of use, and individual user differences. However, studies also continuously report that people are not always rational in selecting and using technologies, and attitudes toward and use of technology are influenced by culture, norms, social contexts, or salient others (Fulk, Schmitz, and Schwartz, 1992; Rice & Love, 1987). As an explanation of such confounding results, Salancik and Pfeffer (1978) developed the SIPM. According to the SIPM, individuals' perceptions of technologies are also influenced by the opinions, information, and behaviors of people they communicate with. Similarly, using the SIPM (or Social Influence Model (SIM) in general) Fulk, Steinfield, Schmitz, and Power (1987) reported that technology-related attitudes are often influenced by social interactions and psychological processes rather than directly by objective and independent assessments of technical characteristics.

According to Salancik and Pfeffer (1987), individuals may be influenced by cues from others about what to attend to, how to value the salient dimensions of workplace phenomena, and how to evaluate the same phenomena. In this regard, when people collaborate with others using technology, exposure to social information may lead to change in attitude. Technology in DL does more than just supplementing traditional communication. Gay and Lentini (1995) described that learning is built through conversations between persons or among groups, involving the creation and interpretation of meaning. Although the TAM is useful in determining factors affecting technology acceptance and use, it is not capable of examining the effect of user communication patterns. In fact, TAM's referent theory, the Theory of Reasoned Action (TRA) (Fishbein and Ajzen 1975) includes social influence via a construct called subjective norm. However, the social influence construct has received little attention in the context of TAM research.

Because of its unique nature, social network analysis has been widely adopted and used for the study of SIPM, or SIM (Burkhardt, 1994; Burkhardt & Brass, 1990; Rice and Adyn, 1991). In the present study, we will also assess social information processing with social network analysis. An extensive discussion of social network analysis is outside the scope of this paper. Briefly, social network analysis is the study of social relations among a set of actors, focusing on patterns of relations (Wasserman and Faust 1994). Using social network analysis to study collaboration technology in DL environments allows us to understand communication patterns among students and to examine changes in these communication patterns over time. In this study, we test the extended TAM in a longitudinal context. While the TAM can explain how initial expectations lead to actual technology

use, and, in turn, satisfaction over time, social network analysis reveals how changes in communication patterns occur in the DL class, and how such changes affect individuals' perceptions of technology. In the following section, we will provide descriptions about the DL collaboration system used for this study and details about the research design. Analysis and results are then presented, followed by the discussion and conclusion sections of this study.

Method

Research Environment

This study was based on a DL project for designing future aerospace systems. The overall goal of the project was to develop the capability for students at distributed geographic locations to interact effectively on the development of aerospace systems. As a means of achieving this goal, a new collaboration system was developed and introduced to the class. The central part of the system was a Web-based application called "Advanced Interactive Discovery Environment" (AIDE). The AIDE is a virtual environment containing application-specific content, application-appropriate simulation and software packages, distributed learning modules, expert systems, knowledge bases, and synchronous and asynchronous communication tools, including message boards, instant messaging, chat, and multi-point audio and video (see Figure 2).

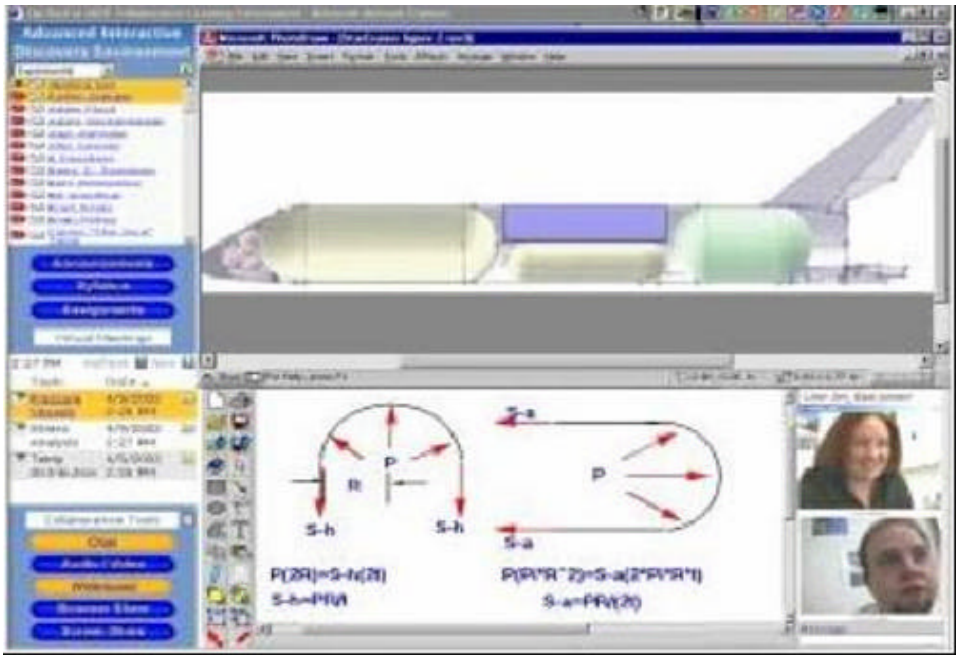

Figure 2. The screenshot of the Advanced Interactive Discovery Environment (AIDE)

Participants and Data Collection

A DL engineering class using the AIDE was offered at two universities. Participants of the current study were 31 senior students (17 and 14 from each university, 23 males and 8 females). Over the course of the study we conducted three surveys. The first survey was administered before the introduction of the AIDE system, measuring students' expectations toward the AIDE. During the course of the semester, students formed groups for the final class design project. The second survey was performed after group formation, measuring student experience with the AIDE system and interaction with group members. The third survey, administered at the end of the semester, measured students' overall perception about and satisfaction with group interaction and the course.

At the start of the semester, two distinct social networks were evident (divided between universities). As the semester progressed, however, students were required to interact with each other to complete their class projects. As such, it was expected that they would form a communication network mediated by the collaboration system. To measure how students' communication network changed over time, we collected data for social network

analysis in the first and third survey. In the network survey, we asked participants to report names of people they talked to and how frequently they communicated.

Measurement Scales

The three questionnaires contained multiple measurement items related to each of the constructs in the research model. Consistent with research literature in the area, multi-item self-report Likert type scales (ranging from 1 to 7) were used to measure all variables. The scales include:

Outcome Expectations (Survey 1): Outcome expectation was defined as the perceived likely consequences of using the collaboration technology. In this study, we used two dimensions of outcome expectation. Performance-related outcome expectations concerned the improvements in study performance associated with using the technology. Social outcomes were those associated with social experiences (i.e., having relationships and fun with others) associated with using the technology. Based on outcome expectation measures of Compeau et. al (1999), we developed and used a 9-item performance expectation scale and a 4-item social expectation scale. The reliability coefficient (Chronbach's alpha) of each scale was .90 and .84 respectively.

PU (Survey 2): This scale consisted of six items from Davis (1989), measuring the extent to which a person believed that the technology was capable of being used advantageously and provided positive expected outcomes (alpha = .91).

PEoU (Survey 2): This scale measured the degree to which a person believed that using a particular technology system would be free of cognitive effort. The scale consisted of six items, developed and validated by Davis (1989) (alpha= .92).

Technology Use Level (Survey 2): Use of collaborative tools was measured by a scale consisting of four items adapted from Cheung, Chang, and Lai (2000). The scale measured the frequency and intensity of technology use and the extent to which students used the technology for various purposes (alpha = .75).

DL Satisfaction (Survey 3): We developed a three-item scale assessing the degree of satisfaction with the lectures, students, and course quality in the DL class (alpha = .84).

