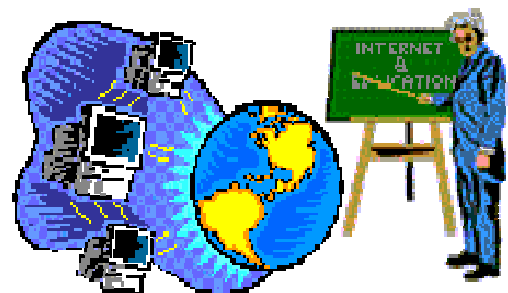


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Aims and Scope

Educational Technology & Society is a quarterly journal published in January, April, July and October. *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 The articles should be original, unpublished, and not in consideration for publication elsewhere at the time of submission to *Educational Technology & Society* and three months thereafter.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 broad. Following list of topics is considered to be within the scope of the journal:

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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*, retrieved July 7, 2002 from <http://leahi.kcc.hawaii.edu/org/tcc-conf96/fulton.html>.

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The submissions should be sent via email to (Subject: Submission for Educational Technology & Society journal): kinshuk@ieee.org.

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Motivation and Hygiene as a Framework for eLearning Practice

Moderator & Summarizer:

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Discussion Schedule:

Discussion: March 29 - April 7, 2004

Summing-up: April 8-9, 2004

Pre-Discussion Paper

Introduction

In the mid 1960s management theorist Frederick Herzberg made a discovery that changed the way in which people understood motivation in the workplace. Some forty years later, Herzberg's (1966) motivation and hygiene principle finds an interesting application in eLearning practice. His work provides a different frame of reference for considering the advantages and potential for eLearning for education.

eLearning is frequently acclaimed as enabling education that is more accessible (available to students), effective (better for their learning) and efficient (cheaper for an institution to provide). Herzberg's framework provides eLearning practitioners with an opportunity to consider how these advantages might best be realized and how eLearning expenditure might be maximised.

Herzberg interviewed 200 engineers and accountants and asked them about one positive and one negative work experience they had encountered. He then probed their answers to find out what was behind each experience. Herzberg discovered a group of 'satisfiers' that were generally responsible for positive experiences, and a set of 'dissatisfiers' that were generally responsible for negative workplace experiences. He further noted that a lack of 'satisfiers' did not generally result in negative experiences and that a positive experience of the 'dissatisfiers' did not result in positive experiences. As Herzberg (2002, 76) stated "The opposite of job satisfaction is not job dissatisfaction but no job satisfaction; and similarly the opposite of job dissatisfaction is not job satisfaction."

Satisfaction leads to a positive workplace contribution. Dissatisfaction on the other hand leads to decreased productivity and less commitment to the workplace.

Motivation and hygiene

Identifying satisfiers and dissatisfiers led Herzberg to determine motivation and hygiene factors that employers could apply to improve employee satisfaction in the workplace. The motivating factors are those that describe the workers relationship to what he or she does, while the dissatisfiers relate to the context within which the work is performed. Motivation factors increase motivation if they are present; hygiene factors cause dissatisfaction if they are absent. By way of example, giving employees responsibility provides them with motivation as it is a motivation factor. If employees are *not* given responsibility, they are not motivated but neither are they dissatisfied. On the other hand, paying employees more (salary, a hygiene factor) will not cause them to be motivated but unless the salary is adequate employees will be dissatisfied.

Table One summarises Herzberg's findings.

Table 1: Motivation and hygiene factors in the workplace

Satisfiers (motivation factors)	Dissatisfiers (hygiene factors)
➤ Achievement ➤ Recognition ➤ The nature of the work itself ➤ Responsibility ➤ Advancement	➤ Company policy and administration ➤ Supervision ➤ Salary ➤ Interpersonal relations with supervisor ➤ Working conditions

Of these, the nature of the work itself, responsibility and advancement caused the most long-lasting motivation. Herzberg's theory has been confirmed by a number of parallel studies in different industries.

eLearning's motivation and hygiene factors

Herzberg's theory is of interest to eLearning because it provides important clues for practice. Exchanging employment for education and employees for students, the following motivation and hygiene factors are proposed.

Table 2: Proposed motivation and hygiene factors for education

Satisfiers (motivation factors)	Dissatisfiers (hygiene factors)
➤ Enthusiasm and commitment of educators. ➤ Feedback and academic mentoring from tutors. ➤ Serendipity. ➤ A sense of community.	➤ Clear expectations. ➤ Prompt assignment return. ➤ Reliable LMS technology. ➤ Flexibility and control. ➤ Institutional policies and procedures.

In Herzberg's framework the motivation factors are those that increase satisfaction if they are present but generally do not lead to dissatisfaction if they are absent. Hygiene factors however cannot motivate but cause dissatisfaction if they are absent. If the proposed motivation and hygiene factors are accurate, the following generalizations can be made about eLearning.

- The online tutor and his or her activity is key to satisfaction in eLearning.
- The establishment of online community is a vital element of eLearning.
- The actual technology used in eLearning cannot satisfy however a poor choice can cause dissatisfaction.
- Providing students with flexible learning opportunities does not motivate them however its absence would cause dissatisfaction.

Implications for practice

As a general conclusion, the following comments can be made with regard to access, effectiveness and efficiency of eLearning. These have a general application to eLearning decision making.

- Access is a hygiene factor in that if it is present it does not necessarily increase satisfaction however it will result in dissatisfaction if it is absent. Increasing access opportunities will not result in improved learning.
- Effectiveness in eLearning relies on leveraging the motivation factors. Activity in the hygiene area will not increase eLearning effectiveness.
- Efficiency gains can only be made by ensuring that the hygiene factors are kept at a 'fitness for purpose' level of activity and the motivation factors should not be subject to cost cutting.

Discussion questions

1. Are the motivation and hygiene factors proposed for education accurate? What research might confirm them or suggest otherwise?
2. Is there a valid link between satisfaction and success in student learning?
3. Is it accurate to consider 'access' as a hygiene factor, 'effectiveness' as reliant on motivating factors, and efficiency gains best possible at the expense of hygiene factors?

References

Herzberg, F. (1966). *Work and the nature of man*, Cleveland and New York: The Word Publishing Company.

Post-discussion Summary

The IFETS discussion held between 29 March and 9 April centred around the applicability of Herzberg's principles to eLearning. Would it be possible to design and deliver courses in such a way that the satisfiers are maximised and the dissatisfiers minimised? If indeed Herzberg's theory applies to eLearning (which is highly likely) it has the potential to assist institutions to better target their eLearning investment. The discussion debated not only this question but also the validity of speculating what satisfiers and dissatisfiers might be.

The opening shots were fired by Charles Adamson, who reasoned that the best way of assessing Herzberg's potential contribution to eLearning was to replicate his research: "What is needed is for someone to reproduce the Herzberg experiment with eLearners in courses that present information and additionally in courses that teach skills." His point was endorsed by Clark Quinn, who added that there would be value in "exploring [the topic] conceptually" in the meantime. David Jones suggested a paper by Chyung, S.Y. (2002). Analyze motivation-hygiene actors to improve satisfaction levels of your online training programme. 18th Annual Conference on Distance Teaching and Learning, Madison, Wisconsin. The paper is available from http://www.uwex.edu/disted/conference/proceedings/DL2002_13.pdf. Chyung (2002) concludes his investigation by saying that his three-year evaluation seems to "support Herzberg's research findings that there are two distinct sets of factors, one of which affects learner satisfaction and the other one of which affects learner dissatisfaction" and further notes that "it is important to put initial effort on improving the condition of hygiene factors before implementing motivational strategies." Frances Bell pointed out that "what is a discontinuity for one person can be a continuity for another". This is echoed in part by Herzberg's own findings; the factors Herzberg describes as satisfiers and dissatisfiers did overlap however not the extent of challenging the overall integrity of his theory. Frances' caution seems to be shared by Mag Hans Horwath, who notes the differences between student's circumstances.

Charles Adamson suggested that Herzberg's satisfiers and dissatisfiers likely transferred directly across into education. Charles' original list forms the basis of the satisfiers and dissatisfiers of eLearning as at the end of the discussion as follows; further comments have been added by additional IFETS contributors.

Satisfiers (motivation factors)
ACHIEVEMENT "Grades improving over time" (Charles Adamson); "successfully executing problems or practice opportunities" (Clark Quinn); "the ability to act spontaneously or at least the feeling that one is capable of doing so" (Peter Isackson).
RECOGNITION Positive feedback and comments from tutors (Charles Adamson); Peter Isackson noted that peer recognition may be more important than tutor feedback because "a learner never knows if the [tutor] feedback isn't meant simply to encourage further effort". Further, Peter suggested that recognition could be linked to "a notion of potential leadership" in that a student's ideas are expressed and may be accepted by others.
THE NATURE OF THE WORK ITSELF The nature of the work itself (Charles Adamson); ensuring that student learning is an "authentic application of the knowledge" that "learners care about" (Clark Quinn); learning what is of interest to the student (Mag Hans Horwath); "the ability to 'identify with' what is being taught" (Peter Isackson), which might involve "risking something of... personality and self-esteem" as learning takes place.
RESPONSIBILITY Responsibility for own learning (Charles Adamson); Clark Quinn pointed out that responsibility may not be a motivator unless students are ready for it (and scaffolding is available for it); Peter Isackson suggested that responsibility related to the relationship of the employee to the company which may have no educational counterpart at present.

ADVANCEMENT

Advancement through a series of class levels (Charles Adamson); Peter Isackson commented that “we would need a new paradigm to apply this to learning” that involves criteria based on “function rather than status”.

ADDITIONAL FACTORS (based on Chyung, 2002):

The learning itself (satisfaction from the gaining of new knowledge and perspectives); gaining confidence with the subject matter; the effectiveness of instructional materials (clarity, structure, use of multimedia); social interaction with other participants; prompt instructional feedback from the instructor; flexibility and convenience. Peter Isackson comments that social interaction seems to be a hygiene factor of Herzberg’s but notes that “learning, unlike work, is rightfully seen as a fundamentally social experience and therefore social interaction SHOULD probably be reclassified a satisfier.”

Dissatisfiers (hygiene factors)

COMPANY POLICY AND ADMINISTRATION

School policy and administration (Charles Adamson); “pedagogical orientation” (Peter Isackson), which would help to differentiate between those institutions who focus on “delivering the curriculum” and those that aim for “stimulating learning”.

SUPERVISION

Tutoring (Charles Adamson); mentoring and coaching (Peter Isackson).

SALARY

Cost of course (Charles Adamson); Peter Isackson suggested that salary not be considered relevant as a hygiene factor for education.

INTERPERSONAL RELATIONS WITH SUPERVISOR

Interpersonal relations with tutor (Charles Adamson); Peter Isackson considered this factor to include relationships between groups of learners.

WORKING CONDITIONS

Study conditions (Charles Adamson); Peter Isackson saw this as consisting of “the physical environment, the utility and availability of resources” to the student.

ADDITIONAL FACTORS (based on Chyung, 2002):

Time spent on completing tasks (long downloads specifically mentioned); technical problems; overly complex online environment; instructional sequence.

The potential importance of Herzberg’s theory to eLearning is that it can help target investment and optimise the learning experience. By identifying satisfiers and dissatisfiers institutions can channel their resources into those activities that manage dissatisfiers (hygiene factors) to an acceptable level and maximise satisfiers (motivation factors). A reliable set of satisfiers and dissatisfiers for eLearning would be of benefit to all eLearning practitioners and decision makers.

Until someone actually does give this topic some serious attention as a PhD or significant research project (Geoff Guttman described this area as “very ripe for research”), we may remain with a substantial gap in our knowledge of how we might better retain and inspire students. Charles Adamson suggested that such research might be performed “at a minimal cost”; it is the hope of the author that someone will make the required investment to see this done.

References

Herzberg, F. (1966). *Work and the nature of man*, Cleveland and New York: The Word Publishing Company.

Law of the Minimum in Learning

Moderator & Sumamrizer:

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Discussion Schedule:

Discussion: April 19-28, 2004

Summing-up: April 29-30, 2004

Pre-Discussion Paper

For a long time i am thinking about "Learning", what it is, how it occurs, what are the limitations, how can we improve its quality etc. eventually, i had a meaning for "learning" and named it "**Law of the Minimum in Learning**".

I have influenced greatly from Justus von Liebig's (For more information on Liebig, see:1,2,3) Law of the Minimum which states that **yield** is proportional to **the amount of the most limiting nutrient**, whichever nutrient it may be. From this, it may be inferred that if the deficient nutrient is supplied, yields may be improved to the point that some other nutrient is needed in greater quantity than the soil can provide, and the Law of the Minimum would apply in turn to that nutrient.

If we redefine "yield" as **learning** and "the most limiting nutrient" as **human readiness (either learner or helper)** then we can easily say that meaningful or active learning is directly proportional to any of the human's readiness. Unlike the plant system, just increasing any of the human readiness or increasing the quality nonliving constituents (instructional materials, methods) of the learning system may not improve the quality of learning process. At this point, we have to define learning system which is composed of living and nonliving constituents. Living constituents cover learner and the living helper of the learning process. Nonliving constituents cover all materials, methods and the environment where the learning process occurs.

Whatever high quality? Non-living constituents present in the environment has secondary effects on learning process. Let's say you have very effective? Instructional material which has tested for many years? The success of this material is directly proportional to the readiness of the any living constituents of the medium. This can be either learner or the learner helper. So, we can not increase the quality of learning process just increasing the quality of materials and/or methods. We have to focus on the living constituents of the learning environment.

Before going further, I want to describe what "learning" means; learning is an active (Bruner) and continuous process which occurs in any time and place and it has no negative value at all. Meaningful Learning is giving meaning and it occurs in a social context.

It is **continuous** and inherited to our offspring via "learnosomes"? which are the basic building blocks of the learning process. Unfortunately, there is no direct evidence for their molecular presence until now, but I am very optimistic for their presence and in near future.

Learning is a **continuous process** therefore we are learning whether consciously or unconsciously but continuously. We can not say that "I didn't learn" because we are learning less or wrong but we are learning something. Therefore, it has no negative value.

It is never lost but it is changed into new meanings by the help of the previous experiences and the social interactions. Learning is changed from one form to another (**Learning is conserved**).

In the light of those hypotheses; we can easily say that:

1. In order to increase the quality of learning we have to focus human constituents of the system. We have to consider both learner and the helper readiness because the less ready human will determine the overall yield of the learning process.

2. We have to find out good problems which have been defined by constructivists' i.e. real life problems.
3. Learning environment should be enriched to give change different type learning
4. The role of the helper should be moderator and/or facilitator
5. Group work should be used during learning process.

References

Gillispie, C. C. (1981-1990). *Dictionary of Scientific Biography*, 7, New York: Scribner.

Brown, C. A. (1942). "Justus von Liebig--Man and teacher." and "Liebig and the Law of the Minimum". In *Liebig and After Liebig: A century of progress in agricultural chemistry*, Lancaster, PA: The Science Press Printing Co.

van der Ploeg, R. R., Böhm, W., & Kirkham, M. B. (1999). On the origin of the theory of mineral nutrition of plants and the Law of the Minimum. *Soil Science Society of America Journal*, 63, 1055-1062.

Bruner, J. (1960). *The Process of Education*, Cambridge, MA: Harvard University Press.

Post-discussion Summary

"Learning is proportional to the readiness of the most limiting human factor (learner or helper) whichever human factor he/she may be. Because teaching and learning are best thought of, not as separate and independent activities, but rather as two sides of the same coin, interconnected and interrelated".

Michell Weisburgh stated "Before I plant my Spring garden, I test the soil to see what nutrients are necessary for the types of plants I intend to have, then I add the fertilizer, lime, etc. And it works. And he has asked a very good question;

Wouldn't it be great to have a similar diagnostic for learning? In my opinion, if we want to have better results we have to give more attention to the learning environment and find out different diagnostic tools for learning. Prof. Giorgio Casadei added his comments "Well. but what does it mean " ... test the soil to see what nutrients are necessary for the types of plants I intend to have", when the soil is the brain and types of plant are types of minds?" Similarly, Vikie Vance continued using the same analogy and stated "the current discussion by Dr Ozden is interesting, and unaccustomed as I am to the literature referred to regarding agricultural chemistry, I have interpreted this example to metaphor...the learner as a plant. I see merit in this; however I have some questions that perhaps Dr Ozden or others may help illuminate some understanding for me.

1. What role would mediation play in this... for instance if we use technology in the process, how does that fit with enhancing, limit or change nutrients for the learner?
2. What about the ecology in which the learner exists - things that don't directly impact upon nutrients but have an impact upon the learner in some fashion - predators, introduction of foreign species? (These are outside the learner and helper you describe, but are living.)
3. What about mutation? Lack of germination for various reasons e.g. virus? At what stage is the plant a learner?
4. What about environmental adaptation - is this Bourdieu's 'habitus'?

Forgive me if you think this frivolous, but I fail to see a plant without seeing the ecology within which it fits." I think, there is no need to find direct relation plants' growth/ecology and human learning. I have used it just an analogy. Human is not plant and/or human learning is not plant growth. But, if we omit any of the human factors in the system it also limits the level of learning. Those questions reminded me that in the real learning environment we are just focusing ecology or external factors (technology/methodology) but the limiting factor is the less ready human.

Michael Barner-Rasmussen stated "Law of the Minimum in Learning" seems to me to be very problematic for the following reason:

It assumes a naturalistic, linear, parametric relationship between discrete and orthogonal parameters that may be shown to be significant to learning.

Much experimental experience seems to me to rather suggest that learning is an emergent phenomenon that cannot be adequately explained as a simple availability (transmission) -> assimilation -> understanding. Dewey, Kolb, Davydov Furthwer, it seems to me the law can not explain innovation, moments of insight where previously unrelated knowledge combine into a new, grander understanding, nor what Peirce called Abductive Reasoning, where knowledge from one domain is applied (successfully) to another. Li Zhou responded, "I think the 'Law of the Minimum in Learning' only becomes problematic when we view learning in a very narrow sense such as planned or prescribed learning. However, the law seems to make sense if we do have a specific purpose in learning something for immediate use as Mitch argued. On the other hand, learning as a life long human productivity can not always be measured, such as life experience in early years or in a different situation might not be significant or meaningful then but years later as we mature and as the situation changes it often comes back to make much better sense of what we experience now as well as what we experienced then. It all depends on what we value. I do agree with Michael that one important property of learning is its recursive nature but the 'Law of the Minimum in Learning' tends to measure each learning event only by itself while neglects the interconnection among different learning experiences without which all our separated experiences will not have any real significant meaning by themselves. I agree with Li Zhou, when we view learning in a very narrow sense. But Learning is a **continuous process** therefore we are learning whether consciously or unconsciously but continuously. We can not say that "I didn't learn" because we are learning less or wrong but we are always learning something. Therefore, it has no negative value. Whatever we learn is never lost but it is changed into new meanings by the help of the previous experiences and the social interactions. Learning is changed from one form to another (**Learning is conserved**).

Vickie Vance also commented on continuous nature of the learning and stated that, "I agree with much of what you say, (we constantly learn, learning is internally and socially constructed) however your 'human factor' is not a nutrient, or anything that we have in the history of mankind been able to accurately measure."

Would there be value in doing so? The environment can be manipulated to encourage maximum learning, or discourage it. We cannot control the histories or experiences that any learner brings to a situation. Any individual is unique, and while we may be able to administer IQ or any other means to provide a standard measurement, what is the point? To have a standard measurement is to take away the value of the individual. Why are you considering the 'human factor' as there is no learning without it?" I know, learning is giving meaning individually in a social context. Therefore, we can maximize or minimize learning up to a certain level just focusing environmental factors. So, we have to consider human factor and give more emphasis how we can make them ready for the desired learning activities. There is no need to administer IQ just let them ready for the learning activities.

Errol Thompson commented on the quality of learning process and stated that "I am sure that I have missed part of this discussion. However, it concerns me when it is said that 'quality of learning process'. We may not be able to influence what goes on inside a learner's head but we can teach 'learning to learn' and I believe that we can assess and improve the learning process being used by the learner. If I have no influence over how a learner approaches learning then I should discard some learners from my classes because their memorisation learning processes or strategies are not going to help them develop creativity or critical reflection." Yes, we can not influence what goes on inside a learner's head but we can access and improve the learning process being used by the learner this means then, we are making them ready for the learning process.

Hellen Griffith stated "As a secondary teacher (grades 10-12), I found the following comment extremely thought provoking -- "So, we can not increase the quality of learning process just increasing the quality of materials and/or methods. We have to focus on the living constituents of the learning environment".

As a teacher, we are continually focused on increasing the quality of our materials, improving pedagogy, and meeting individual learner needs. What, in your opinion would constitute a "focus on the living constituents of the learning environment"? Does this transfer to what we consider in education to be a focus on the individual needs of each learner?" Sujeet Kumar responded "What you want to say, I do not agree with you. Our organization working in this direction and by adopting a proper methodology, learning quality can be improved without using any quality materials. I have met many teachers who try to improve the learning process by including body language in the teaching and not using technology. You can go to our website (<http://futureschools.org>) for details." Yes, just focusing on the human factor of the learning environment it is possible to obtain much better results.

At this point, Richard Dillman made some comments on human factor as follows "As I understand it, human factors analysis applies to specific situations with well defined goals and possible courses of action. Human factors analysis ... is the scientific discipline concerned with interactions among humans and other parts of a system in carrying out a purposeful activity. Human factors include leadership, teamwork, communication and decision-making.... Human factor analysts suggest that the errors, incidents, critical incidents and accidents that arise from human behaviour can best be addressed in a systematic fashion through programs of quality assurance and error and risk management (<http://www.pediatriccardiacinquest.mb.ca/ch10/humanfactors.html>).

One educational situation that might accommodate this method is the "first day of class" problem. On the first day of class the teacher faces a group of students, each of whom arrives with a different set of ideas, skills and attitudes. What is the most efficient way for the teacher to gain the attention of the class and focus it on the task at hand?

Another fruitful area of study might be "grading". The overall course grading process is quite complex, but some grading situations recur on a regular basis: the student who tries hard but does not quite succeed; the student who takes a long time to get acclimated but then does extremely well; the student whose efforts tail off towards the end of the course. I'm sure that there have been studies of grading methods, and of the effect of grading on student progress, but human factors analysis may be able to shed additional light on the problem.

A third possibility is the "what do you want" problem. Is there a most effective way to communicate an assignment to students with a minimum of misinterpretation?

I would like to conclude by saying that quality of learning/teaching is directly proportional human readiness (either learner or helper). In other words, the less ready human factor determines the overall quality of system. Whatever high quality? Non-living constituents (materials, methods etc.) present in the environment has secondary effect on this process. Therefore, human factor analysis would have a specific importance for obtaining better results.

Student Attitudes to Learning Business Statistics: Comparison of Online and Traditional Methods

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ABSTRACT

Worldwide, electronic learning (E-learning) has become an important part of the education agenda in the last decade. The Suan Dusit Rajabhat University (SDRU), Thailand has made significant efforts recently to use Internet technologies to enhance learning opportunities. The results reported here are part of a pioneering study to determine the effectiveness of a new online learning course in the subject "Business Statistics". This paper compares two groups of students, one studying using a traditional lecture-based approach, and the other studying using e-learning. The comparison is based on students' attitudes towards statistics measured using a validated questionnaire, both before and after the 16-week course, and for each of the modes of study. Comparisons are also made with students studying by distance, although the numbers in these groups are too small for sensible statistical analysis. The questionnaire data are augmented by material from interviews and other student reports of their experience. The results showed highly significant differences in attitudes towards statistics between the students studying online and the students using a traditional approach.

Keywords

E-learning in Thailand, Business Statistics, Online learning, Distance education, Web-based instruction

Introduction

Over the last decade, online learning or E-learning has become an important part of the education agenda around the world. Online learning uses the Internet and other information technologies to create educational experiences for students (Horton, 2001). One of the reasons for the popularity of teaching online in higher education is the advantage it affords for learning anywhere, at any place and at any time students may desire.

There is a large body of research on online learning from the years 1995–2003 that seems to conclude that there is no significant difference in learning effectiveness between technology-based and traditional methods of learning. Several studies indicated that students taking online learning courses have similar test scores as students in traditional classrooms. For instance, a review of studies carried out by Capper & Fletcher (1996); Moore & Thompson (1997); Schutte (1997); Morrissey (1998); Paskey (2001); Parker & Gemino (2001); Benbunan-Fich, et al. (2001); Tacker (2001); and Lynch (2002) comparing the effectiveness of online courses with face-to-face traditional classroom-based teaching leads to the conclusion that online education is as effective as traditional classroom teaching and shows no significant differences in learning outcomes. To put these results in context, Russell's (1999) book entitled *The no significant difference phenomenon* provides a review of 355 research reports and papers from 1928–1998 that found no significant difference in grades, satisfaction, or effectiveness among training conducted in classrooms by several types of media, ranging from postal correspondence to video tapes and E-learning (Horton 2001).

Nevertheless, studies such as Daugherty & Funke (1998), Hiltz (1994) and Jonassen (1999) found that online instruction has led to significantly better results on examinations in solving complicated problems and in perceived learning outcomes. In addition, Hiltz's (1994) studies regarding the effectiveness of online education found that mastery of course material was equal or superior to that of conventional courses. Student participation in courses increased and in general produced higher satisfaction. Students' ability to synthesize information and deal with complex problems improved and levels of interest in the content of the course increased. Hartman et al. (2000) found that in an Asynchronous Learning Network (ALN) course there were lower withdrawal rates and higher success rates. Navarro & Shoemaker (2000) found that online learners learn as well as or better than traditional learners, regardless of gender, ethnicity and academic background and computer skills.

In addition to factors concerning learning, using technology in education is seen as a means of improving productivity, efficiency and reliability. There are also other factors that combine to encourage the need for investment in education (Weller 2002). Recently, the Suan Dusit Rajabhat University (SDRU) in Thailand has encouraged the development of effective and efficient course materials for delivery through Internet technologies, in order to increase and enhance opportunities for both campus-based and distance learning. The University's goal is to become a 'Cyber Institution' in the next five years. Presently, there are two methods of teaching the Business Statistics course: either by traditional campus-based or distance learning. The traditional mode uses transparencies and textbooks for delivery of information to students based on the standard lecture approach; distance (remote) students are taught using lectures delivered via a video conferencing system, with four 3-hour sessions each semester. A preliminary investigation of current problems faced by students in the Business Statistics subject found that high failure rates required many students to repeat the subject. Most students felt that it was difficult to understand the statistical concepts and were unable to apply these concepts to the real world. If students missed lectures, their understanding seemed to be impaired when they returned to their studies. Also, in the limited lecture time, it was difficult for teachers to cover all the topics that they felt were important. The major problems with distance learning using the video conferencing system were that students could not always attend during broadcast times, and there was a lack of interaction between teachers and students. Students could not ask questions when they had problems during lectures, because the communication was only one-way. Essentially, they have to study by themselves based on the input from videos and their text book. Overall, these factors result in high failure rates and negative attitudes towards this subject.

The unsatisfactory experience with Business Statistics highlighted the need for a new teaching strategy to improve its outcomes. Coinciding with the rapid expansion of the Internet as a course delivery platform, the SDRU sought to trial a pioneering study of the effectiveness of an online course in Business Statistics in Thailand.

The aims of the research reported here were to investigate a number of factors that are known to influence student learning, primarily students' attitudes towards statistics, but also including their computer literacy, current use of the Internet, educational background, and preferred learning styles and characteristics. Gal & Garfield (1997) suggest that student attitudes are very important because they can affect the extent to which students will develop useful statistical thinking skills and apply what they have learned to their life outside the classroom. It is important to assess student attitudes and beliefs regarding statistics for three major reasons: (1) their role in influencing the teaching and learning process, (2) their role in influencing student behaviour in statistics, and (3): their role in influencing whether or not students choose to pursue further studies in statistics. Gal, Ginsburg & Schau (1997) summarise this by writing: "Thus, it is incumbent upon Statistics educators to know their students' attitudes and beliefs towards statistics before, during and after taking a statistics course."

In keeping with these objectives, this paper focuses on investigating student attitudes towards Business Statistics, comparing the results from classes using online learning, traditional campus-based learning, and distance learning.

Method

Online course design

The online course was constructed and managed using Blackboard 5 (Blackboard, 2003). For more details of instructional design see Suanpang & Kalceff (2003). The four major components of the online system were contents, communications, a groups page and student tools.

Content areas

The main content areas included Announcements, Course information, Staff information, Course Documents, Assignments, Books, and External Links. The most important part was Course Documents, which contained two modules including Descriptive Statistics (Module 1) and Inferential Statistics (Module 2). A pre-test was administered before commencement of each learning module, followed by a post-test upon completion. The online course was based on an 'Electronic Classroom' learning model, engaging students in a planned series of activities via the Internet, and implementing the six 'Learning Pedagogies' as reviewed by Weller (2002). This study incorporated elements of constructivism for the content area, and used the Internet for resource-based instruction with individual and group projects; finally, collaborative learning was used when the students combined for group work. With limited time available for developing material for the online course, only lectures 1-3 (Descriptive Statistics) and 6-8 (Inferential Statistics) were included, the remainder of the course being taught as normal. 'Learning Activities' included weekly study plans, a weekly activity plan (virtual classroom discussion), and assessments. There were also individual and group projects in the online course. The individual project applied a resource-based learning approach to encourage students to use a variety of sources to develop their understanding of using Descriptive Statistics in the business world. Students had to discuss a topic in which they were interested, located from a variety of sources including the Web, discussion, books and journals. The co-operative component was implemented through a group project that required students to work as a team. Each group had to find a real world case study using Inferential Statistics in business. Online students had to participate weekly to complete their tasks with the minimum requirement being at least one hour per week.

Communication areas

Communication between students–teacher and amongst the students used both asynchronous and synchronous modes. Asynchronous communication included e-mail, discussion board and fax. Synchronous communication included roster, virtual classroom (chat), MSN, Yahoo Messenger and the telephone.

Group areas

Group areas included a Home page, Discussion Board, File exchange, Virtual Classroom, and E-mail between group members.

Student tools

The Student Area provided tools to support learning activities, including grade listings, a Digital drop box (for submitting completed work), editing facilities for Students' homepages, Course Searching, Calendar, Student personal information, setting a CD-ROM drive for sharing information, changing passwords and setting privacy options.

Participants

There were approximately 1,000 students enrolled in this subject and of these 230 volunteers participated in the research: the study was approved by the appropriate ethics committees and participating students gave informed consent. The research group was separated into two modes, namely traditional campus-based and distance learning. The sample group was divided into 6 groups: two groups with traditional campus-based teaching, two groups doing online learning, one group doing distance learning, and one group doing distance online learning. Research was conducted in two phases, consisting of an orientation period followed by the main research.

Data were collected over a period of 16 weeks and the results from online learning were then compared with those of traditional teaching. Attitude data were collected from pre- and post-study questionnaires. The purpose of the orientation phase was to introduce the online learning system and provide an example of the online course to the students; it was given to all the students enrolled in Business Statistics by electronic-based delivery (E-based). Students were given the web address for the course (<http://e-learning.dusit.ac.th>) and shown how to logon to the system.

Those students who volunteered to participate were arranged into classes of 40-50 students, except for the distance learning class, which had 20-30 students. Of the total 230 students, there were 112 online students and 118 traditional learning participants. The six groups were categorized as follows:

Groups 1 & 2: Online campus-based learning. These two groups used the computer facilities at the Jarunsanitwong Campus, including the computer lab and virtual library at SDRU. Group 1 had 53 participants, while Group 2 had 48. They used the same textbooks and handouts, and had the same set of midterm and final exams as Groups 3 & 4 but a different teaching method. Online students had to participate weekly to complete their tasks with the minimum requirement at least one hour per week. Communication between students and teachers was via telephone, e-mail, discussion board, and face-to-face by appointment.

Groups 3 & 4: Campus-based traditional learning. These two groups attended classes at the Jarunsanitwong Campus. The sample size in Group 3 was 61 students and Group 4 was 48 students. The two groups were taught as a normal class, which included 16 lectures in one semester. Each lecture was of 3 hours duration.

Group 5: Traditional learning by distance. This group studied at the Central Pinklao Department store in Bangkok. There were 20 students enrolled in the class, some participants being mature-age students seeking to change careers. The traditional distance education course has only 4 lectures per semester, spread over 16 weeks. Each lecture presented 3 chapters in 3 hours via a video conferencing system from the central campus, broadcasting into 7 campuses around Bangkok. Distance students had to participate in the conference class, submitting homework and sitting a final exam.

Group 6: Online learning by distance. This group studied in Nakon Nayok province. There were only 5 students enrolled in this course. The method of teaching was the same as traditional distance learning. Students got the same lectures via the video conferencing system, and had the same textbook and final exam. However, students had authorized access into the online course.

Instruments

Various questionnaires are reviewed in the literature, such as the Statistics Attitude Survey by Roberts & Saxe (1982); Statistical Anxiety Rating Scale by Cruise et al. (1985); Attitude Toward Statistics by Wise (1985); and Survey of Attitude Toward Statistics (SATS) by Schua (1995) and Dauphinee (1997). The questionnaire type decided on for this research was the SATS. The Pre-Test and Post-Test study contained 28 questions (see Appendix 1), consisting of five-point Likert scale items (1 = strongly disagree to 5 = strongly agree) measuring four aspects of students' attitudes to statistics: Affect, Cognitive competence, Value and Easiness (Schau et al. (1995) used the term Easiness, but high scores represented lower difficulty, so we have re-named the scale). As summarised in Table 1, Affect had 6 questions measuring positive and negative feeling concerning statistics; Cognitive Competence had 6 questions measuring attitudes about intellectual knowledge and skills when applied to statistics; Value had 9 questions measuring attitudes about the use, relevance and worth of statistics in personal and professional life; and Easiness had 7 questions measuring attitudes about the ease or difficulty of the statistics subject. The four subscale scores were formed by summing the item scores in Table 1 for each subscale. The scoring for the starred (*) items should be in reverse (1 becomes 5, etc.). Higher total scale scores then correspond to more positive points. Since each subscale comprised different numbers of questions, the scores were converted to a percentage scale (0–100%) using a linear transformation. Data were analysed using SPSS version 11.0.

Table 1: Questionnaire items summarised according to the aspect of student attitude surveyed.

ASPECT	QUESTION NUMBER								
Affect	1	2*	11*	14*	15	21*			
Cognitive Competence	3*	9*	20*	23	24	27*			
Value	5*	7	8	10*	12*	13	16*	19*	25*
Easiness	4	6*	17	18*	22*	26*	28*		

Results

Quantitative results

The attitude scores on the four subscales were analysed using multivariate ANOVA models. Initially, three independent variables and their interactions were studied: TIME (before and after), MODE (traditional and online) and PLACE (campus or distance). TIME, MODE and their interaction were found to be highly

significant ($p < 0.001$ in all cases). The factor PLACE was found to be marginally significant in the multivariate analysis ($p = 0.03$), but not significant for any of the component subscales. Essentially, this was due to the small numbers of students studying off-campus (25 students, 20 in the traditional mode and 5 online). As a result, we decided to present analyses from the campus-based students only.

From the multivariate results, it was found that MODE, TIME and their interaction were all significant, with $p < 0.001$ in each case. The univariate results showed that the interactions and the factors were significantly different on each dimension. A summary of results is shown graphically in Figure 1.

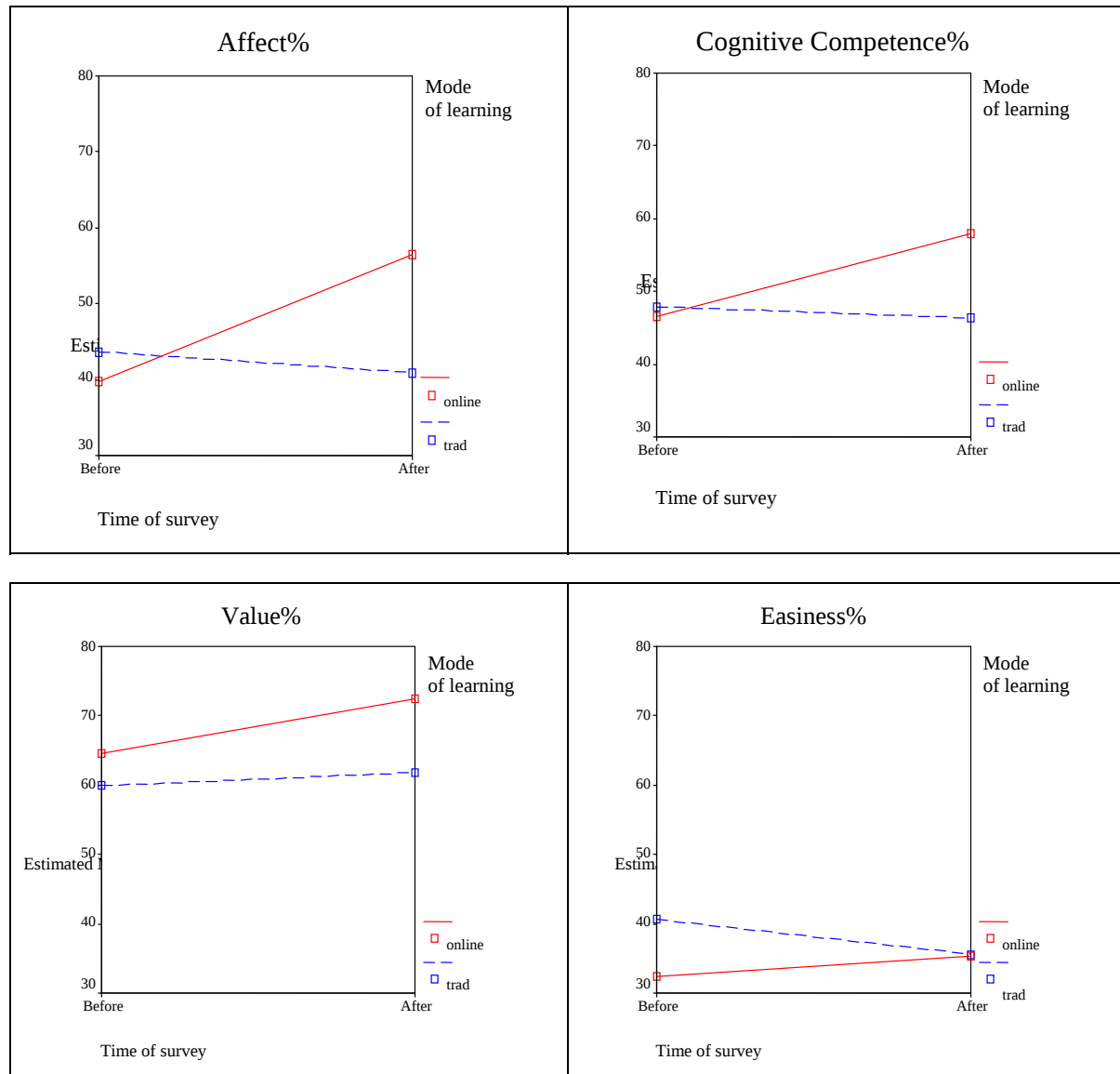


Figure 1: Estimated Means for Subscales by Time and Mode
(Campus-based Students only)

Before instruction, the means for the traditional and online groups were roughly equivalent for Affect and Cognitive Competence; the mean was higher in the online group for Value and lower for Easiness. In all four dimensions, the online group means increased significantly, while the traditional group means remained much the same, and even decreased significantly for the Easiness dimension. It seems that the online group increased the positive aspects of its view of statistics, while the traditional group stayed essentially unchanged, except for an increase in their perception that the subject was difficult. After studying this statistics course, online students had a more positive attitude, a greater ability to solve problems, a greater sense of the importance of statistics in their daily life and future work, and a greater confidence in their ability to do statistics. The traditional group, by

contrast, stayed essentially unchanged, with the exception that they viewed statistics as more difficult at the end of the course. Tables 2 and 3 show the details of the analysis.

Table 2: Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Affect%	15768.730 ^a	3	5256.243	25.015	.000
	CogComp%	8225.369 ^b	3	2741.790	18.466	.000
	Value%	7638.561 ^c	3	2546.187	20.098	.000
	Easiness%	2191.411 ^d	3	730.470	7.850	.000
Intercept	Affect%	615353.423	1	615353.423	2928.494	.000
	CogComp%	743604.281	1	743604.281	5008.222	.000
	Value%	1260975.103	1	1260975.103	9953.185	.000
	Easiness%	389811.640	1	389811.640	4189.366	.000
TIME	Affect%	3645.303	1	3645.303	17.348	.000
	CogComp%	1824.139	1	1824.139	12.286	.001
	Value%	1813.045	1	1813.045	14.311	.000
	Easiness%	79.042	1	79.042	.849	.357
MODE	Affect%	2486.052	1	2486.052	11.831	.001
	CogComp%	1935.270	1	1935.270	13.034	.000
	Value%	4357.327	1	4357.327	34.393	.000
	Easiness%	1381.769	1	1381.769	14.850	.000
TIME * MODE	Affect%	7140.641	1	7140.641	33.983	.000
	CogComp%	3118.569	1	3118.569	21.004	.000
	Value%	651.102	1	651.102	5.139	.024
	Easiness%	1183.667	1	1183.667	12.721	.000
Error	Affect%	65139.142	310	210.126		
	CogComp%	46027.780	310	148.477		
	Value%	39274.088	310	126.691		
	Easiness%	28844.847	310	93.048		
Total	Affect%	742024.000	314			
	CogComp%	845365.000	314			
	Value%	1386072.000	314			
	Easiness%	431169.000	314			
Corrected Total	Affect%	80907.873	313			
	CogComp%	54253.150	313			
	Value%	46912.650	313			
	Easiness%	31036.258	313			

a. R Squared = .195 (Adjusted R Squared = 0.187)

b. R Squared = .152 (Adjusted R Squared = 0.143)

c. R Squared = .163 (Adjusted R Squared = 0.155)

d. R Squared = .071 (Adjusted R Squared = 0.062)

Qualitative data

Qualitative data were collected from several sources. In this paper we support our results with some quotes from the student interviews. These interviews were conducted before, during and after the study, both face-to-face and by e-mail. The interviews took place in Thai, and have been translated into English for the purposes of reporting. The results of a content analysis found that the majority of the students have positive attitudes from their experiences of learning statistics. Students' attitudes towards statistics in term of *Affect*, *Cognitive Competence*, *Value* and *Easiness* were changed after their study, as shown in the following examples:

Table 3: Estimated Means - Time of survey * Mode of learning

Dependent Variable	Time of survey	Mode of learning	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Affect%	1 Before	1 online	39.700	1.733	36.291	43.109
		2 trad	43.690	1.903	39.944	47.435
	2 After	1 online	56.385	1.479	53.474	59.296
		2 trad	40.911	1.528	37.905	43.918
CogComp%	1 Before	1 online	46.514	1.456	43.649	49.380
		2 trad	47.879	1.600	44.731	51.028
	2 After	1 online	57.865	1.244	55.418	60.312
		2 trad	46.367	1.284	43.839	48.894
Value%	1 Before	1 online	64.543	1.345	61.896	67.190
		2 trad	59.879	1.478	56.971	62.787
	2 After	1 online	72.385	1.149	70.125	74.646
		2 trad	61.844	1.186	59.510	64.179
Easiness%	1 Before	1 online	32.343	1.153	30.074	34.611
		2 trad	40.586	1.267	38.094	43.078
	2 After	1 online	35.281	.985	33.344	37.218
		2 trad	35.600	1.017	33.599	37.601

In terms of *Affect*, there were interesting comments on how students felt about statistics, enjoyed the course, or were stressed by and scared of statistics. For example:

Student 1: "This subject was fun and I really enjoyed studying it. I like to calculate statistics values that I have never done before. I could forecast some events."