Change of Attitude Toward Technology (Survey 2&3): Taylor and Todd (1995) devised and validated the 4-item attitude scale, which measured whether individuals like/dislike using the technology and how they felt using the technology (i.e., pleasant/good). Since we were interested in examining attitude change over time, we measured attitude in both the 2nd and 3rd survey (alpha=.87 and .89 respectively), and calculated the difference. The resulting variable was labeled attitude change. (Attitude measured in the 2nd survey was used for testing the TAM.)

Group Satisfaction (Survey 3): This scale, validated by Campion, Medsker, and Higgs (1993), consisted of seven items measuring the extent to which a group member was satisfied with group collaboration, social interactions, and outcomes (alpha = .81). (This variable was used for testing SIPM.)

Other Variables: In addition to the measurement scales mentioned above, we asked students if they had experienced difficulties with the AIDE (2 items, alpha=.79). Also, Internet apprehension (6 items, alpha=.91), Internet efficacy (5 items, alpha=.96), and perceived behavioral control (3 items, alpha=.82) were measured. Internet apprehension measures the degree to which students are apprehensive of using the Internet. Internet efficacy is the self-judgment of how well one can execute courses of actions required to deal with Internet-related technologies. Perceived behavioral control measures the availability of skills, resources, and knowledge to use the AIDE.

Analysis

To test the research hypotheses, we ran a path analysis based on a series of regressions. In the path analysis, we regressed each variable in turn onto the set of variables preceding it in the model. For example, when testing the possible influence of expectations on PEoU, a regression analysis was performed predicting PEoU from performance and social expectation. When determining the influence of expectations and PEoU on PU, a regression analysis was performed predicting PU from performance expectation, social expectation, and PEoU.

By repeating these types of regressions, we created an output path diagram by drawing an arrow for each significant relation.

For network analysis, we used UCINET (Borgatti, Everett, and Freeman, 2002) for analyzing data and producing network diagrams. Centrality of a network indicates who has the most influential connections to and from other actors. Of the many centrality measures available, we used degree centrality. Degree centrality was determined by individuals' frequencies of (incoming/outgoing) communications with others. It is assumed that when an actor has a high degree centrality, the actor is playing an important role (such as an opinion leader) in the social network (Freeman, 1979).

UCINET can calculate inter-network comparisons, such as Quadratic Assignment Procedure (QAP) correlations. QAP calculates Pearson's correlation coefficient (as well as simple matching coefficient) between corresponding cells of the two data matrices. By repeating such calculations thousands times, QAP tests if the association between two networks is statistically significant. Since network data do not hold the independent measurement assumption, usual parametric method is not appropriate for network comparisons. We used the QAP method to compare the social networks at two different time frames.

Results

Table 1 summarizes descriptive statistics for variables used in the analyses. Each scale is based on a seven-point Likert scale. While all other variables showed positive mean values, attitude change had a negative mean value. It seemed that students' attitudes have decreased as the semester progressed. Figure 3 illustrates the results of the path analysis. Each arrow (except for dotted arrows) in the diagram represents a statistically significant relationship ($p<.05$) between variables. Note that social expectation did not produce a significant relationship with PEoU while performance expectation produced a meaningful relationship with PU. All hypotheses of the original TAM (i.e., H1, H2a, H2b, H3) were supported. However, of the four hypotheses developed for the extended TAM, only H4a and H5a were supported. We found a strong direct influence of PU on attitude. Attitude then affected technology use and satisfaction with the DL class. However, technology use and satisfaction showed no significant relationship. With the help of the longitudinal setting of this study, the path diagram clearly shows that when students have goal-oriented expectations (i.e., performance expectation), they form positive attitudes through their perceptions about practical functionalities of the technology (i.e., usefulness). If a user has a positive attitude toward the technology, s/he is likely to use the technology and to be satisfied with the DL class.

Variable	Mean	Std. Dev.
Performance expectation	5.28	1.01
Social expectation	4.92	1.06
Perceived usefulness	3.86	1.12
Perceived ease of use	3.71	1.28
Use	2.98	0.87
DL satisfaction	4.41	1.04
Group satisfaction	4.65	1.12
Attitude change	-0.85	2.07

Table 1. Descriptive Statistics for Main Variables

As expected, network analysis of the first survey illustrated that there existed two large subnetworks (one from each university) at the beginning of the semester. However, the two subnetworks merged as the semester continued, as shown in Figure 4. No isolated people were found in the network. In other words, everyone communicated with at least one person. To examine changes of roles and positions in the social network, degree centralities from the two social networks were compared. The result revealed that central actors occupied similar positions in both of the networks in terms of centrality ($r=.40$, $p<.05$). To explore how similar/different the two networks were, we ran the QAP correlation analysis. The QAP correlation between the two networks was 0.18 ($p<.01$). The result indicated that, despite convergence of the two subnetworks, the internal characteristics of each subnetwork remained structurally similar.

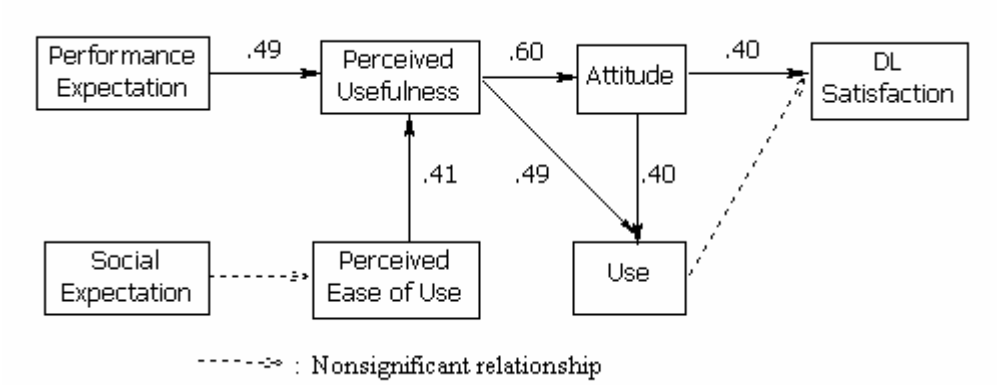

Figure 3. Path Analysis Result

We ran an additional analysis to further examine which internal characteristic was still remaining. UCINET provides autocorrelation analysis for examining the subnetwork structure. Autocorrelation analysis can test whether a network can be divided by actor attributes such as gender or school membership. We used school membership as the actor attribute. The result revealed that the social network at the end of the semester was composed of two subnetworks based on school membership ($p<.05$) implying that the significant QAP correlation came from school membership.

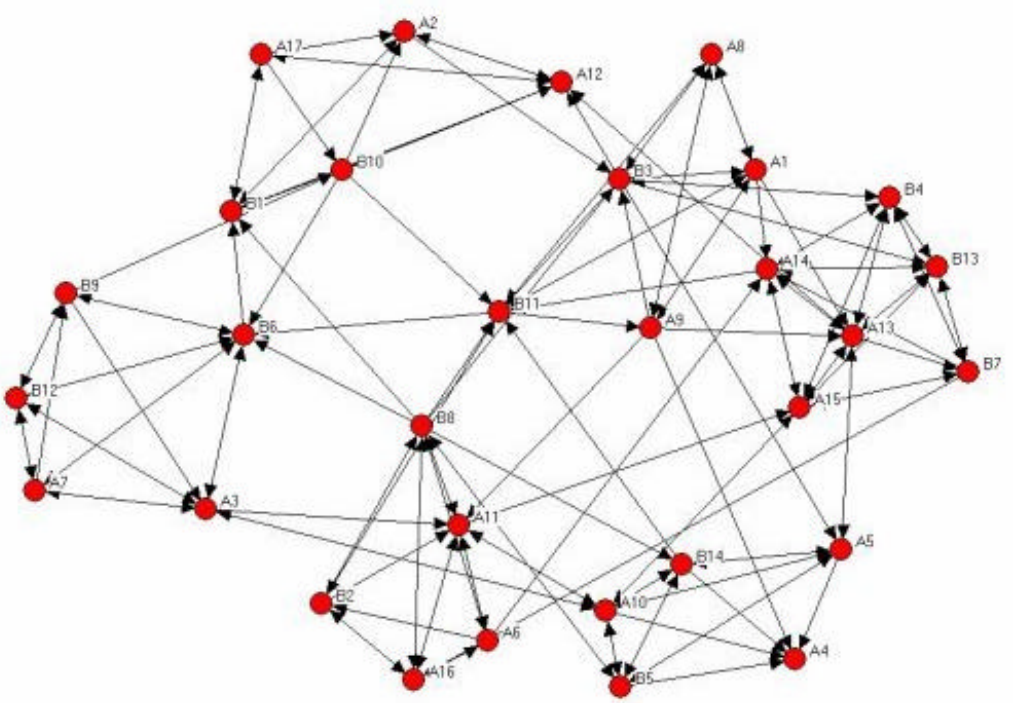

Figure 4. Social Network Diagram at the End of the Semester

To test how students' attitudes were affected by other classmates, we calculated social influence with the following formula. The intuition is that as the amount of communication increases, the likelihood of influence also increases. According to the equation, when person j has no communication with person i, influence is zero. In contrast, when person j has frequent communications with person i, influence is weighted by the frequency of communication.

Social influence to j = Sum [(attitude change of i) * (communication frequency between i and j)]
(note: i represents all other class members except for j)

The correlation between individuals' attitude change and social influence was very high ($r=.72$, $p<.001$). This indicates that social influence played a fundamental role in changing students' attitude. To further examine how attitude change was affected by satisfaction with group activities, we ran a regression analysis predicting attitude change from social influence and group satisfaction. The result demonstrated that both group satisfaction (beta=.31, $p<.05$) and social influence (beta=.58, $p<.001$) predicted attitude change fairly well. The two variables explained 55.4% of the variance of attitude change.

Finally, we ran correlation analyses to examine how central people perceived the collaboration environment. We used students' outdegrees for the calculation. An individual with a high outdegree is a person who talked "to" others frequently. In the setting of the current study, most communication occurred electronically using email, instant messaging, and/or AV conferencing. Since people with higher outdegrees were believed to have used the technology more frequently than others, we compared outdegrees of the second network with other variables. As expected, results indicated that students with high outdegrees had used the AIDE system frequently ($r=.40$, $p<.05$), experienced difficulties with the system ($r=.52$, $p<.01$), and, thus, felt the system was not under their control ($r=-.43$, $p<.05$). They were the people who have less apprehension about communicating over the Internet ($r=-.45$, $p<.05$) and believed themselves to be knowledgeable of Internet technology ($r=.43$, $p<.05$).

Discussion

When the AIDE was first introduced, students were informed that the AIDE would provide various tools for managing and storing information online. Because many of AIDE's promised functions were not easily available even from commercial packages, students were excited about using the AIDE for their work. As shown in Table 1, expectations (performance and social) were the two variables with the highest mean values.

As the semester went along, students seemed to have evaluated the usefulness of the AIDE based on how well the AIDE supported increasing their performance. Although previous research reported that entertainment elements such as playfulness and fun were important motivational factors for successful acceptance of new technology (Moon and Kim, 2001), expectation for social experience and fun did not play a role in the present study. In this study, the AIDE was implemented to a DL class and students' primary concerns about the AIDE were receiving needed information and effectively communicating with others. Hence, students' attitudes toward the AIDE were primarily determined based on how useful the AIDE was in fulfilling their intended tasks efficiently.

General findings of this study were similar to findings of prior research to the extent that while PU exerted a direct influence on attitudes, PEoU had an indirect effect on attitudes through PU. It should be noted that while there have been many studies assessing the acceptance of new technologies with the TAM, it is difficult to find studies that explicitly included satisfaction in the model. In this study, we extended the model to show the relationship between attitudes and satisfaction with the DL class.

In a DL class, technology is essential to the success of the class. Without the technology, it is virtually impossible to have interactions with remote teachers and students. Although students initially had both performance and social expectations for the technology, they became more interested in how to increase their performance using the technology as the semester went along. As such, students seemed to have formed their attitudes based on their perceived characteristics of the technology.

The TAM model explained how individual perceptions influenced attitudes. Students were somewhat rational in determining the usefulness of technology. However, we found that attitudes toward technology are not fixed. As students gained exposure to the technology, they may have experienced failure of the system or their friends may have praised the usefulness of the system. Our results clearly illustrate that, although students initially formed attitudes based on their PU of the system, influences from their communication partners significantly affected their attitude change. The regression result revealed that the degree of attitude change was determined by the amount of social influence and the degree of satisfaction with group members. Hence, it seems that as group cohesiveness increases, and as exposure to social information increases, student attitudes are more likely to become homogenous. This result is intriguing in that while students' initial attitudes were formed in a rather subjective way, the change of thus formed attitudes were socially influenced.

As shown in Table 1, the mean DL satisfaction was relatively low compared with two expectation dimensions. Additional analysis revealed that DL satisfaction was significantly lower than performance expectation ($t=3.14$, $p<.01$). It is well known that central actors in social networks tend to be information gateways, opinion leaders,

and early adaptors of innovations. For the successful diffusion of a new technology, it is important to form positive impressions to central actors of a social network (Burt, 1987; Papa and Tracy, 1988). As mentioned, central people in the class were heavy users of the AIDE, experienced technical difficulties, and thought the AIDE was not under their control. Note that central people had good knowledge of Internet technologies and did not have apprehension of Internet communication. It seems that they experienced difficulties and received negative impressions from the AIDE. These results suggest the reason why attitude change had a negative mean value and why technology use was not related to satisfaction. Heavy users of the AIDE received negative impressions from the system and they exerted greater influence than others resulting in negative attitude change overall.

In summary, we have examined how students formed attitudes toward new information technology in a DL class, and how attitudes changed over time. We approached our research questions from two directions: the TAM and the SIPM. While the TAM illustrated how students' attitudes have formed, the SIPM showed how attitudes have changed over time. The results indicated that the negative influence from central people might have caused an overall decrease of attitudes.

In measuring the amount of social influence, we simply multiplied the amount of attitude change and the strength of ties in the social network. However, there are many ways to determine the level of social influence using proximity measures from social networks. Examples include relational, positional, and spatial proximity (Burt, 1987; Burkhardt, 1994; Festinger, Schacter, and Back, 1950; Hackman, 1983; Rice and Adyn, 1991). Relational proximity is similar to what we used in this study but it can be weighted by a measure of actor importance. Positional proximity primarily concerns whether two actors in a network occupy similar network positions. Many studies have found that people with similar positions are structurally proximate and may have similar attitudes (Burt, 1987). Spatial proximity is based on physical locations such as office locations. Positional and spatial proximities can also be weighted by certain measures of actor importance.

It is believed that all the three mechanisms introduced above are valid sources of social influence. Many studies attempted to determine the relative influence of different mechanisms (Burkhardt, 1994; Rice and Adyn, 1991). However, little attempt has been made to test the effect of the medium through which social influence flowed. For example, in the case of this study, the QAP correlation between two networks and the correlation result of centralities from the two networks illustrate that the network structure and the roles of actors in social networks have not changed dramatically over time. In other words, despite new emergent communication patterns, students in both locations maintained their initial relationships to a significant degree. Hence, we expect that both spatial and relational mechanisms played roles in the social influence process. Spatial influence tends to manifest itself through face-to-face communication. However, relational influence should result from the interaction between face-to-face communication with co-located students and computer-mediated communication with remote students. Hence, it would be worth testing how the use of different media for communication results in the differences of the social influence level. Future research is needed to validate this speculation.