Student 2: "I spent 16 weeks learning the Business Statistics subject. I feel very happy and have good experience from learning this subject."

Student 3: "At first, I felt that there were a lot of numbers and formulas and I might get a headache. But after a while when we had problems, the teacher and my friends helped to clarify them and taught me how to think systematically via the online and traditional class. These made me understand and remember. It was a fantastic experience and very interesting to learn. I had fun studying. Statistics is not as difficult as I thought."

Cognitive Competence was associated with their understanding of statistics, their methods of learning such as solving equations, skill in problem solving and ability to learn. The following are some comments:

Student 4: "I admired everything in the course that she taught especially teaching methodology, disciplines, knowledge of statistics and the Internet. I was so proud of myself, that I could analyse a real world case study which is applicable in Business Statistics. It is not as difficult as I thought before."

Student 5: "I am impressed with learning this subject by traditional and online modes. Especially online made me know about using computer programs that I could use in my daily life, such as EXCEL and SPSS."

Student 6: Because of my lack of mathematics knowledge and calculation skills, I felt negative and lazy. While I was learning and doing my individual report, it was hard for me because I had no experience of searching for information from the Internet. This is the first subject for me in using Internet data searching. At first, it was hard but it was not beyond our effort, and we could use this knowledge in future. This made me understand this difficult subject, because the teacher had a good technique for teaching which made us understand this difficult subject."

Value was associated with the importance of statistics that related to their daily life, future work, and professional job. Following are some typical comments:

Student 7: "Besides the knowledge of Business Statistics, I have learned how to use a computer and the online course to search and study widely. I can apply this knowledge to work for the future. I realise this subject can be learned not only from the teacher but also from all kinds of information technology that enhance efficiency and flexibility."

Student 8: "I used to think this subject was boring and not useful. I was wrong because I can now use my knowledge in my daily life."

Student 9: "I think it is useful for further studies, such as Master degree or we can get a good job in the future."

Easiness measured how easy students found it to study and learn statistics and to apply the results of their studies to computation skills, and ways of thinking in statistics. Students commented on this dimension as follows:

Student 10: "I was so much impressed with this subject and I realized that this subject was not as difficult as people imagined."

Student 11: "After finishing the Business Statistics course, I realised that statistics is not difficult or boring. We can understand it easily and statistics methodology can be trusted."

Student 12: "I used to believe that statistics was extremely hard. Besides, I saw a high drop out rate in seniors. At first, I was scared to study this subject. But when I had finished it, my views changed because statistics wasn't as difficult or scary as I thought."

In addition, there were some interesting positive comments from the online campus-based students:

Student 13: "For the traditional way of learning, we learned from the teacher by attending in the class regularly. When we did not understand the lesson, we could ask the teacher directly. For online learning, we studied via Internet technologies. It was convenient because we had no need to attend classes. We could study whenever we wanted and could revise lessons as much as we wanted."

Student 14: "Learning by online technologies enhanced our knowledge, saving time and travel costs. I could learn and test by myself at home."

Student 15: "I paid a lot of attention, such as learning in class, doing exercises and tests. I also learned by online and introduced my relatives to learn by online too. I felt that I was modern."

There were also a small number of comments from students in the traditional groups concerning further improvements in the method of teaching and learning statistics in the future:

Student 16: "We had problems with understanding statistics because we do not have a good mathematics background from college. Before entering the Business Statistics course, the institution should have an intensive course so that students can have enough knowledge."

Student 17: "Most of us were scared of statistics because we saw the high failure and drop out rates from seniors. It made us worried very much. The teacher should encourage and motivate students to study too."

Student 18: "There should be a new way of learning statistics that is fun and more enjoyable than just sitting in the class and waiting for the lecture to end, going home, doing homework and going to exams. It was kind of boring and routine stuff because after the exam we forgot everything that we had learned. Besides, we have no idea how to apply it in daily life."

Finally, several students from the online group commented about their experience in studying statistics in this mode as follows:

Student 1: "Although doing the report was difficult, it also gave us practice in analysing data. In the past, I did not like analytical subjects because I could not do them. Right now I can do it and I like it very much. Everything was a good experience."

Student 2: "At the beginning, I did not know how to do many things. After trying to learn with fun, I got a lot of knowledge and good experiences of studying online, which increased my knowledge of using computers and the Internet. I really had a good experience and my attitude to learn statistics was changed. I like statistics."

Student 18: "I like Internet technology to help me learn from a distance. I have more friends in the online course. I can revise lessons many times, as much as I can, because I am old and a slow learner. This is really good because I am too shy to ask questions in front of the classes. Besides, I did not have a chance to ask questions in the video conference. Statistics online is great and fantastic. It makes me like statistics, and want to learn more and more."

Conclusion

Some important findings have emerged from the analysis, the most important being:

Significant differences were found in student attitudes towards Statistics between the different modes of learning.

Although students in the online groups had similar scores to students in the traditional groups on the four subscales at the beginning of the study, the online groups improved noticeably on each subscale, while the traditional groups tended to stay at about the same level or even scored lower by the end of the study. Online students had higher scores than traditional students at the end of the course in terms of *Affect*, *Cognitive Competence* and *Value*, and the *Easiness* scores were comparable. Students' attitudes toward statistics were increased positively by e-learning on all four dimensions – *Affect*, *Cognitive Competence*, *Value* and *Easiness*. Gal et al. (1997) explain that scores on these four attitudinal aspects vary in their interrelationships. Scores on *Affect* and *Cognitive Competence* tend to be strongly related to each other. Scores on the *Value* and *Easiness* are moderately related to those on the *Affect* and *Cognitive Competence* scales but seem not to be related to each other.

We can conclude that students taught online develop strongly positive attitudes towards learning statistics, which influence their learning and make understanding statistics easier for them than for students taught in the traditional mode. These results are supported by information from the interviews. In particular, Internet technologies assist students' learning of statistics and make the experience less frustrating, less fearful and more effective.

It could be argued from the evidence in the student interviews that the online group would have rated *Easiness* even higher at the end of the course, except for the occurrence of various computer-based problems. These included computers "hanging up", the slow speed of the Internet connection to the SDRU server, and for at least some of them, a lack of basic computer skills (such as searching for information on the Internet). Many students did not have computers at home, so they were able to study online only when they were on campus, causing occasional access problems due to insufficient numbers of computers.

No significant differences were found in students' attitude towards statistics between the different places (campus-based, distance) of learning

Although the number of students studying by distance was relatively small, we found no significant differences between attitudes of students studying on campus and those studying by distance. In all four subscales, the patterns from before to after, from online to traditional, were essentially the same for the distance students as for the campus-based students. If anything, the distance students studying in the e-learning mode were even more positive than the campus-based students, especially on the *Affect* and *Cognitive Competence* dimensions. However, due to the small numbers involved, the differences observed were not statistically significant (that is, they were reasonably consistent with chance differences).

The consequences of these findings for Suan Dusit Rajabhat University are very positive. SDRU's push to become a 'Cyber Institution' seems to be progressing in the right direction. Students in *Business Statistics* who

have studied using E-learning seem to be very positive about the experience. Their attitudes towards statistics have become more positive on each of the four dimensions measured by the survey, in contrast to the results from the traditionally taught groups, and they have made positive comments about their studies during interviews. The pattern of results is repeated for those students studying by distance education – again, the experience of learning online produces positive improvement in attitudes. SDRU could provide more computer facilities and ways of utilising information technologies to improve and expand educational opportunities to students in rural areas by distance education.

Not only has online learning improved students' attitudes towards statistics, but preliminary results (Suanpang & Petocz, Submitted) indicate that it seems also to improve the outcomes of such learning, as measured by the standard approach of looking at students' results from class work and end-of-course examinations. Of course, the finding that positive attitudes correlate with positive outcomes is not new, and is discussed in the context of statistics in Schau, et al. (1997) and Garfield & Gal (1999), who suggest that one way of improving outcomes of statistics courses is to focus on improving the affective aspects of the course.

Looking beyond the present study, it seems reasonable – although we have no direct evidence – that other statistics courses in Thailand could benefit from an online approach along the lines that we have described. Further, courses in similar “technical” areas, such as accounting or Information Technology, could be enhanced in this way, and the approach could be extended to other countries in South East Asia at a similar stage of development to Thailand. Although the Internet can play a part in learning in any subject, it may be that traditional “humanities” subjects, that rely more on face-to-face discussion and debate in traditional tutorials, would present more of a challenge in E-learning mode. Further, it seems from the comments that students made in interviews that one feature that contributed to the success of the E-learning mode was its novelty and excitement: this may not count for so much in countries such as Britain or the United States that have a longer history of Internet availability and education use.

This study has focused on students' attitudes towards statistics. Further research along these lines could examine the following questions:

- How does technology affect students' learning in Statistics?
- How does technology influence students in developing and changing their attitudes towards Statistics?
- How do students interact with Statistics using an online learning course?
- How can students' learning be improved using an online learning approach?
- What additional information can we get from qualitative research on students' experience of learning online compared to traditional approaches?

Finally, a theoretical framework should be developed for online learning of statistics that combines instructional strategies and delivery media to create positive attitudes in our students and results in the best learning outcomes.

References

- Benbunan-Fich, R., Hiltz, S., & Turoff, M. (2001). *A comparative content analysis of face-to-face Vs. ALN mediate teamwork*. Retrieved March 23, 2003 from http://www.alnresearch.org/Data_Files/articles/abstract/abs_benbunan01.html
- Capper, J., & Fletcher, D. (1996). *Effectiveness and cost-effectiveness of print-based correspondence study*, A paper prepared for the Institution for Defense Analysis, Alexandria, VA.
- Coakes, J. S., & Steed, G. L. (2001). *SPSS Analysis without Anguish Version 10.0 for Windows*. Australia: John Wiley.
- Cruise, R. J., Cash, R. W., & Bolton, D. L. (1985). Development and validation of an instrument to measure statistical anxiety. *ASA Proceedings of the Section on Statistical Education* (pp. 92-97). Alexandria, VA, EE. UU.: American Statistical Association.
- Daugherty, M., & Funke, B. (1998). University faculty and student perceptions of Web-based instruction. *Journal of Distance Education*, 11 (1), 21-39.
- Dauphinee, T. L., Schau, C., & Stevens, J. J. (1997). Survey of Attitudes Toward Statistics: Factor structure and factorial invariance for female and males. *Structural Equation Modelling*, 4 (2), 129-141.

Farrell, G. M. (1999). *The development of Virtual Education: A Global Perspective*, Vancouver, British Columbia: Commonwealth of Learning.

Gal, I., & Garfield, J. (1997). *The Assessment Challenge in Statistics Education*. The Netherlands: IOS Press.

Gal, I., Ginsburg, L., & Schau, C. (1997). Monitoring Attitude and Beliefs in Statistics Education. In Gal, I. & Garfield, J. B. (Eds.) *The Assessment Challenge in Statistics Education* (pp. 37-51). The Netherlands: IOS Press.

Garfield, J. B., & Gal, I. (1999). Assessment and Statistics Education: Current Challenges and Directions. *International Statistical Review*, 67, 1-12.

Hartman, J., Dziuban, C., & Moska, P. (2000). Faculty satisfaction in ALNs: A dependent or independent variable? *Journal of Asynchronous Learning Networks*, 4 (3). Retrieved June 24, 2004 from http://www.aln.org/publications/jaln/v4n3/v4n3_hartman.asp.

Hiltz, S. (1994). *The virtual classroom: Learning without limits via computer network*, Norwood NJ: Ablex Publishing Corporation.

Horton, W. (2001). *Leading E-learning*, Alexandria, USA: American Society for Training and Development.

Jonassen, F., Previs, T., Christy, D., & Stavroulakis, E. (1997). Learning to solve problems on the Web: Aggregate planning in a business management course. *Distance Education*, 20 (1), 49-63.

Lynch, T. (2002). LSU expands distance learning program through online learning. *T.H.E. Journal*, January, 47-48.

Moore, M. G., & Thompson, M. M. (1997). *The effects of distance learning: Revised edition*, ACSDE Research Monograph, Penn State University, USA.

Morrissey, C. (1998). *The Impact of the Internet on Management Education: What the Reason Shows*, USA: Pepperdine University.

Navarro, P., & Shoemaker, J. (2000). Performance and perceptions of distance learners in cyberspace. *American journal of Distance Education*, 14 (2), 15-35.

Paker, D., & Gemino, A. (2001). Inside online learning: Comparing conceptual and technique learning. Performance in place-based and ALN format. *Journal of Asynchronous Learning Networks*, 5 (2), 64-74.

Paskey, J. (2001). *A survey compares two Canadian MBA program, one online and one traditional*. Retrieved 23 June 2004 from <http://chronicle.com/free/2001/04/2001042601u.htm>.

Roberts, M., & Saxe, E. (1982). Validity of statistics attitude survey: A follow-up study. *Educational and Psychological Measurement*, 42, 907-912.

Russell, T. (1999). *No significant difference phenomenon (NSDP)*, North Carolina State University, Raleigh, NC, USA.

Schau, C., Stevens, J., Dauphinee, T., & Del Vecchio, A. (1995). The development and validation of the Survey of Attitudes Toward Statistics. *Educational and Psychological Measurement*, 55, 868-78.

Schutte, J. (1997). *Virtual teaching in higher education*. Retrieved 26 June 2004 from <http://www.csun.edu/sociology/virexp.htm>.

Suanpang, P., & Kalceff, W. (2003). Instructional design and features of an online Business Statistics course, Thailand. *Paper presented at the 29th Congress on Science and Technology of Thailand (STT)*, 20-22 October 2003, Khon Kean Thailand.

Suanpang, P., & Petocz, P. (Submitted). E-learning in Thailand: an analysis and case study. *Submitted to the Journal of Asynchronous Learning Networks*.

Tacker, S. (2001). Distance education: Better, worse, or as good as traditional education? *Online Journal of Distance Learning Administration*, Retrieved June 24, 2004 from <http://www.westga.edu/~distance/ojdla/winter44/tucker44.html>

Weller, M. (2002). *Delivering Learning On The Net, the why, what and how of online education*, UK: RoutledgeFalmer.

Wise, S. (1985). The development and validation of a scale measuring attitude toward statistics. *Educational and Psychological Measurement*, 45, 401-405.

Toward a Web based Environment for Evaluation and Design of Pedagogical Hypermedia

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ABSTRACT

We are working on a method, called CEPIAH. We propose a web based system used to help teachers to design multimedia documents and to evaluate their prototypes. Our current research objectives are to create a methodology to sustain the educational hypermedia design and evaluation. A module is used to evaluate multimedia software applied in educational context. We structured a knowledge base composed from a list of evaluation criteria, grouped in six themes: general feeling, technical quality, usability, scenario, multimedia documents, and didactical aspects. We insisted on multimedia particular aspects: we thoroughly studied the specificity of multimedia documents (investigating various fields such as photography, typography, picture semantics, cinema...). We also evaluated the way multimedia elements are gathered to prepare the reading acts. We finally determined specific criteria for pedagogical aspects, associated to the previous approaches. A global questionnaire joins all these modules. In this paper, we present the first two modules, EMPI and SP/UL/FC (a method for designing pedagogical hypermedia), and an application of distant teaching (and distant learning), commenting the first results of this experiment. We conclude by a short presentation of the third module, on which we are still working.

Keywords

Learning on the web, Evaluation, E-learning, Instructional design

1. Introduction

The role of knowledge transfer in our society becomes more and more important. Different ways of teaching appear, concerning more and more people, beginning earlier and earlier and ending later and later. We do need new tools to answer this new demand. Learning software could be particularly useful in case of distance learning, along-the-life learning, very heterogeneous skills in classes, children helping (etc.).

We are working on a method, called CEPIAH, for the design and the evaluation of pedagogical hypermedia. We propose a web based system used to help teachers to design multimedia documents and to evaluate their prototypes. Our tool integrates three main modules:

- Design Help: SP/UL/FC, a method for designing pedagogical hypermedia (Crozat, 2002), on which we have been working from 1999 to 2002,
- Evaluation Help: EMPI (Evaluation of Multimedia Pedagogical and Interactive software), an interactive software built from 1997 to 2001, for evaluating multimedia interactive software, by using dynamic navigation in a set of questions (Hû & Trigano, 2000),
- A set of Pedagogical Models and patterns, by using pedagogical scenario (work in progress).

In this paper, we present the first two modules of our CEPIAH method, and we will conclude by a short presentation of the third module.

CEPIAH Method

In order to guide and help the educational Web sites authors in the conception/evaluation process of their prototypes, it is especially interesting to propose them interactive guides. Among the existent interactive guides, only few offer a good content structure or an appropriate navigation in their system. For example, the sites CINEMA (CINEMA, 2003) and W3 Educatif (W3 Educatif, 2003) consist mainly of a section “Course” and of a section “Evaluation”. Such structure does not facilitate the navigation between these parts during the conception process. We propose a method for the design and evaluation help for the educational hypermedia having the following characteristics: the flexible navigation in the environment improving the iterative conception/evaluation process, and an offer of predefined models of educational web sites.

Our CEPIAH project has as final goal: a tool to help **teachers to design instructional Web sites**. We want to valorise at maximum the support characteristics in correlation with the particular pedagogical contexts and Human-Computer Ergonomic Multimedia Interface.

In order to help the teacher to design his instructional Web site, we developed an interactive guideline accessible on the Web.

2. Design Help

The first module of our CEPIAH Method, called Design Help, is based on the SP/UL/FC methodology (Crozat, 2002) for the design of multimedia software for education (distant teaching and distant learning), by **using the Internet**. Authors and users of multimedia educational software lack experience in this recent field. We propose to distinguish between three main approaches: the first one centred on documentary discipline, the second one on multimedia one and the third one on pedagogy. This distinction will lead us to suggest integrating these three ways of thinking into one single methodology.

2.1 Three ways of thinking

The documentary approach is based on the organisation of information in the documents. Generally these approaches are based on the separation between the logical structure and the physical one. That means that authors define logical structures, and that editors use this structure in order to present information to the readers. The logical structure can stand at two levels: to determine what can exist inside an information node and to determine what kind of relationships can exist inside a set of nodes.

The bases of multimedia approach is to search the reason why using digital documents instead of normal ones. For each problem, this approach tries to find the supplements the support could bring.

2.2 Integrating the three approaches

Digital documents bring new potentials of information representation, based on dynamic calculation. The position we adopt implies that:

- We need logically structured and annotated documents in order to control their manipulation inside a complex hyperdocument.
- We need multimedia methodologies in order to benefit from the support potentials (multimedia and dynamic interaction) and deal with readability of multimedia documents.
- We need pedagogical design principles and experiments in order to provide useful tools that profit from the support to improve the training process.

Because of the non-linearity of the information representation in a digital support, we propose to model an hypermedia as a graph, *i.e.* a set of nodes and links between them. The first implication of such a representation is that the reading depends on the way the nodes are accessed (*i.e.* computed). Indeed, a node is a computation-unit. Since books or videotapes impose the reading process (one page, or sequence, before the other), digital supports do not: the reader is expected to build by his own a proper linearity. Therefore, there is no guaranty on what the user has accessed before, and what he will access then, while reading a computation-unit. We submit the following hypothesis in order to deal with this problem: the information representation in hypermedia should be based on **information-units** corresponding to computation-units. We define an information-unit as a node of

the graph, the reading of which is necessary and sufficient in order to understand a concept. This implies that the information-unit is indivisible (no hyperlinks inside it for instance) and that no hypothesis should be done, while drafting, on the links between the units.

Two questions emerge from this representation: How to manage the interaction between a set of media that compose an information unit? How to manage the interaction between a set of information-units that compose an hypermedia? The internal structure of an information-unit represents the explicit logical structure of different kinds of multimedia elements that compose it, and the relationships between these multimedia elements. The external structure of an information-unit represents its explicit conceptual links with the other information-units that compose the hypermedia. Thus, our purpose is to integrate documentary, multimedia and pedagogical approach in one single methodology.

The part concerning the module for the Design Help of an educational web site is structured on the *information units*. In our model we imagined a course structure based on this principle. In this structure the body of every unit consists of elements of several text blocks.

We gathered all the information that we want to take into account in a knowledge base, with a hierarchical tree structure, based on: themes, meta-criteria and criteria. We propose this structure because we are not interested only in the « ergonomic » aspect, but also we are interested in the technical quality, the pedagogical structure etc. That is why we introduced the notion of “theme”. Furthermore we think that choosing this structure enables a « finer » content division (« chapter », « section » and « paragraph » type like) in order to respect the Humain-Machine Interface ergonomic rule of « maximum three clicks ». That will improve the legibility and will help an educational hypermedia designer to guide himself during his conception and evaluation work. The themes position in this structure is at the highest level. Each meta-criteria consists of criteria. We identified six main themes:

- The **Project Management** theme determines the design and development stages for a pedagogical hypermedia product. Thus, the meta-criteria decomposing this theme deal with a previous analysis (demands, tasks file, necessity analysis etc.) on the juridical and financial aspects of design procedure for a teaching hypermedia product.
- The **Technical Quality** theme regards the soft elaboration: fastness, compatibility, download etc. Finally, for a good pedagogical Web site utilisation, the user should not encounter technical problems due to certain malfunctions of the system. So, the educational site designer must consider the technical aspects as: an image downloads time, a document or application download.
- The **Web Ergonomic** theme gives general instructions for an ergonomical design of IHM (Human-Machine Interface) and the Web sites. Among the meta-criteria this theme consists of, we remind: the maneuverability, the guide through out, the navigation, etc. To identify these suggestions we inspired ourselves from the works of (Scapin 1997; Nielsen 2000), (Vanderdonckt 1994)
- The theme: **Elements of Human Machine-Interface** deals with the graphic design elements and multimedia elements (such as image, sound etc.). These elements should be the most adapted for a pedagogical hypermedia. Therefore, the indications cover the aspects of graphical presentation (colour, typography, icons etc.), of text elements (tables, lists etc.), the most used in learning hypermedia environment. The indications about the sound, image and video integration, are equally covered by this theme (Nielsen 2000; Preece 1996).
- The **Pedagogical Structure** theme concerns the presentation quality, the content structure and the pedagogical tools (reading tools, interactive tools) appropriate to an hypermedia learning environment. Finally, the content structure must highlight the main logical lines and the main links between various content elements. At this level the different structuring techniques are a priority. The schema facilitates the perception, the comprehension, the memorisation and in conclusion the learning process (Bruner et al. 73).
- The **Pedagogical Environment** theme concerns the instructions upon the pedagogical multimedia characteristic elements such as, the suggested pedagogical activities for the learners and also the tools that enable the communication, the evaluation and the supervising of the learners during the instruction process (Depover 1998).

A text block is an information unit of four elements: definitions, detail accuracy, example lists and annexes (see figure 1).

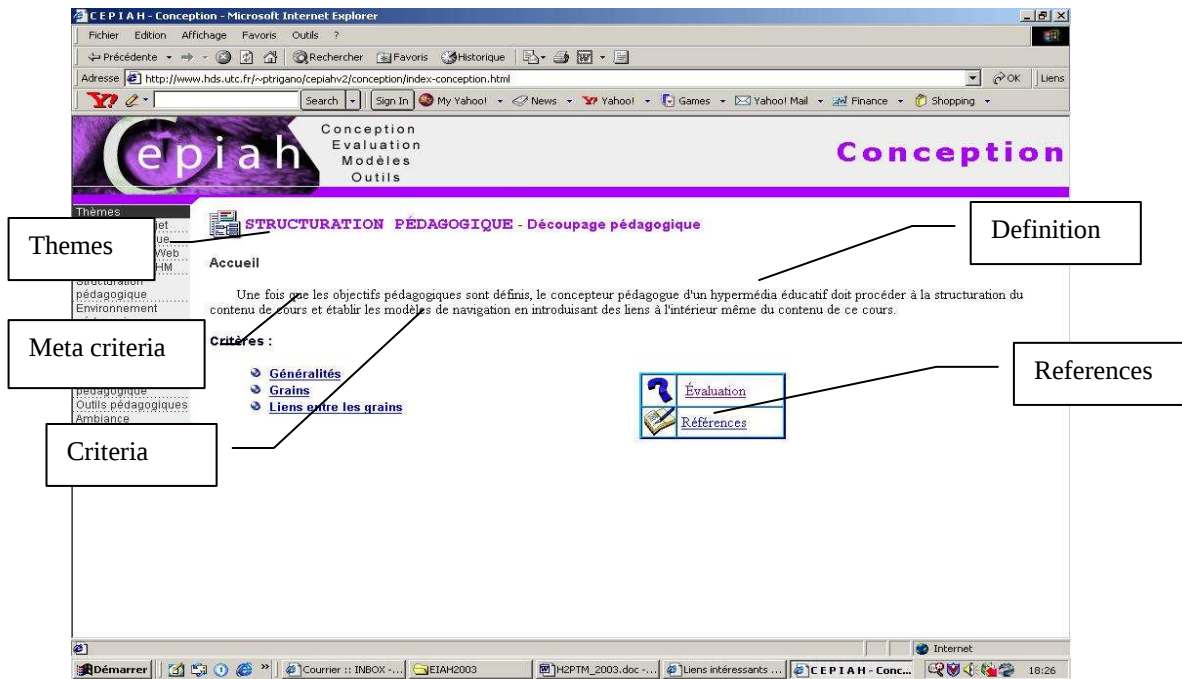
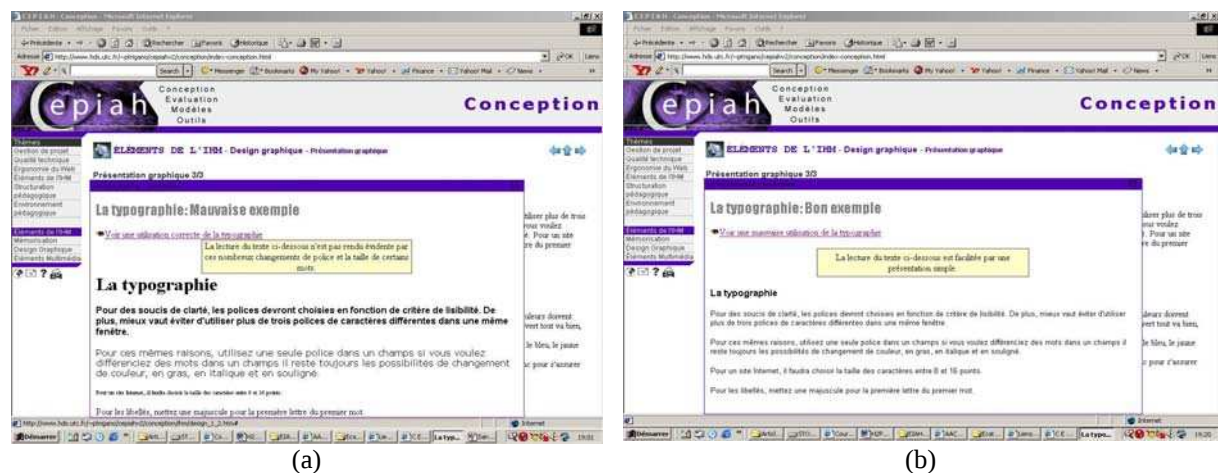


Figure 1: Design module

The definitions describe the recommendations to be considered by the course author during the conception process. These recommendations correspond to different domains such as: IHM ergonomic, pedagogical multimedia environments etc. The detail accuracy provides a detailed view for each recommendation of the course.

The examples can show what the author should avoid- negative examples, and/or what he has to consider during his course conception - positive examples. To illustrate, we present bellow a negative and a positive example (figure 2), connected to the course atom Graphical Presentation.



(a)

(b)

Figure 2: Negative example (a), positive example (b)

The annexes reveal information about the used sources for a module of educational Web sites design help and extra references on request.

3.The EMPI Module for Evaluation Help

We present now the second module, a methodological environment we are building in order to assist designers from specifications to final evaluation.

This second module is directly linked to the first module for Evaluation Help (EMPI). The idea consists in the possibility of the pedagogical web sites authors to evaluate their prototype during designing process. This evaluation enables them to find their design defaults in order to improve the bad points.

3.1 The EMPI Module

Among all existing methods or techniques used to evaluate software, it is particularly interesting to select questionnaires or lists of recommendations. They are easy to implement, usable without help of a specialist and they can evaluate any kind of observable criteria. And so, they are well adapted for the multi-disciplinary evaluations, done by software users and not by software designers. However, the use of such questionnaires have two major inconveniences: results are depending on the subjectivity feeling of the user, and the evaluation is generally done out of the real conditions of use.

When we use guidelines or questionnaires to evaluate software, some problems can appear: the number of questions increases and thus the duration of an evaluation becomes too long; sometimes evaluation becomes too subjective to be relevant; the choice of questions becomes complex, and so on. To try to solve these problems, in educational context, we have conceived a method that dynamically builds an evaluation: precision and depth of analysis, choice and weight of questions, are done during the evaluation. In our method, the evaluator is free to explore questions and to adapt the base to his case. He is guided, helped and confronted to his own subjectivity with an aim of building the most relevant evaluation.

A subjective evaluation (general evaluation), linked to the use of a questionnaire (deep evaluation), is taken into account, capitalized and then compared to the objective evaluation, in order to help the human evaluation. This method has been implemented in a tool, usable during the evaluated software exploration. There are a lot of domains concerned by the evaluation of pedagogical software. If we want a good accuracy in each theme, the set of questions can quickly become very large. Thus, it is important to have a structured tree of questions to improve the use and the modification of this base.

Structure

Questions are gathered into a hierarchical structure, containing six main branches, each branch having three levels (Figure 3). In this way, there are six general themes, divided in criteria, each criteria is divided into subcriteria and then into questions. These themes come from several models of pedagogical software or student activity theory (Linard & Zeiliger, 1995; Linard et al. 1998).

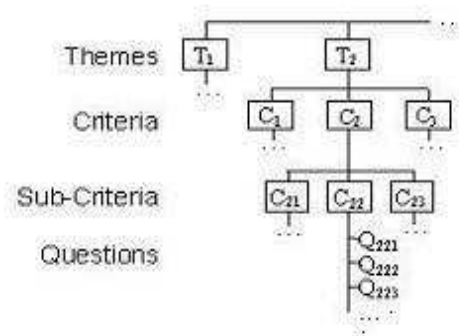


Figure 3: Global structure

In the EMPI method, we have been using six main themes:

- **General feeling** theme concerns what users think about the software.
- **Technical quality** theme allows the evaluation of the technical realisation.
- **Usability** theme corresponds to the ergonomic quality of the interface.
- **Multimedia documents** theme is associated to the quality of texts, sounds, and images.
- **Scenario** theme deals with writing techniques used to design information.
- **Pedagogical tools** theme finally inspects the pedagogical possibility offered by the pedagogical software.

Questions

In order to help evaluators, each question was written as a simple model:

- The formulation must imply evaluator: We prefer a question like "Did you see something...", rather than "Does the software display...".
- Help is given with each question. This help contains several parts:
 - A reformulation of the question.
 - A longer explanation.
 - Some examples and bibliographical references, if possible.

Some questions are subdivided in two phases: the first one to characterize the software's situation, and the second one to evaluate the relevance of this situation. For instance, in order to evaluate the structure of the software, we will firstly determine what kind of structure is concerned (linear, arborescent, etc.) and then if it is a correct one.

The evaluator, with a synthesis of the instinctive and calculated marks and the correspondent ratings, is given a **final mark** by the evaluating system. But the human evaluator keeps ultimately the capacity of judging the final mark of each criterion.

A **structured and contextual help** is provided for each criterion and question, in order to have the most objective evaluation. This help allows to reformulate the questions, concepts' definition, theoretic fundaments explanation and some characteristic examples. The **weight of questions** on a criterion can be either essential or secondary, to express the fact that some aspects or defaults are more important than others.

We propose in the following parts to develop each theme and criterion.

General feelings

Software provides a general feeling to the teachers. This feeling is formed from graphical choices, music, typographic, scenario structure. The important fact is that the teacher's feelings deeply affect the way he learns. Our experiences revealed that the general feeling is mainly instinctive, easily describable by the teachers, quite homogeneous inside a large population, and long lasting.

In order to better understand this phenomenon, we studied various fields, such as visual perception theories (Gibson, 1979), image semantic, musicology, cinematography strategies... With these theories we managed to submit a list of six pairs of criteria. This list comes from an evaluation database that was analyzed by a documents indexing method (Lamrous & Trigano 1999). We also compare this result with theoretical approaches: visual perception theory, for example. These impressions show several characteristics:

- They are *instinctive*: Users provide them without any assistance.
- *Describable*: Users are able to describe them with a few adjectives.
- *Homogeneous*: They are concordant between users.
- *Persistent*: They endure in time and influence further use.

This list allows the evaluator to provide a description of his impressions. He indicates what he feels for each couple of impressions. For example: very diverting, reassuring or very reassuring. There is no "neutral" evaluation to incite the evaluator to give a real opinion. They make it possible to describe quite satisfactorily what one feels in situation of use of learning software.

We shall specify that this theme is particular in the following senses: the criteria are provided by opposite pairs; they are expected to be neutrals, in order to describe the feelings, not to judge them directly.

We propose to him some couples of impressions which will enable him to give a ruling on (Figure 4): Reassuring/Disconcerting; Luxuriant / Moderate; Playful / Serious; Active / Passive; Simple / Complex; Innovating / Traditional.

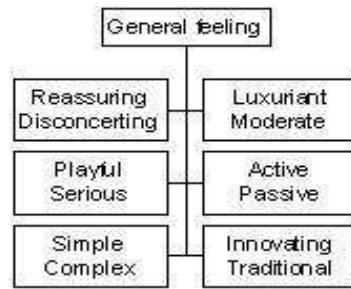


Figure 4: General feelings

The goal is to capitalize, at the beginning of the evaluation, the impressions that the evaluator feels during the use of the software.

Technical quality

Good software is first of all working software. So we decided to begin by giving the technical criteria that software has to satisfy (Figure 5).



Figure 5: Technical quality

When one uses slow, hard to configure or bugged software, the reject is generally obvious. Literature, in software design, abundantly deals with these aspects. We submit here one proposition of criteria organisation. For more details, see (Hû & Trigano, 2000).

Usability

A large set of criteria exists in the field of usability of user interfaces. In our context, our problem was to find a compromise between general criteria (Ravden et al. 1989) and to specify the rules (Vanderdonckt, 1999). To build the following set, we used in depth the INRIA works (Bastien & Scapin 1997), adapting their criteria to our multimedia and educational context (Figure 6). They are more deeply described in (Hû & Trigano 2000) and (Hû & Trigano, 1999).

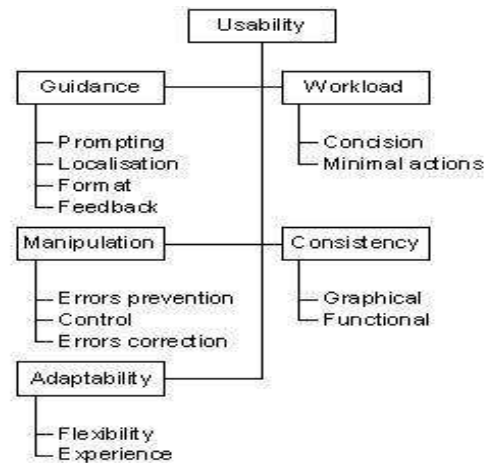


Figure 6: Usability

Multimedia documents

Texts, images and sounds are the constituents of the learning software (Figure 7). They are the information vectors, and have to be evaluated for the information they carry. But the way they are presented is also an important point, because it will influence the way they are read. To build this part of the questionnaire, we had to explore various domains, such as the pictures' semantics (Type et al, 1985), the photography, the audio-visual (etc.).

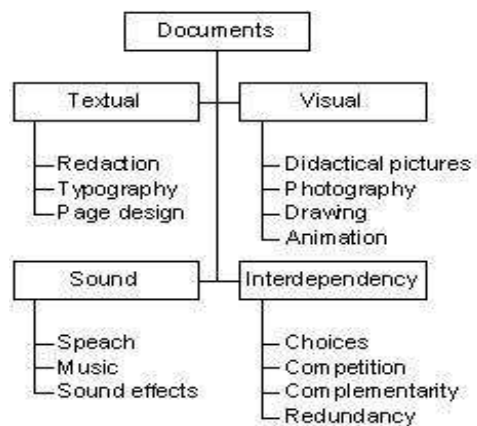


Figure 7: Multimedia documents

Our works also points out that in a multimedia environment each document is always presented along with other documents at the same time. The set of documents presented together generates a web of relations that influences the global signification. These interdependencies between documents are as important as each separate characteristic of the document in the process of interpretation.

Scenario

We define the scenario such as the particular process of designing documents in order to prepare the act of reading (Figure 8). The scenario does not deal directly with information, but with the way they are structured. This supposes an original way of writing, dealing with non-linear structure, dynamic data, and multimedia documents.

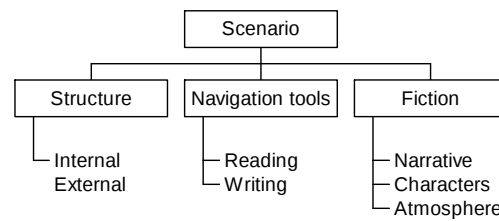


Figure 8: Scenario

Our studies are oriented toward the various classifications of navigation structures (Sabry-Ismail et al. 1997), and the fiction integration in learning software (Sanchez & Lumbreras, 1997).

Didactic

Literature offers plenty of criteria and recommendations for the pedagogical application of computer technology (Park & Hannafin, 1993). We also used more specific studies, such as works on interaction process (Vivet, 1996), or practical experiences. This last theme is expected to describe the specific didactical strategy of the software (Figure 9).

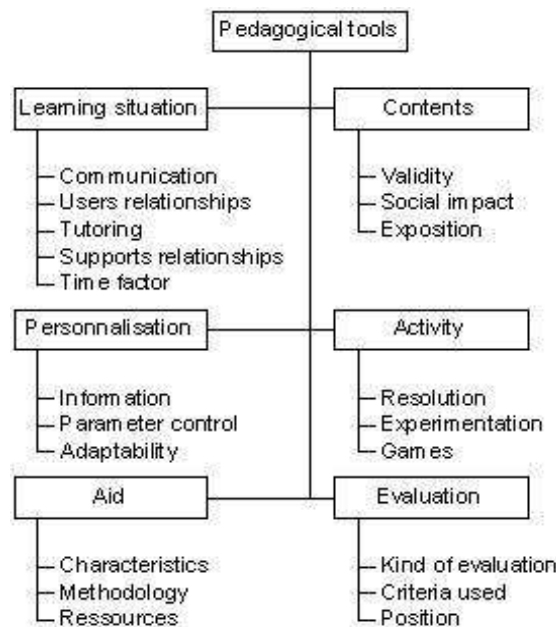


Figure 9: Pedagogical tools

Our goal is not to impose one or other strategy, but stating which is the better one. This normalizing approach can not be applied (whereas it was possible for usability or technical aspects), for two main reasons: We do not have enough experience with learning software to impose a way of doing things and the definition of a didactical strategy is totally context-dependent. That means that our criteria only provide a main grid to have a systematic approach in determining what is relevant in one particular case.

After this presentation of the questionnaire, we now explain how to use it in an evaluation.

3.2 The Evaluation Step

A Dynamic Navigation

An important point of our method is the possibility to use a dynamic navigation into the questionnaire structure during an evaluation. Thus, at each level, and for each question, the evaluator can (Figure 10):

- Delete a criterion or a question and all the associated sublevels, if this criterion or question, is not relevant for him.
- Go thoroughly into a node or not. If the evaluator is very competent in this domain, he will not have to develop sub-levels, and will only answer to this criteria level. That means that the evaluation can directly evaluate each criterion, instinctively, or go deeper in the criteria structure.
- To modify node's importance of each part of the tree, and modify the weight of criteria, sub-criteria and questions in calculations.