Conclusion

Literature on the use of information technology within the context of DL is ample. We know from research on DL, as well as from other areas, that for successful deployment and acceptance of technology, it is important to develop positive attitudes toward technology. Some have argued that attitudes are formed by the usefulness evaluation of technology while others advocated the importance of influence from other people. Both claims have developed their own theoretical models and proved to be useful in explaining related phenomena.

In this study, we tried to test the user acceptance of the technology in a DL environment with two different theoretical approaches. We attempted to identify the process in which attitudes were formed and changed over time. Because of the nature of this study, we were able to test our research questions in a longitudinal fashion and to make strong casual arguments about our findings. We discussed limitations of the method we used for determining the level of social influence. We then introduced various methods to test the effect of social influence and the possible effect of communication channels on social information processing for future research. Although there is much research based on the user acceptance of technology and the social influence model, questions remain regarding how previous research findings could be applied in DL environments. Results of this study are a valuable addition toward the continuing integration of findings from existing research in the context of DL.

Acknowledgements

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WebCT and Online Assessment: The best thing since SOAP?

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Abstract

Cheating and increasing class sizes in Information Systems courses have forced us to reconsider our approach to assessment. Online assessment was introduced in our department in a pilot form in 1996 through an in-house developed package, SOAP (Student Online Assessment Program) and has evolved over subsequent years. This paper examines our explorations into WebCT and compares its Quiz tool with the facilities (potentially) offered by developing an in-house assessment package. We examine the differences between the two examples of learning and teaching technology mainly from a teacher's perspective but include some illuminating examples of feedback from our students. We conclude with some suggestions of factors that govern the successful use of online assessment in Information Systems courses.

Keywords

Online assessment, Cheating, Course design, Technology enhanced learning and teaching, Customised or package learning software

Introduction

Online assessment in our Information Systems courses, which started with an exploratory attempt in our first year course in 1996, is now incorporated as part of the assessment strategy in five courses from first to third year. The period 1996-2000 saw the evolution of the Student Online Assessment Program (SOAP) that was developed to automate tutorial support and assessment. SOAP was developed by Tony Richardson with the work on computer-based assessment partly supported by a grant to Tony Richardson and Judy Le Heron from the Fund for Innovation and Excellence in Teaching, Massey University. SOAP provided the ability to automate the testing of student programming skills using Structured Query Language (SQL) and analytical skills by providing a replica of Dataflow Diagrams (DFDs) and Entity Relationship Diagrams (ERDs) which could be labelled according to student analysis of a small case study (scenario). The use of SOAP dramatically curtailed student cheating and the automation of marking and recording of marks lifted a burden from staff. However, during 2001-2002 inevitably our use of SOAP was impacted by the winds of change. Firstly, the staff member who developed the SOAP software became involved in other courses and had limited time to adapt the software to reflect new assessment material (Boisot, 1998, Castells, 1996, Stewart, 1997). Secondly, a new Information Systems programme was introduced focusing on object-oriented concepts, which changed what particular courses required of the software. Thirdly, our university adopted WebCT as the preferred platform for offering courses online and staff were encouraged, although not compelled, to make use of the facilities provided by WebCT. This paper outlines our motivation for using computer-based testing, our experience of moving from software developed in-house specifically for our courses to generic commercial assessment software. The benefits and limitations of each are summarised, the effectiveness of WebCT in combating cheating is outlined and the impacts of WebCT on staff are discussed. To trace the evolution of our assessment methods see Table 1.

Why computer-based assessment?

Firstly, there should be a harmony between the technological nature of the subject matter and some of the learning and assessment practices (Dowsing, 1999). The students are expected to be adept at using technology as part of their learning mechanisms, for example our courses have provided web access to course material, lecture notes, assignment specifications and administrative information for quite a few years. In addition, our students are required to gain some proficiency in industry software (Computer Aided Software Engineering (CASE) tools) through practice with a minimum of tutorial guidance and written material.

Secondly, technologically based objective assessment has enabled us to reduce the occurrence of cheating (Le Heron, 2001). Teaching staff and the vast majority of honest students find it very demotivating to see students achieve 'success' by cheating. Our experience has shown that if students submit work as a group or have the opportunity to develop work with others before handing in their 'own' work, there will be a small percentage who put their energy into 'beating the system' by cheating. Technology, through monitored (proctored) online tests can provide a significant barrier to the dishonest student. Computer-based testing enables students to be individually tested and features such as randomising of question displays, discourage students from looking at the next screen without the need for heavy handed policing. With SOAP we achieved this by using separate scenarios for different tests so adjacent screens displayed different questions. The use of technology does not of course eliminate the problem of cheating, it just changes some of the mechanisms. Some cheating methods like crib sheets can be used whether the test is computer-based or paper-based and tests have to be monitored in the same way. However, one of our students reported over-hearing, while waiting for a test session, that if you viewed the web page source-code you could see the test password. Although untrue, it does demonstrate that there are always students interested in knowing the answers without knowing their subject. Honest students, such as our informant, want to be assured that cheating is impossible.

Thirdly, educational technology is harnessed in an effort to maintain the quality of learning when student demand outstrips the supply of staff resources (Ward & Jenkins, 1992). The reduction in funding per student over recent years is acknowledged both in New Zealand and Britain (Friedlander &Kerns, 1998, Richardson, 2002). In disciplines like Information Systems where student demand is high but recruiting and retaining academic staff is difficult, this results in very high student-staff ratios. Although it is clear that automatic marking relieves a lot of the work associated with traditional report marking it still requires substantial effort and organisation. Basically, there is a time shift in the work required i.e. more effort is required early in a course to ensure the online questions are formulated, loaded, correctly devised and proof read. An experienced team running courses for the second time can accomplish this smoothly but with constant changes in material and technology (including versions of the learning/teaching package) even this situation can provide tense high-pressure periods early on in a course. Some of this burden may be relieved by collaboration between institutions, the swapping of question banks, the sharing of best practice but this again is rare because it requires not only good planning and continuity of staff but assumes an environment in which institutions collaborate rather than compete.

1996	1997	1998	1999	2000	2002
Paper-based assignment of Microsoft Office Suite skills marked in student's absence plus computer-based skills consistency test	Computer-based test of Microsoft Office Suite skills marked in student's presence with marks recorded manually	Computer-based test of Microsoft Office Suite skills marked in student's presence using SOAP's marking panel to record marks directly to the student database	Computer-based test of Microsoft Office Suite skills marked in student's presence using SOAP's marking panel to record marks directly to the student database *and* to test and automatically mark student's SQL programming skills	Computer-based test of Microsoft Office Suite skills marked in student's presence using SOAP's marking panel to record marks directly to the student database *and* to test and automatically mark student's SQL programming skills *and* conceptual, analytical and DFD & ERD modelling skills	Computer-based test of student's conceptual, analytical and UML modelling skills using WebCT to automatically mark and record marks directly to the student database *and* provide statistics on question, test and student performance

Table 1. Paper to SOAP to WebCT: An evolutionary timeline

From 'our' software to 'their' software

SOAP was our answer to a number of the problems we faced – rapidly increasing class sizes, slowly increasing staff numbers and an increase in student cheating. It allowed us to provide tutorial support, practice tests and supervised tests with automated marking and recording of results. Marking consistency improved, marking was completed quickly, the drudgery of entering results was a thing of the past and cheating was almost impossible

under supervision. SQL testing worked smoothly presenting students with a random selection of questions from the question database and we were able to lay a marking panel on the screen over Microsoft Office applications to enable student test marks to be recorded directly in the marks database. While the software developer was on the teaching team using SOAP there were minimal problems. However, once the developer moved on to teach other courses the staff continuing to use SOAP were reliant on his time and goodwill to make changes to the software to reflect new approaches and to fix errors. And, because the software was not intended for commercial use, it was idiosyncratic. Entering new test questions and matching answers in the test database was painstaking, it was easy to make mistakes and hard to check. Entering a new DFD or ERD was difficult because the diagrams were graphics upon which text boxes and drop-down lists were placed. We were stuck with the original diagram structures as only the developer could make changes to the source code. All we could do was change the content of the drop-down lists that provided our answer options.

Therefore when WebCT was licensed by our institution we were keen to find whether its Quiz tool would give us the independence to introduce new material, particularly diagrams, while maintaining all the advantages to which we had become accustomed using SOAP. We went to training sessions, we heard the accolades, and we were told about the wonderful tools that we could make available to our students. The ability to run tests were alluded to, but the practicalities of actually creating a test were glossed over. And no wonder, it is not an intuitive package for the newcomer. Although WebCT provides a lot of online documentation it is not easy to navigate through or interpret. It wasn't until a departmental visitor with WebCT experience walked and talked us through the basics of test construction that we were able to make any headway understanding the WebCT 'modus operandi'. It was a steep learning curve. However, our previous success with SOAP gave us the motivation to persevere and to push the WebCT boundaries to reflect the complexities of assessing student understanding of analytical and modelling concepts in relation to business scenarios, Unified Modelling Language (UML) and object-oriented CASE tools. But as Figure 1 shows, WebCT's Quiz tool is for our purposes focused primarily on the automated marking of analysis skills and concepts and cannot be adapted to the other situations where we used SOAP, namely running SQL queries or recording assessment of Microsoft Office skills. Nevertheless, WebCT offers website and student record management facilities not provided by SOAP, but it is not those features but where they overlap that are the focus of this paper.

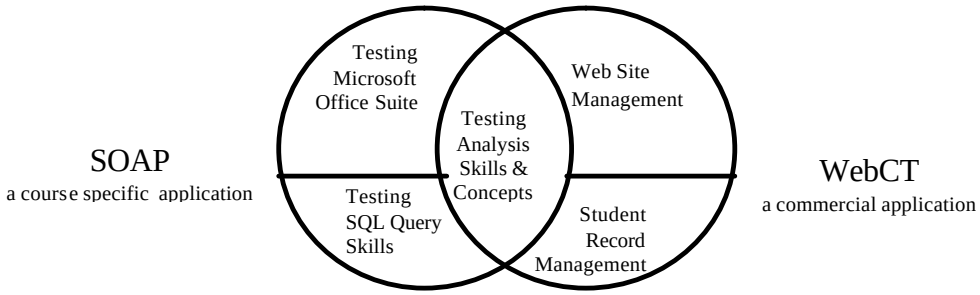

Figure 1. Comparison of WebCT and SOAP tools

Incorporating a test involves five main tasks: creating a question database; constructing a test from questions in the database; setting the specifications for test availability, security, delivery and release of marks; running a test and reviewing a test. The first of these is the most time consuming but all require attention to detail as explained below.

Creating the question database

While creating a set of test questions takes significant time it is only the first step. The second step, which takes as much time, is to convert them into one of WebCT's question presentation formats. Although WebCT provides five types of question formats, only three are relevant to our subject area. 'Short answer' questions require students to enter their own answers while 'multiple choice' and 'matching answer' questions present the student with multiple answers (option buttons/check boxes and drop-down lists respectively) from which to choose. All three of these question formats have the option of providing general feedback to the student once the test is marked. In addition, the multiple-choice format can provide feedback specific to each of the options provided both correct and incorrect. However, each of the three also constrain the way the answers can be provided.

Constructing a test

Bureaucratically, this is the easiest of the five tasks and is carried out by selecting questions, or sets of questions, from the Question Database. However, it provides significant pedagogical challenges when several tests of equal difficulty have to be constructed. Selection is easier if questions have been stored by category. Once the questions for the test have been chosen each is allocated a mark. When questions are created marking is specified as a percentage of the allocated mark for each sub-question or partially correct answer. This enables the decision about the value of each question to be determined when a test is created. If a set of questions is used each question in the set must be worth the same mark. From this set the designer can specify that some or all of the questions be randomly selected for each student who sits the test. Random selection, even if all the questions in the set are used, means that the questions are presented in a different order to each student who takes the test.

Setting test specifications and test security

Two important aspects of security are ensuring the integrity of the tests and maintaining the integrity of the recorded results. WebCT has two modes of access – designer access to create material for student use, and student access to material or quizzes made available for the class. If a designer wants to check the WebCT material from the student perspective then the designer is also allocated a 'student' usercode and password. Students are not aware of the existence of the question database and tests are not visible to them until the designer makes them visible. Even when a test is made visible to students their access can be restricted. Likewise, student access to their results can also be restricted until a specific date and time of release. Students only see their own results, which they cannot change, and the designer can determine whether they can also review their own test answers with or without the correct answers and feedback comments.

Test security is controlled by 'Quiz Settings' where test access is prescribed in terms of release date/time, availability to specific students, availability on specific computers and test password. WebCT also provides the ability to specify the style of question delivery, test duration, the form results are displayed in and the timing of the release of marks. It is necessary to specify the number of times the student can take the test. We limit this to once to reduce opportunities for cheating. The 'selective release' section allows staff to hide a test from the view of all students not specified on the 'release to' list. As part of our security measures, prior to the test, we limited release to a student ID used only by the teaching team. The 'security' section allows both an 'IP address mask' which restricts test availability to specific machines and a 'proctor password' which must be entered by/for each student before s/he can start the test. We used both these options firstly, to restrict test access to machines available in the university computer laboratories, and secondly, to restrict test access to test supervisors so that students could not gain access to the test at home or on university computers in unsupervised laboratories. The randomising feature of WebCT means that the questions are presented in a different order for each person who takes the test, which discourages those who try to copy from the person at the next computer. Finally, as an additional security measure we use different, but comparable, tests at each session to prevent students at later sessions finding out the questions from those who took it earlier.

Running a test

To minimise cheating we run our tests under supervision in university computer laboratories. As part of our test security we list tests for release to only one student user ID (known only by the teaching team) thereby hiding it from actual students. Just before the test is due to start it is made visible by removing the selective release criteria. Because we run multiple test sessions with different test versions over two evenings we only release the test versions we will be using immediately. We have found it is a good idea to check that the dates and times specified for the test to start and finish are accurate, and that we have remembered the proctor passwords for each test.

WebCT will give access to user IDs on the class list; it does not identify who enters that user ID so identification of each student who takes the test is important. We carry out multiple checks. We register students on arrival for their test session, check that the student name on the WebCT screen matches the name on the student ID card during the test, and require each student to sign a class register at the conclusion of the test so we can compare signature and appearance with the student ID card. These measures appear to deter 'stand-ins'.

Reviewing a test

Pedagogical problems such as incorrectly penalising unexpected but correct answers requires a diligent review of students results because even the most imaginative teacher will not come up with the same responses that the students are capable of. We included the statement that "Incorrect answers will be penalised" to discourage students from guessing True/False questions. However, we discovered later that a student for whom English is a second language thought this meant each choice of 'False' would be penalised, while a student for whom English is a first language thought it implied that an unanswered question would be penalised. If we discover a mistake in a test question after the test has been run we can change the question, the answer and/or the student marks to correct the situation. WebCT allows the changes to retroactively affect the completed tests and therefore student test results. Student grades can be adjusted by changing the mark allocation for a particular question for everyone or a specific student's score for a single question or the test overall. As a result students, by and large, have accepted that the assessment has been fair, even when they have been disappointed in their own performance (Quirk, 1995). Statistics on individual student tests and class performance by question mean that not only can student performance be monitored but also that tests and their component questions can also be analysed and fine-tuned to ensure they are appropriate assessment instruments (Snow, 1989). Our in-house package, SOAP, had little in the way of features for reviewing marks. We could scale a test's marks if there were problems during a particular test session but there were no records of an individual's answers or statistics on particular questions.