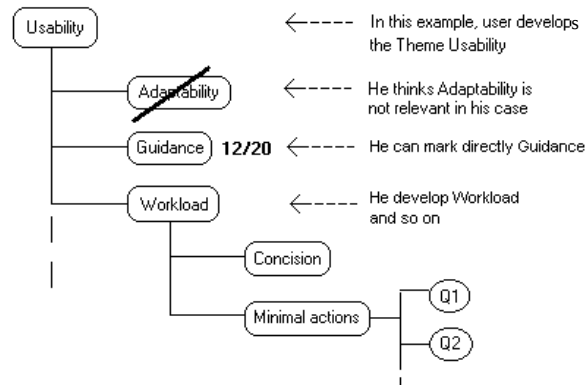


Figure 10: An example of navigation in our structure

Thus, the navigation into the questionnaire is not fixed. It depends on the evaluator's competencies and needs: The evaluator will be able to adjust the set of questions to his own situation. Moreover, the structure of the questionnaire may automatically be modified by the answers given by the evaluator. Then the software dynamically chooses the questions depending on the previous answers.

Use of Evaluator's Subjectivity

The seduction and the pleasure have an evident impact on the student's motivation and thus on the way of learning. On one hand, the evaluator, during a short period of time, is seen as a final user. Then, he can give his general feelings on the software he has tested. On the other hand, our evaluator knows sufficiently the final users and we think that their opinions are relevant. Moreover, all the evaluators are not specialists in ergonomics, in educational sciences or in multimedia design, and it is impossible to develop a questionnaire with all the characteristics of every software application in all educational contexts. By enabling an evaluator to give his judgment, we add new chances to detect a default felt by the evaluator, even if they cannot identify the exact reasons of this default.

For all the themes, criteria or sub-criteria, the evaluator can give a mark "instinctive" on the scale `` - - ; - ; + ; + + ". Because the evaluators do not have the required competencies in all evaluated fields, help must be provided. This help is divided in three parts: A reformulation, an illustration and a deepening. We obtain an information of how the teacher perceives the reality. This result can be compared with the objective evaluation of this same reality by the questions themselves.

Calculation

Once the questionnaire is filled out, the method gives a report enabling the evaluator to see a global view of his evaluation. A notation has been done at any point of the tree: Themes, Criteria, and Sub-criteria. For a question, the answer corresponds directly to the mark. In order to detect major defaults, some marking could be not linear (Figure 11).

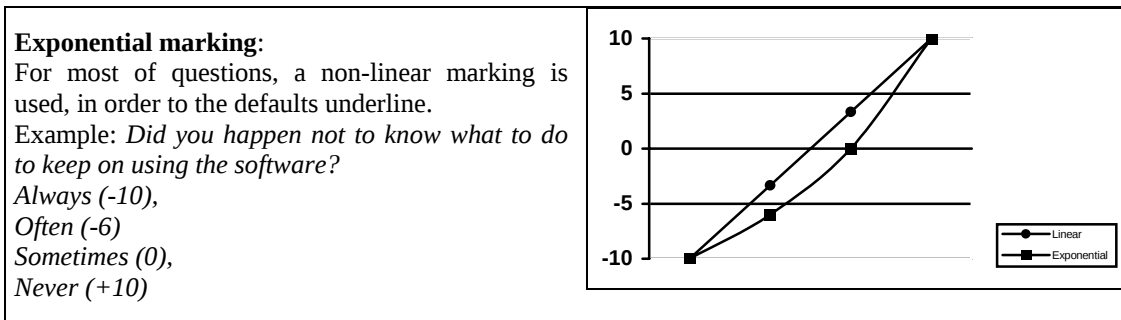


Figure 11: Example of exponential marking

Final Mark

As we already mentioned, our objective is to help an evaluator to use a questions base and not to judge for him. Thus, and contrary to other approaches (such as (MEDA, 1990) for example), the final mark will be proposed by the method: The evaluator can modify it if he wishes. To help him in this step, some marks and indications are proposed to him for each theme, criterion and sub-criterion:

- *A calculated mark:* It results from the questions themselves.
- *An instinctive mark:* It corresponds to the instinctive mark given to this level by the evaluator. A more global instinctive mark is also given; it is an average between the instinctive mark of this level and the ones of lower levels.
- *A correlation index:* It measures the similarity between instinctive mark and calculated mark.
- *A coherence index:* It measures the coherence of instinctive marks between a level and its lower levels.

$$I_{coherence} = Moy. \left(\frac{|NI - NI_i|}{10 + \max(NI, NI_i)} \right); \quad I_{correlation} = \frac{\min(NI, NC)}{\max(NI, NC)}$$

NI: instinctive note of the level; NI_i: instinctive note of the i level; NC: calculated note of the level.

- *A final mark:* it is computed with the calculated mark, the global instinctive mark and the coherence index. The weaker is the coherence index, the closer the final mark is to the calculated mark.

With all these marks and indexes, the evaluator will be able to fix for each theme, criterion and sub-criterion, the final mark that he considers to be the right one (see figure 12).

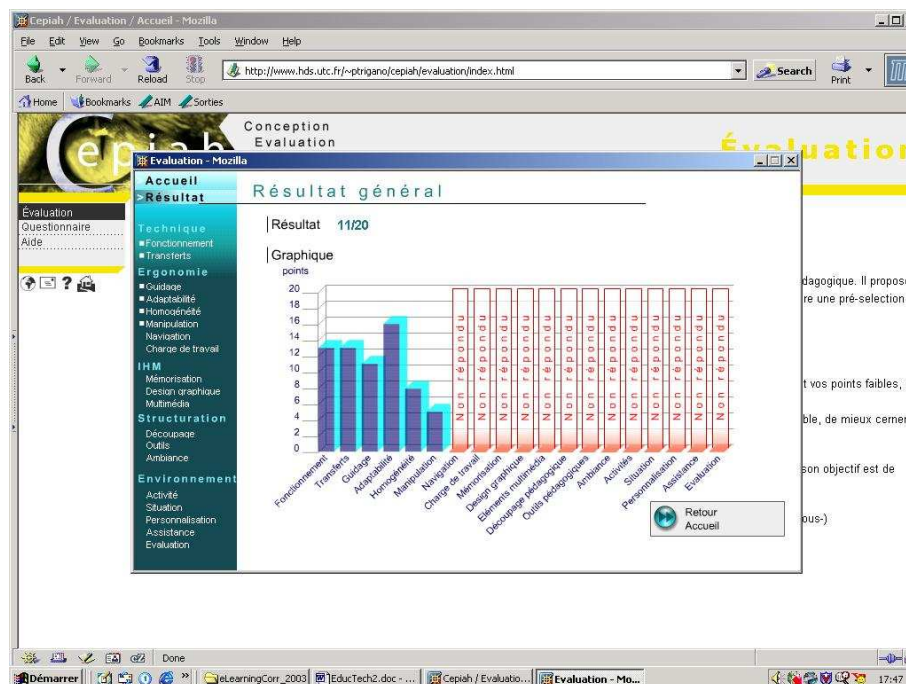


Figure 12: Global results

An important feature of our questionnaires is the explanation they give to the evaluator. Thus, we can notice three different information levels that can be used for evaluation: the explanation of each theme and of each meta-criteria, the new-formulation of the question and references to theoretical points and bibliography of the subject (figure 13). These levels guide the evaluator to formulate his choice without influencing him.

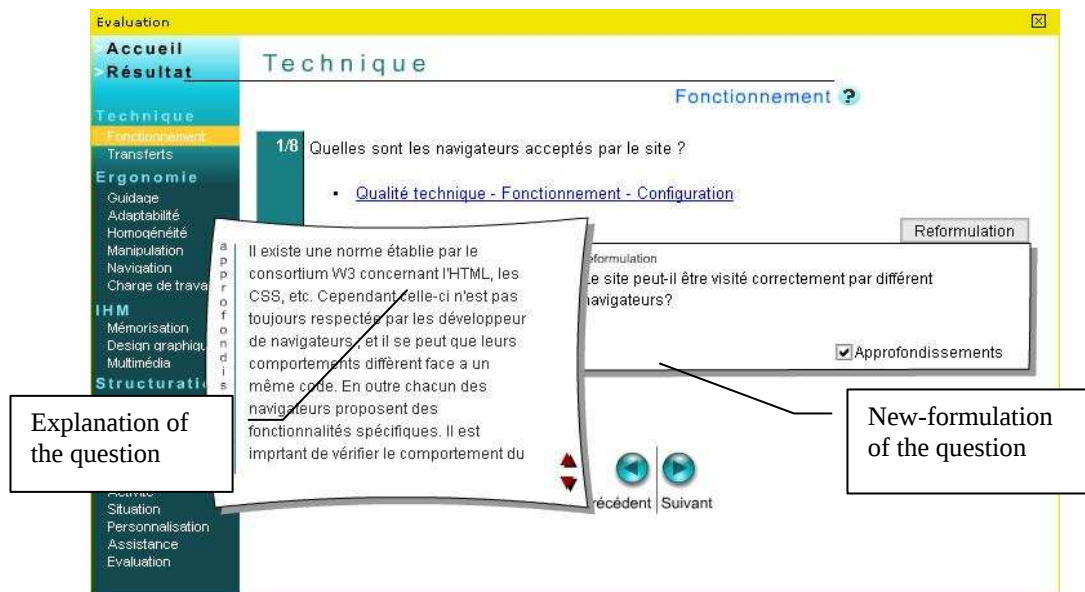


Figure 13: Example of question with new-formulation

Flexible navigation

We propose a “both way” navigation in order to reduce the eventual disorientation in our interactive guide and in order to help teachers, designing their web site to evaluate and to modify, if required, their prototype. Concerning the Evaluation section, the questionnaires are structured with a flexible navigation enabling the evaluator to have permanent access to the design section by the existing links between the two sections of the site at the themes and meta-criteria level. The Conception section also enables the user to navigate through different evaluation questionnaires using the indirect links that exit at the themes and meta-criteria level. For instance in figure 14, we show the explanation on the Pedagogical Division meta-criteria of the Pedagogical Structure theme from the Evaluation section. We notice the links towards the atomic information of the same meta-criteria from the Design section.



Figure 14: Navigation between the Evaluation and Conception sections

Validation of the EMPI module for the Evaluation of web prototype

Several versions of the questionnaire have been interactively realized, and several validations have been done. All these experiments are validations done during an iterative conception of our questionnaire. They have not been realized in real situation of use. Our goals were to validate calculation techniques of our method, to test stability of our evaluations (several evaluation of a same product, with various evaluators must produce same results) and to verify the usability of our dynamic questionnaire before submitting our method to real evaluators, teachers for example. Several important results appeared during these tests:

- The exponential notation and ponderations of some parts of the tree increase a lot the evaluation stability (Differences on minor points are erased). This also allows the detection of major defaults of the evaluated software.
- The use of digital marks as a unique form of results does not reflect all aspects of the evaluation. For example, it is difficult to see the difference between a bad characteristic and the lack of this point in the software.
- The comparison between subjective feelings and objective questions improves the evaluation quality.
- Finally, the use of a dynamic tree offers more flexibility in our method. It enables evaluations according to different levels of details, lowers time to fill in a questionnaire, and the opportunity to focus evaluation on precise points.

In a second step of validation, we wanted to check if our method is well adapted to our public- teachers. We have worked with teachers from several standards (school, high-school, university...) and from several domains (foreign language, computer science, mathematics, technical studies...).

Then, they used EMPI module for their evaluations and noted down all their comments. Such experiment had two goals: First, we wanted to check with the potential users, if our method is pertinent and easy to use. Secondly, it was important to test the limits of EMPI on a large set of pedagogical software in several pedagogical situations. We already obtained various results. The evaluation of software tools (text processing, data management...) did not produce really pertinent results.

Other experiments have been done in order to check if our results correspond to the ones coming from real users (teachers), during pedagogical process. We had interviewed several teachers using the same software ("Perfect your English 3eme", edited by the CNDP: The French National Center for Pedagogical Documentation). The results showed a good detection of ergonomic defaults actually detected by students.

Our goal was to make a set of more dynamic questions, in order to improve it and make it useful and easily usable. The use of an adaptive questionnaire, which dynamically takes into account the human needs, seems to be a good point. In the following section we present the experiment of a pedagogical Web site built with our SP/UL/FC method as well as an evaluation carried out with EMPI method (using the two first modules of our CEPIAH Method).

4. Validation

Technicians working in firms can follow along-the-life training in our university (UTC), in order to obtain an engineer diploma. To follow the engineer training, they first have to acquire basic skills they might have missed or forgotten through their initial training. These basics were taught during one year, while students keep working in their firms. Some of them cannot be present in Compiègne for the courses and have to follow distance training.

4.1 Training in Computer Science

An application has been designed for **teaching basics have algorithmic and computer programming field**, in Pascal language, **on the web**. We have implemented a web site, integrating pedagogical simulations, lectures, exercises (drills) and their solutions, and practical works. All these modules are integrated in an interactive and multimedia environment.

Several ways of teaching this material have been tested, mainly based on books and videotapes. The main problem of these previous approaches was the lack of interactivity and adaptability of the supports to the specificity of each student.

We decided to submit an original device, mainly based on a Web site and a CD-ROM. We thought that the particular characteristics of digital supports could help in introducing ways of teaching that could bring in more interactivity and help in taking into account the personal needs of each student. Introducing closer tutoring can also treat this personalization problem, what we jointly decided to do.

Device description

The following parts compose the device that the students have:

- A Web site enables the course consultation, to make exercises and auto-evaluations after each chapter. A controlled access to the correction of exercises makes it possible to follow the students' evolution in their training. They are expected to send their auto-evaluation results before being able to access the correction.
- A CD-ROM permits the off-line consultation of the courses' contents.
- A paper version presents a linear version of the lessons.
- Each month the students have one hour to meet the teacher and check if they well understood the concepts.
- The students can also ask questions more regularly by e-mail to a tutor.
- They also use a Pascal compiler to apply the algorithms they learn.

Evaluation

The first remark of the evaluation we can make is that our approach seems reasonably efficient, as the students learning this way obtained similar results to the exams as the students attending classical courses. In order to deeply evaluate our experiment we sent a questionnaire to the students. We used this questionnaire along with the remarks we already capitalized at the beginning of the training. This set of elements allows us pointing out the strengths and the lacks of our device. In the following paragraphs we submit a thematic development of the principles we identified as essential in our approach. Some of these aspects are not still completely treated, however they have been identified as important interpreting the current lacks of our device.

Multi support environment

The Web site is used to access dynamic information, i.e. information that is expected to change in time. For instance, the exercises' corrections accessible when auto-evaluation has been sent or the exams memory that is refreshed each semester.

The CD-ROM documents are used for the advantages provided by a non-linear consultation. It makes it possible to have a personal approach in the reading choosing between various scenarios the teacher offers. It also allows more efficient consultation when doing exercises or programming algorithms, thanks to the links between concepts. Nevertheless the readability problem, linked to screen display, hinders hard concentration on texts.

Tutoring

An aspect that deeply emerges from our experiment is about teacher intervention in the learning process. Two main means exist to help the teacher in the follow-up of the students' works: The auto-evaluation (after each chapter the students are expected to send a form with the time they spent doing the exercises) and the meeting once a month between the students and the teacher. We observe that the students hardly work when the meeting comes closer, and the students confirm that the auto-evaluation principle help them in being regular and scheduling their work. Moreover, the students ask for more means to be followed in their learning process: For instance corrections and remarks about their works, indicators about exercises (difficulty, expected time to do them, etc.), more elaborated auto-evaluation (Multiple Choice Questions with automatic correction and work suggestion).

Tree experiments have been conducted. Two of them were carried out using a digital support and one was conducted based on a classical approach. As regarding the experiments of digital support, we have concluded that 90% of students were generally satisfied, but 40% of them missed the courses. At the same time, half of students preferred to be more supervised, while the other half preferred to work independently. When using the digital support approach, the exam grades were overall good, ranging around the average of 8.8/20 and 15/20 (very good marks). While the grades of students using the classical approach, were evaluated above the average

9.5/20 and at 4/20 (very bad marks). The students that used the digital support received less low grades, a fact that proves a higher motivation for this approach.

4.2 Extension to twelve other trainings

After we have described the advantages of our work on the development of the interactive guide, we present the steps, which we had applied into the realization of the first validation of the prototype.

During the Multimedia Projects course at UTC, we have realized a validation (March – May, 2003) of the prototype with 3rd year at students Engineering. In fact, the students had to create the web sites for twelve different courses at UTC. During the first session of courses the person responsible of the Multimedia Projects gave to students a list of subjects proposed by different teachers (ten teachers) from UTC. These teachers want to have a web site for their courses. Beginning with the first course we presented the CEPIAH method to the students and our prototype was available online. We asked them to use our prototype during the period of realization of their conception and development projects of web sites for different courses. The project realization lasted for two months.

For the realization of this experience we had a group of about 45-50 students distributed into three groups of course, on three days (Group A on Wednesday, Group B on Thursday and Group C on Friday). Each group was divided into subgroups of three or four students. At the end of the projects we asked the students to fill out the evaluation questionnaire. This questionnaire was structured according to the three parts, which composed the interactive guide: there were questions on Design Help, Evaluation Help and Pedagogical Models.

We have analysed and represented the results under the graphic form using Excel. In fact, we had done a quantitative analysis of these results and averaged the responses of each student group. Figure 15 presents the average results of three groups. In the legend of the graphic the letter W represents the group of Wednesday, the letter T represents the group of Thursday and the letter F represents the group of Friday.

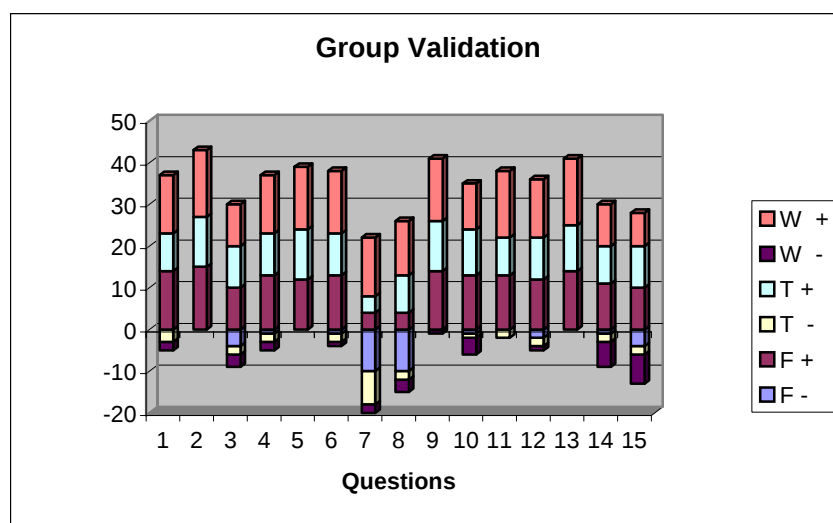


Figure 15: Validation

In general, we observe that the obtained resultants are mostly positive. However, we also observe the negative points for the questions (questions 7 and 8) about the significance of the “Bibliographic references “ into the Design Help module. We obtained the negative points from the groups of Thursday and Friday. In return, we observed that the group of Wednesday globally had more positive results. Note that the exterior teachers from CEPIAH project supervised the days of Thursday and Friday.

5. Conclusion and perspectives

We are now working on the third module proposing predefined sites models. The module proposes predefined site models that the authors may download and customize as they prefer. The customizing concerns the course structure, projects, laboratories and also the content division and site navigation.

For the moment, we continue to develop this module, directing our research to the pedagogical scenarios design, starting from the learning theories fundamentals (Gagné, 1996) and also the Instructional Design Theories, using the current research results of D. Merrill (Merrill, 1999) and C. Reigeluth (Reigeluth, 1999).

In a short term, we expect soon the first validation of the Pedagogical Models by the teachers of our university from Compiègne (France).

6. Acknowledgements

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7. References

Bastien, C., & Scapin, D. (1995). Evaluating a user interface with ergonomic criteria. *International Journal of Human Computer Interaction*, 7, 105-121.

Crozat, S. (2002). *Ingénierie multimédia dans des contextes éducatifs*, PhD Thesis, University of Technology of Compiègne, France.

Cinema (2003). Conception et Intégration de Nouveaux Environnements Multimédias d'Apprentissage. Université du Montréal, Canada, Retrieved 19 July 2004 from <http://www.fas.umontreal.ca/com/com3561/bta/ergo/frame1.html>.

Gagné, R., & Medsker, K. (1996). *The conditions of learning: Training applications*, ASTD, USA: Harcourt Brace College Publishers.

Gibson, J. J. (1979). *The Ecological Approach to Visual Perception*, Boston: Houghton Mifflin.

Hû, O., & Trigano Ph. (1999). Considering subjectivity in software evaluation - Application for teachware evaluation. In J. Vanderdonckt & A. Puerta (Eds.), *CADUI II, Computer Aided Design of User Interfaces* (pp. 331-336), Louvain, Belgique: Kluwer Academic Publisher.

Hû, O., Trigano, Ph. (2000). A tool for evaluation using dynamic navigation in a set of questions. In *Proceedings of the International Workshop on Tools for Working with Guidelines (TFWWG'2000)*, London: Springer-Verlag, Retrieved 19 July 2004 from <http://www.hds.utc.fr/~ptrigano/publications/tfwwg.pdf>.

Lamrous, S., & Trigano, P. (1999). Assistance for Sensory Analysis of Products in Design with the Automatic Indexing Methods in Full-Text. *Paper presented at the CSCWD99 4th International Workshop on Computer Supported Cooperative Work in Design*, September 29 - October 1, 1999, Compiègne, France.

Linard, M., & Zeiliger, R. (1995). Designing an interface in an educational context : first steps to a principle approach. In Lillehammer, K. Norby, P. Helmersen, D. Gilmore, S. Arnesen (Eds.), *Proceedings 5th Conference INTER'ACT 95* (pp. 401-404), London: Chapman & Hall.

Linard, M., Belisle, C., & Zeiliger, R. (1998). Reconciling information processing and activity theories: HELICES, a foundation model for creating cognitive artifacts. *Paper presented at the ISCRAT98 - 4th Congress International Society for Cultural Research and Activity Theory*, June 7-11, 1998, Aarhus, Denmark.

Merrill, D. (1999). Instructional Transaction Theory: Instructional Design Based on Knowledge Objects. In Charles M. Reigeluth (Ed.), *Instructional Design Theories and Models: A New Paradigm of Instructional Technology* (pp. 397-423), Mahwah, NJ: Lawrence Erlbaum Associates.

MEDA (1990). *MEDA - Evaluer les logiciels de formation*, Paris: Les Editions d'Organisation.

- Nielsen, J. (2000). *Conception des sites Web: l'art de la simplicité*, France: Campus Press.
- Park, I., & Hannafin, M. J. (1993). Empirically-based guidelines for the design of interactive media. *Educational Technology Research en Development*, 41 (3), 63-5.
- Preece, J., & Rogers, Y. (1996). *Human Computer-Interaction*, Wokingham, UK: Addison-Wesley.
- Ravden, S. J., & Johnson, G. I. (1989). *Evaluating usability of Human-Computer Interfaces: a practical method*, Chichester, England: Wiley.
- Reigeluth, C. M. (1999). The Elaboration Theory: Guidance for scope and Sequence Decisions. In C.M. Reigeluth (Ed.), *Instructional Design Theories and Models, Volume II: A New Paradigm of Instructional Theory* (pp. 5-28), Mahwah, NJ: Lawrence Erlbaum Associates.
- Sabry-Ismail, L., Roisin, C. E., & Layaïda, N. (1997). Navigation in structured multimedia document using presentation context. In *Proceeding of H²PTM'97 - Hypertextes et Hypermedias*, Hermes, France.
- Sanchez, J., & Lumbreras, M. (1997). Hyperstories: Interactive narrative in virtual worlds. In *Proceeding of H²PTM'97 - Hypertextes et Hypermedias*, Hermes, France.
- Scapin, D., & Bastien, C. (1997). Ergonomic criteria for evaluating the ergonomic quality of interactive systems. *Behavior & Information Technology*, 16, 226-231.
- Type, J. H. Mc, & Frommer, W. D. (1985). Effects on character/background color combination on CRT character visibility. *Proceedings of human factor society HFS'85*.
- Vanderdonckt, J. (1994). *Guide ergonomique de la présentation des applications hautement interactives*, Namur: Presses Universitaires.
- Vanderdonckt, J.(1999). Development Milestones Towards a Tool for Working with Guidelines. *Interacting with Computers*, 12 (2), 81–118.
- Vivet, M. (1996). Evaluating educational technologies: Evaluation of teaching material versus evaluation of learning. *Lecture Notes in Computer Science*, 1108, 37-38.
- W3 Educatif (2003). Université Laval, Canada, Retrieved July 19, 2004 from, <http://aptic.ulaval.ca/guidew3educatif>.

Utilisation-Focused Evaluation of ICT in Education: The Case of DFAQ Consultation Space

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ABSTRACT

This paper describes an evaluation of a web-based consultation space (a dynamic frequently asked questions environment - DFAQ) in which learners consult one another using questions, and in which both the flow of interaction and its artefacts become a resource available to a community of learners. The DFAQ is a special form of a Computer-Mediated-Communication tool specifically developed to facilitate question-based interaction. We argue that education is too complex a social structure to be evaluated using deterministic positivist quantitative approaches. Given the volatility of determining what constitutes value, costs, inputs and outputs and the complexity of dynamics of socialization, a non-deterministic qualitative approach, utilisation-focused evaluation approach is used. Our conclusion is that the DFAQ does contribute to students' academic performance and frees the lecturer-learner consultation time.

Keywords

Utilisation-Focused-Evaluation, ICT in Education, Computer-Mediated-Communication, and Dynamic Frequently Asked Questions (DFAQ)

Introduction

To begin with, we ask the following questions - has the use of Information and Communication Technologies (ICT) in education reduced the cost of education? Do ICTs add value to learning? If ICTs reduce the cost of education and add value to learning, then it is worth the investment. With the soaring costs of technological investments for education, proponents of the technology continue claiming that technology does add value to teaching and learning, and argue that the value added is higher than its cost. Linda Harasim, a professor of communication and commentator in the areas of CMC and distance learning, (in Palloff and Pratt 1999:50) report on negative aspect of learning online and student reactions, citing "information overload, communication anxiety in relation to the delayed responses in an asynchronous environment, increased work and responsibility, difficulty in navigating online and following the discussion threads, loss of visual cues, and concerns about health issues related to computer use." Rather than brush off Harasim's experience as an isolated case, it is experiences such as these that bring to question the value claims of using technology in education. We do not use the term *education* in a narrow sense, but use the term as conceptualised by Bowers. Bowers (1987:31) contends that the term education, communication and socialization are one and the same thing and can therefore be used interchangeably. According to Bowers, education involves communication, and therefore socialization, and calls for an acknowledgement of the dual nature of socialization as having the potential to liberate thought and facilitate the communication of new ideas to others; it is also a binding force that may prevent people from seeing how their lives are shaped by social conventions. Accepting Bowers view of education, we are faced with several problems when it comes to evaluating educational technological (ET) interventions. Implied by Bowers is that ET interventions are sandwiched by education, communication and sociological factors, hence becomes a multivariate problem that cannot be evaluated through deterministic isolation of individual variables. Having accepted Bowers' argument it follows that teaching and learning is multicausal and this understanding also implies that the effect of technology is multicausally impacted and has multicausal effect, we call a multicausal duality of technological effect. Suchman (1977:50) observed that in social research we generally deal with multicausal models in which no event has a single cause and each event has multiple effects.

No single factor is a necessary and sufficient cause of any other factor. These logical conditions of "multiplicity of causes" and an "interdependence of events" apply equally to evaluative research. It means that activity A becomes only one of the many possible actions or events, which may bring about (or deter) the desired effect. Furthermore, both activity A and effect B will have many other effects and consequences (Suchman, 1977:50).

Our argument is that most evaluation models of ICT interventions adopt a simplistic approach of causality by failing to acknowledge the complexity of multicausal duality of technological effect. By way of an example, in their recent paper Elissavet and Economides (2003) devised a suitability scale evaluation questionnaire with one hundred and twenty four items each with a five point rating ranging from strongly agree to strongly disagree. Our view is that Elissavet and Economides model is both simplistic and deterministic.

Nygren and Fisher (1998) observe that “assessing costs in the framework of university structures and cultures one must confront several difficult issues”. Nygren and Fisher add that “once costs are determined, it still may be difficult to specify what counts as efficiency because of poorly understood pedagogic gains, or because relations between outputs and inputs are highly volatile”. We argue that failure to unravel ‘what counts as efficiency’ is in part attributed to implementation of deterministic ‘recipes’ of methods based on theories that fails to account for complexities of ET intervention contexts. Bowers (1987:32) cautions that “unless the dynamics of socialization are taken into account, along with culture’s pattern for organizing reality, educational theories are likely to be little more than expressions of well intended visions that have little chance of being realized anywhere.” Needless to say, both the dynamics of socialization and the culture’s pattern for organising reality are important evaluation ingredients and yet are often ignored or missing from evaluation cookbooks.

The volatility of determining what constitutes value, costs, inputs and outputs alluded to by Nygren and Fisher (1998) and the complexity of dynamics of socialization (Bowers 1987) point to the need for non-deterministic qualitative approaches to evaluation. In this project the thinking was to use pragmatic approaches to determining value and premised the study in the utilisation-focused evaluation approach. Utilization-focused evaluation does not advocate any particular evaluation content, model, method, theory, or even use (Patton, 1997:22). Patton (1978:20) argues that real world circumstances are too complex and unique to be routinely approached through the application of isolated pearls of evaluation wisdom. Patton adds that it is like trying to live your life according to Ben Franklin’s *Almanac* or any of the full range of proverbial gems that constitute our cultural heritage. Patton (1997:20) postulates that “*Utilization-Focused Evaluation* begin with the premise that evaluations should be judged by their utility and actual use; therefore, evaluators should facilitate the evaluation process and design, noting that everything that is done, from *beginning to end*, will affect use. Nor is ‘use’ an abstraction. ‘Use’ concerns how real people in the real world apply evaluation findings and experiences the evaluation process.” To the extent that ‘real people in the real world’ are complex and non-deterministic, naïve evaluation approaches has led to costly evaluation processes leading to voluminous reports that end up gathering dust on shelves with little or no impact on either the object and subject of evaluation process. It is for this reason that Patton (1997:20) argues that the focus in utilization-focused evaluation is on intended use by intended users.

The aim of this evaluation was two fold:

- a) To assess whether the use of a Computer Mediated Communication (CMC) tool for student to lecturer, and student-to-student consultation can impact on student academic performance.
- b) To assess whether the use a CMC as in a) above “frees up” the lecturer’s consultation time.

The research approach employed was action research. This method is ideally suited to the study of technology in its human context (Baskerville and Wood-Harper, 1996). It merges research and practice, resulting in findings that are relevant to the context (Baskerville and Wood-Harper, 1996).

We now describe the cases for which the intervention was developed. In both cases 1 and 2, lecturers setup consultation hours but most students would not use those times and those who did use the time slots, were either the same students with different questions or different students with the same questions. In both cases, the technology became an invaluable tool.

Problem Description

In order to contextualise the research questions, we present two cases that are grounded on empirical evidence and scenarios of three students who are registered in these courses.

Case 1: This case is based on an Information Systems course with 100 registered students. The Lecturer scheduled 2 hours each day for students to come for consultation if they so required. Each consultation was approximately 15 to 30 minutes. Normally, there was no more than one consultation in each session. Consultations were more intense around due dates for deliverables. When deliverables were in groups, consultations were often with the whole group. There were a few students who made regular use of these times,

and a large majority never did. There were also a few that came in outside of consultation times, to ask ‘simple’ questions, whose answers were either in the course handouts, or on the course website.

The course was made up of a concepts section (worth 55%), a practical section (worth 35%), and a project, which aimed to combine lessons learned from both conceptual and practical sections (10%). The practical section consisted of computer laboratory exercises based on Microsoft Office suite.

The overall mean for the practical section was calculated from the following:

- PC Literacy Test (5%)
- Best 3 Tutorials (15%)
- Web Page Tutorial (5%)
- Practical Exam (10%)

For the concepts (Theory section), the deliverables were as follows:

- Asst 1 (2.5%)
- *** Asst 2 (2.5%)**
- Test 1 (5%)
- Test 2 (5%)
- Final Exam (40%)

* Basis for this project

Case 2: Participants were honours students registered for a degree in Education. Most of these students were full time teachers and studying part time. The lecturer had set aside Monday: 13h30-15h30 and Tuesday: 14h00-15h30 as consultation times. Generally, students did NOT (*lecturer’s emphasis*) adhere to these times and “*would interrupt me during office hours!*” end of quote. The lecturer on an average saw 8 of the 20 students during the scheduled consultation time and spent about an hour with each student in total (i.e. 8 hours). She had no record of the number of students that consulted with her outside normal consultation times, as according to her, “*sometimes I will have students seeing me from 8h00-16h00 non stop!*” She went on to say, “*Students will come and ask the same questions all the time and they do not read the times on my door, they do not abide by the students consultation times and this leads to a very inefficient use of my time because I have different students coming and asking the same question.*”

Below we present scenarios of three students registered on these courses. As these cases show, it was not practical for students to see the lecturer during the set consultation times. We show these in order to highlight why we developed the DFAQ consultative space to address the problem. The narrations are reported unedited so as not to dilute their stories.

S1: “*I am a teacher, deputy principal at the school where I am ... I do part-time studies which is a bit tough so I come here at 4 o’clock, the school ends at 3:30 and I rush through to UCT (University of Cape Town) and get home at about 6:30, 7 o’clock sometimes. ... it is difficult to sit together with my fellow students after class because we still have community work to do also.*”

Summary: Lecturer’s **scheduled consultation times are impractical and access to fellow students difficult.**

S2: “*... with the working full-time, with all of us that are working, we need a full-time job, to actually be able to pay your fees to do a degree. So all of us are finishing work at 5, and you don’t get to the lecturers. I mean if you look, most people, what, if they finish early, its 4’ o’clock. By the time you’ve got through, realistically, things like traffic, by the time you’ve actually got there, if you’ve made concerted effort – I mean, on the days that I did see the lecturer, I’ve had to dash back and forth. And it was really difficult and I’ve normally had to cancel something else, you know, it’s just a logistical nightmare, and I just felt it wasn’t...I mean things like weekends are the, basically the only time that you have to study, because you are working during the week. And then you don’t have access you your lecturer anyway; ‘because that is the only time that you’ve actually got.’*”

Summary: Lecturer’s **scheduled consultation times are impractical and lack of access to the lecturer.**

S3: “*...And I just feel, as post-grad students, ... if you are paying close to R8000 (approx. US\$1050) fees a year, which is a lot of money, we... if you look at the amount of time that I actually spend in class with the lecturer, it’s not relative, its’ not relative to what we’re paying. We should... and it’s not fair because we working full-time, that we haven’t got access to them (lecturers).*”

Summary: **Demand for more access to the lecturer beyond contact teaching times.**

In view of the above cases and student scenarios we sought to find answers to the following questions:

- Can a lecturer provide individualised help to students at minimum cost to the lecturer in terms of time/effort?
- Is it possible to increase the number of students being helped without each increment of student demanding more time and effort on the part of a lecturer?
- Can student access to a lecturer and fellow students for academic help purposes be maximised without additional costs on part of a student?

Choice of Evaluation Approach

The above evaluation questions were not viewed as cast in stone but were to be revised as the project went by depending on the emerging information in line with the active-reactive-adaptive approach of the *utilisation-focused* paradigm. Patton (1997:135) explained that utilisation-focused evaluators are, first of all, active in deliberately and calculatedly identifying intended users and focusing useful questions. Patton observes that they are reactive in listening to intended users and responding to what they learn about the particular situation in which the evaluation unfolds. They are adaptive in altering the evaluation questions and designs in light of their increased understanding of the situation and changing conditions. Active-reactive-adaptive evaluators don't impose cookbook designs. They don't do the same thing time after time. They are genuinely immersed in the challenges of each new setting and authentically responsive to the intended users of each new evaluation (Pg.135).

In choosing an evaluation method we were mindful of the inadequacies of the scientific approaches to *evaluation*. Elissavet and Economides (2003) in proposing an evaluation instrument for Hypermedia Courseware acknowledges "a piece of hypermedia courseware is socially acceptable, its practical acceptability is examined through the evaluation of content, presentation and organization of the content; technical support and update processes and evaluation of learning." Our argument is that Elissavet and Economides' instrument suffers from determinism and fails to acknowledge the complex learning environment of a hypermedia course. Fisher and Nygren (2000) argues that in a scientific" approach (quasi-experimental design) of carrying out an evaluation, the cost measurements are typically captured by taking apart the constituent activities in teaching a class (with and without the technological intervention), costing out the goods and services entailed, then reconstituting the whole activity in terms of the dollars expended.

The problem with this deterministic approach is that it fails to acknowledge the difficulty of holistically accounting for the *constituent* activities of teaching a class such as strategies of using technology in a classroom to mention but one.

Ehrmann (1995) observed that few educators, evaluators and researcher have paid much attention to *educational* strategies for using technologies. Too often they have been victims of "rapture of technologies." Mesmerized, they focus on individual pieces of software and hardware, individual assignments and, occasionally, to individual courses. Fisher and Nygren (2000) argue that some portion of each of these costs must be calculated in order to understand the cost of delivering a course.

One should count some portion of the costs of designing, building, loading, or maintaining web-based curricular components as part of the cost of course delivery, just as one would count some portion of classroom usage time (along the lines of paying per square foot multiplied by time used, or amortizing the cost of the physical infrastructure). In the high-tech case, one would measure some fraction of total technology infrastructure costs, per individual class and per course. (Fisher and Nygren, 2000)

In this project we assume Fisher and Nygren's arguments as superficial and academic in nature. We do not calculate the costs of the intervention except to mention that the intervention was web based, hosted on a local server (MEG web server) and therefore bandwidth cost of accessing the site from student labs was insignificant.

Consultation through CMC

Cecez-Kecmanovic and Webb (2000, p310) postulate that Web-based technologies extend the communicative space of learners, and they outline three characteristics of the new extended space that affect learning conditions:

- unrestricted participation in a group activity as long as technical access is available
- permanent recording of learner interactions, including flow of interactions in a period of time
- any-time-any-place access to these records by participants, learners and instructor alike.

A web-based consultative space, a special purpose CMC tool, called the Dynamic Frequently Asked Questions (DFAQ) environment has been developed (Ng'ambi, 2002a). CMC provides a way of sending messages to a group of users, using computers for storage and mediation (Salmon, 2000: 15). The goal of this project is to create a web-based communicative space for learners in which they consult one another using questions, and in which both the flow of interaction and its artefacts become a resource available to a community of learners. Thus, the DFAQ is a web-based interactive consultative space (Ng'ambi, 2002a). Within the DFAQ, each FAQ creates a room or virtual space in which a conversation occurs, may do so or has done so (Ng'ambi, 2002b). We built into the environment some intelligence capable of anticipating the user's future questions and of pre-empting predicted questions through a proactive response (Ng'ambi, 2002c). The DFAQ does not come pre-packaged with questions and responses but the environment is populated with questions and responses as learners ask and respond to each other. Figure 1 shows part of the DFAQ interface.

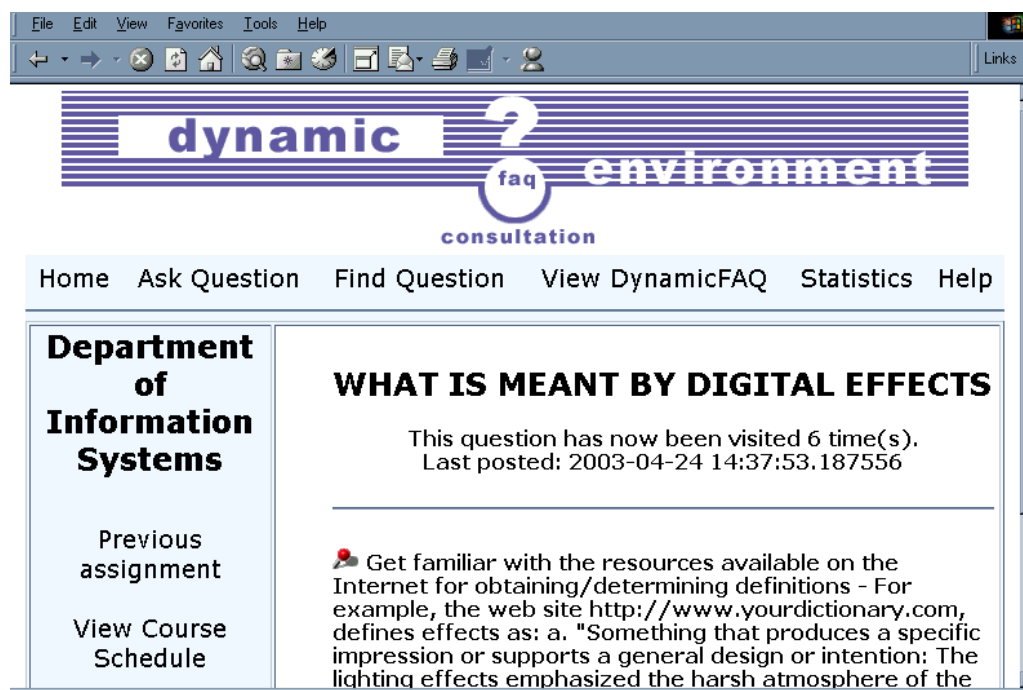


Figure 1: The Dynamic FAQ Environment

Observations

Case 1:

As indicated in the problem description, the DFAQ environment was used specifically for one of the deliverables – Assignment 2, to deal with queries, questions, and clarification of requirements. After an initial introduction to the DFAQ environment, students had access to the facility at any time, and from anywhere. Thus, questions and responses were not only posted during lab sessions.