Our first live test - held hostage by hyphens

Although we had 'tested the test' in the student environment beforehand we still encountered some unexpected problems which made our test unavailable for our first test session. Firstly, WebCT's instructions suggested that to release the test to all students, all that was required was to ensure that nothing was entered in the 'release to' field. Unfortunately, this instruction is insufficient. In addition, the 'release based on' box should contain hyphens, which are inconspicuously located at the top of the drop-down list of identifiers. If the User ID remains selected WebCT attempts to find a User ID for the empty 'release to' list. Selecting the hyphens from the 'release based on' list made the test visible to the students.

Secondly, WebCT performance differed unpredictably by Web Browser. Despite the student computer laboratories all having identical software, WebCT was found to be more reliable using Netscape Navigator in some laboratories and more reliable using Internet Explorer in others. One problem was that although the IP address mask was set to allow access from any machine in any of computer laboratories, students using Internet Explorer on some of the machines were restricted from accessing the test. This was resolved by removing the IP address mask. A second problem was that the 'proctor password' was rejected as incorrect by some computers when using Internet Explorer but accepted by Netscape Navigator. The third problem was that Netscape Navigator shut out some students during the test requiring them to log on to WebCT again. This problem was exacerbated by the continuation of WebCT's timer during the log off/log on period. Designers are alerted to this problem in WebCT's documentation. However, there is no way to extend the length of the test for individual students or allow individuals to attempt the test more than once because test settings affect every computer. So we allocated them each a 'dummy' user log on and password to enable them to resit the test at another session and transferred their marks to their records manually. These can be regarded as 'teething' problems that have not recurred at subsequent test sessions but this type of difficulty will re-occur when there are changes to the assessment software and the testing environment.

Some limitations of WebCT's Quiz tool

Although the amount of time required to become comfortable with the way the WebCT Quiz tool operates is significant, the main limitations of WebCT, summarised in Table 2 and explained below, relate to creating the question database and delivering tests.

Creating Questions	➢ Course assessment must be adapted to fit the question templates and marking criteria ➢ Question types are primarily multi-choice ➢ Cannot enter answers on diagrams ➢ Creating a question database is time-consuming ➢ Inadvertently penalising unexpected but correct answers
Running a Test	➢ Test delivery may differ by Browser

	➢ Student ID is not continuously displayed ➢ Test timer is updated only on 'Save' ➢ Test timer continues while student is logged off ➢ WebCT can be minimised to get access to private files
Evaluating Tests	➢ Time required to analyse the statistical information

Table 2. Limitations of WebCT's Quiz tool

When you are creating questions the first limitation you become aware of is that course assessment must be adapted to fit the WebCT question templates and there is no opportunity to create new question types or test formats to suit the unique requirements of a course. While there are three main question formats with different presentation styles and marking criteria, test questions must be formulated very simply to facilitate automated marking. Complex questions must be broken down and presented as a series of more simple sub-questions. Although diagrams can be incorporated into the presentation of a question it is not possible for students to label elements of a diagram directly (to better replicate a CASE tool). Instead parts of a diagram must be labelled and identified by the student in the labelled answer section below the diagram. While WebCT provides for essay questions their marking cannot be automated. Multi-choice questions are the primary delivery mechanism. Presentation of answer choices can be either by a series of option buttons/check boxes (for a single question) or by one or more drop-down lists, for one or more related questions. The marking options, which differ for each question type, might also influence which of the question formats is chosen. How a question will be marked requires extra consideration in the 'short answer' format because students may type in a misspelling, an alternative spelling, a synonym, a different tense, a different part of speech, in a different case or with more spaces than the answer you envisaged. There are pedagogical problems that can be encountered in parallel, such as having too narrow a view of acceptable responses and therefore incorrectly penalising unexpected but correct answers.

All these decisions for each question being created means that a significant investment of time is required to build up the question database (Brown, Race & Bull, 1999). Although this investment of time pays dividends in the future the initial impact is not inconsequential. Also, the nature of these decisions means that creating the database cannot just be handed over to a data entry person. It is possible to import questions into WebCT provided they have been formatted using WebCT's codes to indicate specific question display formats, answer options, marking alternatives and student feedback. Familiarity with the codes and layout required may lessen the time to create questions in the database but it also makes it more difficult to detect errors. However, checking is still necessary to ensure the imported questions are appropriate for your course.

The test delivery problems with different browsers, mentioned previously should not be an ongoing problem provided you could choose your browser. However, WebCT test delivery does leave a couple of loopholes for those determined to cheat. Firstly, the name of the student (which reflects the user ID entered) is only displayed at the top of each question and disappears as the student scrolls down through the question. Once the test is finished there is no way of checking whom the test was completed for. So test supervisors must site the name on the screen, to compare with the ID of the student taking the test, while the test is in progress. Secondly, it is possible to minimise the WebCT screen to get access to private files that may contain study notes. While vigilant supervision discourages this sort of activity, we make it more difficult by logging all computers onto a password secured network drive that gives no access to student files. So far we have had no incidents of students trying to view material on a floppy disk.

Some advantages of WebCT's Quiz tool

Although WebCT only provides one aspect of the functionality previously offered by SOAP, its Quiz tool has a number of advantages, as summarised in Table 3 and outlined in more detail below.

Creating Questions	➢ WebCT template for entering questions is easy to use once it is familiar ➢ Question banks in WebCT format can be imported ➢ Ability to incorporate an image into any/all questions ➢ Ability to provide question specific feedback statements
Creating Tests	➢ Ability to control & customise of most aspects of test creation – presentation, content & marking ➢ Ability to control & customise test security ➢ Ability to provide unique tests

	➢ Ability to assign a different mark for a question when it is used in different tests
Running a Test	➢ Can control time taken ➢ Can control number of attempts ➢ Password protection ➢ Control over which machines have access
Evaluating Tests	➢ Students appear to have greater confidence in a commercial application ➢ A test can be automatically re-graded for the entire class if a mistake is discovered in a question ➢ Ability to guarantee the security of test results ➢ Ability to analyse the answering patterns for each question

Table 3. Advantages of WebCT's Quiz tool

A commercial application such as WebCT provides the user with a lot more control over the presentation, content, marking and security of automated assessment than a teacher adapting an in-house application in response to teaching pressures has time to incorporate. WebCT provides flexibility to introduce reasonable variety into what is essentially a 'multi-choice' approach not only in the way questions can be presented to students but also in the way automated marking can be customised for each question. The facility to incorporate an image, diagram or text passage into a question increases the ability to test the knowledge, comprehension, application and analytical skills of students, as educational objectives (Pritchett, 1999).

The WebCT test designer is able to incorporate a number of security measures to prevent unauthorised access to tests. These range from specifying precisely to which students the test will be made visible, when and for how long, the duration of the test, the number of attempts permitted and the computers on which it will be released. In addition, a 'proctor password' can be specified which an authorised person must enter on each computer before the student can access the test. WebCT's randomising facility not only presents questions in a different order for each new test begun but also alters the order of the answer choices on drop-down lists, which essentially provides a different test for every student. WebCT has the ability to provide feedback statements for each question, which enables the Quiz tool to be used for remedial use (Crooks, 1988). However, we have not yet had the time to invest in that refinement and felt it was important to concentrate on producing high quality tests first before we introduced additional functionality (Whittington, 1999).

Students certainly appear to have more confidence in a commercial software application than an application they know has been created in-house. Our experience of using both, a departmentally focussed, customised assessment tool, SOAP, and a university-wide (20,000 accounts) package, WebCT, would suggest that the wider familiarity and general significance of the latter gives it more acceptance within the student body than the less well known more specific SOAP software. This may be a function of (local) market dominance i.e. our students use WebCT for many of their courses and although they may be critical of its interface/response times etc. they do not perceive it as anything other than part of the university's infrastructure, over which they have little power. But even though some of the problems we encountered with WebCT were very visible to students, no one complained that the software was to blame for their poor performance. The WebCT log on restricts a student's access to their own tests and test results. They cannot access another student's record while they are logged on under their own user code and password so they cannot copy someone else's work or see their results.