It was noticed when analyzing the results for the course as a whole that on average Black students had lower marks than other students on most deliverables, whether theoretical or practical. This was attributed to the fact that these students may have had less prior experience with and exposure to information technology than other groups, most likely as a consequence of past apartheid policies that marginalized such students. Being non-technical postgraduates, these contrasts are greater than with undergraduates, who may have benefited from the post-apartheid efforts of bringing redress, for example, through the provision of computers into formerly disadvantaged schools and access to all into formerly advantaged schools.

It was therefore decided to assess the impact of the DFAQ environment on the performance of these students in particular. Results were therefore examined by race, using categories employed by Stats SA (2003) – Black African (B), Coloured (C), White (W) and Indian (I). These categories are still in use in South Africa to monitor progress on issues such as employment equity and various other efforts aimed at reducing the socio-economic disparities created by apartheid..

Since the DFAQ intervention was used with Assignment 2, for the purposes of comparison it was appropriate to compare results with performance on Assignment 1, which was of similar scope, but did not use the DFAQ intervention. Performance on both assignments was assessed using normal formative methods.

Assignment 1 was done in groups of 2 to 3 students, or individually if a student so desired. Students chose their own groups voluntarily. The assignment was based on conceptual work done. **Questions, queries, and exhaustive explanation of requirements were conducted in a lecture theatre.** The graph below (Figure 2) depicts the breakdown by race. Black students had the lowest average. It is pertinent to note that the poor performance of Black students in comparison to the class average was consistent in many other deliverables. There is only space here to show one such negative performance.

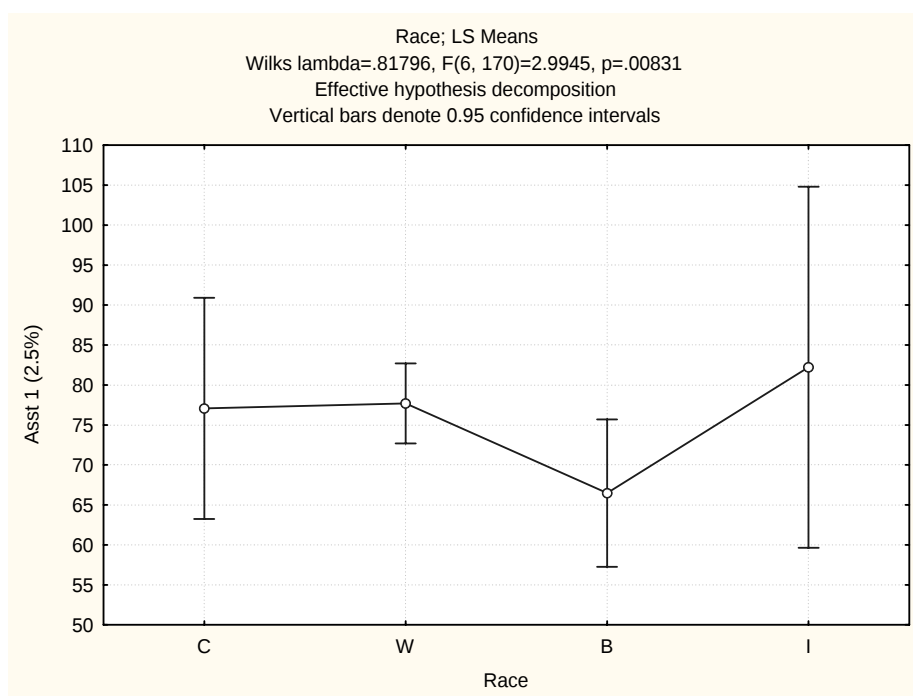


Figure 2: Student Performance before intervention

Assignment 2 was similar to Assignment 1 in that students worked in groups of 2 to 3, or individually if so desired. The assignment focus was also on conceptual work done in the course. Instead of allowing students to ask questions, queries, exhaustive explanation in a face to face session in a lecture theater, students were encouraged to use the **DFAQ environment to facilitate asking and answering of queries, and for clarifying requirements.**

For the sake of brevity, we show only two typical question-response interactions.

What is Yahoo? Is it a server, search engine or what?

Last posted: 2003-04-24 14:41:08.53617

 "Yahoo! is a directory of World Wide Web sites organized in a hierarchy of topic categories. As a directory, it provides both new and seasoned Web users the reassurance of a structured view of hundreds of thousands of Web sites and millions of Web pages. It also provides one of the best ways to search the Web for a given topic. Since Yahoo is associated with the most popular Web search sites, if a search argument doesn't lead to a Yahoo topic page, it will still lead to results from the six or seven popular search engine sites Yahoo links to. Taken from <http://whatis.techtarget.com> Next time you want to find a definition, visit the whatis.com site. Cheers.

Although some students had heard about “Yahoo”, what the question seen to have done was to allow for some deep reflection on what they thought Yahoo was. What is interesting about the question is that not many

students would have asked it, as it was not related to the assignment at hand. However, the response which was given by a lecturer did not only benefit the author of the question but the rest of the class as well.

What do you mean by the shoot and director

Last posted: 2003-04-24 14:24:32.156205

 A shoot is the actual physical recording of a movie. Shoots are most commonly either conducted in studios and/or a real physical location (e.g. the beach or on top of a building). Generally actors act during a shoot, while a cameraman records (a.k.a. shoots - this is where the word comes from). But if a specific scene does not require the actors, a shoot can take place without them. A director does exactly what the name says. He/she directs what happens during the shoot. His/her chief role is to direct the actors. E.g. if they should say a line differently, walk in from a different door, the facial expressions they should have, etc. A director is in general control of the shoot. He/she can, and more often than not, is involved in what happens before and after a shoot (pre- and post-production). In most movie productions, people who are specialists in certain areas (e.g. cinematographers, editors, make-up artists) help to make what the director would like to achieve a reality. People often aren't sure what the difference is between a director and a producer. While a director is purely concerned with the contents of the movie, the producer is concerned with all other issues surrounding the making of the movie. Who should be hired, paying those people, technical staff, feeding the cast and crew, etc. In big productions, organising some of these are conducted by people other than the producer. But ultimately, it is still the producer's responsibility. Hope that clears it up!

The significance of the above example lies in the fact that the response was provided by one of the students. The response is so detailed and clear that none of the students in class remained in doubt as what the differences between the shoot and director was. Our argument is that, if this response was given outside the environment we would have lost an opportunity to learn from the brilliance/experience of a student who responded to the question.

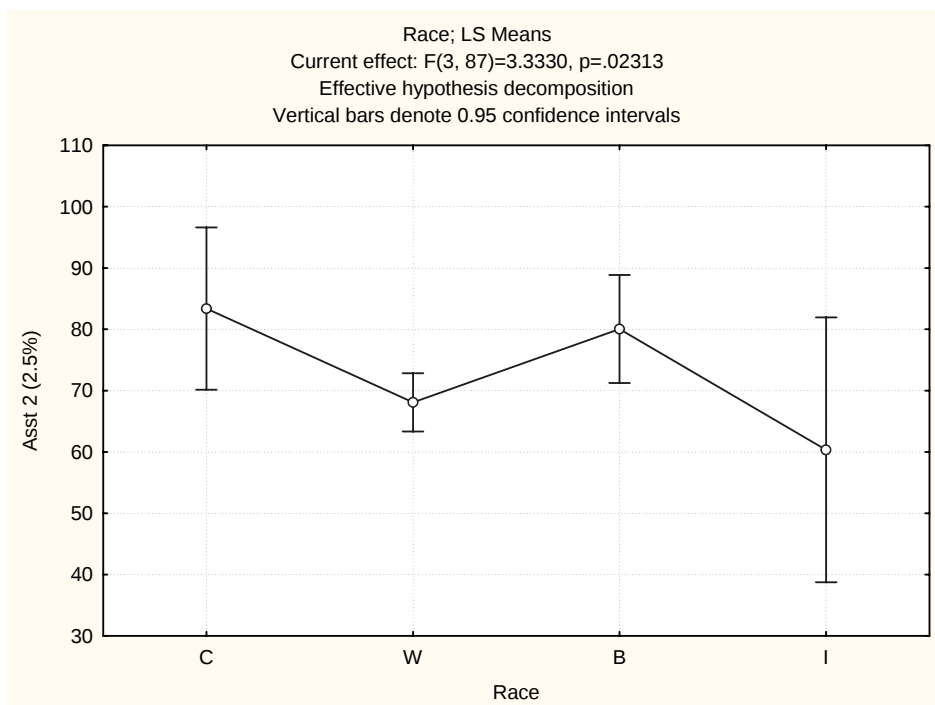


Figure 3: Student Performance after DFAQ intervention

There were 100 questions posted into the environment, an average of a question per student. While the DFAQ environment captures user email addresses, it does not categorize its users in terms of race. The lecturer's knowledge of the group, however, allowed such classification to be quite accurately estimated. Estimates were

that 67% of Black students used DFAQ to post questions; 18% of White students; 25% of Coloured students; and none of the Indian students.

The graph below (Figure 3) shows that Black students for Assignment 2 had the second highest average, after the Coloured group. This *went against all other trends* where Black students had the lowest average.

Consistent with the utilization-focused evaluation, our observation of possible effect of the DFAQ on student performance allowed us to alter the evaluation questions in the light of the ‘potential effect on academic performance’. Listening to intended users of the evaluation (lecturers and students), it became clear that they both wanted to know the impact of the DFAQ on student performance while lecturers were also keen to know how much of consultation time was freed up when the DFAQ environment was used for consultation.

Case 2:

Evaluation of Teaching

A total of 157 questions were posted into the environment from 20 students. This is an average of 7.8 questions per student.

The narrations below are extracts from an interview with the lecturers.

Efficiency benefit

“The fact that I could post a response to a question once into the environment that response would be available for everybody who wanted to have known what a particular X is, and I did not need to explain again and again to different students every day. That was the first kind of goal that the DFAQ achieved an efficiency goal. It is not efficient in terms of time when I spent time answering the same question all the time. So do I think it that the DFAQ has been effective, yes, from my perspective as a lecturer it has given me a reservoir of questions. I think, it has freed up my time, let me say that, remarkably I think it has freed up my time.”

Diagnostic benefit

“I had not envisaged that the DFAQ environment would serve a diagnostic purpose. That was not one of the things I thought it would do. In fact that is one of the things it did particularly well, given that I focussed on questions as indicators of cognitive activities, getting learners to post their questions on-line and being able to see what kind of questions they asked, at a glance was incredibly useful for me diagnostically in many ways. The first way I could tell what learners did not know. Now that seems a simple thing but let me tell you in a class full of people who are from previously disadvantaged background, particularly I have noticed in my class women who are black South Africans do not put up their hand and say, “I want to know X.””

Student performance benefit

“In the sense of being a space where learners can go for responses, I think it has worked for the learners. I can’t say that it has an impact on their marks. I can say that this group this year (2003) did incrementally better than the group did last year (2002) who did not have access to the sophistication of responses. So I have not controlled the other variables but it is unlikely that students have suddenly become incrementally better than those of last year. It is also unlikely that the class is substantially better than they were last year because it is always pretty much the same kind of people that we face so anecdotally I think we can say that the marks have shifted.”

“One of the students provided an example of assimilation and accommodation in the DFAQ and his colleagues responded very well to that, they said “Gee that’s excellent – brilliant example” while we were in the lab and in his exam he produced that same example and he got 80% for that question. Yes, he ended up getting a first-class pass for the year and this is someone who would be classified as traditionally disadvantaged student, so that is anecdotal evidence but I doubt he would have produced that answer in the exam had he not been validated in the class.”

Confidence and self-esteem benefit

“Most of the women in my class who are from disadvantaged backgrounds will not ask questions in class, they won’t put themselves out on the line to be ridiculed by the class, although the class does not actually ridicule you if you ask a question, they won’t do it. Years of experience has taught them that when you ask a question you

open yourself to criticism. In an on-line anonymous environment asked whatever they wanted and if you look at their questions you get a sense that they really did ask whatever they wanted because some of the questions, let's face it, are bizarre, I mean they are really very odd, totally out of this world. Now if they had been worried about being regulated, if they had been worried about a kind of a normative discourse, if they had been worried about people looking at them they would not have asked those kinds of questions, they would not have asked anything, but they did ask, so I think that the use of an environment that is anonymous may have had some impact. For some reason it motivates and motivates them to ask questions and to pose responses which they would not do in a class for sure and they would not even do it if I gave them a paper and pencil. They would be quite reticent."

Evaluation of Learning

The following extracts (unedited) are the students' evaluation of the DFAQ environment.

"Value for money" benefit

"Every time I login there's something different; there's more questions; there's stuff that's being answered. So I constantly have to take cognisance. I can't login to it and that's it, stops there. Each time I login there's something different, so I constantly had to rethink and re-look and build and accelerate. And that, to me, was the biggest thing that I felt really strongly about. So that's why I say, "accelerated learning", 'cause you're constantly learning. And you can't get that; and I think that one should, if you're paying university fees, I think, you know. As opposed to having, only growing when you're with the lecturer once a week, you know. For the first time it actually felt like I was doing a course that I didn't mind paying for, because I really got my money's worth out of it."

Academic performance benefit

"I personally feel that, I mean, with working full-time, and just reading, basically, that, um, the site played a very big part in being able to get marks in the 70's, at the end of it, even though I didn't have the most enormous amount of time. Because I could actually [cognitively?] shift on, and I could actually feel it happening. For the first time now I am, and I could actually show them that I could... um, and I've never been like the all-'round A-student, but I could actually say that I with not a lot of academic background, could, um, register for a course that I had no background on, and it's an Honours course – I've never done education or psychology – and get 73%, there's got to be a reason. Something about that course, to pull a student onto that level of understanding – I mean it's not an amazing mark, but to... d'you know what I mean? – With no background, there's got to be..."

Unexpected "Mirrored" benefit

Student 1: "Whereas, with this, you could actually, for me, one of my biggest learning curves was, um, looking at other people's questions. A lot of mine were answered by looking at how other people think. 'Cause you immediately get things mirrored. Often you'll be doing it yourself, but you can't see it until you see someone else doing it."

Student 2: "I did not agree with many of them until I went to read up again and realized that this is what it should be but I did not post my response again to those questions... it is going to make assignments and whatever much more easily for other students than for us that started with the environment."

Student 3: "...the more you read other students' questions, the more you're changing, 'cause you're constantly having to... it's that thing I said the Rubix Cube, where you're constantly having to look at it in different ways."

Cost saving benefit

"I don't necessarily need to have a lecturer one-on-one. I mean, if we could have a DFAQ site, that we engaged in, and then when you got stuck, and you've actually worked through it, you could actually go to a lecturer and say, "okay, this is what I've done," and then, you know, really go with problems, as opposed to questions that you could maybe have answered on the site, or that you can maybe have sorted out by looking through other people's questions. You know, it would be saving the University and ourselves a lot of money; you know, it just seems so much more efficient, and it seems like such a logical way of doing it. That's why I'm saying it's so ironic that there's this Global Village, that the world's getting smaller, but we don't seem to be doing it, you know? We don't seem to be applying it, you know, as well as we could."

Efficiency benefit

"You could actually teach more, a lot more efficiently, and the kids would be getting a lot more out of it. 'Cause that's the big thing, is in a class of 25 you've got a class average, you know? Where you go at the pace of the average; the stronger ones pull and the weaker ones hold back, and in-between is kind-of the way you progress."

I mean this way kids would be able to progress and cognitively grow at their own pace, which would be amazing. And it's been an amazing course to me and my key would be... keyword would be, um, for the first time is accelerated learning. I really felt that, um, I could learn when I needed to. I'm going to find it very difficult to attend any course after this, if we don't have this (DFAQ), because it just seems unfair. You know what I mean? It just seems like you start on a back foot. You know?"

Discussion

Can a lecturer provide individualised help to students at minimum cost to the lecturer in terms of time/effort?

Each question posted in the DFAQ environment was responded at an individual level and this meant that the student who asked the question received an individualised help. As the figures below show, if the questions asked in the environment each represented a physical consultation with the lecturer, the number of hours required to provide individualised help would increase with each question. However, it would appear the time and effort required on the part of the lecturer to respond to questions was minimal or did not increase with consultation.

Case 1:

Consultation hours = 2hrs/day X 5 days = 10 hrs/week

1X consultation = 30 minutes (worst case) = ½ hour

Assume 100 questions posted = 100 consultations

Then: 100 consultation = ½ hrs X 100 = 50 hours

If all consultation slots were used (Mon, Tue, Wed, Thu, Fri) and each consultation took 30minutes it will take 50 hours (i.e. 5 weeks of consulting with students everyday).

Case 2:

Consultation hours = 2hrs (Mon) + 1 ½ hr (Tue) = 3 ½ hrs/week

1X consultation = 30 minutes = ½ hour

Assume 157 questions posted = 157 consultations

Then: 157 consultation = ½ hrs X 157 = 78½ hours

If all consultation slots were used (Mon, Tue) and each consultation took 30 minutes it will take 78½ hours (i.e. 22 weeks of consulting with students everyday).

Although these calculations are hypothetical in that not all questions take the same amount to respond to, what we are attempting to show is that face-to-face consultations with students can be time consuming. Palloff and Pratt (1999: 54) recommend the use of online office hours. Palloff and Pratt report on an instructor Seinfeld who notified students that she would be checking the course site every few minutes on Monday evenings from 09:00 P.M. until 10:00 P.M. and on Thursday evenings from 09:00 P.M. until 09:30 P.M. It was observed that all students began watching Seinfeld, checking the course site, interacting with the instructor and also with each other, and posting questions for the instructor. Palloff and Pratt postulate those online office hours not only serves to create an opportunity to get questions and answered by the instructor and serve as her office hours but also deepens the sense of community developing within the group (pg. 55).

Is it possible to increase the number of students being helped without each increment of student demanding more time and effort on the part of a lecturer?

Given, that both the question and response were made available "public" for all students to see and also to respond, the question and response tended to be of benefit to a lot more students. There are two possible ways that this approach could have been of help; a) students thoughts got "mirrored" as they saw questions asked by their colleagues b) Benefited from the questions they never thought about before. Palloff and Pratt (1999: 82) contend that in an online environment, learners are expected to view problems and questions from a number of perspectives, including the perspectives of other learners involved in the process.

Learners are expected to question the assumptions presented by the instructor and those of the other students, as well as their own assumptions and ideas. In so doing, learners in the online classroom are constructing new forms of knowledge and meaning. By engaging in the learning process in this way, learners are learning about learning as well as gaining research and critical thinking skills (Palloff and Pratt, 1999: 82)

Can student access to a lecturer and fellow students for academic help purposes be maximised without additional costs on part of a student?

As reported in the student perspective section, students did not have to see the lecturer face-to-face, time and space restrictions were no longer valid. The fact that students were able to know what fellow students were asking and struggling with, there was access to fellow students. As indicated from the student interviews, there was access to the lecturer such that it made it worth while paying for the course. There were no additional costs incurred by students to access the lecturer or fellow students.

Conclusion

While the project attempted to answer the research questions, there are several new questions that we now ask as a result of this project, questions we could not have asked before. As we conclude this report, we pose these questions as they inform our future work on the project:

- a) What caused the Black students in Case 1 to perform exceptionally well after using the DFAQ environment? To what extent can we attribute this performance to the DFAQ? These questions are asked because if we can understand what caused or influenced that performance, it is both in our interest and that of students to encourage that factor to sustain performance.
- b) We had observed some incremental improvement in Case 2 class of 2003 over the 2002. Student interviews confirmed that some students performed well and attributed this to the DFAQ. The impact of the DFAQ on academic performance was consequential in that it was not our research question. It goes without saying that, we do not understand how the DFAQ impacts on performance. It is therefore important for us to ask the following question: If improved performance is to some extent attributed to the DFAQ, then how is the DFAQ impacting learning?
- c) Empirical evidence from this project postulates that the DFAQ saves the lecturer time and effort in providing individualised consultation to students. However, time and effort saved is of no value unless it is deployed for some good use. Therefore, it is pertinent to ask what lecturers do with the time that is saved from consultation. To what extent is the saved time used for the benefit of students?

References

- Bowers, A. C. (1987). *The Promise of Theory: Education and the Politics of Cultural Change*, New York: Teachers College Press.
- Baskerville, R., & Wood-Harper, T. (1996). A critical perspective on action research as a method for information systems research. *Journal of Information Technology*, 11, 235 – 246.
- Cecez-Kecmanovic, D., & Webb, C. (2000). Critical inquiry into Web-mediated collaborative learning. In Aggarwal, A. (Ed.), *Web-Based Learning and Teaching Technologies: Opportunities and challenges* (pp. 307-326), Hershey: Idea Group.
- Ehrmann, S. C. (1995). Asking the Right Questions: What Does Research Tell Us About Technology and Higher Learning? Retrieved July 19, 2004 from <http://www.learner.org/edtech/rscheval/rightquestion.html>.
- Elissavet, G., & Economides, A. A. (2003). An Evaluation Instrument for Hypermedia Courseware, *Educational Technology & Society*, 6 (2), 31-44.
- Fisher, S., & Nygren, I. T. (2000). Experiments in the Cost-Effective Uses of Technology in Teaching: Lessons from the Mellon Program So Far. Retrieved July 19, 2004 from <http://www.ceutt.org/ICLT%20CEUTT.pdf>.
- Ng'ambi, D. (2002a). Dynamic Intelligent Handler of Frequently Asked Questions. In Gil, Y. and Leake, D. B. (Eds.), *Proceedings of the International Conference on Intelligent User Interfaces* (pp. 210-211), New York: ACM Press.
- Ng'ambi, D. (2002b). Using Question-Based Chat Rooms to Negotiate Varying Meanings in Non-Static Knowledge Environment. In Kinshuk, R. Lewis, K. Akahori, R. Kemp, T. Okamoto, L. Henderson & C.-H. Lee (Eds.), *Proceedings of the International Conference on Computers in Education* (pp. 278-282), Los Alamitos, CA: IEEE Computer Society.

Ng'ambi, D. (2002c). Pre-empting User Questions through Anticipation – Data Mining FAQ Lists. In Kotze, P., Venter, L. and Barrow, J. (Eds.), *Proceedings of the International Conference of the South African Institute of Computer Scientists and Information Technologists* (pp. 101-109), Port Elizabeth, South Africa: South African Institute for Computer Scientists and Information Technologists.

Nygren, I. T., & Fisher, S. (1998). *Cost-Effective uses of technology in teaching: current issues and future prospects*, Retrieved July 19, 2004 from <http://www.ceutt.org/CEUTTx98.htm>.

Patton, Q. M. (1978). *Utilization-Focused Evaluation*, California: Sage Publications.

Patton, Q. M. (1997). *Utilization Focused Evaluation: The New Century Text (3rd Ed.)*, London: Sage Publications.

Palloff, M. R., & Pratt, K. (1999). *Building Learning Communities in Cyberspace*, San Francisco: Jossey-Bass.

Stats SA (2003). *Census 2001*, Department of Statistics South Africa, Retrieved July 19, 2004 from <http://www.gov.za/reports/2003/census01brief.pdf>.

Suchman, A. E. (1977). Evaluating Educational Programs. In F. G. Caro (Ed.), *Readings in Evaluation Research* (pp. 43-48), New York: Russell Sage Foundation.

Salmon, G. (2000). *E-Moderating - the key to teaching and learning online*, London: Kogan Page.

Pedagogical Strategies to Increase Pre-service Teachers' Confidence in Computer Learning

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ABSTRACT

Pre-service teachers' attitudes towards computers significantly influence their future adoption of integrating computer technology into their teaching. What are the pedagogical strategies that a teacher education instructor or an instructional designer can incorporate to enhance a pre-service teacher's comfort level in using computers? In this exploratory report, the researcher synthesizes related literature, provides a comprehensive list of theory-based instructional strategies, and describes a study of the perceptions of 189 pre-service teachers regarding strategies related to increasing their comfort in using computers.

Keywords

Pedagogical strategy, Pre-service teacher, Computer learning, Confidence levels

Introduction

The emergence of computers and information systems is certainly the single biggest factor impacting education during the past couple of decades. Despite the proliferation of computers, there continues to exist a large number of teachers who are very uncomfortable with computers (Bohlin, 2002; Cradler & Cradler, 2001; Fletcher & Deeds, 1994; Gordon, 1995; US Department of Education, 2001). For instance, the U.S. Department of Education (2001), in their 1999-2000 Annual Performance Reports for Preparing Tomorrow's Teachers to Use Technology (PT3), emphasized that "preparing teachers to use technology effectively to improve students' learning is a major challenge facing our nation's schools." Cradler & Cradler (2001), reporting for a technology challenge grant, indicated that less than 20% of California teachers feel comfortable using technology.

Widespread teachers' discomfort regarding computers contrasts with the belief that computers hold great promise for enhancing teaching and learning. The millions of dollars being poured into the purchase of computers for schools may be wasted if large numbers of teachers avoid using computers. To properly and effectively integrate computer technology into the classroom daily curriculum, teachers need to have the confidence and positive attitudes toward computers that will motivate them to integrate computers into their instructional strategies.

It is true that simply making technology available does not produce an appropriate use of technology. Assuming that a sound teacher education program with a couple of required computer courses will change pre-service teachers' anxiety, confidence level, or attitude towards computers is a big mistake.

Obviously, pre-service teachers' attitudes are strong predictors of their future actual voluntary behaviors or decisions regarding the integration of technology into their teaching. If computer anxiety is combined with low confidence, low motivation, or negative attitudes, individuals will strive to avoid interactions with computers (Bohlin, 2002).

Students' achievements in computer skill learning are certainly associated with their anxiety or avoidance levels. Researchers (Morgan, 1997) have firmly claimed that stress and anxiety reduce performance effectiveness. Although a moderate level of anxiety can be healthy in most students as it indicates an interest in what they are doing, students certainly will gain the most through learning computer skills with comfort and confidence. Therefore, it is imperative for computer teachers or instructional designers to know the pedagogical strategies that can reduce students' anxiety/avoidance in learning computer skills and increase their comfort level.

Purpose of the Study

The purpose of the study is twofold: to provide systematic theory-based pedagogical strategies that are believed to be able to make positive changes on learners' attitudes towards computers, and investigate practical instructional strategies that can increase pre-service teachers' comfort levels toward computers. Understanding theory-based pedagogical strategies to increase computer learners' learning with technology is essential; however, it is even more important to identify which practical instructional strategies are needed by computer learners. The practical instructional strategies include tactics that have helped computer instructors or instructional designers to better assist their students in learning with computer technology as well as the methods that computer instructors can provide for pre-service teachers to better prepare themselves in learning with new computer skills. Specific research questions consist of the following:

1. What theory-based pedagogical strategies for reducing learners' anxieties in learning computers have been offered in the literature?
2. What pedagogical strategies can an instructor incorporate to alleviate pre-service teachers' avoidance of computers and what advice or method can a computer instructor provide to increase students' comfort levels in using computers?

Affective Constructs toward Computers

A review of the literature suggests two major affective constructs regarding learners' computer use: positive feelings and negative feelings. Positive constructs include motivation, confidence, satisfaction, and so forth. On the other hand, students' negative feelings associated with computers include anxiety, frustration, stress, fear, embarrassment, irritation, and so on. Investigating both perspectives of the literature could offer some insight into ways that instructors and instructional designers might help learners to better adopt computers as tools to enhance teaching and learning.

Most of the literature related to learners' affective feelings toward the computer focuses on studying the impact of computer anxiety (Bohlin, 2002; DeLoughry, 1993; Elder et al., 1987, Howard & Smith, 1986; Igbaria & Chakrabarti, 1990; Morgan, 1997; Orr, 1997; Tseng et al., 1997). Similar terms, such as "computer avoidance" (Bohlin, 2002), "computer aversion" (Bohlin, 2002), and computer stress, were used to investigate the associated issues. Few researchers investigated the impact of learners' positive feelings such as motivation, confidence levels, and a satisfaction index toward computers. The most popular theory on the impact of positive affection in learning with computers was the ARCS (Attention, Relevance, Confidence, and Satisfaction) model proposed by Keller (1987; 1999). To better address the impact of learners' affective constructs on their learning with computers, the author reviewed literature from both viewpoints.

Negative Attitudes: Computer Anxiety/Avoidance/Aversion

Although computer anxiety plays a powerful influence on a learner's use of computers, there has been little or no agreement on the definition of computer anxiety. Howard & Smith (1986) defined computer anxiety as the "fear of impending interaction with a computer that is disproportionate to the actual threat presented by the computer." Orr (1997) indicated that "those who are computer anxious may experience fear of the unknown, feeling of frustration, possible embarrassment, failure and disappointment."

Bohlin (2002) used the term "computer avoidance" instead of computer anxiety. He defined computer avoidance as "an overall feeling of aversion to using computers based upon the emotions, attitudes, and motivation levels of the individual." Computer stress is another similar term borrowed from the physical sciences and refers to a situation containing stimuli that arouse uneasiness (or "tension") in a person while dealing with a computer. When this uneasiness is the result of a specific, known, and immediate threat, it is called "computer fear" (Bohlin, 2002).

Bohlin (2002) concluded that the link from the factors of negative attitudes and high anxiety to an individual's avoidance of computers was known to be a strong one. Researchers (Howard & Smith, 1986; Igbaria & Chakrabarti, 1990; Morgan, 1997) have also established firmly that stress and anxiety reduce performance effectiveness, and stress might cause some individuals to avoid using computers completely.

A literature review on teachers' computer anxieties indicates that a great number of K-12 teachers have been influenced by uncomfortable feelings toward computers. For example, Fletcher and Deeds (1994), in their study

with secondary agriculture teachers, found that 40.9% of them suffered from computer anxiety. Another study by Gordon (1995) also found that 46% of technical education teachers suffer from computer anxiety. Medcalf-Davenport (1998) studied the attitudes, beliefs, and preparation of in-service teachers, pre-service teachers, and student teachers regarding the uses and integration of technology into the classroom and curriculum in elementary, middle, and high schools in four school districts in San Antonio, Texas. She found that there was still resistance and fear in the integration of anything new into the classroom. Moreover, teachers did not recognize the usefulness or necessity of using technology for teaching and learning. Bohlin (2002) further concluded that computer avoidance was very common in teachers and could strongly interfere with their instructional choices.

Yet, with the gradual rise in popularity of computer technology in libraries, classrooms, and school settings, teachers with negative feelings toward computers find it more and more difficult to work in environments that are free of computers. Furthermore, there is a strong demand for enhanced pre-service and in-service computer training (US Department of Education, 2001; Cradler & Cradler, 2001).

Research indicates that teachers' confidence levels towards computer use can be increased by experience and training. Bradley and Russell (1997) found that computer anxieties were inversely related to the quality of prior computer learning experiences. Dyke & Smither (1992) similarly concluded that students' negative feelings would decrease by increasing their computer experience. Shirley (1996), in her study of the computer literacy and computer anxiety of junior high teachers, emphasized the importance of training and continuous on-site support.

Positive Feeling: Computer Attitudes/ Confidence

A review of the literature indicates that there has not yet been a study of learners' positive feelings toward computer use. However, some educational theorists and researchers have provided different theory-based pedagogical strategies to increase learners' motivation or confidence levels in learning computers. Researchers used the term "computer attitudes" or "computer confidence" instead of learners' positive feelings toward computers. Bohlin (2002), defined attitude as "a way of being set for or against something." He emphasized that the definition includes a motivational perspective, e.g., the individual's beliefs and cognitions. "In this sense, learned cognitions have colored an individual's perceptions about computers; a change in the individual's attitude toward and response to computers will require a change in the individual's cognitions about them (Bohlin, 2002)." Therefore, understanding theories and factors related to attitude change could assist in identifying strategies and prescriptions for changing learners' attitudes towards computers.

Theory-based Pedagogical Strategies

The importance of designing instruction to reduce anxiety-related fears toward computers has been stressed in the literature. Theory-based strategies include Bandura's confidence-building strategies (1988), Martin and Brigg's social learning theory (1986), and Keller's ARCS model (1987). A few other researchers, such as Bohlin (2002), Tobias (1979), and Bohlin, Milheim and Viechnicki (1993), have also proposed some instructional strategies to increase computer learners' motivation in using computers. The literature review provides pedagogical strategies for computer education instructors to increase pre-service teachers' attention, alleviate pre-service teachers' avoidance of computers, and increase pre-service teachers' confidence in working with computers.

Bandura (1989) argued that an important factor in the reduction of anxiety was confidence in one's ability to cope with a stressful situation. "People tend to avoid activities and situation they believe exceed their coping capabilities" (Bandura, 1989, p. 1178). Bandura (1988) identified several strategies to increase learners' levels of coping efficacy, including modeling of coping strategies, breaking steps into progressively more easily mastered steps, and providing guided mastery experiences. He emphasized that guided mastery experiences were especially effective after learners had gained the ability to exercise personal control under the stress. He suggested when introducing new computer skills, instructors should provide assignment guidance for their learners, should break each computer skill into several specific steps, and should make sure learners have mastered the newly introduced skill before another skill would be introduced.

Martin and Briggs' (1986) social learning theory was one of the most widely recognized theories of behavior change and attitude change. Their theory defined attitude as one type of behavior that heavily depended on

individuals' interaction with each other or with the environment. The theory focused on the importance of reinforcement and cognitive processes such as attention, remembering, and motivation that helped the individual define, discriminate, and generalize environmental stimuli. The theory suggested that behavior change could occur as a result of (1) directly experiencing the consequences of one's behavior, e.g., by direct reinforcement or by extinction; (2) watching the consequences of someone else's behavior, called modeling or vicarious learning; (3) reading or hearing about the consequences of a behavior and inferring a causal relationship; and (4) making associations that arouse emotions. They recommended that computer education instructors should apply strategies that could attract learners' attention, provide opportunities to discuss ways of coping with negative emotions about computers, and encourage learners to express a range of emotional reactions to situations.

Keller (1987) identified four categories of motivation in learning situations: Attention, Relevance, Confidence, and Satisfaction (ARCS). Keller's ARCS model contained specific methods or strategies that were aimed at producing motivational outcomes when learners were lacking sufficient interest or motives. The pedagogical strategies in his ARCS model included strategies to increase learners' attention, strategies to increase the relevance of subject matter, strategies to increase learners' confidence, and strategies to increase learners' satisfaction.

On the other hand, Bohlin (2002) also suggested several pedagogical strategies to decrease learners' anxiety when working with computers. The pedagogical strategies that he recommended could be classified into five categories: strategies to stimulate the learners' interest, strategies to meet the learners' personal needs, strategies to satisfy the learners and promote continuing motivation, strategies to relieve learners' anxiety, and strategies to decrease negative attitudes toward computers.

Although the pedagogical strategies proposed in Keller's ARCS model and Bohlin's model had different focuses (Keller's proposed strategies could be used for any instruction; however, Bohlin's strategies intended for decreasing learners' anxiety when working with computers.), there were several common pedagogical practices in their models. Table 1 illustrates the common pedagogical strategies in Keller's ARCS model and Bohlin's model.

Table 1: The Common Pedagogical Strategies in Keller's ARCS Model and Bohlin's Model

Strategies to increase learners' attention and motivation	Strategies to increase the relevance of subject matter and to meet the learners' personal needs	Strategies to increase learners' confidence and relieve learners' anxiety	Strategies to increase students' satisfaction
Instructors should 1. provide information that captures the interest and attention of the learner. 2. use problem solving activities or let learners choose topics for study or projects.	Instructors should: 1. show the learners how the material they learn would be useful to them, 2. allow opportunities for practical application of the content, 3. demonstrate to the learners how they will personally benefit from the knowledge acquired in the class, 4. provide opportunities to work with other learners to provide for those with a high need for affiliation, and 5. make the subject matter seem important, and make learners feel curious about the subject matter.	Instructors should: 1. give clear and thorough feedback to work, 2. provide positive consequences be a part of good performance, and 3. make sure that the difficulty level stretches the learners but doesn't create too much stress.	Instructors should: 1. provide small easily managed sections with frequent opportunities for hands-on practice to reduce dependence upon memory and improve expectancy for success. 2. provide early experiences that are in a low-risk environment, and 3. state clearly the requirements for successful completion.

Tobias (1979) suggested that anxiety interferes most with learning before and during information processing by the learner. She explained that before the learner processed information, anxiety acted as a diversion away from attention. During information processing, anxiety directly interfered with cognitive processing by the learner. At

post-processing, anxiety played a much lesser influence on the learner's learning. Based on her theory, Tobias made recommendations regarding instruction that were expected to reduce the anxiety effects on learning. She suggested that instruction for anxious learners should allow learners to repeat content and reduce the extent to which learners must rely on memory. Providing opportunities for learners to do hands-on experiences could reduce the learners' anxiety towards the computer.

Bohlin, Milheim and Viechnicki (1993) suggested that instructional strategies for the motivation of pre-service and in-service teachers should focus on how to make learning about and using computers more interesting. Their proposed strategies were aimed at clearly communicating the benefits of using computers and matching experiences with learners' personal needs.

The theory-based pedagogical strategies related to increasing learners' confidence levels in using computers primarily came from the theorists' belief (Bandura, 1988; Bohlin, Milheim, & Viechnicki, 1993; Bohlin, 2002; Keller, 1987; Tobias, 1979), yet no research has been found to investigate computer learners' beliefs. Specifically, researches on pre-service teachers' perspectives regarding what effective instructional strategies or activities and what methods a computer instructor could apply to increase their confidence levels in learning with the technology have not been found. This was why the current research was conducted.

Methodology

The Development of the Survey

To study the pedagogical strategies that instructors can incorporate into their teaching and the advice that instructors can give to their students, the author designed and developed a questionnaire to collect information from the two perspectives: the instructors' pedagogical strategies and the methods of improving learners' learnabilities. Therefore, questions in the survey (See Appendix A.) were divided into two categories: pedagogical strategies that a computer instructor may apply, and methods that computer learners should use to increase their comfort level towards the technology.

There were nine popular strategies in the first category. The nine popular pedagogical strategies listed in the first session of the questionnaire were based on instructional activities proposed by theorists in the literature review. The seven methods in the second category were based on a pilot interview with a small group of pre-service teachers. At the end of each category in the survey, an open-ended area that allowed participants to fill in their thoughts was provided. Participants were asked to check the three most essential strategies in each category.

Data Collection

The survey was given to pre-service teachers who were taking one of seven sessions of advanced classroom computer technology classes in the summer and fall of 2002 at a large state university in Northern California. On the first day of each class, the author asked pre-service teachers to complete voluntarily an anonymous questionnaire regarding strategies to increase learners' comfort levels in using computers. There were approximately 30 students in each class. 189 pre-service teachers completed the questionnaire, a response rate of 90%.

All of the 189 pre-service teachers took a beginning computer literacy course prior to the survey. In fact, all California pre-service teachers are required to take two different levels of computer classes before they can receive their teaching credentials. The author believed that with prior computer experience, the learners would be able to provide more accurate and concrete ideas about what they believed to be the effective pedagogical strategies to increase their positive attitude towards computers.

Results

According to the collected data, most of the pre-service teachers (92.6%) believed that demonstrating computer assignment samples was the most important strategy that an instructor should apply. The second important pedagogical strategy (81.4%) was that computer instructors should let students do individual hands-on computer engagement activity. Third, 77.7 % believed that visual demonstration of the computer skills with a data

projector was an important pedagogical strategy. Having students do cooperative group computer activity or working with a partner was considered by 74.7% of the participants to be important.

Table 2 indicates the specific findings regarding the importance of various instructional pedagogies from the survey.

Table 2: Percentage of pre-service teachers' ranking of the importance of instructional pedagogies that an instructor should use in a computer course

Pedagogical Strategies	Percentage of pre-service teachers considering the importance of the strategies
Demonstrate computer assignment samples.	92.6%
Have students do individual hands-on computer engagement activity.	81.4%
Give a visual demonstration of the computer skills with a data projector.	77.7%
Have students do cooperative group computer activity, working with a partner.	74.7%
Before new computer skills are introduced, the instructor reviews related computer skills first.	48.1%
Give an oral demonstration of the computer skills.	44.4%
Provide oral support in the use of computers.	33.3%
The instructor applies a humorous tone in his/her teaching.	22.2%
The computer skill that the instructor demonstrates is useful in the job market.	22.2%

As to what advice a computer instructor could give students to better prepare for the course, pre-service teachers had a greater diversity of opinions than they did regarding the importance of instructor's pedagogical strategies. Nearly three-quarters of the participants believed that it was very important for learners to have prior knowledge about certain computer skills. 70.3% of participants believed that having a nice computer at home that could do the tasks that the computer course required, and having a friend or relatives who knew computers well were very helpful in increasing their comfort levels in using computers. It was interesting to find that 44.4% of pre-service teachers believed that it was important to understand what computer skills you already knew, and what new computer skills that you needed to know. 40.7% of students considered it important to have taken computer classes before, and only 22.2% of students believed having prior experiences of playing computer games was important. Table 3 is a list of the percentages and associated methods or status.

Table 3: Percentage of pre-service teachers considering the importance of methods or status that they should possess in order to increase their comfortable levels in using technology

Methods that make students feel comfortable in learning with computers	Percentage of pre-service teachers considering the importance of the methods
Have prior knowledge about certain computer skills.	74.1%
Have a nice computer at home that can do the work that a computer instructor requires.	70.3%
Have a relative or a friend who knows computers well.	70.3%
Understand what computer skills you know, and what new computer skills that you need to know.	44.4%
Have taken computer classes before.	40.7%
Have prior experiences playing computer games.	22.2%

Discussion

Since the study investigated teaching strategies that a computer instructor should apply and methods that a learner could use in order to increase their confidence levels in using computers, the author discussed the finding from the two perspectives

Teaching Strategies for Computer Instructors

Although there were a lot of teaching strategies being considered important for computer instruction, the following discussion of the study only focuses on the four most important pedagogies that were found in this study. That is because findings in this study indicated that the four strategies were considered imperative by over 50% of the participants.

The study found that pre-service teachers considered that demonstrating computer assignment samples was the most important pedagogical strategy that a computer instructor should apply. Most of them commented that through demonstrating the assignment samples, they gained a concrete idea about what they needed to do and what were the instructor's expectations. The finding corresponds to Keller's ARCS model that suggested applying "expectations" as a strategy to increase learners' confidence. Keller defined expectations as instructors letting learners set realistic goals and know the likelihood for success at different levels of difficulty. Bohlin (2002) also suggested that to relieve learners' anxiety when working with computers, one of the strategies was to state clearly the requirements for successful completion.

The second important teaching strategy found in this study was to have students do individual hands-on computer engagement activities. Participants in the study responded that individual hands-on computer activities allowed them to practice, engage, and reinforce the newly introduced skills. Researchers such as Keller (1999), Bohlin (2002), and Tobias (1979) also suggested similar pedagogical strategies. Keller indicated that allowing learners to practice under safe conditions could help them to build self-confidence. Bohlin and Tobias both also suggested using the strategy; however, they emphasized the importance of allowing learners to repeat content and reduce the extent to which learners had to rely on memory.

The third important teaching strategy found in this study was that the instructor should visually demonstrate the computer skills that were going to be introduced with a data projector. The visual demonstration of a new computer skill helped learners understand the process and procedure to operate or manage the new skill. Some participants stated that it was very good for visual learners. The strategy was also reflected in Keller's ARCS model, which indicated that to increase learners' confidence, instructors should specify learning requirements. According to Keller's interpretation, learning requirements mean that when teaching, instructors should make sure that all of the learners clearly know the lesson that is being taught.

The fourth important pedagogical strategy found in this study was to have students do cooperative group computer activities. Participants in the study commented that doing group computer activities allowed team members to brainstorm the new computer skills and to learn from each other. The findings responded to the social learning theory proposed by Martin and Briggs (1986). Social learning theory focuses on interaction among learners. Interaction facilitates learners' behavior and attitude changes. By adapting cooperative group activities, computer instructors could help pessimistic computer learners in changing their attitudes toward the use of computers.

Table 4 provides a comparison between findings of the pedagogies and those of theory-based strategies:

Table 4: A comparison of theory-based strategies and practical pedagogical strategies

Important pedagogical strategies found in this study	Corresponding theory-based strategies suggested by other theorists
To demonstrate computer assignment samples.	1. Keller's ARCS model suggested applying "expectations" as a strategy to increase learners' confidence. Keller defined expectations as instructors let learners set realistic goals and know the likelihood for success at different levels of difficulty. 2. Bohlin (2002) suggested that to relieve learners' anxiety when working with computers, one of the strategies should be to state clearly the requirements for successful completion.
To have students do individual hands-on computer engagement activity.	1. Keller indicated that allowing learners to practice under safe conditions could help them to build self-confidence. 2. Bohlin and Tobias both suggested the strategy to allow learners to repeat content and reduce the extent to which learners had to rely on memory.
To visually demonstrate the computer skills.	Keller's ARCS model indicated that to increase learners' confidence, instructors should specify learning requirements. This means that when

	teaching, instructors make sure that all of the learners clearly know the lesson that is being taught.
To have students do cooperative group computer activities.	Martin and Briggs' (1986) social learning theory emphasized the importance of modeling to facilitate students' behavior change.

Methods of Improving Computer learners' Learnability

Discussion of methods or means for computer learning only focused on the three most important strategies found in this study because findings in this study indicated over 50% of the participants believed that the strategies were essential to increase learners' confidence levels in using computers.

The most important means of reducing a computer learner's anxiety was to provide them with knowledge about certain computer skills. Participants in the study indicated that having prior knowledge about computers helped them feel comfortable enough to learn new computer skills. This implied that computer instructors could advise their students to prepare themselves by playing with computers prior to taking a computer course or before each class meeting period. The finding reflected one of the suggested activities in Keller's ARCS model. The strategy is that an instructor should let learners know how the lesson will utilize their present skill or prior knowledge to increase the relevance of subject matter.

The second important means that pre-service teachers believed would increase their confidence levels in learning with computer skills was to have a nice computer at home that could do the work that the instructor required. Participants indicated that being able to practice the newly introduced computer skills from a home computer made them feel comfortable and allowed them to practice at a convenient time. A participant commented: "It makes a big difference to have a powerful computer at home that can do all of the assignments required in a computer class." The finding justified the reason that more and more universities, colleges, or even high schools have programs to loan out laptop computers for their students.

The third important means of improving learning new computer skills was to have a relative or a friend who knows computers well. Pre-service teachers in this study stated that having a relative or a friend who knew computers well could assure their home computers function as required so that they were able to complete their assignments. Sometimes, friends or relatives who were competent with computers could serve as a mentor to help them in advancing their assignments. Ages of friends or relatives who were competent with computers were not an issue. A few participants indicated that they even got assistance from their school-age children.

Implications and Conclusions

It was important to understand theory-based pedagogical strategies to increase computer learners' learning with technology; however, it was even more important to identify essential practical instructional strategies needed by computer learners. The argument was based on two reasons. First, theory-based strategies provided a list of detailed, inclusive, and systematic methods for instructors and instructional designers; however, practical strategies offered just-in-time methods. Second, theory-based strategies did not prioritize the importance of different strategies; yet the importance of different pedagogical strategies varies in real life teaching, particularly teaching with computers.

This study ranked the importance of different pedagogical strategies. It offered computer instructors and instructional designers a quick solution to design and carry out effective instruction. Theory-based strategies provided a comprehensive list of inclusive systematic pedagogical strategies instead of the most needed strategies in daily teaching. Teaching is an ongoing, reciprocal, creative, and time consuming process. Most of the time, teachers do not have time to review all of the theory-based strategies before they design and carry out their lessons.

On the other hand, pedagogical concepts, such as student-centered learning and meta-cognition, which address the importance of learners being aware of what they have known and have not known in their learning processes, are very popular at present. If a computer instructor could provide advice or methods to empower his/her learners' learning with computers, the advice certainly would increase their confidence levels in integrating computers for their future teaching.

The study concluded that when teaching pre-service teachers computer skills, a computer instructor should:

1. demonstrate computer assignment samples which provide guidance for learners and help learners to clarify requirements for successful completion of assignments,
2. have students do individual hands-on computer engagement activities,
3. provide visual demonstration of the computer skills with a data projector, and
4. have students do cooperative group computer activities.

To increase students' confidence in using computers, instructors could also provide helpful advice for their students, such as:

1. having prior knowledge about certain computer skills: to have prior knowledge about certain computer skills, pre-service teachers could take a preliminary computer class first, or self practice computer skills before each class.
2. having a nice computer at home that can do the works that the instructor requires: a nice home computer should have pre-installed software that allow pre-service teachers to practice the newly introduced computer skills. If a pre-service teacher does not have a computer at home, he/she might consider using some computer loan-out programs provided by universities or schools; or he/she should try to have easy access to a computer that could do the course work.
3. having a relative or a friend who knows computers well: a relative or a friend who is competent in computers should be able to assure a pre-service teacher's computer function as required and should have an understanding of computer skills introduced in computer courses. With possession of such computer skills, a relative or a friend could offer assistance for a pre-service teacher to successfully complete their assignments.

References

Bandura, A. (1988). Self-efficacy conceptions of anxiety. *Anxiety Research*, 1, 77-98.

Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist*, 44, 1175-1184.

Bohlin, R. (2002). Avoiding Computer Avoidance, Retrieved on July 19, 2004 from <http://it.coe.uga.edu/itforum/paper35/paper35.html>.

Bohlin, R. M., Milheim, W., & Viechnicki, K. (1993). Factor analysis of the instructional motivation needs of adult learners. *15th Annual Proceedings of Selected Research and Development Paper Presentations at the 1993 Annual Convention of the Association for Educational Communications and Technology*, 177-191.

Bradley, G., & Russell, G. (1997). Computer experience, school support, and computer anxiety. *Educational Psychology*, 17 (3), 267-84.

Brosnan, M. (1998). The impact of psychological gender, gender-related perceptions, significant others, and the introducer of technology upon computer anxiety in students. *Journal of Educational Computing Research*, 18 (1), 63-78.

Cambre, M. A., & Cook, D. L. (1984). Computer Anxiety: Definition, Measurement, and Correlates. *Paper presented at the Annual Meeting of the American Educational Research Association*, April 23-27, 1984, New Orleans, LA, USA.

Cradler J., & Cradler, R. (2001). *Improving California Schools: Meeting the Challenge with Technology*, Atlanta, Georgia: NetSchools Transforming Education.

Deloughry, T. J. (1993). Researchers Say "Technophobia May Afflict Millions of Students". *The Chronicle of Higher Education*, April 28, A25-A26.

Dyck, J. L., & Smith, J. A. (1992). Computer Anxiety and the Older Adult: Relationships with Computer Experience, Gender, Education and Age. *Proceedings of the Human Factors Society 36th Annual Meeting*, Atlanta, GA.

Fletcher, W. E., & Deeds, J. P. (1994). Computer anxiety and other factors preventing computer use among United States secondary agricultural educators. *Journal of Agricultural Education*, 35 (2), 16-21.

- Gaudry, E., & Spielberger, C. (1971). *Anxiety and Educational Achievement*, Sydney: Wiley.
- Gordon, H. R. (1995). Analysis of the computer anxiety levels of secondary technical education teachers in West Virginia. *Journal of Studies in Technical Careers*, 15, 21-29.
- Howard, G. S., & Smith, R. (1986). Computer anxiety in management: Myth or reality? *Communications of the ACM*, 29, 611-615.
- Igbaria, M., & Chakrabarti, A. (1990). Computer anxiety and attitudes towards microcomputer use. *Behavior and Information Technology*, 9, 229-241.
- Igberia, M., Pavri, F., & Huff, S. (1989). Microcomputer applications: an empirical look at usage. *Information and Management*, 16, 187-196.
- Johanson, R. P. (1985). School computing: Some Factors affecting student performance. *Paper presented at the meeting of the American Educational Research Association*, April, 1989, Chicago, IL.
- Keller, J. M. (1983). Motivational design of instruction. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: An overview of their current status*, Hillsdale, NJ: Lawrence Erlbaum.
- Keller, J. M. (1987). Development and Use of the ARCS Model of Motivational Design. *Journal of Instructional Development*; 10 (3), 2-10.
- Keller, J. M. (1999). Using the ARCS Motivational Process in Computer-Based Instruction and Distance Education. *New Directions for Teaching and Learning*, 78, 39-47.
- Keller, J. M., & Kopp, T. (1987). Applications of the ARCS model of motivational design. In C. M. Reigeluth (Ed.), *Instructional theories in action: Lessons illustrating theories and models*, Hillsdale, NJ: Lawrence Erlbaum.
- Keller, J. M., & Suzuki, K. (1988). Use of the ARCS model in courseware design. In D. H. Jonassen (Ed.), *Instructional designs for computer courseware*, New York: Lawrence Erlbaum.
- Martin, B. L., & Briggs, L. J. (1986). *The affective and cognitive domains: Integration for theory and research*, Englewood Cliffs, NJ: Educational Technology.
- McInerney, V., McInerney, D. M., & Sinclair, K. E. (1990). Computer Anxiety and Student Teachers: Interrelationships between Computer Anxiety, Demographic Variables and an Intervention Strategy. Paper presented at the Australian Association for Research in Education Annual Conference, Sydney, Australia.
- Medcalf-Davenport, N. A. (1998). Historical and Current Attitudes Toward and Uses of Educational Technology: A Work in Progress. *Paper presented at the 3rd World Conference of the WWW, Internet and Intranet*, November 7-12, 1998, Orlando, FL.
- Morgan, A. (1997). *Computer Anxiety: A Survey of Computer Training, Experience, Anxiety, and Administrative Support Among Teachers*, Retrieved July 19, 2004 from <http://oas.okstate.edu/ojas/amorg.htm>.
- Orr, L. (1997). *Computer Anxiety*, Retrieved July 19, 2004 from <http://www.usm.maine.edu/~com/lindap~1.htm>.
- Rosen, L. D., Sears, D. C., & Weil, M. M. (1987). Computerphobia. *Behavior Research Methods, Instruments and Computers*, 19, 167-179.
- Shirley, R. (1996). Improving Junior High School Teacher Computer Literacy through the Use of an Electronic Gradebook. *Eric Digest* 394515.
- Tobias, S. (1979). Anxiety research in educational psychology. *Journal of Educational Psychology*. 71, 573-582.
- U.S. Department of Education (2001). *Analysis of the 1999-2000 Annual Performance Reports for Preparing Tomorrow's Teachers to Use Technology*, Retrieved July 19, 2004 from <http://www.ed.gov/offices/OUS/PES/higher.html#pt3>.

Appendix A: Technology Survey

In what way, you will feel more comfortable in using computers?

(Mark all that apply and rank the top three activities that you believe can most reduce your anxiety in working with computers, and please state your reasons.)

a) Instructor's pedagogy

Pedagogy	Why do you think it is important?
☐ Oral demonstration of the computer skills.	
☐ Give a visual demonstration of the computer skills with a data projector.	
☐ Have students do individual hands-on computer engagement activity.	
☐ Have students do cooperative group computer activity.	
☐ Provide oral support in the use of computers.	
☐ Demonstrate computer assignment samples.	
☐ The instructor applies a humorous tone in his/her teaching.	
☐ Before new computer skills are introduced, the instructor reviews related computer skills first.	
☐ The computer skill that the instructor demonstrates is useful in the job market.	
☐ Others, please list:	

b) Students' Perspectives

Methods/Status	Why do you think it is important?
☐ Have a nice computer at home that can do the work that the instructor requires.	
☐ Have a relative or a friend who knows computers well.	
☐ Have prior experiences playing computer games.	
☐ Have prior knowledge about certain computer skills.	
☐ Understand what computer skills you have known, and what new computer skills that you need to know.	
☐ Took other computer classes before.	
☐ Took two or more computer classes at the same time.	
☐ Others, please list:	

Factors Contributing to the Successful Implementation of Technology Innovations

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ABSTRACT

This paper reports the results of a study into the conditions that facilitate the implementation of instructional innovations. One hundred seventy-nine participants completed an online instrument designed to determine the relative importance of eight conditions shown to facilitate implementation. This paper describes the construction and testing of the instrument and the value of its role in measuring implementation profiles. Means and standard deviations of profile scores are reported for the overall sample, by gender and by occupational groups. A factor analysis was conducted to determine if the eight conditions had any underlying relationship. The results from this analysis produced four factors. The discussion describes the four factors as well as additional research questions that result from the findings.

Keywords

Innovation, Implementation, Technology, Change

Factors Contributing to the Successful Implementation of Technology Innovations

In recent years, instructional designers have taken a more active role in the change and implementation of innovation. This trend places designers in the role of change agents and implementers of innovations, as well as, requires that they become more familiar with variables that can influence the implementation of both instructional and non-instructional innovations.

The instructional design process is often thought of having five phases: Analysis, Design, Development, Implementation, and Evaluation. This process, often called the "ADDIE Model," is familiar to most instructional designers. The activities or practices associated with each phase provide guidance for the development of an instructional product. However, the ADDIE model provides little guidance on implementing a completed product or innovation. As a result, innovations designed to solve instructional or performance problems often fail during product implementation resulting in the loss of time, effort and money. To compensate for the lack of implementation guidance of the ADDIE model, others have suggested strategies for increasing successful implementation. Farquhar and Surry (1994) propose conducting an adoption analysis as part of the instructional design process. They recommend that designers and developers of instructional products consider the social context in which the product will be used. They identify two main factor groups, organizational factors and individual factors that must be assessed before and during product design and development. Tessmer (1991 & 1990) emphasized the need to study the learning environment as a means of increasing utilization. He identified two main environmental factors to analyze before design and development of a product - the instructional environment and the support environment. The environmental analysis assesses who will use the product, how the product will be used, where it will be used and how it will be maintained. These two methods attempt to address the issues surrounding the change process in particular the factors that will influence the utilization of the instructional product.

Change Theories, Models, and Strategies

Instructional designers need to have an understanding of change theory in order to facilitate the successful implementation of their products. Change theory isn't one unified, universally accepted theory, but rather a broad family of theories. One of the most widely accepted researchers and theorists in this field is Everett

Rogers. Three commonly referenced ideas of Rogers' include his innovation–decision process, the attributes of the innovation, and the adopter categories.

Rogers' innovation–decision process provides a basic model for change. It consists of five steps that typically occur in sequential order. This process involves gaining awareness of the innovation, forming either a positive or a negative opinion about the innovation, choosing to adopt or reject the innovation, using the innovation, and seeking evidence that supports the decision to adopt or reject the innovation (Rogers, 1995).

Along with a process for adoption, Rogers provides a theory of how the innovation itself can affect this process. He identified five attributes of innovations that influence the decision to adopt an innovation. These attributes are relative advantage, compatibility, complexity, trialability, and observability (Rogers, 1995).

In addition to the attributes of the innovation, the traits of an individual or group can also influence the rate of the adoption. Rogers identified five adopter categories (i.e. innovators, early adopter, early majority, late majority, and laggards) that have different social and psychological characteristics. Research indicates that the adopter categories approximate a bell shape curve within a social system (Rogers 1995).

Havelock and Zlotolow's (1995) CREATER model gives change agents a guide for developing implementation plans or change strategies by providing them with a series of steps and strategies that allow them to develop relationships, identify resources and define problems and solutions, as well as assist in the implementation of the solution.

Hall and Hord's Concerns-Based Adoption Model (CBAM) incorporates eight levels of use that can be assessed to determine the progress of the implementation. The model also has seven levels of concern that an innovation moves through sequentially. These levels of concern address affective issues related to the process of adopting and implementing an innovation. Each level of use is associated with one of the stages of concern. (Ellsworth, 2000).

Stockdill and Moreshouse (1992) identified five factors (i.e. "educational need," "user characteristics," "content characteristics," "technological considerations," and "organizational capacity" p. 57). The factor, "organizational capacity," refers to the variables within the organization that influence the adoption of an innovation. These include "staff," "linkages," "equipment," "expertise," "rewards," and the "attitudes and values of the individuals" (p.57).

The User Oriented Instructional Development (UOID) process contains five steps that focus on identifying the intended users, assessing the needs of the user, incorporating user feedback suggestion into the product, and assisting in product adoption and implementation. In the final step the designer works to support the implementation by establishing "moral support," "tactical support," "training support," and "material support" (Burkman 1987, p.450.).

The field of business also has models and strategies intended to assist in the implementation of innovation and change within an organization. Many of these models and strategies have processes similar to those in education.

Kotter (1996) presents an eight-step process. The first four steps deal with creating a change environment and breaking down the status quo. Steps five through seven focus on establishing new methods for producing the desired change. Step eight centers on institutionalizing the change.

Klien and Sorra (1996) describe factors that influence implementation of innovations or change. Among these is the "climate for implementation" which involves variables such as the existing skills and knowledge of employees, positive reinforcement for the use of the innovation, and the removal of obstacles that would reduce the use of the innovation.

Variables Related to Implementation

While the focus of change research has traditionally been on adoption (the initial decision to begin using an innovation), much of the recent research in this area has been related to implementation (Surry & Ely, 2001). Implementation is the process of introducing an innovation into an organization and fostering its use.

Along with specific strategies and models for change, researchers have looked at the variables that influence the success or failure of implementing an innovation within an organization. Bishop-Clark and Grant (1991) recommend “top-down” implementation when introducing computer technology in education. Top-down refers to the involvement of powerbrokers who provide a plan that includes needed resources, support, as well as follow up to ensure the technology is being used correctly (p. 321). Dhanarajan (2001) found the lack of existing infrastructure (i.e., resources), lack of commitment from powerbrokers, low level of skills, and the need to train intended users influenced implementation. Dalton (1989) emphasized the importance of training for the adoption and diffusion of computers in schools. Herson, et al. (2000) listed knowledge and skills of users, involvement of the intended users in the development of the product, and a perceived need to change old methods as factors that influenced implementation. Jost and Schneberger (1994) used information system models as a basis for implementing educational technology. Using this strategy they determined that support from upper level management in the form of “funding”, “job redesign”, “rewards and incentives,” “operational support” and “training” was essential, along with gaining information from intended users when designing the innovation (p. 221).

Others have considered the barriers to implementing technology in education. Rose (1998) identified four groups of barriers that impact implementation of educational technologies. Ebersole and Vornddam (2003) list numerous variables affecting implementation including insufficient time, insufficient resources, lack of leadership, and lack of skills and knowledge. Rogers (2000) identified issues related to user involvement in design, insufficient time for learning or developing instruction and inadequate resources. Pajo and Wallace (2001) reduced barriers to web based technology in higher education into three factors. The first factor, labeled “personal variables,” includes variables related to inadequate time, inadequate skills, and access to training (p. 79). The second factor, “attitudinal barriers,” includes variables related to the general perception and feelings about the innovation (p.79) The final factor, “organizational barriers,” includes variables related to hardware, software, and technical support. (p. 80)

The same variables that affect implementation in education also influence implementation of innovations in business. In a study of key factors related to process innovation in industry Meyers, Sivakumar, and Nakata (1999) reported four factors related to implementation – “seller characteristics,” “buyer seller interface,” “environment,” and “buyer characteristics” (p. 303).

Sims and Sims (2002) emphasize the importance of empowering the frontline employee in the process as the means for creating successful change. Dirks, Cummings, and Pierce (1996) describe the need for developing psychological ownership by employees in order to successfully implement a change within an organization. Conger (2000) focuses on top-level management as the key group in the change process. Smith and Mouier (2000) suggest that organizations set up or adapt existing rewards and incentive programs to favor those who actively support the change, as well as involve the employees in the development of the innovation or change process.

Donald P. Ely is perhaps the most widely cited author in the area of implementation of instructional innovations. Ely’s main contribution to the literature has been the development of eight conditions that facilitate implementation. These conditions apply to both technological and process/administrative innovations. Additionally, Ely’s research indicates that the eight conditions transcend the cultural and organizational lines (Ely, 1999, 1990).

The eight conditions developed by Ely are:

1. Dissatisfaction with the status quo: refers to an emotional discomfort resulting from the use of current processes or technologies that are perceived as inefficient, ineffective or not competitive. This affective state is either self-induced or results from organizational awareness or leadership campaigning for the need to change (Ely, 1999, 1990; Surry & Ely, 2001). This condition is similar to relative advantage (Rogers 1995), establishing a sense of urgency (Kotter 1996), innovation values fit (Klien & Sorra, 1996), and matching product to users needs and values (Burkman 1987). Others citing concepts similar to dissatisfaction with the status quo include Pajo & Wallce (2001), Hernson et al. (2000), and Vrakking (1995).
2. Adequate Time: refers to the willingness for organizations to provide paid time for users to learn the new skills or procedure in order to use the innovation, as well as the user’s willingness to devote time to develop these new skills (Ely, 1999, 1990). This also represents the individual’s belief that with time they can successfully adapt to the change. Klein and Sorra (1996), Ebersole and Vornddam (2003), and Pajo and Wallace (2001) also discuss time as a an important implementation condition.
3. Resources: refers to availability and accessibility to resources needed to implement the innovation. Resources include finances, hardware, software, materials, personnel, and technological support (Ely,

- 1999,1990). This condition relates to the general infrastructure of the organization and how well that infrastructure can support the innovation. Burkman (1987) discusses the development of the necessary equipment, materials, and facilities in order to support the implementation of a new instructional product. During the management stage of the CBAM, concern is focused on developing the necessary infrastructure to support the innovation (Ellsworth, 2000). During the acquire stage of the CREATER model, the change agent identifies existing resources and that can be used during the implementation process (Havelock & Zlotolow, 1995). Equipment is considered an important variable in the “organizational capacity” factor (Stockdill & Morehouse, 1992, p. 57.) Other researchers who have identified resources as an important part of implementation include Ebersole and Vornddam (2003), Dhanarajan (2001), Okumus (2001), Pajo and Wallace (2001), and Klein and Sorra (1996).
4. Knowledge and Skills: refers to users possessing and or acquiring the needed skills and knowledge to employ the innovation. This condition also reflects users’ feelings of self-efficacy about using the innovation. Training may be a necessary part of the implementation plan (Ely 1999,1990). It is important to note that knowledge and skills not only reflect the intended users’ current level but also their belief in being able to develop the necessary skills to successfully use the innovation. The “complexity” of the innovation will affect implementation in that it will require more training or skill development by the users (Rogers, 1995). Kotter (1996) emphasizes the development of competencies in order to facilitate the change process. Varkking (1995) identifies training as part of the implementation phase. Burkman (1987) discusses “Training Support” during implementation (p. 450). Expertise is cited as one of the important factors within “organizational capacity” (Stockdill & Morehouse, 1992, p. 57). Other researchers linking knowledge and skills or training to successful implementation include: Ebersole and Vornddam (2003), Dhanarajan (2001), Okumus (2001), Pajo and Wallce (2001) Herson et al. (2000), Klein and Sorra (1996) and Dalton (1989).
 5. Rewards and Incentives: refers to either intrinsic or extrinsic rewards that result from using the innovation; these rewards vary from user to user (Ely 1999,1990). External rewards are provided to intended users as means to motivate them to employ the innovation. Rogers (1995) lists several types of incentives and discusses the role social observation and vicarious reinforcement plays in the implementation process. Burkman (1987) discusses the use of rewards as part of “moral support” during implementation (p. 450). Stockdill and Morehouse (1992) identify rewards as a significant factor in “organizational capacity” (p.57). Others citing this condition as part of implementation include: Okumus (2001), Smith and Mouier (2000), Klein and Sorra (1996), and Jost and Schneberger (1994).
 6. Participation: refers to the level of involvement stakeholders have in the decision making process to adopt and implement an innovation. Participation may take the form of user group representatives if it is difficult to get feedback from all potential users (Ely 1999, 1990). This condition helps intended users develop a sense of ownership of the innovation. “Participation in the design phase is in fact the first step of implementation” (Varkking, 1995, p. 35). Step two of the UIOD model seeks information from the product user in order to direct product development (Burkman, 1987). Participation by intended users or employees during innovation design is stressed by others as well (Sims & Sims, 2002; Hernson et al., 2001; Smith & Mouier, 2000; Myers, Sivakumar, & Nakata, 1999; Dirks, Cummings, & Pierce, 1996).
 7. Commitment: refers to “visible” support by the upper level leaders or powerbrokers. The key to this condition is how the users perceive the powerbrokers’ commitment to the implementation of the innovation. Simple verbal endorsement of the innovation by leaders and powerbrokers does not constitute commitment (Ely, 1999, 1990). Visible forms of commitment include such things as personal communication, development of strategic implementation plans, dedication of resources, and active involvement in the implementation of the innovation. Kotter (1996) discusses building a guiding coalition of powerbrokers that share the common change goal. These members must have key characteristics such as power, expertise, credibility, and leadership. Vrakking (1995) includes this as part of the implementation phase. Changes to policies and procedures can send the signal that the powerbrokers support the new product (Burkman,1987). Bishop-Clark and Grant (1991) describe “top down” implementation as powerbrokers developing plans and committing resources. Dhanarajan (2001) lists lack of commitment from university administrators as a barrier to implementation. Others emphasizing the importance of powerbrokers in the change process include: Conger (2000), Meyer, Sivakumar, and Nakata (1999), and Jost and Scherberger (1994).
 8. Leadership: refers to the level of ownership and support given by the leaders who will manage the daily activities of those using the innovation (Ely, 1999, 1990). The enthusiasm of these leaders directly affects the motivation of the users of the innovation. Immediate supervisors must provide support and encouragement, answer questions, address concerns, and serve as role models. Kotter (1996) emphasizes the need for supervisors to take an active role in supporting and communicating the change to front end workers. Varkking (1995) stresses the importance of front line managers endorsing the change or innovation. Support or championing of the innovation by supervisors is a critical variable (Ebersole & Vornddam, 2003; Meyer, Sivakumar, & Nakata, 1999; Kelin & Sorra, 1996).

Several dissertations (e.g., Bauder, 1993; Jeffery, 1993; Read, 1994; Stein, 1997; Ravitz, 1999) have investigated the importance of Ely's conditions in implementing innovations. These studies have explored the role these conditions play in implementing technological innovations, program innovations and processes innovations. These dissertations indicate that Ely's conditions do facilitate implementation. Questionnaires developed for these studies were specific to the innovation being studied and were not designed to measure profiles of intended users. To facilitate implementation, designers, as well as others responsible for change or adoption of innovations, must acquire information about the factors that affect implementation. More precisely, they need to know which factors the intended users perceive as important. This requires a method of assessing those factors and then generating individual as well as organizational profiles to gain an understanding of which factors are perceived as most important in regards to the implementation of specific innovations.

A study by Surry and Ensminger (2002, 2003) measured the perceived importance of these eight conditions using scenario-based questions. This study was the first attempt to determine the relative importance of the eight conditions prior to the implementation of an innovation. This study served as the catalyst for the development of an instrument to measure implementation profiles, and also provided the foundation for the theoretical view that by assessing the eight conditions before implementation, organizations could develop tailored implementation plans to facilitate the change.

The primary purpose of the study described in this paper was to determine if there are underlying relationships between Ely's eight conditions. We hypothesized that several of the conditions were related and that patterns in those relationships could be identified. In order to measure the underlying relationships between these conditions it was necessary to develop an instrument that measured an individual's perceived importance of each condition in relation to the others.

Method

In this section, we will describe the development of the implementation profile inventory and the process used to verify the content validity and reliability of the instrument. Additionally, we will describe the data collection process and the analysis methods used to analyze the data.

Instrument Development

The primary data collection instrument used in this study was a 56-item questionnaire. Because the main purpose of the study was to determine which of the eight conditions individuals considered more important compared to the other conditions, a forced choice format was selected. Each item would pair two of the eight conditions and participants would be forced to choose which condition they considered to be more important. In order to have a more reliable measure of an individual's perception, we decided that all conditions would be paired together twice. This would result in 56 comparisons and would require two statements that represented each condition. We also determined that two forms of the instrument would be designed: one to measure process innovations and one to measure technology innovations. In order to create two separate forms and have each condition paired twice, 32 statements would need to be written to complete both forms. We independently developed several technology-based and process-based statements for each condition. These statements were then reviewed jointly and the best statements for each condition were selected.

Content Validity

The content validity study for the 32 statements was conducted using experts who have either conducted research or worked in the area of adoption, change, or implementation. This group of experts was provided with a definition for each Ely's conditions and the four statements that represented that condition. They were asked to rate each statement on a scale from 1 (low) to 5 (high) based on how well the statement represented the defined condition. Space was also provided to allow the experts to provide individual feedback about the statements.

Seven of the ten experts who agreed to participate in the content validity study returned completed forms. Prior to reviewing the forms, we determined that an average score of 3.5 or higher on any statement would be used to immediately accept the statement as valid. The averages for individual statements ranged from 2.6 to 4.1. Ten of the 32 statements had averages above 3.5. Of the 22 remaining statements, 15 had average-rating scores of 3.0 to

3.4, and seven had average ratings from 2.6 to 2.9. Six statements with average rating of either 3.3 or 3.4 were accepted as valid because only one or two of the experts had given them a rating score of below three. The rest of the questions were reworded using the comments provided by the experts.

Once the statements were finalized, a paper-based version of the instrument was constructed and provided to several colleagues with experience in questionnaire development. These colleagues were asked to provide feedback on the format and face validity of the inventory. Changes were made based on their feedback.

Next, an online version of the instrument was created. The online version is self-scoring and provides profile scores on the eight conditions to the user. The online version of the questionnaire underwent prototype debugging and testing before going online.

Test / Retest Reliability

In order to test the reliability of the technology form of the instrument, a test / retest study was conducted. Thirty-nine participants completed the instrument on two occasions that were approximately 14 days apart. The reliability scores for each condition ranged from .586 to .864 with the average of all eight scores being .730. The results of the reliability study indicated that the technology form was consistent in measuring an individual's implementation profile. See Table 1 for retest reliability coefficients.

Condition	Coefficient
Status Quo	.586
Skills	.646
Resources	.687
Time	.761
Participation	.773
Rewards	.864
Commitment	.782
Leadership	.778

Table 1. Test/Retest Coefficients

Participants

We solicited participants for this study by sending messages to several electronic mailing lists related to the field of instructional design. Of the 179 participants who participated in the study, 20 worked in K-12 settings, 89 worked in higher education settings, 22 in business or industry, 9 were in the military, 11 worked for the Government, 12 were self employed, and 16 did not respond to the question. The sample consisted of 54 males and 86 females; 39 participants did not report their gender. The educational level of the group was diverse: 32 had a high school education, 41 had a bachelor's degree, 71 had master's degrees, 5 had Education Specialist degrees, 26 had either a doctorate or professional degree, and 3 did not report their educational level. Caucasians were the largest represented ethnic group (n=138), followed by Asian/pacific Islanders (n=11), then African Americans (n=10). The remaining ethnic groups were: Hispanics (n=5), Native Americans (n=1), and Other (n=9). Five participants did not report their ethnicity.

Data Collection and Analysis

Data were collected over a three-month period using the online instrument. Based on responses to the inventory, we calculated an "implementation profile" for each participant. The implementation profile shows how many times the participant selected each condition on the questionnaire. An implementation profile is, in effect, a score from 0 to 14 on each of the eight conditions. Profile scores were entered into SPSS file for analysis.

We used two data analysis methods in this study. The first was descriptive analysis to show the mean score and standard deviation for each condition for the various demographic groups. The second data analysis method was a factor analysis to determine if there were any underlying relationships between the conditions. The results of the data analyses are presented in the following section.

Results

Descriptive Statistics

The mean score and standard deviation of each condition were calculated for the overall sample and for each of the primary demographic groups. The descriptive data show the rank order of importance of each condition for the various groups. Descriptive statistics indicate that for the total sample leadership and commitment were the least important conditions (see Table 2), while resources and participation were the most important. Commitment and leadership were the least important conditions for both males and females (see Table 3). Females selected knowledge/skills and resources as the most important variables while men reported participation and resources as the most important.

	N	Mean	Std. Deviation
Status Quo	179	7.24	4.26
Skills	179	7.98	3.70
Resources	179	8.39	2.98
Time	179	7.13	3.29
Participation	179	8.11	4.13
Rewards	179	7.36	3.76
Commitment	179	4.42	3.80
Leadership	179	5.37	3.45

Table 2. Profile Scores for Total Sample

Condition	Gender	N	Mean	Std. Deviation
Status Quo	Female	86	6.81	4.29
	Male	54	7.65	4.21
Skills	Female	86	8.72	3.58
	Male	54	7.59	3.49
Resources	Female	86	8.56	2.99
	Male	54	8.04	3.07
Time	Female	86	7.38	3.06
	Male	54	6.87	3.80
Participation	Female	86	7.87	4.25
	Male	54	8.63	3.89
Rewards	Female	86	6.78	3.78
	Male	54	7.28	3.80
Commitment	Female	86	3.95	3.49
	Male	54	5.07	3.83
Leadership	Female	86	5.92	3.36
	Male	54	4.87	3.39

Table 3. Profile Scores by Gender

Table 4 shows the implementation profiles for various occupational categories. Participants working in K-12 environments viewed resources and time as the most important conditions related to implementation of technology. Participants employed in higher education also perceived resources as most important. They considered skills and rewards as important as well. Those working in business settings placed more importance on participation, with adequate resources, and dissatisfaction with the status quo also being viewed as critical to implementing a new technology. Military employed participants considered skills, dissatisfaction, and resources as the three most important factors. This occupational group also considered time important. Those participants working for the government considered skills, participation, and resources as the top three conditions when implementing a technological innovation. Participants who identified themselves as self employed perceived resources, dissatisfaction, and participation as the most important factors.

	K-12 N= 20		Higher Ed. N= 89		Business N= 22		Military N= 9		Government N= 11		Self Employed N= 12	
Conditions	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Dissatisfaction	6.95	4.57	6.81	4.36	7.41	3.51	9.11	4.70	6.18	4.21	9.17	3.41
Skills	6.90	4.34	8.15	3.56	6.68	3.88	9.22	3.31	9.00	2.32	7.75	4.45
Resources	9.50	2.86	8.16	3.10	7.73	3.45	9.11	1.83	8.27	2.05	10	2.17
Time	9.05	4.12	7.29	3.42	6.18	3.29	8.56	4.10	6.73	2.83	8.25	2.93
Participation	6.70	3.81	8.06	4.10	8.82	4.01	7.00	3.81	8.63	5.30	6.17	3.79
Rewards	4.65	3.89	7.62	3.58	6.68	4.13	7.00	3.71	7.45	4.66	8.08	4.17
Commitment	4.95	3.89	4.46	3.71	5.82	4.44	2.67	2.83	3.82	3.57	3.33	3.68
Leadership	5.70	2.58	5.46	3.56	6.68	3.26	3.33	2.69	6.18	3.68	3.25	3.14

Table 4. Profile Scores by Occupational Category

Factor Analysis

We conducted a factor analysis of the implementation profiles of all 179 participants to determine if there were any underlying factors within the data. The factor analysis was conducted using the principle component method of extraction and varimax rotation. We decided that for a condition to load on a factor, it must have a minimum absolute value of .45 and must not have loaded on another factor at an absolute value of .45 or greater. The eight conditions reduced to four factors, which accounted for 73.3% of the variance. Factor loadings ranged from -.945 to .901. The results of the factor analysis are shown in Table 5. A detailed discussion of each factor is provided in the following section.

Conditions	Factors			
	Managed Change	Performance Efficacy	Rewards	Resources
Status Quo	-.628	-.172	.055	-.496
Skills	-.426	.528	.434	.060
Resources	-.136	-.023	.079	.901
Time	-.082	.774	.028	.066
Participation	-.081	-.782	.133	.046
Rewards	-.201	.089	-.945	-.056
Commitment	.800	-.237	.127	-.217
Leadership	.858	.029	.103	-.048

Table 5. Coefficient Loadings of Conditions for Factors

Discussion

The main finding of this study is that four factors emerged from the data. Two of the factors had multiple loadings, while two had only one condition loading on the factor. The condition dissatisfaction with the status quo loaded above .45 on two factors and therefore was not considered to load significantly on any factor. These results indicate that there is an underlying relationship between conditions. In this section, we will describe each of the factors.

Factor #1: Managed Change

This factor accounted for 25.3% of the explained variance. Individuals who score high on this factor want upper level management and direct supervisors to play an active role in the change process. They want managers in an

organization to provide direction and leadership during implementation. This may include the need to provide direct communication of why the change is occurring and actively campaign for the implementation of the innovation. Conditions that loaded on this factor were Leadership (.858) and Commitment (.800).

Factor #2: Performance Efficacy

This factor explained 19.8 % of the total variance. Individuals who score high on this factor believe that they will be successful in using the innovation because they either currently have the needed skills, or will be able to learn the skills if provided time. They are not concerned about actively participating in the change process because they feel confident that they will be able to perform and use an innovation. Conditions that loaded on this factor were Participation (-.782), Time (.744) and Skills & Knowledge (.528).

Factor #3: External Rewards

This factor contributed 14.2 % to the total variance explained. This factor was interpreted and labeled by reversing the meaning of the factor. Thus, individuals with a low score on this factor are more likely to want some compensation or reward for implementing an innovation. They will be more likely to participate in the implementation process if they receive some recognition or reward for using the innovation. Only one condition loaded on this factor Rewards (-.945).

Factor #4: Resources

This factor explained 14% of the total variance of the combined factors. Individuals scoring high on this factor view resources as the important variable in the implementation process. They want to know if the equipment, finances, personnel and other resources are in place and easily accessible before implementing an innovation. Only one condition met the criteria for loading on this factor, Resources, (.901).

In addition to the new factors, the technology inventory developed for this study appears to give a reliable and accurate measure of a person's "implementation profile." This inventory provides researchers studying technology implementation a method for assessing the eight conditions that influence the implementation of technology innovations. This inventory can be used to help researchers further explore how the importance of these conditions are influenced by the type of technology being implemented. Additionally, researchers can use this inventory to explore how various groups value the importance of each condition given a particular technology innovation.

On a practical level, by assessing individual and organizational profiles, those responsible for implementing an innovation can work to ensure that the key conditions, as reflected in the inventory results, are addressed prior to and during the implementation phase of change process. In essence, the inventory would allow change agents to evaluate the importance of each condition before implementation and use the results to develop implementation plans tailored to the organization. Thus, an organization whose profile indicates that organizational members perceive adequate time and adequate resources as important conditions will have to develop strategies to ensure that necessary resources are easily accessible to all users and that users are provided with on the job time to develop the skills in order to use the technology.

Future Research

Based on the results of this study, we have identified three key questions that will form the basis for our future research in this area. In this section, we will briefly discuss each question and describe our plans to conduct research to address these questions

The first key question that arose from this study is "Are the factors discovered in this study consistent?" To answer this question we propose replicating the current study. We intend to collect data using the online version of the instrument. We will contact other list servers and recruit participants from other disciplines and fields. We will then analyze the new data using the same factor analysis method.

The second key question that arose from this study is “Do these factors hold true for process innovations?” The current study focused on implementing a technological innovation. Research needs to be conducted to determine if the process form of this inventory produces the same factors. Currently we are constructing an on line version of the process form of the implementation inventory using the statements from the content validity study previously mentioned. Once constructed and shown to be reliable, this form will be used to test whether the factors found in this study are consistent when implementing a process innovation.

The third key question is “Do the profiles generated from the implementation inventory, reflect the conditions that people think are important when implementing a new technology?” In order to investigate this question, we will use a mixed methods approach. First we will develop an interview protocol designed to collect qualitative data on participant’s views of technology implementation. The questions will focus on what conditions participants think are important when implementing a new technology. After the interview, participants will be asked to complete a version of the technology form implementation profile instrument. Qualitative analysis will consist of categorizing comments from participants into one of the eight conditions, if it reflects the condition, and comparing participants’ qualitative statements with their implementation profiles.