SOAP on the other hand can be seen as more or less course specific and therefore more open to criticism and over which the students may (through their comments) have more control. They felt they could talk directly to the software developers and knew we were more amenable than the vendors of some large package that the university has licensed, especially as we invite criticism of any information system with which the students interact. When we were using SOAP there were always a few students who insisted they were disadvantaged by the software not working properly.

Impacts of computer-based testing

There must be institutional support for the students; just because computer-based testing exists doesn't mean it can be used successfully, they need guidance/practice in the particular technology used to assess them. We have found that although our students tend to be skilled computer users we noted considerable improvement in their acceptance of the technology and their scores when we increased the time devoted to guidance and practice directed at particular screens/test types used by SOAP (Race, 1995). This is easy to overlook, particularly when

there are pressures on time and resources. Although some students will be able to take to a new format with relative ease and little preparation most will not. Given the stress associated with any assessment situation it is important that it is the content of the test that challenges them not the use of the software. While the naïve view maybe that online learning is a low maintenance option for teaching staff, considerable work is required to prepare the learner for the format of the assessment or the result will be the under performance of both student and software.

One of the problems introduced by lab-based testing is not being able to test a class of 250 students at the same time. In our institution individual computer laboratories contain 25-45 machines and even four adjacent laboratories are insufficient to cater for the whole class. In addition, competing teaching and learning demands of other courses usually preclude the block booking of these facilities, especially during the day. Scheduling testing over several evenings provides students with some flexibility to work around their other commitments and simplifies the logistics. The major drawback is that some students pass on test information to others who attend later sessions, even though they are aware they are in open competition with one another, and we have found that the later test sessions are always booked up first.

The most straightforward solution to this obvious breach of security is to run different tests at different sessions. This poses two significant difficulties - that of fairness, producing tests of equal difficulty (Simms Williams, Maher, Spencer, Barry & Board, 1999), and that of workload, producing seven tests instead of one. Both of these difficulties can be reduced over time as question responses supplied by WebCT are analysed for level of difficulty and a question bank is built up. The ability to analyse question responses was not possible using SOAP. However, it should be noted that this analysis requires a considerable amount of effort and meticulous record keeping each time a course is offered for it to be useful. It also requires continuity of staff in the teaching team to avoid this pedagogical effort and knowledge being lost.

Conclusion

Despite having a course specific piece of assessment software, SOAP, at our disposal we have chosen to move to WebCT largely because of the independence it gives us as assessment designers. In addition given its status within the University it is respected and trusted by the students. We feel that the benefit of cheat resistant assessment has been retained and we have gained the significant features of review and remarking of tests.

Although we spent a lot of time learning the test 'ropes', exploring the idiosyncrasies of each question type, the results of the marking options, and the ramifications of the different quiz settings before we went 'live', we still encountered unanticipated problems in our initial tests. As well, a significant investment of time was required, not just for understanding and finding our way around WebCT, but also for actually creating a question database and tests. WebCT provides a plethora of statistics about student performance, on both an individual and class level, and about the assessment instruments, overall and in detail, but it requires time to analyse them and time to respond to them.

If the provision of high quality education is to be maintained there must be institutional support for educational software. This requires investment in WebCT support staff with the ability to assist teaching staff trying to come to grips with the complexities of a large application such as WebCT, and the technological expertise to overcome the inevitable problems that arise from the diverse university network platforms. The quality of this support is a significant factor in how comfortable the teacher will find working with a package such as WebCT and whether or not they continue to use some or all of its features. The provision of institutional support is problematic given universities find it difficult to recruit and retain good IT staff at current salary levels. Our own institution lost one of its university-wide WebCT experts at the beginning of the semester who had not been replaced by the end of semester. Some colleges within the university employ their own WebCT support staff while others do not. Even when good staff are in place and stay for a while it is difficult to balance the short-term trouble-shooting role with the longer term educational and development role. It is too much to expect the same people who are developing and running courses on the development of online teaching and learning to be on the end of a phone for emergencies during evening testing sessions.

The emphasis on preparation and review indicates that computer-based teaching, learning and assessment requires a lot of effort to set up, review and run. There will be problems, no matter how good the software, hardware platforms and institutional support so what is important is preparation, damage limitation and recovery from difficulties and knowing who is responsible for these. We have had technical problems with both SOAP (the occasional unexplained crash and installation difficulties) and with our use of WebCT (browser differences

and password problems). We have had problems ranging from seemingly impenetrable network difficulties to insufficient machines working. Whatever the cause, exotic or ordinary, the result is just as stressful for the student who is "ready to go" and the teacher trying to resolve the problem with a rescheduling nightmare threatening. The crucial issue, for both staff and students, is credibility – can the system be trusted, will it work as expected and can the information collected (test answers) and the information reported (results) be relied upon. The view that the university infrastructure, student management systems, computer networks and lab booking mechanisms are working well behind the scenes, should not be taken for granted by the teacher trying to estimate the effort required to deliver a high quality learning experience with online technology.

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Facilitating Online Learning: Effective Strategies for Moderators

(Book Review)

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Textbook Details:

Facilitating Online Learning: Effective Strategies for Moderators
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Atwood Publishing, Madison, WI, USA
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With the advent of the 21st century, educators are being thrust into a new teaching environment: the cyber-classroom. In an attempt to stay competitive, many courses are being offered through higher learning institutions such educational software platforms such as Blackboard (http://www.blackboard.com/) and WebCT (http://www.webct.com/). Often, in-house training seminars attempt to target the manner in which course content is delivered through these platforms, but fail to inform teachers of the importance and need for creating healthy communication between participants within the course. With this in mind, Facilitating Online Learning: Effective Strategies for Moderators uniquely focuses on the teacher/moderator as a communication agent within the online learning environment. In Facilitating Online Learning: Effective Strategies for Moderators, Collison, Elbaum, Haavind, and Tinker (2000) address this critical issue, noting that "course design and presentation mechanisms - together with excellence in online dialogue facilitation - separate the excellent online course from the mediocre or weak one" (p. xiv).

Clearly written and well organized, the purpose of Facilitating Online Learning: Effective Strategies for Moderators is to enlighten moderators to best practices for creating rich dialogue as well as fostering learning between participants enrolled in online courses. As staff members of the Concord Consortium - a non-profit research and development organization based in Concord Massachusetts - the authors are devoted to transforming education through the implementation of information technology. Using two educational cohorts as a medium for exploration - namely The Virtual High School® Cooperative (http://www.govhs.org/website.nsf) and the International Netcourse Teacher Enhancement Coalition (http://intec.concord.org/), the text is rich with examples of effective online discussion forums designed to maximize learning goals within an e-learning format. Such experience of the authors results in a good balance between the theory and the practicality for conveying their important message. The following is a brief chapter-by-chapter review of Facilitating Online Learning: Effective Strategies for Moderators.

Book Content

In Chapter One: "Principles that Support Effective Moderation," Collison et al. posit three guiding principles for effectively moderating online courses which include:

- Moderating takes place in both professional and social context.
- The style of "Guide-on-the Side" (vs. "Sage on the Stage") is the most appropriate for leading a virtual learning community.
- Online moderation is a craft that has general guiding principles and strategies that can be learned by prospective moderators.

With these principles in place, Collison et al. maintain that participants want and require a sense of community within online learning environments. Additionally, with a "guide-on-the-side" approach to facilitation, the moderator serves to guide participants as they create a good bit of the learning experience through their dialog

with each other. Finally, as this new avenue of course delivery may be a bit daunting for the first time moderator, the reader is assured that new skills are possible in the navigation of this "new landscape."