Conclusion

Implementation can be thought of as the “mystery phase” of the ADDIE Model. However, instructional designers must work to unravel this mystery in order to ensure that their instructional products are implemented successfully. This will require that designers familiarize themselves with change theories, models and strategies, as well as become knowledgeable about what factors and variables facilitate implementation. Finally, the implementation profile inventory used in this study can provide designers with an additional tool for assessing these factors and variables as part of the ADDIE process in order to develop plans that will increase the likelihood that their products are successfully implemented.

References

- Bauder, D. Y. (1993) Computer integration in K-12 schools: Conditions related to adoption and implementation. *Dissertation Abstracts International*, 54 (8), 2991A.
- Bishop-Clark, C., & Grant, R. (1991). Implementing computer technology in educational settings. *Journal of Educational Technology Systems*, 19 (4), 313-326.
- Burkman, E. (1987). Factors affecting utilization. In R. M. Gange (Ed.), *Instructional Technology: Foundations* (pp. 429-455), Hillsdale, NJ: Lawrence Erlbaum.
- Conger, J. A. (2000). Effective change begins at the top. In M. Beer & N. Mohria (Eds.), *Breaking the Code of Change*. (pp. 99-112), Boston, MA: Harvard Business School Press.
- Dalton, D. W. (1989). Computers in schools: a diffusion/adoption perspective. *Educational Technology*, 11, 20-27.
- Dhanarajan, G. (2001). Distance Education: promise, performance and potential. *Open Learning*, 16 (1), 61-68.
- Dirks, K. T., Cummings, L. L., & Pierce, J. L. (1996). Psychological ownership in organizations: conditions under which individuals promote and resist change. In R. W. Woodman & W. A. Pasmore (Eds.), *Research in Organizational Change and Development: Vol 9*. (pp. 1-23.), Greenwich, CT: JAI Press Inc.
- Ebersole, S., & Vordan, M. (2003). Adoption of computer based Instructional Methodologies: A case study. *International Journal of e-Learning*, 2 (2), 15-20.
- Ellsworth, J. B. (2000). *Surviving Change a Survey of Educational Change Models*, Syracuse, NY: ERIC Clearing House on Information & Technology (ED99CO0005).
- Ely, D. P. (1990). Conditions that facilitate the implementation of educational technology innovations. *Journal on Research on Computing in Education*, 23 (2), 298-305.

- Ely, D. P. (1999). Conditions that facilitate the implementation of educational technology innovations. *Educational Technology*, 39, 23-27.
- Havelock, R. G., & Zlotolow, S. (1995). *The Change Agents Guide*. (2nd Ed.), Englewood Cliffs, NJ: Educational Technology Publications.
- Herson, K, Sasabowski, M., Lloyd, A., Flowers, S., Paine, C., & Newton, B. (2000). Implementation strategies for educational intranet resources. *British Journal Of Educational Technology*, 31 (1), 47-55.
- Jeffery, J. A. (1993) Conditions that facilitate implementation of peer coaching. *Dissertation Abstracts International*, 54 (8), 2826A.
- Jost, K. L., & Schneberger, S. L. (1994). Educational technology adoption and implementation: learning from information systems research. *Canadian Journal of educational Communication*, 23 (3), 213-230.
- Klien K. J., & Sorra, J., (1996) The challenge of innovation implementation. *Academy of Management Review*, 21 (4), 1055-1080.
- Kotter, J. (1996) *Leading Change*, Cambridge, MA: Harvard Business School Press.
- Nadler, D. A., & Tushman, M. L. (1997). Implementing new designs: managing organizational change. In M. l. Tushman & P. Anderson (Eds.), *Managing Strategic Innovation and Change a Collection of Readings*. (pp. 595-606) New York, NY: Oxford University Press.
- Myers, W. P., Sivakumar, K., & Nakata, C. (1999). Implementation of industrial process innovations: factors, effects, and marketing implications. *Journal of Product Innovation Management*, 16 (2), 295-311.
- Okumus, F. (2001). Towards a strategy implementation framework. *International Journal of Contemporary Hospitality*, 13, 327-338.
- Pajo, K. & Wallace, C. (2001). Barriers to the uptake of web based technology by university teachers. *Journal of Distance Education*, 16 (1), 70-84.
- Ravitz, J. L. (1999). Conditions that facilitate teacher internet use in schools with high internet connectivity: A national survey. *Dissertation Abstracts International*, 60 (4), 1094A.
- Read, C. H. (1994). Conditions that facilitate the use of shared decision making in schools. *Dissertation Abstracts International*, 55 (8), 2239A.
- Rogers, P. L. (2000). Barriers to adopting emerging technologies in education. *Journal of Computing Research*, 22 (4), 455-472.
- Rogers, E. M. (1995). *Diffusion of Innovations* (4th Ed.), New York, NY: The Free Press.
- Rose, S. N. (1982). Barriers to the use of educational technologies and recommendations to promote and increase their use. *Educational Technology*, 12, 12-15.
- Sims, S. J., & Sims, R. R. (2002). Employee involvement is still the key to successfully managing change. In R. Sims (Ed.), *Changing the Way We Manage Change* (pp. 33-54), Westport, CT: Quorum Books.
- Smith, M. E., & Mourier, P. (1999). Implementation: key to organizational change. *Strategy & Leadership*, 27 (6), 37-41.
- Stein, R. F. (1997). Conditions that facilitate the implementation of innovative freshman experience courses: A comparative analysis of three courses. *Dissertation Abstracts International*, 58 (12), 4586A.
- Stockdill, S. H., & Morehouse, D. L. (1992). Critical factors in the successful adoption of technology: A checklist based on TDC findings. *Educational Technology*, 1, 57-58.

Surry, D. W., & Ely, D. P. (2001). Adoption, diffusion, implementation, and institutionalization of educational innovations. In R. Reiser & J. V. Dempsey (Eds.), *Trends & Issues in Instructional Design and Technology* (pp. 183-193), Upper Saddle River, NJ: Prentice-Hall.

Surry, D. W., & Ensminger, D. C. (2003). Perceived importance of conditions that facilitate implementation. *e-Journal of Instructional Science and Technology*, 6 (1), Retrieved July 19, 2004 from http://www.usq.edu.au/electpub/e-jist/docs/Vol6_No1/perceived_importance_of_conditions.htm.

Surry, D. W., & Ensminger, D. C. (2002). Perceived importance of conditions that facilitate implementation. *Paper presented at the Annual Meeting of the American Educational Research Association*, April, 1-5, 2002, New Orleans, LA, USA.

Surry, D. W., & Farqhar, J. D. (1995). Adoption analysis and user-oriented instructional development. In M. Simonson (Ed.), *Research Proceedings: 1995 AECT National Conference*. Washington, DC: Association of Educational Communications and Technology.

Tessmer, M. (1991). Back to the future: The environmental analysis stage of front-end analysis. *Performance and Instruction*, 30 (1), 9-12.

Tessmer, M. (1990). Environmental analysis: A neglected stage of instructional design. *Educational Technology Research and Development*, 38 (1), 55-64.

Varkking, W. J. (1995). The implementation game. *Journal of Organizational Change Management*, 8 (3), 31-46.

Online Learning: Social Interaction and the Creation of a Sense of Community

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ABSTRACT

This paper centres on the sense of isolation that online study may engender among learners, a factor often ignored by many educators, but one that may make the difference between a successful and an unsuccessful online learning environment for many students. The importance of a proper appreciation of the learners' social context is stressed, as is the concept of the 'virtual self' that individual learners may choose to portray during online communication.

The authors suggest three protocols that can be built into the fabric of online courses in order that a sense of community may be enabled to exist, and productive social interaction can occur. These are (1) the greater use of synchronous communication facilities (in addition to, rather than instead of, asynchronous ones), (2) the deliberate design and inclusion of a 'forming' stage, or 'warm-up' period, incorporated as an essential component into the course structure, and (3) a much greater emphasis on the provision of (and adherence to) guidelines for successful online communication.

The paper concludes by suggesting that by creating an online sense of 'self', the participants of an online course can alleviate feelings of isolation, and create an online community that assists the learning process.

Keywords

Asynchronous communication, Communicating online, Community, Forming stage, Insider, Outsider, Self, Synchronous communication

Introduction

For students studying in an online environment, social interaction with peers and educators can often be an exercise in frustration. If such frustration is to be minimised, much thought needs to be given to the methods of communication that will be utilized, so that the online environment fulfils the human desire for social interaction. Asynchronous communication may not give the immediacy that is required for successful social interaction. The lapsed time that can occur between question and answer may not assuage the tyrannies of distance, time zones, and isolation from which learners may suffer.

The inability to interact freely with other students may exacerbate feelings of aloneness, and provide a less-than-ideal environment for successful study. Techniques such as the incorporation of protocols and guidelines for social interaction into the learning concepts of the online environment (Curry, 2000) can be utilized to minimize the feelings of aloneness that affect many students.

What is Isolation?

Isolation or the feeling of aloneness that many students may feel is the hardest symptom for educators to combat (Palloff & Pratt, 1999). This feeling of isolation is not always generated simply because of geographical distance

- even on-campus students undertaking an online course may experience a feeling of isolation from the rest of the courses participants.

Many issues are cited in the literature that may cause students, undertaking online education, to re-consider their enrolment – such as technical problems, computer illiteracy and cost (Fyfe, 2000). It would be reasonable to suppose that all such factors, compounded perhaps by a difficulty with mastering the course concepts, are likely to feed in to feelings of isolation.

Daugherty and Funke (1998) indicate that this issue of isolation is ‘an important criterion for student satisfaction’ with the web-based online course. This feeling is often ‘based on the physical separation between student and instructor’ and is one that educators may be able to ameliorate, but are unlikely to ever be able to successfully eradicate (Daugherty & Funke, 1998).

Galusha (1997) points out that:

‘Support for distance learners should not be overlooked when planning distance programs (as) ...Students ...want to be part of a larger (learning) ...community.’

Isolation can influence a student’s attitude to online learning, and as such needs to be given greater consideration when designing web-based courses. Wegerif (1998) illustrates the frustrations that can so quickly become alienation by quoting from one of the students involved with his study of an Asynchronous Learning Network course:

‘It is a cold medium. Unlike face to face communication you get no instant feedback. You don't know how people responded to your comments; they just go out into silence. This feels isolating and unnerving. It is not warm and supportive.’

Curry (2000) states that:

‘...the attrition rate of online learners, ...(is)... brought about in large part by a sense of isolation’

thereby backing Wegerif’s student in the belief that the online medium can be a cold one. This view is further reinforced by Palloff and Pratt (1999: 29).

Cereijo, Young & Wilhelm (2001, p37) also indicate that isolation can be a problem with web-based learning.

‘Participants who expressed extreme frustration with isolation and technical problems also:

- 1.were extroverts ...*
- 2.were visual learners ...*
- 3.lived near campus*
- 4.had some serious technical problems, and/or*
- 5.were inexperienced computer users ...’*

Despite this, Cereijo et al (2001) are among many who indicate that for those students who are working and/or have families, the concept of online education is a preferred option, as their other commitments may prevent them from attending on-campus classes.

Online education is often chosen for its convenience and flexibility, and the resulting enhancement of the learning process that is frequently seen as a perceived outcome for the student. Although no one style of education is going to be successful for all students, it is important that educational bodies and educators appreciate that effective support may be given to distant online learners by the implementation of, and adherence to, appropriate communication protocols.

Synchronous and Asynchronous Communication

Many authors stress the importance of asynchronous communication: for example, Aitken and Shedletsky (2002) state that they:

‘...find chat and instant messaging to be less useful for group interaction than email or messageboard communication’

and

‘... that messageboard and email discussion lend themselves to more serious, on-task discussion than does online chat.’

However, both types of forum are often required for the successful operation of an online course. Wang and Newlin (2001) advocate the simultaneous use of asynchronous and synchronous communication for an online course to be successful:

‘...we believe that the type of interaction fostered by online chat rooms will enhance and clarify the information that is gathered via asynchronous interactions. Both types of information delivery systems are needed.’

Further

‘... we think of asynchronous communication as the "backbone and muscle" for course content, online chats are the "heart and hustle" of our Web-based classes.’

They assert that asynchronous online courses often have a one-way flow of information between the lecturer and student, and are a passive method of teaching, which simply turns the Internet based online course into another form of distance education. By utilizing synchronous chat rooms, a sense of social presence develops that often leads to a greater sense of community.

The Importance of the Social Context

The social context of the learner is a factor in determining the success or otherwise of study. Few could dispute this, yet it is often ignored by many educators. Matel & Ball-Rokeach (2001) are of the opinion that the:

‘...(the) theoretical corollary... is that the social effects of the Internet should be placed in the framework of people's sociostructural connections, including cultural, ethnic, social, and local-physical circumstances.’

The assertion that the study of social interaction in the online medium cannot be separated from an investigation into the social interaction that occurs in the everyday world is of course a valid one. Although the Matel and Ball-Rokeach (2001) study was undertaken outside of the educational environment, it is equally relevant to those seeking to learn online. Thus, educators need to have an appreciation and understanding of the non-academic social communities of the learners.

The notion of a learning community is relevant and Tu and Corry (2001; 2002) define such a learning community as:

‘... a common place where people learn through group activity to define problems affecting them, to decide upon a solution, and to act to achieve the solution’

The sense of self alluded to by Tu and Corry (2001; 2002) is not given adequate coverage in much of the current research into online learning. This failure leads to an unsatisfactory understanding of the online community by educators.

A Sense of ‘Community’

The use of the term ‘community’ most often refers to a place-oriented concept. The two most common elements, according to the Dictionary of Sociology (Marshall, 1998: pp. 97-98), in this concept are: (1) a gathering of people within a singular social structure, (2) a sense of belonging to a social structure. In today’s world, the meaning of ‘community’ is changing from geographic specific to relationship specific and it is becoming increasingly difficult to define the term (Wilson, 2001).

Clifton (1999) points out that the level of trust between all involved in the educational process has to be high if a sense of community is to develop.

‘...when people do not trust each other, and when they do not share norms, obligations, and expectations, as is presently the case in many universities, the community is not likely to develop, and the self-interest of people in their status is likely to predominate.’ (Clifton, 1999)

In the face-to-face classroom, students are expected to absorb knowledge and social interaction is not given a lot of consideration (Palloff & Pratt, 1999). On campus, students tend to assemble and interact before, during and at the conclusion of class. This is where friendships are formed using a myriad of communication styles and activities. Conrad (2002a) states that:

Online educators who understand that safe, nurturing environments are foremost in contributing to learners' happiness, sense of comfort, and ultimately rates of completion place the creation of community high on their list of priorities.

Yet, conversely she found that the students in her study 'did not understand the concept of community' (Conrad, 2002a; 2002b). The question though is whether this really is unusual. In the online 'classroom', students and instructors are represented by text on a screen – they have become disembodied entities and in the majority of cases will never meet face-to-face.

With the text-based communication that occurs in the online learning community, it can be easy for that text to be misinterpreted (Curtis & Lawson, 1999) due to the lack of visual expressiveness by the participants involved. This misinterpretation, although it may occur unintentionally, can often either lead to a break down in the community's cohesion or be the reason behind the lack of community.

Wegerif (1998) suggests that some students, who he has termed 'insiders', successfully complete and enjoy a course, while the students who do not complete or enjoy a course are termed as 'outsiders'. The difference between the two terms may be summarised in the following way:

- An 'insider' is comfortable with the medium being used during the course and is confident in its use.
- An 'outsider' is uncomfortable with the medium being used during the course and is not confident in its use.

At the beginning of a course, all students should be considered 'outsiders'. This gives them the impression that there is a threshold they need to cross to become a part of a successful 'insiders' domain.

A survey given at the conclusion of Wegerif's (1998) ALN course showed that one student was nervous about using her computer, and about entering the online community. As the course progressed, the nervousness dissipated resulting in her actively seeking out the company of her online community; this implies that she crossed the threshold and became an 'insider'. Another stated that she felt uncomfortable in conferencing sessions, because she could never catch up when sessions were missed. She also found the online aspect of the community unfriendly and cold. The implication here is that she never crossed the threshold and stayed an 'outsider' for the duration of the course. Wegerif (1998) further stated that:

'...this threshold is essentially a social one; it is the line between feeling part of a community and feeling that one is outside that community looking in'.

The use of synchronous chat rooms and the communication styles they represent may have made the progression from 'outsider' to 'insider' easier, as would tighter control on the communication guidelines required for any structured online course.

Technology supported learning communities can be fostered and assisted by educators to combat the feelings of isolation that many experience. Wang and Newlin (2001) advocate the use of synchronous chat rooms as a means of fostering communication and interaction between lecturers and the students in the online course because:

'Regardless of the exact method of interaction, asynchronous communication is slow and limits the type and amount of communication between instructor and student. Furthermore, this type of communication tends to remove any feelings of connection between the student and instructor.'

Wang and Newlin (2001) also discuss the use of synchronous communication in the facilitation of online courses and the impact it can have on the social interaction of the students and the decrease in isolation that occurs for both students and educators. They:

'...believe that online chats fulfil the promise of computer mediated communication: it offers the opportunity for people who are geographically distant to feel interpersonally close to one another.'

The students who participated in Wegerif's (1998) case study suggested that a 'warm-up' period be incorporated into the course structure. They wanted an informal setting where they could become familiar with each other's communication style, online personalities, level of commitment and learn how to develop a presentation of 'self'

(Tu & Corry' 2002). On-campus students already experience this in the time spent interacting before, during and after class (Palloff & Pratt, 1999).

The Presentation of the 'Self'

In educational systems the online community is one with set agendas and set rules of conduct and protocols, all of which have to be taken into account when analysing the concepts of social interaction, social community and 'self'.

The virtual 'self' can be different from the 'self' presented to the off-line world, but the differences that occur are likely to be slight, unless the participants are wilfully acting out of character. These differences though do not make that 'self' any less relevant to the study of online learning communities (Marshall, 1998: 589-590). Tu and Corry (2001) when discussing online communities state that:

'Participating in an online community creates uncertainty among its participants regarding which roles) they should play, what scripts they should follow, how they should behave, and what are the appropriate interactions with fellow members.'

In sociological terms, all humans present themselves to others in a manner that will gain them acceptance within the community's norms – performing to 'scripts' (Tu & Corry, 2001; Goffman, 1990) helps them do this.

The simplest method of explaining the 'script' scenario is to look at our everyday lives and our conduct of them. Our sense of 'self' is bound up with the 'script' we read from and the role we play, whether it is as a worker, husband, mother, friend, or whatever. All of us follow the 'script' of the moment:

'... 'selves' are presented for the purpose of interacting with others, and are developed and maintained with the cooperation of others through the social interaction. The practice of following certain scripts is a critical element in the development and portrayals of roles played out on various stages of the drama of life in which communicators have to perform.'
(Tu & Corry, 2001)

Of course, all of this is not to deny that, for some students, social interaction during the learning process is something of an anathema. They consciously prefer to study in isolation, without presenting a 'self', or performing a 'script' (except perhaps for an off-stage one), at all. A spirited defence of such students has been recently put forward most eloquently by Hopper (2003).

The Art of Good Communication

The use of both asynchronous and synchronous forums for communication, combined with a 'warm up' or 'forming stage' allows students to become comfortable with their sense of 'self' and also to develop their own online personality. All of this aids them in their learning and can lead to decreases in the attrition rate of the online course. They make the transition to 'insiders' rather than remaining 'outsiders'. Learning can and should be pleasurable, no matter how serious the content.

'Online discussion provides a clearly unique way to experience communication, while simultaneously prompting discussion about that experience.' (Aitken and Shedletsky, 2002)

At its most fundamental level, teaching is a process of communication (Conway, 1996) and one that all educators have to understand. Students:

'...have to be there with you, meeting each point, thinking ahead, trying to get to the consequences of what you've said and testing their own knowledge all the time' (Conway, 1996)

The educator has to create an effective learning environment by first learning how to communicate and socially interact with the students and it is the very act of the 'warm up' period which makes this possible. Carbone, Conway and Farr (1996) state that:

'...teaching is the communication of the facts, ideas, skills, and techniques particular to a discipline ... teaching is the act of communicating the "comprehensibility" of the subject matter - demonstrating a mastery that reassures the students that they too can understand and master the material.'

Three Protocols To Aid Online Social Interaction

Three simple protocols:

- the use of synchronous communication;
- the introduction of a forming stage; and
- the adherence to effective communication guidelines

are suggested as an aid to the development of social interaction and community in the online environment. The implementation of these may be educationally beneficial, but expensive in terms of time and resources. The extent of their implementation may therefore depend to a significant extent upon the level of commitment of the college or university to the provision of the best-possible learning environment.

1. *The use of synchronous communication*

The implementation and operation of synchronous communication via the use of software tools (such as WebCT, Blackboard, etc.) is likely to enhance social interaction within the online course.

Synchronous communication can be an effective method of ensuring that all students are familiarized with assignments and tutorial topics, and questions and answers can be almost simultaneous, and can avoid repetition for the educator. Chat-rooms and other such forums are an excellent way for students to socialize, to assist each other with study, or to learn as part of collaborative teams. The intensity of interaction within these groups is likely to vary as the term progresses, assignments become due, and other factors intervene.

This is not intended in any way to negate the importance of asynchronous communication. Email and discussion boards are very important components of the online learning environment, particularly where the student cohort may include a large number of overseas students living in different time zones. It is notoriously difficult to coordinate synchronous chats even within a single country (due to work commitments and time zones etc.), and the problems become almost insurmountable when dealing with courses involving students from around the world.

To alleviate such problems, the educator may decide to allocate students to particular groups – given the consideration of time zone problems or work commitment – and to limit the size of the group to no more than the number one would have in a face-to-face group tutorial or workshop.

A successful online course may make use of both synchronous and asynchronous communication, which if properly structured and controlled leads to both the students and the educators creating a more enjoyable and productive learning and working environment.

2. *The introduction of a forming stage*

The forming stage is a warm up period, designed to assist the formation of a “sense of community”.

Synchronous chat rooms provide an ideal environment whereby students and educators can meet for initial contact, and the beginning of social interaction. Here all participants can be educated about the guidelines under which the room will operate, and assisted in understanding and effectively utilising the processes and resources to be used during the course.

One example of on-campus students building a learning community that will aid in social interaction is attendance at orientation. At most universities, orientation sessions are arranged for on-campus students, so that they may be introduced to the learning environment that they have joined. It allows students to meet others within their faculty (including staff) and develop friendships before study begins. It is at least plausible therefore to suggest that an orientation program would also be beneficial also to online students, as a means of building a sense of community in cyberspace. A timetable of synchronous and asynchronous discussion forums could be utilized to assist in this process.

Discussion on almost any topics (the latest movies, sporting results, etc.) can be utilized by the educator as a prelude to the building of trust and community that is essential to any successful online experience. This also

provides a means by which new students may be familiarised with such forums, and allows students and staff to find common areas of interest, and facilitate the 'getting to know each other' process (Palloff & Pratt, 1999).

Another support for a 'warm-up' period is that group development happens in stages, with the initial one being the "forming stage" (Tuckman, 1965; cited in Kemery, 2000) where students (and educators) tend to be excited and anxious about being new members of a group. Excited, because they are embarking on a new learning experience, and anxious, as to how they will fit into this new environment. Giving students and educators time to familiarize themselves with the new learning environment before actual study begins is likely to be advantageous to all parties involved.

The forming stage also gives educators the opportunity to conduct lessons on how to use the different forums with which each student must become familiar, and allows students who feel that they need additional help to gain the necessary skills and confidence required before the pressure of learning begins. Students who have used this environment before, and are therefore familiar with its protocols, may be able to be co-opted into helping their less experienced peers to learn how to use these communication forums effectively.

During this period, students may need to be encouraged to post introductions to the lists or chat rooms so that they can allow themselves to build an electronic presence within the online community (Palloff & Pratt, 1999). In order to maximize the advantages, the period should if possible include all students undertaking online courses that term. Such sessions may be run by each independent online educator, or as a combined effort by a team of online educators.

3. *The adherence to effective communication guidelines*

Foremost among these guidelines is the need for unambiguous instructions and communications from the educator to the students involved in the course. To this end instructions regarding both course requirements and communication protocols should be placed on the course web site. They then need to be reiterated at the beginning of term in a message sent to all students emphasizing their importance.

The moderators or facilitators of the synchronous and asynchronous forums are thus able to guide the communications to stop inflammatory messages ('flaming') from occurring and to keep the subject matter relevant to the course. The correct 'netiquette' is important for the effective operation of an online course (See for example <http://www.albion.com/netiquette/> & <http://www.fau.edu/netiquette/net/>).

If educators are to demonstrate their 'mastery of a subject' and inspire students to hope that they too will be able to master the material, they must first know how to communicate the information to the students. However, for successful communication to occur the following guidelines will need to be successfully implemented (Hurst, 1991: 11):

- 'Understanding' Ensure a limited use of jargon and complexity in instructions.
- 'Common ground' Do not digress from the objectives set in the course outlines.
- 'Perception' Realize that students are not experts in the area being taught.
- 'Awareness' Realize that students may be struggling with new ideas, concepts and technology.
- 'Self-confidence' Be self-confident but not arrogant when communicating with students.
- 'Clarity' Adhere to the K.I.S.S. principle – Keep It Short and Simple – where possible.

When communicating online, participants have to learn to fill in the blanks that are left when they are unable to 'read' the body language of the people to whom they are 'talking'. Lewis (2000) asserts that it is:

'... helpful (to) engage in the W.R.I.T.E. way to communicate online. (W)arm, (R)esponsive, (I)nquisitive, (T)entative, and (E)mpathetic.'

Lewis' W.R.I.T.E. concept uses emoticons, warmth, promptness, and the ability to place oneself in someone else's shoes. It would assist educators if they incorporated these concepts into the communication guidelines and encouraged the students to be W.R.I.T.E. in their communication in both synchronous and asynchronous forums. What Lewis did not, but should have incorporated into his concept, is the quality of (R)espect. This is a vital ingredient. All should give respect to the ideas of others, whether online or face-to-face, regardless of whether those ideas are right or wrong.

Summary

Often it is considered inevitable that students who study online will suffer a sense of isolation. This sense of isolation can however be minimized if forethought is given to the development of the online milieu by the educators involved.

Amongst the many methods which may be utilized to improve the development and therefore the interaction and socialization of students are the greater use of synchronous communication facilities (in addition to, rather than instead of, asynchronous ones). The deliberate design and inclusion of a 'forming stage', or 'warm-up' period, needs to be incorporated as an essential component into the course structure, and a much greater emphasis needs to be given to the provision of guidelines for successful online communication.

The development of an online community is of paramount importance, and can be achieved with the use of most synchronous communication software (such as WebCT and Blackboard). By so doing the educator can generate a feeling of trust amongst the students involved in online education. As suggested by Wegerif (1998), they become 'insiders' instead of remaining 'outsiders'.

Goffman (1990: 13) succinctly summed up the way people look at 'self' and the way that they socially interact:
'When an individual enters the presence of others, they commonly seek to acquire information ... or to bring into play information ... already possessed.'

By creating an online sense of 'self', the participants of an online course can be enabled to alleviate that feeling of isolation, and a truly online community can be created.

To help ensure that the creation of a sense of community has the maximum possible chance of success, the educator should implement and adhere to a series of communication guidelines. The guidelines formulated by Hurst (1991) are simple to follow and ensure that effective and clear communications occur. The K.I.S.S. principle applies very effectively to clear communication, and further helps to ensure that the three protocols for creating a sense of community elucidated in this paper are successful.

References

- Aitken, J. E., & Shedletsky, L. J. (2002). Using electronic discussion to teach communication courses. *Communication Education*, 51 (3), 325-331.
- Carbone, A., Conway, D. M., & Farr, G. E. (1996). Techniques for effective tertiary teaching. 96/273, Department of Computer Science Technical Report CS 96/273, Department of Computer Science, Monash University, Melbourne, Victoria, Australia, Retrieved July 19, 2004, from <http://www.csse.monash.edu.au/~damian/papers/HTML/TeachingTechniques.html>.
- Cereijo, M. V. P., Young, J., & Wilhelm, R. W. (2001). Factors Facilitating Student Participation in Asynchronous Web-Based Courses. *The Journal of Computing in Teacher Education*, 18 (1), 32-39.
- Clifton, R. A. (1999). The education of university students: A social capital perspective. *College Teaching*, 47 (3), 114-118.
- Conrad, D. (2002a). Community, Social Presence, and Engagement in Online Learning. A Dissertation, Retrieved July 19, 2004 from <http://www.unbf.ca/education/welcome/people/conraddissertation.htm>.
- Conrad, D. (2002b). Deep in the Hearts of Learners: Insights into the Nature of Online Community. *Journal of Distance Education*, 17 (1), 1-19.
- Conway, D. M. (1996). *Only Connect: Teaching as Communication*, Retrieved July 19, 2004 from <http://hawthorn.csse.monash.edu.au/~ajh/adt/resources/DamianAnecdotes.html>.
- Curry, D. B. (2000). *Collaborative, Connected and Experiential Learning: Reflections of an Online Learner*, Retrieved July 19, 2004, from <http://www.mtsu.edu/~itconf/proceed01/2.html>.

- Curtis, D., & Lawson, M. (1999). Collaborative online learning: an exploratory case study. *Paper presented at the HERDSA annual International Conference*, July 12-15, 1999, Melbourne, Australia.
- Daugherty, M., & Funke, B. L. (1998). University faculty and student perceptions of Web-based instruction. *Journal of Distance Education*, 13 (1), 21-39.
- Fyfe, S. (2000). Collaborative learning at a distance: The Human Biology experience. *Paper presented at the 9th Annual Teaching Learning Forum*, February 2-4, 2000, Perth, Australia, Retrieved July 19, 2004, from <http://lsn.curtin.edu.au/tlf/tlf2000/fyfes.html>.
- Galusha, J. M. (1997). *Barriers to learning in Distance Education*, Retrieved January 19, 2004, from <http://www.infrastructure.com/barriers.htm>.
- Goffman, E. (1990). *The presentation of self in everyday life*, London: Penguin Books.
- Hopper, K. B. (2003). In defense of the solitary learner: A response to collaborative, constructivist education. *Educational Technology*, 43 (2), 24-29.
- Hurst, B., (1991). *The Handbook of Communication Skills*, London: Kogan Page.
- Lewis, C. (2000). Taming the Lions and Tigers and Bears. In K. W. White & B. H. Weight (Eds.), *The Online Teaching Guide: A Handbook of Attitudes, Strategies, and Techniques for the Virtual Classroom* (pp. 13-23), Boston: Allyn and Bacon.
- Marshall, G. (1998). *A Dictionary of Sociology*, Oxford: Oxford University Press.
- Matel, S., & Ball-Rokeach, S. J. (2001). Real and virtual social ties: Connections in the everyday lives of seven ethnic neighborhoods. *The American Behavioral Scientist*, 45 (3), 550-564.
- Palloff, R. M., & Pratt, K. (1999). *Building Learning Communities in Cyberspace: Effective strategies for the online classroom*, San Francisco: Jossey-Bass.
- Tu, C.-H., & Corry, M. (2001). A paradigm shift for online community research. *Distance Education Journal*, 22 (2), 245-263.
- Tu, C.-H., & Corry, M. (2002). *Research in online learning community*, Retrieved July 19, 2004 from <http://www.usq.edu.au/electpub/e-jist/docs/html2002/chtu.html>.
- Tuckman, B. W. (1965). Development sequence in small groups. *Psychological Bulletin*, 63, 384-399.
- Wang, A. Y., & Newlin, M. H. (2001). Online Lectures: Benefits for the virtual classroom. *T.H.E. Journal*, 29 (1), 17-24, Retrieved July 19, 2004 from <http://www.thejournal.com/magazine/vault/A3562.cfm>.
- Wegerif, R. (1998). The Social Dimension of Asynchronous Learning Networks. *Journal of Asynchronous Learning Networks*, 2 (1), Retrieved July 19, 2004 from http://www.sloan-c.org/publications/jaln/v2n1/v2n1_wegerif.asp.
- Wilson, B. G. (2001). *Sense of Community as a Valued Outcome for Electronic Courses, Cohorts, and Programs*, Retrieved July 19, 2004 from <http://carbon.cudenver.edu/~bwilson/SenseOfCommunity.html>.

Electronic Repositories of Marked Student Work and their Contributions to Formative Evaluation

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ABSTRACT

The educational literature shows that formative assessment is highly conducive to learning. The tasks given to students in formative assessment generally require open-ended responses that can be given, for example, in essay-type format and that are assessed by a human marker. An essential component is the formative feedback provided by the marker that needs to assist the student in recognising knowledge gaps and in formulating steps to close these gaps. The concepts of 'electronic repositories of marked student work' introduced in this article suggests an approach to support learning from formative assessment. At the core of this concept lies the realisation that the artefacts submitted by students and assessed by markers are a valuable resource. This resource should not just be used by the submitting students but should be made accessible to future students studying the same concepts. These students can learn from the artefacts and the formative feedback attached to these artefacts. Self- and peer-assessment, important concepts closely linked to formative assessment, can be integrated with the repositories to develop the students' subject knowledge, to enhance their critical thinking skills and to familiarise them with assessment procedures. This article develops the concepts of electronic repositories of marked student work. Special emphasis is put on reviewing the educational literature on formative assessment and on binding the concepts introduced into the literature findings.

Keywords

Formative assessment, Web-based repositories, Onscreen marking, eLearning

Introduction

To introduce our work we first want to provide a high-level overview of goals and context followed by an initial look at the technical environment.

Goals and context

Our work on 'Electronic Repositories of Marked Student Work' combines formative assessment and a networked computer environment to offer an innovative learning approach in an eLearning context. In our repositories we deal with formative assessment based on written, essay-type work. Due to the cognitive complexity of essay-type artefacts and the importance of formative feedback we rely on human markers. We regard the essays produced by students and the feedback given by markers as a very valuable resource that we want to retain and make available as a learning resource to future students.

One characteristic of teaching is that to a large degree the concepts to be transmitted remain the same from year to year or class to class. What changes are the examples used to explain, exercise and examine these concepts. An example from our own teaching would be the concept of data modelling using entity relationship diagrams, which we teach to our second year computer science students. The concepts and modelling techniques stay largely unchanged but we vary the example domains, looking at modelling a video library, the management of sports teams or the allocation of parking spaces.

Current eLearning approaches to assessment commonly demand specific question and answer formats. With difference to these approaches we do not want to restrict the way assessment tasks are set but want to support written assignments of any content or format. We aim to provide an approach that can be used by any discipline. With this we explicitly want to include non-technical disciplines like the humanities, education and social sciences. The essay-type artefacts of student work we are looking at can contain a mixture of formats including text, diagrams, graphs and pictures. In short, we are considering anything that can be presented on paper and is printable.

As mentioned earlier the essay-type student work will be assessed by a human marker, who provides formative and summative feedback. This stands in contrast to multiple-choice style tests as offered by learning management systems like WebCT (2003) or BlackBoard (2003). Such tests can be assessed with an automated system and the focus is on summative feedback. Our research presented here does not consider these forms of tests.

An important aspect of our research is that we want to reuse the valuable material that is produced by students and assessed by markers with considerable effort and time commitment from both parties. This material can be used for highly relevant exercises. In our university context students submit assignments throughout the semester and receive feedback within a matter of weeks. We suggest collecting assessed assignments in repositories and using these for exercises for subsequent students. As presented in later sections of this article in more detail these exercises are likely to contain self- and peer-assessment.

We are focusing on a university context and on assignment artefacts yet other uses of the repositories are possible. For example, the tertiary context could be exchanged for a primary or secondary school setting. The student work submitted could be less formal exercises or more formal examination material.

Technical environment

As we want to construct electronic repositories we need electronic copies of the student work. In the tertiary context a large majority of students uses computers to write their assignments. In these cases we can ask the students to hand in electronic copies of their work instead of printed copies. Where students construct their work using pen and paper, for example in drawings, sketches or handwriting, it is possible to generate electronic copies by scanning or taking photographs with a digital camera.

Once we have obtained electronic copies of student work we need access to a marking tool that assists the marker in annotating the student work. Our understanding of ‘annotating’ is to put textual and graphical comments on the work and to add marks. Figure 1 gives an example of annotations performed with a tool we are currently developing that relates back to work published in Heinrich and Wang (2003). The annotations are added to the student work in electronic format and are stored separately from the artefacts in a database. An important consequence of this approach is that the student work can be presented with and without annotations. In the ‘paper world’ the analogy would be to write the annotations on transparencies that can be added or removed at will. Yet, as we will see, the electronic version opens many more possibilities.

The marking tool we have just introduced focuses on technical assistance. One of its core design goals is to replicate the way we commonly work with pen and paper. Human markers use the tool to put their assessment comments ‘on’ the artefacts. While the marking tool is designed to support the markers in their tasks as well as possible it offers no intelligence, cognitive processing or any form of automated marking.

To build repositories we need to compliment the marking tool with a web-based system that provides students, lecturers and markers with access to student work and its annotations. This web-based system needs to include management functionality for uploading work into the repositories and, importantly, to control user access rights. A web-based system brings with it the important advantage of ‘any place and any time’ access, supporting students working at their own pace and enabling collaboration. As we will see in later sections of this article the control of access rights does not only refer to regulating the access of individuals but also to the management of the timing when releasing information.

After setting the scene with this introduction the remainder of this article is structured as follows. In the next section we link the repositories of marked student work with educational theories on assessment and learning related to assessment. This is followed by a presentation of related work that has taken assessment into an eLearning arena. We then summarise the arguments presented throughout the article that demonstrate the advantages of electronic compared to paper-based repositories. Learning from assessment is a complex area and there are a number of issues that still require full exploration. We present these issues towards the end of the article. Before concluding we give the current status of our work in regard to using repositories for our own teaching. A fuller version of this article has been published as an Institute’s report at our university (Heinrich, 2004).

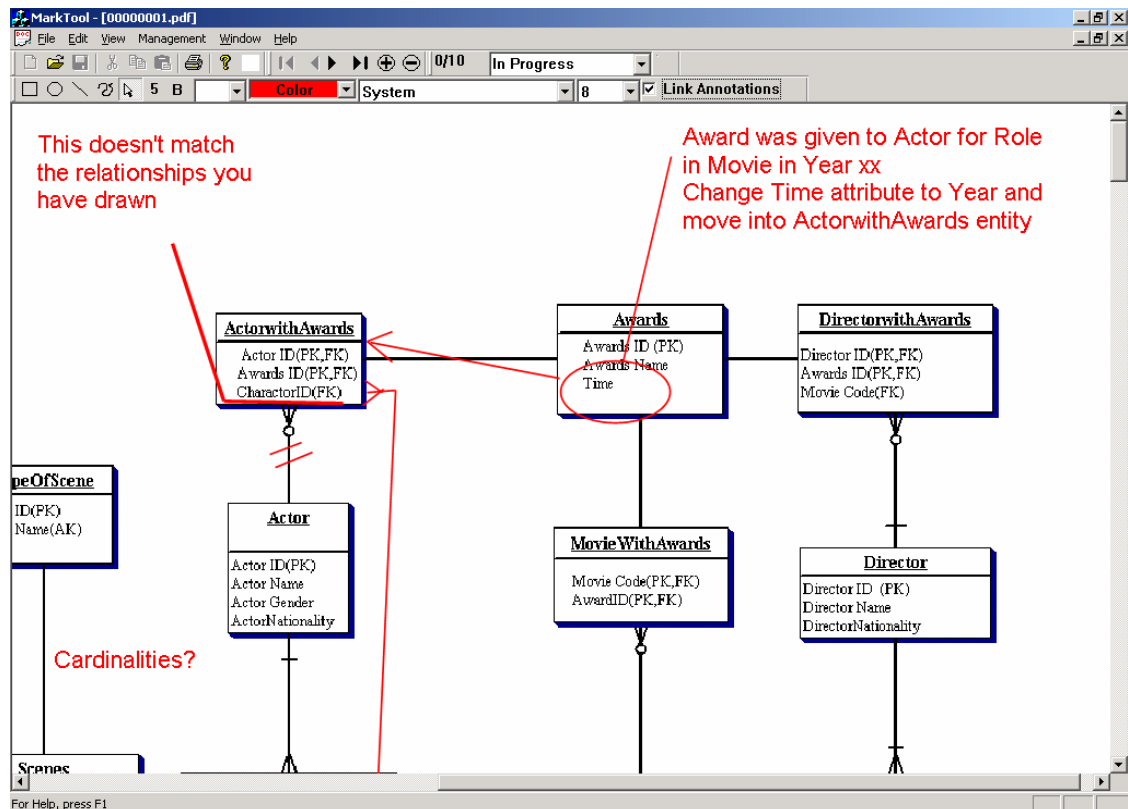


Figure 1: Screenshot of the MarkTool showing the onscreen marking of assignments (the annotations are in a different colour as the assignment artefact which is important for readability; this is lost in a black and white printout)

Foundations in educational literature

In this section we investigate the literature on educational assessment theories and on learning from assessment and relate the findings to the electronic repositories of marked student work. We are using the substantial literature review on classroom formative assessment by Black and William as a major source for this section. In the conclusions to their review Black and William point out the significance of formative assessment for learning: 'The research reported here shows conclusively that formative assessment does improve learning' (p35). They further state that while the theories surrounding formative assessment are not yet fully developed and the impact of feedback is not yet widely understood there is still enough evidence of positive gains to incorporate more formative assessment in various ways into the teaching: 'Significant gains can be achieved by many different routes, and initiatives here are not likely to fail through neglect of delicate and subtle features' (p36). These conclusions encourage us to investigate how we can provide mechanisms to support formative assessment and raise our confidence that we can contribute while still fine-tuning our processes.

Quality of feedback

One important concept of formative assessment is feedback (Black and William, 1998; James, 1998) that focuses on identifying the gap between present and desired achievement and on developing a plan on how to close this gap. The quality of feedback given to the students is of highest importance to the success of formative assessment (Black and William, 1998; Kluger and DeNisi, 1996; James, 1998; Topping, 1998). Feedback should direct attention to task-motivation or task learning processes (Kluger and DeNisi, 1996). Despite this importance of the quality of feedback and its essential role in the assessment process a lack of training of lecturers in assessment is reported (Ecclestone and Swann, 1999). Besides the quality of the feedback it is important to look into the procedures by which feedback is returned to the students. For example, it is essential that the students attempt to answer questions themselves before being given the correct answers, and that they gain access to the answers only after they receive the feedback (Black and William, 1998).

These considerations on the quality of feedback impact on the investigations into electronic repositories in several ways. It is important for our work to look into the training for quality of feedback and into the management of release of information. We need to pick up on the lack of training in assessment, which affects both lecturers and markers. We aim to build quality of feedback training systems that centre on sample repositories. We need to build management structures around our repositories. With these feedback provided by markers can be monitored allowing release to students only after comments have passed through quality filtering. Further, a staggered release of feedback, marks, and sample solutions can be implemented.

The role of assessment in guiding learning

The assessment in education literature calls for a tighter integration of assessment and learning (Black and William, 1998; Ecclestone and Swann, 1999; James, 1998). The potential of formative assessment to motivate learners has to be utilised and actions have to arise from assessment that contribute to learning.

The trends identified have several implications for our work. We can react to the demand of shifting attention towards formative assessment by building repositories that contain essay-type assignments and formative feedback annotations. This is in contrast to components widely available in current learning management systems that focus on multiple choice-style tests representing summative assessment.

The literature calls for using assessment to inform learning. What we want to do with our repositories is to use the artefacts produced by students and marked by lecturers in one year as a learning resource for students in the following years. Students in subsequent years study the same concepts that are presented with different examples. This year's students can learn from the work previous students have submitted by examining their solutions and attempting to assess these. As the repositories contain the feedback provided by the lecturer at the time the new students can compare their own attempts at assessment and benefit from the effort the lecturer has spent. We will expand on these ideas in the later section on the use of examples for learning.

Assessment communities

To be successful it is essential that students understand learning goals, realise the gap between their current and the target levels, identify the steps required to bridge this gap, and take responsibility for executing these steps. One way of achieving this is for students to become part of an assessment community in which they work together with their lecturers on assessment and on improving the quality of their work (Ecclestone and Swann, 1999). A further important aspect of the involvement in an assessment community is the effect of familiarising students with assessment procedures and criteria (Black and William, 1998; Klenowski, 2000; Wilson, 2004).

The idea of assessment communities can be taken up to involve the students in assessment. The core part of this process would see a student gaining access to an artefact contained in the repository without being able to see the annotations provided by the lecturer. The student then assesses the artefact and once this is done compares their comments with the ones given by the lecturer. This core process can be extended in various ways, for example using scaffolding or collaboration, as we will outline in more detail in later sections.

Self- and peer-assessment

Closely linked to the assessment communities are the concepts of self- and peer-assessment, with the literature consistently emphasising their benefits (Black and William, 1998; Brookhart, 2001; Ecclestone and Swann, 1999; James, 1998; Juwah, 2003; Sivan, 2000; Topping, 1998). What is commonly mentioned is that self- and peer-assessment encourages students to take responsibility for their learning, is important for understanding goals, and facilitates the development of critical and independent thinking skills. Looking into the potential problem area of reliability and validity Topping (1998) examined 31 studies and reported that the majority of these studies (18) found adequate reliability and validity.

In the remainder of this section we focus on four specific aspects of self- and peer-assessment, namely feedback on self/peer-assessment, student responses to feedback, formulating assessment criteria, and developing confidence.

Black and William (1998) report on the general discrepancy between students' self-perception of their work and the judgement provided by others and suggest providing students with feedback on their self-assessment. We can integrate this suggestion into our repositories with a collaboration component. Looking at peer-assessment, a student would assess an existing artefact and make their comments available. Other class members can access the artefact inclusive of the first student's comments and provide alternatives, agreement or corrections. The students develop a dialogue, closely focused on the artefacts and assessment comments. Looking at self-assessment, this approach would be extended by the students first developing their own artefacts for a given task. They would then possibly gain access to marking guidelines and others students' submissions before engaging in self-assessment. This approach would concur well with Black and William's (1998) demand that students should initially attempt the answer questions for themselves before being given feedback or solutions.

One of the issues that arose from studies reported in Ecclestone and Swann (1999) relates to the responses of students to the feedback given to them by their teachers. The question asked is how we can find out which feedback helped the students to improve the quality of their work. One step towards answering this question could be to facilitate a dialogue between student and teacher. After gaining access to their work annotated with feedback via a password-protected electronic system the students could use a dialogue functionality that would allow them to easily respond to a specific comment without having to approach their teachers in their office.

Sivan (2000) suggests that initially the lecturers should provide the assessment criteria and that later in the process the students themselves could develop these criteria. Linked to this are findings by Black and William's (1998) stating that students learn and think more by formulating their own questions. We can integrate these suggestions into our work in various ways. For example, we can direct the students to work on a first set of artefacts for which we provide assessment criteria. We then provide a related set of artefacts (e.g., relating to the same concepts but demonstrated with examples from a different domain) for which the students have to adjust the assessment criteria provided previously. Over various stages we can move from giving guidance towards requiring students to develop their own criteria.

Assessing work provided by others is not an easy task. Besides requiring well-founded subject knowledge, confidence is an important factor and has to be developed over time (Ecclestone and Swann, 1999; Sivan, 2000; Bhalarao and Ward, 2001; Wen and Tsai, 2003). The issues around confidence relate to electronic repositories in various ways, affecting not only student but also staff confidence. In a traditional setup the feedback provided by a lecturer is only seen by the student (or a small group of students) who has submitted the work. A lecturer who employs markers will only conduct spot-checks on a small sample of assignments. The assessed work only 'lives' for a short period of time, mostly until the student has passed the respective paper and moves on to other subjects. An electronic repository has the potential to change these conditions considerably. The lecturer can more easily access the work done by the markers, the marked assignments live in the repositories for years to come, accessible not only to a few students but to the whole class. Careful management will be required to mitigate the potential for resistance against electronic repositories to facilitate taking advantage of their proposed benefits. As the literature reports, it is essential to improve the quality of feedback - supervising and training markers will lead to such an improvement. The more teachers learn about the theories linked to marking the more confidence they develop. Involvement of students in the assessment community increases their understanding and acceptance.

A very different characteristic of web-based systems, that is the lack of face-to-face contact, can help reducing the reluctance towards criticising the work of someone one knows. Anonymity can be conducive to providing feedback and can be implemented fairly easily in an electronic environment (Schuck, 2003; Wen and Tsai, 2003). Electronic repositories will allow us to provide the required degree of anonymity so student (and staff) will feel less inhibited to contribute even in the early stages until more confidence has been developed. This could be supported by introducing pseudo identities meaning that students can choose online identities that hide the students' real identities.

Scaffolding

In the previous section we have mentioned some psychological barriers that might affect peer-assessment. Setting these issues aside, students might initially need some assistance on the actual subject matter or on marking procedures to get started with either self- or peer-assessment. The literature talks about scaffolding. Scaffolding refers to providing a stepping stone rather than a full solution or to supplying an example to guide students in their assessment (Black and William, 1998; Sivan, 2000; Renkl and Atkinson, 2002).

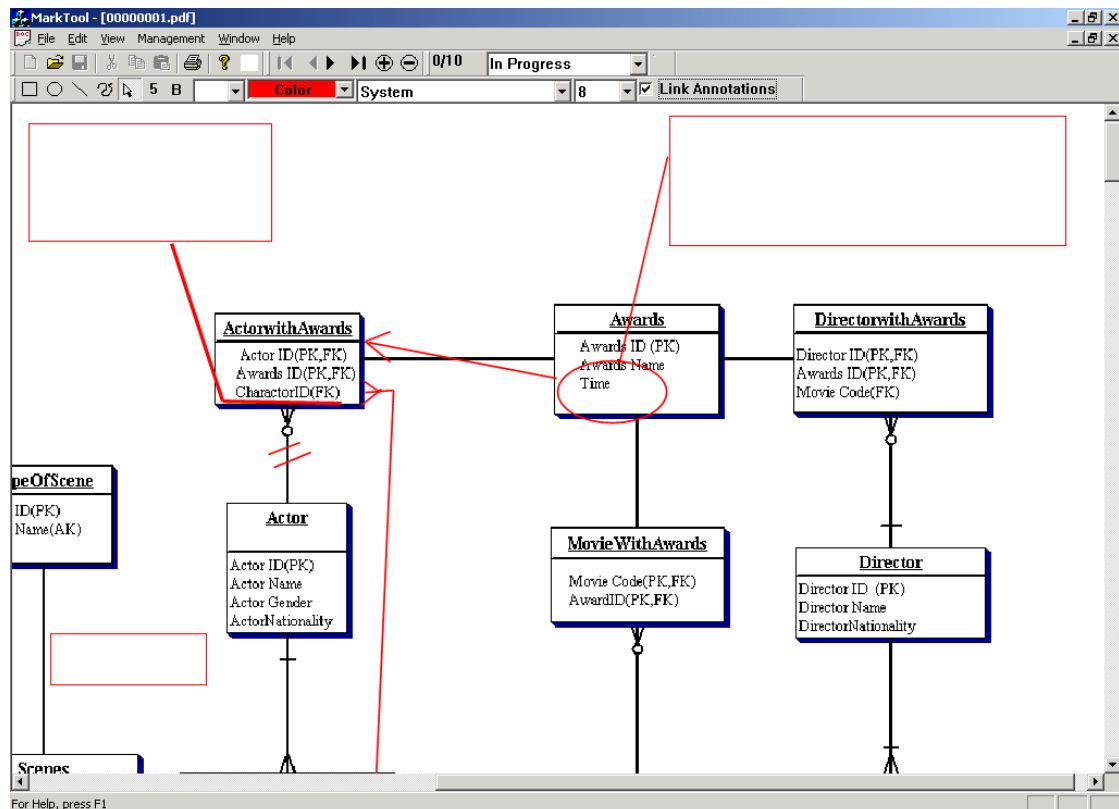


Figure 2: Screenshot of the MarkTool showing the reference points for comments but not the comments themselves

Again, we see various ways of how to integrate scaffolding into electronic repositories. One approach can provide the students with a list of comments that refer to concepts taught and that have to be matched to the applications of these concepts in the artefacts. Taken the data modelling example we referred to previously, one of these comments would be ‘this many-to-many relationship must be resolved’. This comment points the students to an important concept in data modelling (the resolving of many-to-many relationships required to normalise the data model) that is frequently violated by data modelling novices. The student performing the self- or peer-assessment can now try to match this comment with an instance in the artefact - a task that is less challenging than having to come up with the idea that many-to-many relationships could be a problem in the first place. Another way to approach scaffolding is to present only part of feedback provided by someone else. Assuming we have an artefact available that has been assessed previously by the lecturer, instead of presenting the artefact to the student including full annotations we can suppress the textual components of the annotations and only show the graphical annotations. This would indicate to the student that a particular part of the artefact requires a comment (the part the graphical annotation points to), but would leave it up to the student to discover what kind of comment is required. Figure 2 gives another screenshot of the MarkTool demonstrating this kind of scaffolding.

Learning from examples

A number of authors advocate the use of examples of student work to benefit both teachers and students (James, 1998; Renkl and Atkinson, 2002; Black and William, 1998; Wen and Tsai, 2003). Access to assessed examples of student work is important to illustrate how standards look in practise and assists teachers in achieving consistency in marking. The examples presented should not be restricted to model answers but can also demonstrate weaknesses. Students can learn from the feedback provided by the teacher that points out the problems in the work and makes suggestions on how to eliminate these problems. Further, students can be asked to analyse the work provided and to construct the feedback themselves.

These references to learning from examples relate very well to our repositories of marked student work. Our artefacts stem from student-submitted assignments and therefore naturally span the range from weak to excellent. Our repositories will contain both assignments and the formative feedback provided originally by the teacher.

Based on the way in which we will store the repositories electronically we will be able to display artefacts and comments both combined and separately. This allows for both forms of learning as suggested in the literature. Local context will be achieved naturally by using the assignments from one semester or year as artefacts in the repositories for the same paper or subject in the following period (yet this local context should not preclude sharing repositories across institutions).

The repositories of marked student work can also be used for the training of lecturers and markers. Both groups can benefit from studying example feedback to improve the quality of their marking comments. Lecturers can use the repositories to demonstrate standards of achievement to their markers and to facilitate consistency across the markers.

Summary

In this section we have examined formative assessment and its relationship to learning. The educational literature stresses the importance of formative assessment and indicates a shift from assessment for ranking towards assessment for learning. An essential component of formative assessment is feedback. Feedback assists the students in identifying gaps in their knowledge and guides them towards measurements to close these gaps. The quality of this feedback is of the highest importance and the literature strongly recommends task- instead of self-related feedback. Self- and peer-assessment help students in the development of higher order thinking skills and bind them into an assessment community. Examples of commented student work benefit both teachers and students, in demonstrating standards and in assisting learning.

Parallel to reviewing the literature on formative assessment we have introduced components of our proposal for electronic repositories of marked student work and have linked these components with the respective educational theories. In summary, we see the following main application areas for the electronic repositories of marked student work:

- Learning from previously assessed work: learning from the formative feedback provided with the assignments through receiving explanations what is correct or incorrect and why; having access to a range of approaches to the task set, providing alternate viewpoints beyond a sample solution; getting a feeling for what is required in volume and level of detail for the assessment in this paper; being able to access all this material in their own time using it both for assignment and examination preparation;
- Learning through self- and peer-assessment: building of an assessment community; attempting the task before having access to the solution; providing and receiving peer-feedback; improving the understanding of assessment criteria and tasks;
- Guidance and supervision of markers: providing of marked assignment samples to markers; collaboration between markers and lecturers in reviewing marking decisions and comments; assisting lecturers in their tasks of monitoring the work of their markers; extracting all textual comments for quick suitability checking;
- Improvement of feedback quality: supporting staff development in the assessment area; staff training systems based on repositories of artefacts annotated with feedback of different quality levels; anonymous access to allow staff to participate in confidence.

We are not aware of any work that addresses formative assessment and its relationships to learning in the way we have suggested. Yet, some aspects of assessment related learning have been covered in other eLearning approaches. In the next section we look at examples of such studies.

Related work linking assessment with eLearning

In this section we present some examples of work that link assessment with eLearning and that demonstrate the application of some of the findings from the literature review on educational assessment theories.

Bhalerao and Ward (2001) advocate the use of multiple-choice tests combined with peer-assessment of free response questions. The authors teach computer programming to large classes of several hundred students and conduct laboratory assessments about four times per course. As with tests in many other disciplines, computer programs cannot fully be assessed automatically. Bhalerao and Ward use a two step system for their laboratory tests that involves automatically assessed multiple choice questions followed by peer-assessed free response questions. Bhalerao and Ward report that the students' results have improved after being involved in the

marking. The authors suggest that their approach, after some modifications, could be used for essays in the social sciences.

Sitthiworachart and Joy (2003) discuss a web-based peer-assessment approach to support students' learning of programming. They have developed a three-stage system in which the students first solve a programming task, and then individually peer-assess other students' programs with subsequent discussion of their peer-assessment in groups, followed by students marking the quality of the peer-assessment provided. Sitthiworachart and Joy report that their approach positively contributes to the students' learning experience. They emphasise that the students need to be given adequate guidance for the marking process and that the marking of the work of friends can result in favourable marks.

Tsai et al. (2002) have investigated the use of peer-assessment to support the collaboration among pre-service teachers conducting open-ended tasks like the design of science activities. The system used is modelled on the submission and review process of academic journals. Tsai et al. report an improvement in performance with the students displaying important cognitive skills. They further state that the students regarded peer-assessment as effective for their learning and were motivated by it. The authors emphasise the opportunities that have arisen for the implementation of peer-assessment with the wide availability of the internet and web-based systems. The advantages of web-based systems are that they overcome time and place restrictions and that they allow for anonymity, important for an objective manner of judging.

Wilson (2004) used an asynchronous learning network environment for the development of multiple-choice style exam questions by students in the teaching of emerging information technologies. The students displayed a high level of participation that can partly be explained through course structure and social pressures but seemed to extend beyond these factors. The identities of the contributing students were visible and the lecturer provided some monitoring of the interactions. Possibly due to this setup the students co-operated in very polite manner. Despite their willingness to participate the students strongly disliked being criticised by their peers.

Nokelainen et al. (2003) report the use of a document-based annotation tool for learner-centred collaborative learning. The tool allows learners to add textual annotations to learning material displayed on the web. The annotations appear in textboxes close to the highlighted reference points in the learning material. The authors show a strong agreement among students that the use of this document-based annotation tool added value to their learning. The students emphasised strongly the benefits they perceived gaining from self-made comments. While the work by Nokelainen et al. does not relate to assessment it shows parallels to our research in the annotation tools used and the collaboration aspect of document-based annotation.

Summary

This small selection of example studies reiterates a number of points made in the assessment literature:

- Answers to free-response questions need to be assessed by a human marker;
- Examples of student work are a valuable learning resource;
- Self- and peer-assessment is highly conducive to learning;
- The monitoring of interactions and the provision of guidance are important;
- Anonymity facilitates the acceptance of peer-assessment;
- Networked computer systems are highly useful for the implementation of assessment.

We are encouraged to see that these issues identified in the literature have been implemented successfully in various projects. While the selection of these projects is obviously not exhaustive it is still interesting to note that the first three projects address a computer sciences/information technology context. The technical nature of the context seems to be typical for projects that either apply some form of automated assessment (beyond multiple-choice style assessment) or that have developed fairly sophisticated systems to guide students through an assessment process.

Why electronic compared to paper-based repositories

Having painted a clearer picture of what we want to achieve with the repositories we now want to summarise the advantages of using computers to support the repositories. While some of the suggestions made in this article could as well be implemented with paper-based repositories the concept overall can only be realised with an electronic format. There is plenty of evidence in the literature for the advantages of electronic or online systems

(Buchanan, 1998-99; Kemm et al., 2001; McLoughlin et al., 2003; Northcote and Kendle, 2001; Renkl and Atkinson, 2002; Sclater and Howie, 2003; Tsai et al. 2002). In the following paragraphs we outline in regard to the repositories how an electronic format opens up possibilities not present in the pen and paper environment.

Document management

Part of the repository idea is that a single artefact is accessible by multiple users. In a paper system that means either the provision of multiple physical copies or restricted access through a sequential scheme, passing on the physical copies from person to person. In the electronic format artefacts can be copied without effort on demand. Electronic repositories can easily be archived and activated when required - today's learning management systems already offer the basis for such facilities.

The conversion of an assignment into an artefact requires some preparation. The identity of the author has to be removed and it might be suitable to split the assignments into different components. With electronic copies these tasks can be performed easily.

A very important advantage inherent in electronic formats is the flexibility gained in regard to adding and removing marking comments. Electronic comments can be displayed or suppressed at will. This means that multiple students or markers can work on the same artefact in parallel and that an assignment can be displayed in its original, unmarked form first, revealing the annotations only after the students have attempted assessment themselves.

A related aspect to this is that the electronic comments will usually be typed and not hand-written. This brings advantages both for the person making the comments, as typing is often physically less strenuous than hand-writing, and for the reader, as typed comments are easier to decipher than most people's hand-writing.

Access management

Access to an electronic repository can be protected by user codes and passwords. Besides controlling who is granted access, schemes can be implemented that stagger the release of information. That can mean creating a timed sequence of access to task description, artefacts, marking comments and sample solutions. While this would be possible in a paper-based system also, the management effort required would be extremely high, specifically if one wants to control access at the individual but not class level. Individual schemes are very important as they allow students to work at their own pace. Electronic formats are essential if one wants to implement an any-time and any-place access policy.

Communication

One feature of electronic repositories is that students (or students and markers) can communicate on marking comments. Students can comment on artefacts and enter these comments into the repository. Other students then read these comments and respond with their own assessments. An electronic repository means that this communication is independent from being at the same location at a specific time and does not require the exchange of physical documents.

Issues requiring full exploration

As mentioned earlier we have so far omitted several critical procedural issues that need to be considered to make these repositories reality. These issues have arisen in wide-ranging discussions with colleagues from a variety of disciplines and both from academia and university management.

Integration of the repositories into the learning process

It is not trivial but undoubtedly technically possible to build the repositories. Technically similar work using the internet and database management systems has been implemented already (Cho and Schunn, 2003; Kemm et al., 2003; Nokelainen, 2003; Sithiworachart and Joy, 2003; Sung et al., 2003). Further, at least to a certain degree,

the technology can assist with the implementation of protocols or procedures. What we mean by this will become clearer by looking at some examples. The literature on formative assessment states that students should first attempt a task themselves before receiving sample solutions. We have built this into the scenarios by suggesting that students first have to submit their own solution attempt before gaining access to the repository artefacts annotated with formative feedback and to sample solutions. Technically it is possible to monitor submission and to control access rights accordingly. The difficulty occurs on a semantic level. A computer system is generally not able to assess the meaningfulness of a submission. Based only on automated control a student could easily bypass the spirit of the requirement to attempt the task first by submitting a more-or-less meaningless document. A meaningful level of access management would require the involvement of a human assessor, the lecturer or a marker or possibly even a student peer. One of the questions arising therefore is how much active involvement for controlling the learning process should be built into the repository system.

Similar issues arise with access to summative feedback. Again, technically it is easy to separate summative from formative feedback and to give access to marks only after the formative feedback has been studied. The question here is how a computer system decides if a student has actually 'taken in' the comments provided and has not just followed some mechanical steps to fulfil some computer-controlled requirements.

Creating the right atmosphere

In an ideal world everyone would be willing to share their artefacts and assessment annotations. In reality this is not necessarily the case. Conversations with colleagues around the university suggest that people are likely to feel insecure about opening their marking to a wider audience for scrutiny. Open access might prompt students to a higher degree than currently to question marking decisions. It could be psychologically difficult for lecturers to expose their marking performance to their colleagues.

For the success of the repositories it is essential to acknowledge these fears and insecurities and counteract them. One possibility might be to initially work with pseudo identities as has been discussed earlier. This might allow people to start making contributions to marking and to develop more confidence, based on feedback received to these contributions. As the literature reports that the more we know about marking the more confidence we gain about sharing (Black and William, 1998). This would allow us to assume that the fears and insecurities can be overcome with training and education. Part of this will be to develop the right atmosphere, among students in a course, and among lecturers and markers working together in assessment, and among staff participating in staff development.

Ethical issues and informed consent

Ethics and privacy issues have gained increasing importance. From our own experience in dealing with our university's ethics committee we know that, for example, it is necessary to gain informed consent from the students for using their examination answers for research purposes. The right procedures will have to be developed and followed to make student assignments or other work accessible in electronic repositories.

Using an informal approach we surveyed the opinions of our students regarding access to their work. This revealed that students seemed to be willing to grant permission for the use of their assignments anonymously in repositories for teaching in the following year. The students did not feel comfortable with sharing their assignments with their current peers, even if all links to the students' identities had been removed. Our students are from computer science and technology disciplines who commonly work either by themselves or in small groups. Attitudes might be different among, for example, education or social science students.

Institutional policies and support

The successful implementation of electronic repositories as advocated in this article or of any other networked computer support for formative assessment will, to a certain degree, depend on institutional policies and support. At this stage the climate seems to be that individuals have to display a considerable amount of initiative and determination to overcome obstacles. One of the policies required would be on ethics and informed consent, as discussed in the previous section. Another area relates to the security of electronically submitted and stored assignments or student work in general. Learning management systems already offer some facilities in this regard yet these are possibly not sufficient. At our university, for example, the development of an assignment

tracking system is underway that is to facilitate the electronic submission of assignments from our distance education students. A further point concerns the requirement of equal access for all students. If access to suitable computer equipment is essential to participate in a course the university has to classify this course accordingly.

Besides policies, procedures need to be developed towards creating a supportive environment. In relationship to using computer laboratories for tests and examination purposes, the information technology services laboratory administrator at our university recently circulated a message. This message stated that it was necessary to apply for such use of the laboratories three months in advance and that a rationale for this request had to be provided. The information technology section would then decide on granting this request and would advise on costs to be carried by the applying department. Such procedural and decision processes are not conducive for encouraging the use of electronic resources.

We are certainly not advocating a university-wide use of electronically submitted, marked and stored assignments. Yet, we would hope for some level of institutional support to encourage the uptake of these technologies and the related learning opportunities.

Practicalities

Briefly in the introduction to this article we have talked about how to obtain electronic copies of assignments. Ideally we see the repositories to be used in conjunction with electronic submission of assignments and the marking of these electronic copies 'onscreen' (Heinrich and Wang, 2003). This would evolve into a two step process. In the first year, the students submit assignments for assessment. This work is submitted, marked and returned electronically and stays confidential to the submitting students. In the second year, the assignments (without identification of the submitting students) become accessible to the new students as learning material. This process works well with our understanding of the privacy considerations our students have demanded. On a practical level the advantage of this approach is that we gain material for our repositories basically as a by-product of our normal assessment procedures (this actually is a great advantage as experiences with initiatives like LOM (2003) have shown that repositories of learning material grow slowly if there is not strong incentive for contributing material). We will have the assignments as artefacts and the marking comments as formative feedback. Issues to be handled are the removal of student identification numbers and names and the separation of summative from formative feedback.

An alternative process, suitable for fast-tracking the development of the repositories, is to select a representative sample of paper-based assignments and to re-create electronic copies. We have gained some experience in doing this by scanning assignments and using a graphics program to erase any marking comments on the electronic copy. We then used our electronic marking tool to re-create electronic, flexibly removable copies of the original marking comments. Depending on the quality of the paper original and the image settings during and after scanning this process results in artefacts of sufficient quality. We felt that the time effort required was bearable and specifically the re-creating of the marking comments felt surprisingly fast.

One issue that has been raised in context of electronic assignments is the question about the need for printed copies. Are printed copies required, who is responsible for the printing and who bears the costs? In our current university system the students print their assignments before submission. In the full electronic system we envisage the students would submit electronic copies. The electronic copies would be marked without printing and returned to the students electronically. The students could then decide if they wanted to produce printed copies. With this approach, the students would certainly not be disadvantaged in regard to their printing budgets. The university would not incur any costs, as it would not be required to print.

Obviously, electronic assignments depend on the availability of a suitable tool for marking (like our MarkTool) and on the appropriate support processes. Even with the best tools this approach will not be acceptable for everyone for every type of assignment. Yet, this should not stop us exploring the possibilities and the opportunities for learning.

The current status of our work

The implementation of the electronic repositories of marked student work has two main technical components, the marking tool and the web-based repository. For the marking we have an alpha-release application, the MarkTool shown first in Figure 1, available. For the web-based repository we have a preliminary design.

The design of the MarkTool goes back to work by Heinrich and Wang (2003) and technical details of the current version are described in Heinrich and Lawn (2004). A central idea is that we convert assignments into PDF-format (PDF Reference, 2001). This allows us to basically deal with all types of printable documents and therefore does not restrict the students either in format or application program. Further advantages of using PDF are that the documents are protected from change and that formatting and page layout remain unchanged. MarkTool offers a range of annotation features: graphical highlighting in various shapes and colours, textual comments optionally linked to the graphical highlighting, and a numeric tool entering and adding marks. All annotations are automatically stored in a database and the artefacts can be viewed with and without annotations. All document handling features are as expected from a PDF-reader program, including page management and zooming. At this stage MarkTool comes with a simple artefact management component. A class list, exported from our student management system, is imported and used to link artefacts to students. The status of each assignment can be set to 'not marked', 'in progress', 'review', or 'marked'. The current work on the MarkTool focuses on the development of a student-end for the viewing of marked assignments, the implementation of further features and on end-user testing.

The preliminary design for the web-based repository features fairly standard components of a web server, a relational database management system and a web-based user interface. The MarkTool currently is implemented as an application that could be downloaded to the user's computer. We envisage both online and offline modes to allow users to work independently from the web. This will require the definition of an XML schema for the marking information. With this, the marking information could be downloaded to the user's computer in XML format, stored there on a local database and uploaded again as XML data. On upload the annotation data have to be synchronised with other annotations for the respective artefact. This design would allow a student or marker to download artefacts of interest, do their assessment offline and then synchronise with a central repository.

Besides the technical components we have a small sample of twelve, electronically annotated and marked assignments from this year's data modelling class available for use in a first repository. We have gained informed consent from the authors of these assignments to use their artefacts anonymously in next years teaching. Now, where MarkTool is ready for use by a wider audience we will quickly gather more artefacts.

Conclusions

A review of the education literature clearly shows the benefits of formative assessment for learning. Many studies undertaken over the last years have demonstrated that formative assessment can be effectively supported by utilising web-based computer environments. Characteristic of formative assessment is that it requires open-ended response from the students and that multiple-choice style tests therefore are not sufficient. As a consequence automated marking is not possible and the assessment and here specifically the feedback has to be provided by a human marker. Open-ended responses lead to essay-type assignments that are used across all disciplines or subject areas.

The literature also shows that both in theory and practice a lot more needs to be done to improve the quality of formative assessment. One aspect here is the requirement to better educate and train staff providing formative feedback. Another aspect is the integration of formative assessment into the learning process.

In this context we have introduced the concepts of electronic repositories of marked student work. These repositories focus on the learning aspect of formative assessment. A central thought behind the repositories is to regard the students' marked work as a valuable resource. This resource should not only be used as a 'one-off' but should be retained and used with future students. The artefacts provided by students can serve as examples for the solution of tasks. As the literature states, both weak and strong solutions are valuable resources. Besides the artefacts the repositories contain the feedback provided by the marker, originally formulated for the submitting student. This feedback will guide students through their understanding of the example artefacts.

Besides advocating for the electronic repositories we suggest the marking of assignments in electronic format. We suggest a conversion of essay-type assignments into PDF-format and the marking of these assignments 'on screen'. Electronically stored marking annotations open up various possibilities both for the marking process and the flexibility in studying the feedback. An important side-effect of using an electronic marking tool is that the data produced while marking automatically are in the right format for inclusion in the repositories.

The technical implementation issues around on-screen marking and electronic repositories of marked student work can all be resolved. We already have developed a marking application, called MarkTool that allows

marking of electronic assignments in a style similar to the familiar 'pen-and-paper' techniques. System architectures with a web interface and database back-end are fairly common. We suggest such a standard architecture extended by XML data transfer to facilitate the option of working away from a network connection and subsequent synchronisation of data.

As demonstrated throughout the article the concepts of electronic repositories of marked student work fit in very well with educational theories. Yet, for this approach to be successful a number of issues have to be carefully considered. As with any eLearning initiative it is essential to ensure that the technology serves the pedagogy. The repositories need to be integrated well into the learning process. This includes careful selection of repository content, a managed process, possibly step-by-step, of granting access to the full repository data, and the involvement of the lecturer in guiding and monitoring the students. Assignments, feedback and marks need to be treated confidentially. Ethics requirements mean that permission needs to be sought to include material in the repositories. Initial informal inquiries among our students have shown that these are willing to give consent for their work to be used by future students. An important factor will be the level of comfort among lecturers and markers to expose their marking to a wide audience in a repository. Based on conversations with some of our colleagues we are prepared for at least an initial feeling of discomfort in this regard. On the other hand, the literature indicates that confidence in regard to marking grows with increasing knowledge about what constitutes high quality marking. This is paired with a call for better training of lecturers in marking, an issue taken up for example by our own university as a focus for staff development in the upcoming year. We see electronic repositories of marked student work as a tool to assist in this area and are confident that an initial resistance against using the repositories can be overcome.

To conclude, we see an enormous potential for electronic repositories of marked student work to contribute to formative assessment and to student learning.

References

- Bhalerao, A., Ward, A. (2001). Towards electronically assisted peer assessment: a case study. *Association for Learning Technology Journal (ALT-J)*, 9 (1), 26-37.
- Black, P., & William, D. (1998). Assessment and Classroom Learning. *Assessment in Education: Principles, Policy & Practice*, 5 (1), 7-68.
- BlackBoard (2003). Retrieved November 6, 2003 from <http://www.blackboard.com/>.
- Brookhart, S. M. (2001). Successful Students' Formative and Summative Uses of Assessment Information. *Assessment in Education*, 8 (2), 153-169.
- Buchanan, T. (1998-99). Using the world wide web for formative assessment. *Journal of Educational Technology Systems*, 27 (1), 71-79.
- Cho, K., & Schunn, C. D. (2003). Validity and Reliability of Peer Assessments with a Missing Data Estimation Technique. In D. Lasser, & C. McNaught (Eds.), *Proceedings of Ed-Media2003 World Conference on Educational Multimedia, Hypermedia & Telecommunications.*, Association for the Advancement of Computing in Education (pp. 1511-1514), Norfolk, USA: AACE.
- Ecclestone, K., & Swann, J. (1999) Litigation and Learning: tensions in improving university lecturers' assessment practice. *Assessment in Education*, 6 (3), 377-389.
- Heinrich, E. (2004). Electronic Repositories of marked Student Work. In E. Kemp & D.Bailey (Eds.), Institute of Information Sciences and Technology Report Series (pp. 1-22), No 94, Palmerston North, NZ: Massey University, Retrieved June 4, 2004 from http://www-ist.massey.ac.nz/reports/public_reports/94/IISTReport.pdf.
- Heinrich, E., & Lawn, A. (2004). Onscreen Marking Support for Formative Assessment. In L. Cantoni & C. McLoughlin (Eds.) *Proceedings of ED-MEDIA 2004 - World Conference on Educational Multimedia, Hypermedia & Telecommunications*, USA: AACE.

Heinrich, E., & Wang, Y. (2003). Online Marking of Essay-type Assignments. In D. Lasser, C. McNaught (Eds.), *Proceedings of Ed-Media2003 World Conference on Educational Multimedia, Hypermedia & Telecommunications*. Association for the Advancement of Computing in Education (pp. 768-772), USA: AACE.

James, M. (1998). *Using Assessment for School Improvement*, Oxford: Heinemann Educational Publishers.

Juwah, C. (2003). Using Peer Assessment to Develop Skills and Capabilities. *Journal of the United States Distance Learning Association*, 17 (1), 39-50.

Kemm, R. E., Williams, N., Fritze, P., Kavnoudias, H., & Stone, N. (2001). Learning of key scientific concepts in a web-based on-campus collaborative learning environment. In C. Montgomerie, J. Viteli (Eds.), *Proceedings of EdMedia 2001* (pp. 914-919), USA: AACE.

Klenowski, V. (2000). Portfolios: promoting teaching. *Assessment in Education*, 7 (2), 215-236.

Kluger, A. N., & DeNisi, A. (1996). The Effects of Feedback Interventions on Performance: A Historical Review, a Meta-Analysis, and a Preliminary Feedback Intervention Theory. *Psychological Bulletin*, 119 (2), 254-284.

LOM (2003). Learning Technology Standards Committee, Retrieved November 13, 2003 from <http://ltsc.ieee.org/wg12/index.html>.

McLoughlin, C., Northcote, M., & Marshall, L. (2003). Assessment Online: New Horizons and Blue Skies. In D. Lasser, C. McNaught (Eds.), *Proceedings of Ed-Media2003 World Conference on Educational Multimedia, Hypermedia & Telecommunications*. Association for the Advancement of Computing in Education (pp. 2460-2463), USA: AACE.

Nokelainen, P., Kurhila, J., Miettinen, M., Floreen, P., & Tirri, H. (2003). Evaluating the Role of a Shared Document-based Annotation Tool in Learner-Centered Collaborative Learning. In V. Devedzic, J. M. Spector, D. Sampson, Kinshuk (Eds.), *Proceedings of The IEEE International Conference on Advanced Learning Technologies* (pp. 200-203), Los Alamitos, CA: IEEE Computer Society Press.

Northcote, M., & Kendle, A. (2001). Online Assessment Criteria in Action: Task Design in Contrasting Tertiary Education Contexts. In C. Montgomerie, J. Viteli (Eds.), *Proceedings of EdMedia 2001* (pp. 920-924), USA: AACE.

PDF Reference (2001). *Portable Document Format, Version 1.4, PDF Reference Third Edition*, Boston, USA: Addison-Wesley.

Renkl, A., & Atkinson, R. K. (2002). Learning From Examples: Fostering Self-Explanations in Computer-Based Learning Environments. *Interactive Learning Environments*, 10 (2), 105-119.

Schuck, S. (2003). Help Wanted, Please! Supporting Beginning Teachers Through an Electronic Mentoring Community. In D. Lasser, C. McNaught (Eds.), *Proceedings of Ed-Media2003 World Conference on Educational Multimedia, Hypermedia & Telecommunications* (pp. 1904-1911), USA: AACE.

Sclater, N., & Howie, K. (2003). User requirements of the “ultimate” online assessment engine. *Computers & Education*, 40, 285–306.

Sitthiworachart, J., & Joy, M. (2003). Web-based Peer Assessment in Learning Computer Programming. In V. Devedzic, J. M. Spector, D. Sampson, Kinshuk (Eds.), *Proceedings of The IEEE International Conference on Advanced Learning Technologies* (pp. 180-184), Los Alamitos, CA: IEEE Computer Society Press.

Sivan, A. (2000). The Implementation of Peer Assessment: an action research approach. *Assessment in Education*, 7 (2), 193-213.

Sung, Y.-T., Lin, C.-S., Chiou, S.-K., & Chang, K.-E. (2003). Using Web-based Progressively Focused Self- and Peer- Assessment to Enhance Students’ Reflective Thinking and Performance on Hypermedia Design. In D. Lasser, C. McNaught (Eds.), *Proceedings of Ed-Media2003 World Conference on Educational Multimedia, Hypermedia & Telecommunications* (pp. 1867-1870), USA: AACE.

Topping, K. (1998). Peer assessment between students in colleges and universities. *Review of Educational Research*, 68 (3), 249-276.

Tsai, C.-C., Lin, S. S. J., & Yuan, S.-M. (2002). Developing science activities through a networked peer assessment system. *Computers & Education*, 38, 241–252.

WebCT (2003). Retrieved November 6, 2003 from <http://www.webct.com/>.

Wen, M. L., & Tsai, C.-C. (2003). College Students' Perceptions of and Attitudes toward Online Peer Assessment. In D. Lasser, C. McNaught (Eds.), *Proceedings of Ed-Media2003 World Conference on Educational Multimedia, Hypermedia & Telecommunications* (pp. 1883-1888), USA: AACE.

Wilson, E. V. (2004). ExamNet asynchronous learning network: augmenting face-to-face courses with student-developed exam questions. *Computers & Education*, 42 (1), 87-107.

Representing the Learning Design of Units of Learning

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ABSTRACT

In order to capture current educational practices in eLearning courses, more advanced 'learning design' capabilities are needed than are provided by the open eLearning specifications hitherto available. Specifically, these fall short in terms of multi-role workflows, collaborative peer-interaction, personalization and support for learning services. We present a new specification that both extends and integrates current specifications to support the portable representation of units of learning (e.g. lessons, learning events) that have advanced learning designs. This is the Learning Design specification. It enables the creation of a complete, abstract and portable description of the pedagogical approach taken in a course, which can then be realized by a conforming system. It can model multi-role teaching-learning processes and supports personalization of learning routes. The underlying generic pedagogical modelling language has been translated into a specification (a standard developed and agreed upon by domain and industry experts) that was developed in the context of IMS, one of the major bodies involved in the development of interoperability specifications in the field of eLearning. The IMS Learning Design specification is discussed in this article in the context of its current status, its limitations and its future development.

Keywords

Learning Design, Learning Objects, Educational Modelling, Open Specifications & Standards

Introduction

It is said that while open specifications (or standards) make interoperability possible, they come at the price of limiting options. Current eLearning specifications appear largely limited to page turning and single learner tracking. This is in stark contrast to the wide range of experimental systems developed to date which provide courses with more advanced pedagogical approaches, but lack portability. The challenge is to develop a specification that lifts these limitations while maintaining interoperability.

Most current open eLearning specifications and platforms available for course development and presentation can only represent courses that are restricted to a certain type of pedagogy that can be summarized as: in order to learn, a single learner has to work through a sequence of learning objects. The underlying assumption is that learning is a process of consuming content. Teaching is envisioned as the art of selecting and offering content in a structured, sequenced way, and of tracking the learner's progress and assessing the acquired knowledge. Current educational practice is more complex and advanced than this. In most settings multiple interacting roles are involved: tutors interact with the learners and learners with each other, possibly in different roles in the learning environment. Furthermore, social-constructivist pedagogical approaches have introduced different (active, learner-centred and community-centred) models and have strong arguments to reject the structured knowledge consumption approach. The current interoperability specifications have to be extended to include the multi-role interactions and the various pedagogical models that are needed to provide real support for learners and teachers in more advanced and newly developing educational practices.

We extended the current eLearning specifications by developing an additional layer to express the 'learning design' of courses in an interoperable and abstract way. We assume that every educational practice can be represented in a design description, i.e. that even for the most open course or workshop, there are underlying design ideas and principles that could be captured in an explicit representation. Furthermore, we assume that the design of any course is driven by 'pedagogical models' that capture the teacher's beliefs about good teaching and learning. More precisely, a pedagogical model is a set of rules that prescribe how a class of learners can achieve a class of learning objectives in a certain context or knowledge domain in the most effective way. Examples of pedagogical models are mastery learning, problem-based learning, active learning, or any notions of teachers about good teaching and learning. An example of a rule within a pedagogical model could be: "when teaching a new concept in higher education, start with an advanced organizer", or: "..., provide authentic problem descriptions to stimulate learners to search for solutions and study underlying concepts and facts".