Chapter Two: "Negotiating Space: Forms of Dialogue and Goals of Moderating" identifies patterns of discussion most common within the culture of an online course. Collison et al. describe such patterns as "forms of dialogue" which include social, argumentative, and pragmatic forms. While social and argumentative forms of dialogue tend to inhibit discussion, a pragmatic approach helps to maintain a productive focus, aiding in goal attainment of the learning environment. Such goals according to the authors include building community, shaping a supportive culture of respect, and cultivating reasoned discourse.

Key Facilitator Roles is the focus of chapter three. Here, Collison et al. detail the three major roles of moderators: guide-on-the-side, instructor/project leader, and group process facilitator. According to the authors, the guide-on-the-side approach allows the moderator to assist participants in constructing their own patterns of dialogue. Additionally, such an approach allows the participants to shape the culture of the environment more so than the moderator.

In addition to a "guide-on-the side" role, the authors suggest that moderators act as project leaders within the course. This role involves designing a regular and manageable feedback loop, separating content from process issues, and facilitating peer support within the online classroom environment.

Finally, Collison et al. encourage moderators to act as the leaders of group processes. The authors note that such a role involves leading introductory, culture building activities, providing virtual "hand-holding" to the "digitally-challenged," as well as acknowledging the diversity of the participants. This role also involves organizing posts and discussions as well as balancing private emails and public discussion postings.

Being a communications major, Chapter 4, "Healthy Online Communication" was one of this reviewer's favorites. This chapter offers sound advice and strategies for maintaining the functionality of online learning environments through the communication process. The authors, through multiple examples, identify how moderators can create, maintain, and evaluate the communication culture within the course.

Chapters 1 through 4 give the reader basic principles and practices for creating an effective communication environment within an online course. Additionally—dubbed advanced strategies—Collison et al. have developed a "palette of voices, tones and critical thinking strategies" that a moderator might implement to improve the on-line communication and learning experience. Chapters 5 through 8 speak to these advanced strategies.

Chapter 5 introduces moderators to the concept of "Voice" within an online educational culture. Much like a role player within the discussion, the authors encourage the facilitator to act as generative guide, conceptual facilitator, reflective guide, personal muse, mediator, and role player. According to the authors, the concept of "voice" gives the facilitator many options for achieving and maintaining effective interactions within various discussions. The situation generally dictates which role or "voice" the facilitator might choose.

Chapter 6 discusses the concept of "Tone" that identifies the importance of a moderator offering an empathetic and nurturing approach to those participants who are struggling with the content or technological aspects of the course. The authors expertly discuss how a moderator—through electronic communication—can effectively craft such an emotive expression. Nurturing, curious, analytical, neutral and whimsical tones are explored.

Chapter 7 discusses several advanced "Critical Thinking Strategies" available to moderators who are interested in producing ideas within the group. Acting as a "guide-on-the-side" the authors suggest that a facilitator should guide the direction of the discussion, aid in the sorting of ideas, and help participants focus on key points in an attempt to sharpen the focus of online dialogue.

Additionally, for a rich learning experience and idea generation, Collison et al. suggest certain key ways for deepening the dialogue between participants. Here, facilitators are encouraged to promote full spectrum of questioning, offer opportunities for participants to make connections, and support an environment that honors multiple perspectives. For optimum success, Collison et al. firmly note that ownership of the direction of the dialogue must remain with the participants as the facilitator remains a "guide-on-the-side."

In concluding the book, Chapter 8: "Roadblocks and Getting Back on Track" identifies several typical barriers that moderators may face while facilitating an online course. Here, Collison et al. note that even the best

moderator may inadvertently block dialogue within the course by "hijacking the dialogue" or letting key discussion points "whoosh right by."

Based on the experiences of the authors in maintaining effective communication and learning in online offerings, Facilitating Online Learning: Effective Strategies for Moderators is a beneficial tool for any instructor looking to maximize the learning potential of their own online course. What makes this text especially helpful is the fact that it centers on best practices for maintaining the communication culture within online courses.

While this is an outstanding text in the field of online education implementation, a few constructive comments are offered. As this reviewer feels that training for online course offerings is often overlooked in educational institutions, "end-of-chapter" assignments targeted toward the communication development process might better guide a novice online instructor through the design process. Additionally, as the online education environment is guided by visual stimuli, an accompanying CD-ROM that offers computer-based examples that guide moderators through the communication development stages of course development would be a nice addition to any further editions of this book.

Summary

From their collective expertise in such cohort projects as The Virtual High School® Cooperative and the International Netcourse Teacher Enhancement Coalition, Collison et al. provide a practical and valuable resource for moderators who find themselves navigating their way through the 21st century virtual classroom. The authors provide a unique focus on the teacher/moderator as communication agent within the online learning environment. Through their experiences with online teaching, Collison et al. keenly explore and proclaim the power of dialogue and communication in online teaching and learning environments. Expertly blending theory with actual practice, this book is an excellent guidebook for the first time moderator as well as the seasoned veteran. For the instructor looking to create an online course that is rich and full of impact via the communication process, Facilitating Online Learning: Effective Strategies for Moderators is the text to refer to.

Education and Artificial Intelligence or Foundations of Modern Didactics of University Education (in Russian)

(Book Review)

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Education and Artificial Intelligence or Foundations of Modern Didactics of University Education (in Russian)
G. A. Atanov and I. N. Pustinnikova
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The book "Education and Artificial Intelligence or Foundations of Modern Didactics of University Education" is devoted to the overall theory of education and, to a lesser degree, to the use of artificial intelligence in education. The author is writing largely from the perspective of the Soviet/Russian school. Reflecting this fact, the overwhelming majority of 200+ references given at the end of the book are to Soviet, Russian and Ukrainian sources.

Chapter 1 is devoted to the description of an action-based approach to education. It includes the consideration of the aims of education, educational ideology and methodology, models of activity in general and education-related activity in particular, educational tasks and ways to their fulfilment. The author considers approaches for establishing structure in educational activities, and puts particular emphasis on functional structure. The chapter concludes by outlining approaches to learner modelling and to controlling learning activity.

Chapter 2 is devoted to knowledge engineering. The authors consider vertical and horizontal structure of knowledge, and discuss the approaches to knowledge representation, including logical, production, semantic nets, and frame methods.

Chapter 3 is devoted to subject learner modelling, including thematic subject learner modelling, functional subject learner modelling, procedural subject learner modelling, operational subject learner modelling, and semantic subject learner modelling.

Chapter 4 concentrates on current student modelling. Vertical and horizontal structure approaches to current student modelling are considered. Various types of tests are described in detail. The chapter concludes by considering the ways to determine if university education targets are met.

Chapter 5 is devoted to problem-based education. Problem-based education is viewed from the perspective of an error model. The history of problem-based education is considered. Contradictions in education are analysed from the point of view of dialectics. The chapter is concluded by suggesting a structured approach to developing problem situations.

Chapter 6 considers notions in subject domains and their structuring. Associative nets are suggested as an approach to establishing hierarchies of notions. Production methods are used to establish relationships between notions. Finally, the structuring of notions as an activity is presented as a type of learning.

Chapter 7 considers the role of expert systems and their classification. Bayesian networks and diagnostic expert systems are covered in detail. Examples of using expert systems are given, and their use in teacher education is considered.

Finally, Chapter 8 considers realizations of the action-based approach to education in Computer Based Training applications. A system devoted to teaching physics in described in detail, which is used to provide an in-depth coverage of the frames method.

Overall, the book serves as an introduction to educational theory and its implications for computer-based teaching, presented from a perspective that somewhat differs from mainstream. It may be valuable as a source of fresh thinking and new ideas. On the other hand, it does not constitute a comprehensive up-to-date coverage, as certain important topics, such as constructivist education or the use of Internet in Computer Based Training, are not covered.