A 'learning design' is defined here as an application of a pedagogical model for a specific learning objective, target group and a specific context or knowledge domain. The learning design specifies the teaching-learning process. More specifically, it specifies under which conditions, what activities have to be performed by learners and teachers to enable learners to attain the desired learning objectives. A learning design can refer to physical resources (learning objects and learning services) that are needed during the teaching and learning process. The learning design and the included physical resources can be packaged into a 'unit of learning' (UOL). A unit of learning can be seen as a general name for a course, a workshop, a lesson, etc that can be instantiated and reused many times for different persons and settings in an online environment.

There are hundreds of different pedagogical models described in the literature and new models continue to be formulated. Modelling each separate model, and then developing tools to support it, would be an inefficient path to follow. For this reason we aimed at the development of a more abstract notation that is sufficiently general to represent the common structures found in these different pedagogical models. With such a notation, learning designs for concrete units of learning can be specified that are applications of a specific pedagogical approach. A layered approach is followed: the notation is used to describe the learning design, and the learning design along with referenced physical resources are packaged in a unit of learning. The unit of learning can then be distributed and instantiated many times in many different eLearning runtime systems. This provides a powerful means of creating more effective, cost-efficient, flexible and advanced eLearning courses.

In this article we present and discuss the representational language for learning designs that we developed. It is currently available as the IMS Learning Design specification (LD). The detailed specification itself can be obtained from the IMS website (IMSLD, 2003). This article summarizes the analysis behind the specification, provides evaluative comments and indicates future directions.

Needs in education

Current needs and trends in education point to directions that are different from the ones reflected in the current eLearning specifications. Some of the major trends that are related to the requirements of learning technology specifications are (from Howell, Williams and Lindsay, 2003):

- Instruction is becoming more personalized: learner-centred, non-linear and self-directed.
- The distinction between face-to-face and distance education is disappearing through the use of eLearning. Courses that can be followed at a distance and blended distance and face-to-face approaches will be dominant in future.
- Lifelong learning is becoming a competitive necessity, resulting in a need for interoperable, networked learning (e.g. interoperable learning networks and portable learner dossiers).
- Academic emphasis is shifting from course completion to competency attainment.
- Traditional faculty roles are changing toward more specialized roles (course designer, tutor, etc).
- Faculty members demand decreased workloads, especially while working with learning management systems or online collaborative and conference environments. More automated support in the work process of faculty members is needed.

Based on a study of current pedagogical models, Merrill (2003) summarized them as follows: "... the most effective learning products or environments are those that are problem-centred and involve the student in four distinct phases of learning: (1) activation of prior experience, (2) demonstration of skill, (3) application of skill and (4) integration of these skills into real-world activities". Instead of transferring facts to learners, the major focus should be on the attainment of complex skills and competencies in authentic task situations (e.g. Van

Merriënboer, 1997). Merrill summarizes the underlying so-called 'first principles of instruction' as follows: Learning is promoted when:

- learners are engaged in solving real world problems.
- existing knowledge is activated as the foundation for new knowledge.
- new knowledge is demonstrated to the learner.
- new knowledge is applied by the learner.
- new knowledge is integrated into the learner's world.

The focus of Merrill's analysis and the pedagogical models he studied, takes the perspective of a single learner in a problem-situation. Other pedagogical developments add the notion of learning communities, communities of practice and collaboration (see e.g. Hooff, Elving, Meeuwssen and Dumoulin, 2003; Wenger, 1998; Retallick, Cocklin and Coombe, 1999). One of the current issues is the shift towards more social-constructivist approaches to learning (see: Brown, Collins and Duguid, 1989; Duffy and Cunningham, 1996). Effective education should be learner-centred, assessment-centred, knowledge-centred *and* community-centred (Bransford, Brown and Cocking, 2000). One of the underlying notions is that knowledge is not absolute, but is relative to the interpretation and beliefs of communities of practice. This social notion of knowledge means that facts, events, data and information can only be interpreted and acted upon when the social context is represented in the learning situation (e.g. Lave & Wenger, 1991).

These further educational requirements need to be reflected in the methods and instruments that support the learning and teaching process, including the design methods & tools, the runtime systems and the interoperability specifications. In this article we will not focus on the tooling, but mainly on the consequences of the new requirements for the interoperability specifications that capture the *design* of the learning and teaching process: the Learning Design (LD) specification.

Requirements for a learning design specification

The major requirement for the development of a LD specification is to provide a containment framework that uses and integrates existing specifications, and can represent the teaching-learning process (the LD) in a UOL, based on different pedagogical models – including the more advanced ones - in a formal way. More specifically, following the needs analysis provided above, a LD specification must meet the following specific requirements:

1. **Completeness:** The specification must be able to fully describe the teaching-learning process in a UOL, including references to the digital and non-digital learning objects and services needed during the process. This includes:
 - - Integration of the activities of both learners and staff members.
 - - Integration of resources (objects and services) used during learning.
 - - Support for both single and multiple user models of learning.
 - - Support for mixed mode (blended learning) as well as pure online learning.
2. **Pedagogical expressiveness:** The specification must be able to express the pedagogical meaning and functionality of the different data elements within the context of a LD. While it must be sufficiently flexible to describe LDs based on all kinds of pedagogies, it must avoid biasing designs towards any specific pedagogical approach.
3. **Personalization:** The specification must be able to describe personalization aspects within an LD, so that the content and activities within a UOL can be adapted based on the preferences, portfolio, pre-knowledge, educational needs and situational circumstances of users. In addition, it must allow the designer, when desired, to pass the control over the adaptation process to the learner, a staff member and/or the computer.
4. **Compatibility:** The specification must enable learning designs to use and effectively integrate other available standards and specifications where possible, such as the IMS (imsglobal.org) and IEEE LTSC (ltsc.ieee.org) specifications (see Olivier & Liber, 2003).

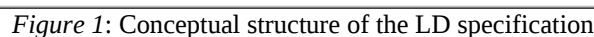
Because a LD specification should extend and integrate existing specifications, it must also inherit most of the more general requirements for interoperability specifications and standards:

5. **Reusability:** The specification must make it possible to identify, isolate, de-contextualize and exchange useful learning objects, and to re-use these in other contexts.
6. **Formalization:** The specification must provide a formal language for learning designs that can be processed automatically.
7. **Reproducibility:** The specification must enable a learning design to be abstracted in such a way that repeated execution, in different settings and with different persons, is possible.

The LD specification, following common IMS practice, consists of: (a) a conceptual model that defines the basic concepts and relations in a LD, (b) an information model that describes the elements and attributes through which a LD can be specified in a precise way, and (c) a series of XML Schemas (XSD) in which the information model is implemented (the so-called 'binding') (d) a Best Practices and Implementation Guide (BPIG), (e) a binding document and example XML document instances that express a set of learning requirement scenarios. In the following sections we will focus on the conceptual analysis work that informed the Learning Design specification.

Educational Modelling Language (EML, 2000; Hermans, Manderveld, and Vogten, 2004; Koper and Manderveld, in press) was selected as the base from which to develop the LD specification. The main changes made to the EML specification were:

- However, the central core of the EML language was preserved in LD. Figure (1) provides an overview of the conceptual structure of the LD specification.



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In this role he or she works towards certain *outcomes* by performing *learning* and/or *support activities* within an *environment*. The environment consists of the appropriate *learning objects and services* to be used during the performance of the activities. Which role gets which activities at which moment in the process is determined by the LD *method*, or by a *notification* (both drawn as an association relationship with role – activity).

The LD *method* is designed to provide the coordination of roles, activities and associated environments that allows learners to meet *learning objectives* (specification of the outcomes for learners), given certain *prerequisites* (specification of the entry level for learners). This is the core part of the LD specification in which the teaching-learning process is specified. All the other concepts are referenced, directly or indirectly, from the method. The teaching-learning process is modelled using the metaphor of a theatrical play. A play has acts, and each act has one or more roles or parts. Acts follow each other in a sequence, although more complex sequencing behaviour can take place within an act. The roles within an act associate each role with an activity. The activity in turn describes what that role is to do and what environment is available to it within the act. In the analogy, the assigned activity is equivalent to the script for the part that the role plays in the act, although less prescriptive. Where there is more than one role within an act, these are ‘on stage at the same time’, i.e. they run in parallel. Thus a method consists of one or more concurrent *play(s)*; a play consists of one or more sequential *act(s)*; an act consists of one or more concurrent *role-part(s)*, and each role-part associates exactly one role with one activity or activity-structure.

The *roles* specified are those of *learner* and *staff*. Each of these can be specialized into sub-roles. It is left open to the designer to name the roles or sub-roles and specify their activities. In simulations and games, for example, different learners can play different roles, each performing different activities in different environments.

Activities can be assembled into *activity structures*. An activity structure aggregates a set of related activities into a single structure, which can be associated with a role in a role-part. An activity-structure can model a sequence or a selection of activities. In a *sequence*, a role has to complete the different activities in the structure in the order provided. In a *selection*, a role may select a given number of activities from the set provided in the activity structure. This can, for instance, be used to model situations where learners have to complete two activities, which they may freely select from a collection of five activities contained in the activity structure. Activity structures can also reference other activity structures and external UOLs, enabling elaborate structures to be defined if required.

Environments contain the resources and references to resources needed to carry out an activity or a set of activities. An environment contains three basic entities: learning objects, learning services and sub-environments. Learning objects are any entities that are used in learning, e.g. web pages, articles, books, databases, software, and DVDs. The learning services specify the set-up of any service that is needed during learning, e.g. communication services, search services, monitoring services, and collaboration services. An example of set-up information is the specification of which LD roles have user rights in the learning service. This, for instance, enables automatic set-up of dedicated forums each time a LD is instantiated.

A method may contain *conditions*, i.e. If-Then-Else rules that further refine the assignment of activities and environment entities for persons and roles. Conditions may be used to personalize LDs for specific users. An example of such a personalization condition could be: "If the person has an exploratory learning style, Then provide an unordered set of all activities", or "If the person has prior knowledge on topic X, Then learning activity Y can be skipped".

The ‘If’ part of the condition uses Boolean expressions on the *properties* that are defined for persons and roles in the LD. Properties are containers that can store information about persons’ roles and the UOL itself, e.g. user profiles, progression data (completion of activities), results of tests (e.g. prior knowledge, competencies, learning styles), or learning objects added during the teaching-learning process (e.g. reports, essays or new learning materials). Properties can be either global or local to the run of a unit of learning. Global properties are used to model portfolio information that can be accessed in any other unit of learning that is modelled with LD and has access to the same persistent storage for property data. Local properties are only accessible within the context of a specific run of a unit of learning and are used for temporary storage of data.

In order to enable users to set and view properties from content that is presented to them, so-called *global elements* are present in LD. These global elements are designed to be included in any content schema through namespaces. Content that includes these global elements is called ‘*imsldcontent*’. The preferred content schema is XHTML. Global elements can be included in the XHTML document instances to show (or set) the value of a

property, for instance a table with progression data, a report added by a learner, a piece of text or URLs added by a teacher, etc.

LD also contains *notifications*, i.e. mechanisms to make new activities available for a role, based on certain *outcome* triggers. These outcomes are, for example, the change of a property value, the completion of an activity, or certain patterns in the user profiles. The person getting the notification is not necessarily the same person as the one who triggered the notification. For instance, when one learner completes an activity, then another learner or the teacher may be notified and set another activity as a consequence. This mechanism can be used to model adaptive task setting LDs, where the supply of a consequent activity may be dependent on the kind of outcome of previous activities. General pedagogical rules can also be implemented using the combination of conditions and notifications, e.g. "If a user has profile X, Then notify learning activity Y".

The information model and XML binding

The conceptual model is implemented as follows. A UOL is represented as a specific type of extended IMS Content Package (CP). It is extended by adding a LD element within the CP Organizations element (figure 2).

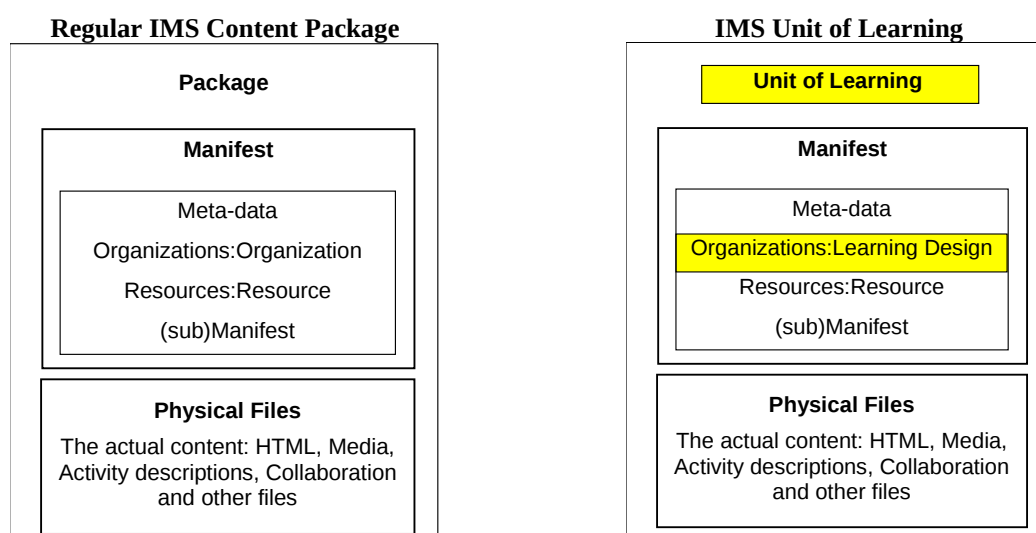


Figure 2: Comparison of a regular IMS CP and an IMS UOL

The LD element is itself a complex structure that includes elements that represent the conceptual model already outlined. The details of these elements are spelled out in the Information Model document, together with their behavioural specifications.

These elements are given an XML representation, or 'binding', provided as XML Schema that are designed to be included in an IMS CP XML structure.

The LD XML schema itself can be represented as a tree (figure 3).

The properties, activities and environments of the components element and the conditions of the method element all, in turn, have complex sub-structures but these are not shown here for the sake of simplicity.

A distinction is always made between the package (reflecting the UOL at the *class* level) and the run of that package (an *instance*). In creating instances from a package, some customization and localization may typically take place.

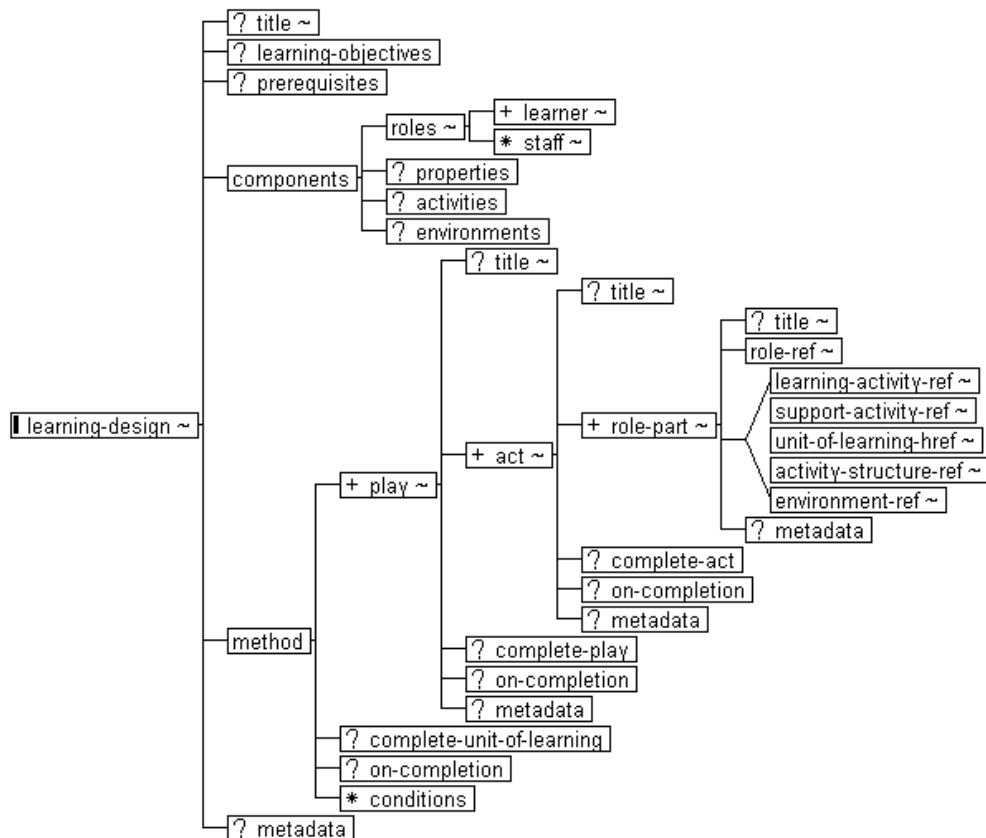


Figure 3: The LD schema represented as a tree.

A UOL package represents a fixed version of a UOL, with links to the underlying learning objects and service types. It may contain further XML document instances valid against the other appropriate schemas (IMS LD, IMS CP, IMS QTI, etc) along with the physical files that are referred to in a fixed version and URIs to other resources, including services. Such a package can be instantiated and run many times for different learners in different settings. If desired, it can also be adapted prior to instantiation in order to reflect local needs. This will create another version of the UOL and accordingly another

Evaluative comments

In the previous sections the requirements and the LD specification that is developed to meet these requirements were specified. In this section we will provide some evaluative comments about the fit of the LD specification to the requirements.

Because the IMS LD specification has only recently been released (Feb 2003) and because it is a relatively large specification, comprehensive, conforming implementations cannot be expected soon after its release. A proper evaluation of LD in its full scope will only become possible when supporting authoring, content management and runtime tools to create, store, share and interpret the LD document instances become available. However, there have been implementations of the Educational Modelling Language, EML, from which IMS LD was derived, and during the development of LD some validation activities were performed.

We will now evaluate the LD specification against each of the requirements outlined above.

Completeness

The specification describes the activities both of learners and staff in the teaching-learning process. It integrates resources and services within the environment in which activities are performed. It supports both a single and multiple user model of learning.

The EML specification included packaging, testing and content in the model, where LD references other specifications for these functions, like IMS Content Packaging, XHTML, global properties and IMS QTI. For the packaging and content part this delivers the same functionality, but the integration of QTI introduces additional problems. When interpreting a LD document instance, the LD interpreter must know that another specification is included to call another suitable interpreter. Another problem occurs when some events in the LD are dependent on test results. This requires integrating the property mechanisms of LD with QTI results. This work has now been started in IMS.

To test the requirement one can run a LD encoded course in several LD runtime systems. For any given UOL, each runtime system should deliver the same activities, with the same learning objects and services in the same order, with the same personalization facilities. This test can only be performed when different players become available. The internal tests at the Open University of the Netherlands (OUNL) with four different EML and LD runtime systems, provides some support for the assumption that this requirement has been met. Although each system implemented a different version of EML, which provides a bias, in all cases the conversion of the courses from the one EML version to the other was done automatically. A course created in EML and run in system X, was converted to a later EML version and run in system Y with the same functionality, but with a different user-interface (see for instance the interfaces discussed in: Hermans, Manderveld & Vogten, 2004; Paas & Firssova, 2004).

Pedagogical expressiveness

Literature study

One approach to testing the pedagogical expressiveness of the LD specification is by performing literature driven tests, i.e. studying the pedagogical models described in literature and testing whether learning designs based on these models can be represented in LD. Most of the groundwork of abstracting, testing and refining the core concepts, language and the XML Schema was carried out during the three year development of EML before LD was started. Models in literature have been studied (see Koper, 2001; Koper & Van Es, in press) in the three major streams of instructional theories and models (see Greeno, Collins & Resnick, 1996): empiricist (behaviorist), rationalist (cognitivist) and pragmatist-sociohistoric (social-constructivist & situationalist). Furthermore we studied different handbooks that summarize approaches (e.g. Gagné & Briggs, 1979; Reigeluth, 1983, 1999; Roblyer and Edwards, 2000), different websites with lesson plans (e.g. ERIC, 2003) and websites with pedagogical patterns (e.g. Ryder, 2003; Pedagogical Patterns Project, 2003). EML/LD was able to represent the UOLs described in literature and websites.

Check the core aspects of current pedagogical models

As discussed in the introduction, current views on pedagogical models can be summarized as learner, knowledge, assessment and community centered. We have looked into whether it is possible to represent these different aspects in LD.

LD can represent *learner centered* approaches, as it is possible to define learning designs where the learner is fully in control: e.g. learners can select activities and ask for support. Underlying such learner-centered approaches are designs that provide options, resources and access to support, and are created prior to the learners' involvement. In principle, however, it is also possible that a UOL, including the learning design, is designed specifically for and by learners themselves. This process can be supported by appropriate design tools and automated support services.

'*Knowledge-centered*' means two things according to Bransford *et al* (2000): a) the representation of information that is shared and acted upon by people in order to acquire new knowledge, and b) the attainment of the competencies that are required in certain communities of practice. LD can represent the former through learning objects within the environment and the latter through learning activities. In competency-based education, learners increase their level of competency of a given type by carrying out study tasks of increasing complexity,

starting from a baseline level. Learners work through a collection of study tasks until they have acquired the desired level of competence. The competence level itself can be specified in the objectives section. This is typically done by referencing a competency that is kept in an external competency map (as compared to normal learning objectives which are specified locally in the course itself).

Assessment is supported in several ways, depending on the type of assessment. Traditional multiple choice test items are supported through the inclusion of IMS QTI as discussed earlier. More advanced forms of assessment (e.g. portfolio-assessment and peer-assessment) are typically more integrated with the learning activities and can be modeled using LD in combination with its property mechanism. The properties can store, process and retrieve portfolio data. The notification mechanisms can support peer-review mechanisms by triggering certain persons to review work which has been produced.

Communities are supported in a variety of ways. First, it is possible to store the results of others' activities within the properties during the run of a UOL. These results can be viewed by new learners and provide a sense of community without direct peer-interaction. More direct interaction can be specified according to principles of collaborative learning where different learners jointly perform tasks or solve problems in a shared environment. Heterogeneous communities are supported by defining different roles (e.g. experts, novices), who interact with each other according to various learning design principles. LD is particularly strong in the modeling of multi-user, multi-role learning environments.

Evaluating learning scenarios

Another evaluation approach to test pedagogical expressiveness has been followed. In this approach a variety of courses which are desired or have been used in practice, are mapped into the XML language to see if it can adequately represent them. Dozens of UOLs of varying size and granularity, using different pedagogical approaches, have been encoded in EML and LD. During the development of LD, such a process was set up to validate its expressiveness. Members of IMS were asked to provide learning scenarios, or 'use cases' (i.e. narratives of a teaching-learning process) to test whether they could be expressed. Ten such use cases from universities and industry were submitted and presented in the Best Practices and Implementation Guide (BPIG, see IMSLD, 2003). These could all be represented without requiring changes in the LD model. Some concrete examples of the use cases that were sent in and represented in LD are discussed here. These varied from classical instructional design to more advanced approaches.

LD can support the modeling of *Role Play* learning. The roles of LD can be sub-typed, allowing a designer to specify any roles they need, with appropriate activities assigned. It also supports their coordination and sequencing at runtime. An example is provided in the BPIG (the Treaty of Versailles scenario) representing a complex, multi-player, multi-institutional role-play that lasts for several weeks and also includes project-based learning and blended (face-to-face and online) learning.

In *Learning by Doing* (activity-based learning), instructions are provided for carrying out a particular task. This task may be computer-based or it may be performed separately from a computer, with the computer being used to provide instructions, re-playable examples of how to perform the task, and separate skill sessions that can be undertaken before the main task is tackled.

In *problem-based learning*, a problem is set which will challenge learners to apply their existing understanding, knowledge and skills to finding solutions. In the case where more than one learner is involved, participants seek to clarify the problem, agree on an approach or method they will adopt, and share out the task in some way amongst themselves. The group may identify the learning goals of the problem and individuals then embark on their agreed tasks. The group then reconvenes to share their findings and/or their work. They evaluate these and on the basis of their evaluation they may draw up one or more solutions. These may be repeated and refined. Eventually they present the solutions. These may then be discussed with a teacher or facilitator and/or an assessment made of the group and/or individual contributions.

Programmed instruction was a very early form of computer-supported learning, developed to support Skinner's Analysis of Behaviour. In its basic form, the learner is provided with a sequence of simple tasks, whereby each task has a high chance of being completed successfully. When completed successfully, positive reinforcement is provided and the next task is presented. In variations, remedial tasks or adaptation is provided, using predefined conditions.

Literature Circles is a technique used to develop learners' discussion skills, based on discussing literary works they have read. Often arranged in small groups, the learners are given a book to read and assigned roles each with assigned tasks. For instance, a 'Discussion Director' will produce a list of questions, reactions, etc, while an 'Artful Artist' will produce a set of drawings and a 'Word Wizard' will supply definitions for any unfamiliar words. Other roles may also be used. After reading the book and completing their preparatory tasks, they meet to discuss the book with the Discussion Director as Chair. On completion of this book, they are then assigned another book and the roles are rotated. This process is repeated with different books until each member has played each role.

Personalization

The design of personalization in LD is supported through the conditions and property mechanism. Personal characteristics can be measured and stored in properties. Conditions can be defined to adapt the learning design to the learner characteristics in runtime. This generic mechanism can support a variety of personalization examples:

- Adaptation of the learning design method, given a learner's needs or characteristics. In a Jazz course the OUNL developed in EML, the learning styles of learners were measured with a validated learning style test. On the basis of the test findings they were advised to follow a particular learning approach, either more exploratory or more structured. Users were only advised: they could change the learning approach themselves if they wished to do so.
- Sometimes students in different fields have to follow the same course (e.g. students in economics and social sciences may both have to take an introductory statistics course). In LD it is possible, within the same LD, to hide or show different examples for different student profiles.
- Some students want to study at their own pace and not in a group, while others want to have extensive support from peers or tutors. With LD it is possible to provide the same course with multiple support and group options, for example, doing the course in a self-study mode or in a group, and with or without tutoring.
- It is possible to provide extra, remedial activities or learning objects or examples for students with certain prior knowledge gaps.
- It is possible to have a different LD method for different phases in the learning process: when studying the UOL for the first time, the LD method is designed for learning; when coming back after first time completion, the LD method supports the repetition and later the LD method optimizes reviewing the learning content.
- Support staff can also benefit from personalization, e.g. some teachers only want to see the activities that they have to perform to support the students and others want to view this in the context of the learning activities of the learners.

In the EML practice of the OUNL, we see that conditions are used in almost every course design. In principle, a course can contain any number of personalization conditions. However, it is up to the designer to decide which personalization conditions it is prudent to include. In general, every personalization condition brings extra design and test work during course development. This is only worth the effort if the user gains or if the expected number of users is high enough. This should be further investigated in future.

Compatibility

LD acts as an integration framework for other specifications that are needed to specify an eLearning course. In addition to being designed to act as an add-in component to the IMS Content Packaging specification, it can use different metadata schemas like the IEEE Learning Object Metadata (LOM), or the Dublin Core. The generic mechanism is to include these schemas through the use of XML Namespaces. In principle this can be done anywhere in any XML document instance, but LD specifies specific placeholders for the prudent inclusion of these schemas. Every container element in LD has a placeholder for metadata. Testing schemas (e.g. IMSQTI, 2003) are included in the environment. IMS Simple Sequencing can be included in the environment to sequence the entities or within an aggregated learning object to sequence the underlying building blocks (e.g. chapters in a book). The IMS Reusable Definition of Competency or Educational Objectives can be used to specify competencies, learning objectives and prerequisites. SCORM content can be included in the environment (ADL, 2003). IMS Enterprise can be used for mapping learner and staff roles when instantiating a UOL. The IMS Learner Information Profile (IMSLIP, 2003) can be used to import and export persistent learner property structures to and from an LD runtime system.

The basic problem with the inclusion of external schemas is that the runtime engine must be able to call all the necessary sub-runtime engines that support the different schemas. In practice this is rather problematic, and most organizations are advised to restrict their use of embedded schemas as support for these will be implementation dependent, at least until common practice is established. More generally, application profiles will need to be included with UOL packages to specify what content types can be expected in the package.

Reusability

The position taken in LD is that reusability can be defined at different levels of reuse (see Koper, 2003), ranging from whole units of learning, through learning designs and learning methods, to learning activities, learning objects and learning services, but that not all objects are intended for reuse. Different scenarios apply. A learning object may often be used in a new context without any adaptation. In most cases, however, an object is found within its context, from which it can be isolated, but must be repurposed (adapted) for use in other contexts (e.g. Doorten *et al.*, in press). This depends on issues such as granularization (e.g. Wiley, 2002; Duncan, 2003) and implicit and explicit dependencies between objects. LD supports the different reusability scenarios in principle, because objects can be searched for using the higher-level context of use provided by a UOL, and then isolated and repurposed. In EML practice we also have seen different examples of reuse (e.g. one school for higher professional education reuses the same EML complex environment structure for every course, but with different activities specified). However, the issue of reuse in general is underdeveloped in theory and practice and needs further elaboration.

Formalization – automatic processing

EML and IMS LD provide a semantic specification, i.e. the names and structures are chosen in such a way that they can be understood by human beings (as opposed to computers). This has many advantages, but the question then becomes whether such a specification can be interpreted and managed by computers. LD is an 'under the hood' technique that is not meant to be visible to any end-user. It is typically used in authoring tools, content management systems and runtime systems to create, store, share and present eLearning courses. These tools should be developed in such a way that they are optimally suited to the job of authoring, storing, sharing and presenting eLearning courses with high usability for the specific target group. Specifically the authoring tools should hide the complexity of XML tagging and interpreting. Truly user-friendly tools have yet to be developed, but for the test of the formalization requirement we have already built several prototypical systems (see Koper & Manderveld, in press for an overview of the different runtime systems that were developed to test the formalization requirement). The major findings were that: authoring can be done in a generic XML editor, but because of usability issues it is better to develop a more generic, usable authoring tool that exports valid LD at any moment in the development process (see Brouns, 2003). EML and LD can be interpreted in runtime systems. Several EML and LD systems have already been implemented or are currently being developed (e.g. Edubox at OUNL and Reload at JISC/CETIS). In the context of the EU project Alfabet (IST-2001-33288), tools for LD authoring and runtime are being developed and further refined (see also the Open Source LD engine CopperCore (2004).

For content management, any system that is able to store and retrieve XML files and fragments is suitable. We explored the use of several systems with EML and LD and didn't find any specific LD related problems in using them.

Reproducibility

The LD specification doesn't contain any information about specific groups, details, dates or service facilities that would bind a design to a specific context—this kind of information needs to be supplied when a design is instantiated. EML and LD courses that have been produced to date can be instantiated as often as needed for different people at different times and places. This supports the "write once, deploy many times, in many places" principle required in the context of eLearning, blended learning, distance education and other mass-education approaches.

Future Developments

The above discussion points to several areas for further exploration. The following points are all necessary:

- Evaluation of how well LD meets the pedagogical expressiveness requirement.
- Better integration of QTI into the LD.
- More work on prudent personalization rules.
- Further work in the field of reuse.

All these require better and more complete tools and systems (authoring, content management, delivery) to be available.

The integration of QTI and LD has to be studied further. This will focus on the mapping of QTI results to LD Properties. It may prove that some minor adjustments in the specification are needed to accommodate the integration more effectively, particularly to allow learning and formative assessment to be integrated smoothly. Similarly the effective integration of LD with any of the above specifications may require some adjustments, but changes are expected to be at the level of minor details.

Another area for development is the provision of additional schemas for new types of learning services to be integrated into the environment (as separate modules), together with a generic multi-user service schema. There is a potentially large number of learning services. They will extend what can be done in online learning, but the danger is that this will occur at the expense of interoperability. There will thus be much to be gained from an abstract, generic service definition. In the meantime, the ability to plug in new service schemas will be necessary and these will form the basis for exploring commonalities needed to inform a generic service schema.

A taxonomy of pedagogies is a common request as this would enable people to search for learning designs according to the embedded pedagogy. However, this is a difficult task as there is no commonly agreed taxonomy. If agreement can be achieved, it will need to be extensible as pedagogical approaches are likely to evolve with the technology.

Some areas for future development include the integration or coordinated use of ontologies (W3C Web Ontology Working Group: OWL - Web Ontology Language: www.w3.org/2001/sw/WebOnt), topic maps (XML Topic Map XTM specification: <http://www.topicmaps.org>; Park, 2003) and broader aspects of the semantic web as a layer that could both be separate from but link to learning designs by reference or become more integrated as part of the learning design itself. In general, the inclusion of semantic web principles would allow, for instance, software agents to interpret the underlying pedagogical structure of learning designs so that they are able to support designers in creating new designs, or supporting learners during learning.

The possibility of using LD for search purposes has to be explored. Authors are aware of the subject, the learning objectives, and the characteristics of the learners they are developing for. They can therefore be expected to find it easier and less onerous to create this higher-level metadata than providing metadata for every learning object and resource they include in a design. By the same token, it is these higher-level characteristics that they are likely to be most comfortable searching for. By searching at the level of learning design, they would be presented with complete UOLs, with the links to all the resources used by it, together with the activities describing how they are used. An appropriate authoring system, linked to a series of learning design repositories, would enable them to browse, review, extract and reuse or modify the content, learning objects, learning activities and entire learning designs. It thus provides a framework for metadata that more directly meets the needs of authors.

General agreement on learner characteristics is needed if persistent learner information is to be used across learning designs to personalize learning. At present, accessibility requirements are the first such learner characteristics to be defined as extensions to IMS Learner Information, and further work in IMS is being undertaken for Accessibility extensions to Metadata. However, learning styles, such as representational modalities, and many others offer possible candidates.

Last but not least, a number of tasks are necessary for the adoption of any specification. On the technical side, a key task is establishing consistent interoperability across implementations. Specific tasks leading to adoption include:

- The provision of one or more open source reference implementations.
- Support for implementers, typically through an industry association.

- Consistent implementation of LD in authoring tools and runtime system supported by Plugfests to establish interoperability.
- Awareness raising and training of authors and learning providers.
- Authoring tools geared to different pedagogical, learning development methods and cultural needs.
- Repositories that understand the structure of LD to analyse designs and make its components searchable and available for reuse

To accomplish these tasks it is necessary to establish appropriate communities of practice with good communication between them. The European Framework 6 Project UNFOLD (IST-1-507835) will support the development and operation of such communities of practice. These will build on the existing Valkenburg Group, providing communities of practice for software developers, learning designers and authors, and learning providers. Each has a different perspective and role to play in moving LD from a paper standard into effective use.

Conclusions

This article has outlined some of the requirements, capabilities and potential of LD to significantly enhance what can be done in online learning:

- Coordination of multiple users (single user becomes a special case).
- Integration of learning objects and services.
- Providing a learning activity layer over learning objects and services.
- Supporting generic properties and conditions enabling dynamic personalization/adaptation, including accessibility.
- The ability to support multiple pedagogical approaches through a single notation.

Because LD provides a formal language for expressing learning designs, it affords the intriguing possibility of comparing and contrasting different learning designs in a more systematic way than has been possible to date.

However, the greatest potential advantage of LD is that it offers support not just for rather simplistic learning designs (sequenced learning content), but also for newer, and more realistic pedagogical approaches that put the learning and teaching process in the centre, rather than the learning content. This approach to modelling more advanced teaching-learning processes, with the possibility of automating parts of the process merits serious implementation efforts and usage trials. Only then can these possibilities be fully tested, their current limitations determined, and the need for future enhancements made clear.

References

- ADL (2003). *SCORM*, Retrieved July 19, 2004 from <http://www.adlnet.org/>.
- Bransford, J., Brown, A. L., & Cocking, R. R. (2000). *How People Learn: Brain, Mind, Experience, and School* (expanded edition), Washington: National Academy Press.
- Brown, J. S., Collins, A., & Duguid, P. (1989) Situated Cognition and the Culture of Learning. *Educational Researcher*, 18 (1), 32-42.
- Brouns, F. (2003). Editing IMS Learning Design. *OTEC TD Report*, Heerlen: Open Universiteit Nederland, Retrieved July 19, 2004 from <http://learningnetworks.org/forums/attachment.php?s=&postid=220>.
- CopperCore (2004). *Open Source IMS Learning Design Engine (software)*, Retrieved July 19, 2004 from <http://sourceforge.net/projects/coppercore>.
- DC (2003). *Dublin Core Metadata Website*, Retrieved July 19, 2004 from <http://dublincore.org>.
- DOCB (2003). *DOCBOOK Website*, Retrieved July 19, 2004 from <http://www.docbook.org>.
- Doorten, M., Giesbers, B., Janssen, J., Daniëls, J. & Koper, E. J. R. (in press). Transforming existing content into reusable 'LOs'. In R. McGreal (Ed.), *Accessible education using learning objects*, London: RoutledgeFalmer.

Duffy, Th. M., & Cunningham, D. J. (1996). Constructivism: implications for the design and delivery of instruction. In D.H. Jonassen (Ed.), *Handbook of Research for Educational Communications and Technology* (pp. 170-198), New York: Macmillan.

Duncan, C. (2003). Granularisation. In A. Littlejohn (Ed.), *Reusing Online Resources: A Sustainable Approach to eLearning* (pp. 12-19), London: Kogan Page.

EML (2000). *Educational Modelling Language Website*, Retrieved July 19, 2004 from <http://eml.ou.nl>.

ERIC (2003). *ASK ERIC Lesson Plans Website*, Retrieved July 19, 2004 from <http://www.eduref.org/Virtual/Lessons/index.shtml>.

Gagné, R. M., & Briggs, L. J. (1979). *Principles of instructional design* (2e Ed.), Fort Worth , TX : HBJ College Publishers.

Greeno, J. G., Collins, A. M., & Resnick, L. B. (1996). Cognition and Learning. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of Educational Psychology* 9pp. 15-46), New York: Simon & Schuster Macmillan.

Hermans, H., Manderveld, J. M., & Vogten, H. (2004). Educational modelling language. In W. Jochems, J. van Merriënboer, & R. Koper (Eds.), *Integrated E-learning* (pp. 80-99), London: RoutledgeFalmer.

van den Hooff, B., Elving, W., Meeuwssen, J. M., & Dumoulin, C. (2003). Knowledge Sharing in Knowledge Communities. In M. Huysman, E. Wenger & V. Wulf (Eds.), *Communities and Technologies* (pp. 119-142), Dordrecht: Kluwer Academic Publishers.

Howell, S. L., Williams, P. B., & Lindsay, N. K. (2003). *Thirty-two Trends Affecting Distance Education: An Informed Foundation for Strategic Planning*, Retrieved July 19, 2004 from <http://www.westga.edu/~distance/ojdla/fall63/howell63.html>.

IMSLD (2003). *IMS Learning Design. Information Model, Best Practice and Implementation Guide, Binding document, Schemas*, Retrieved July 19, 2004 from <http://www.imsglobal.org/learningdesign/index.cfm>.

IMSLIP (2003). *IMS Learner Information Package. Information Model, Best Practice and Implementation Guide, Binding document, Schemas*, Retrieved July 19, 2004 from <http://www.imsglobal.org/profiles/index.cfm>.

IMSLOM (2003). *IMS-LOM Metadata. Binding document, Schemas*, Retrieved July 19, 2004 from <http://www.imsglobal.org/metadata/index.cfm>.

IMSQTI (2003). *IMS Question and Test Interoperability. Information Model, Best Practice and Implementation Guide, Binding document, Schemas*, Retrieved July 19, 2004 from <http://www.imsglobal.org/question/index.cfm>.

Koper, E. J. R., & Manderveld, J. M. (in press). Modelling reusable, interoperable, rich and personalised units of learning. *British Journal of Educational Technology*.

Koper, E. J. R. (2001). *Modelling Units of Study from a Pedagogical Perspective: the pedagogical metamodel behind EML*, Heerlen: Open Universiteit Nederland, Retrieved July 19, 2004 from <http://eml.ou.nl/introduction/docs/ped-metamodel.pdf>.

Koper, E. J. R. (2003). Combining re-usable learning resources and services to pedagogical purposeful units of learning. In A. Littlejohn (Ed.), *Reusing Online Resources: A Sustainable Approach to eLearning* (pp. 46-59), London: Kogan Page.

Koper, R., & van Es, R. (in press). Modeling units of learning from a pedagogical perspective. In R. McGreal (Ed.), *Online education using learning objects*, London: RoutledgeFalmer.

Lave, J., & Wenger, E. (1991). *Situated learning: legitimate peripheral participation*, Cambridge: Cambridge University Press.

Merrill, M. D. (1994). *Instructional Design Theory*, Englewood Cliffs: Educational Technology Publications.

- Merrill, M.D. (2003). *First Principles of Instruction*, Retrieved July 19, 2004 from [http://www1.moe.edu.sg/itopia/download/abstracts/Applying%20First Principles of Instruction to Technology-Based Education.pdf](http://www1.moe.edu.sg/itopia/download/abstracts/Applying%20First%20Principles%20of%20Instruction%20to%20Technology-Based%20Education.pdf).
- Olivier, W., & Liber, O. (2003). Learning Technology Interoperability Standards. In A. Littlejohn (Ed.), *Reusing Online Resources: A Sustainable Approach to eLearning* (pp. 146-155), London: Kogan Page.
- Paas, F., & Firssova, O. (2004). Usability evaluation of integrated e-learning. In W. Jochems, J. van Merriënboer, & R. Koper (Eds), *Integrated E-learning* (pp. 112-125), London: RoutledgeFalmer.
- Park, J. (2003). Topic Maps, the Semantic Web and Education. In J. Park (Ed.), *XML Topic Maps: Creating and Using Topic Maps for the Web* (pp. 507-529), Boston: Addison-Wesley.
- Pedagogical Patterns Project (2003). Retrieved July 19, 2004 from <http://www.pedagogicalpatterns.org/>.
- Reigeluth, C. M. (1999). What is Instructional-Design Theory and How is it Changing? In C. M. Reigeluth (Ed.), *Instructional-Design Theories and Models: a New Paradigm of Instructional Theory* (Vol. II) (pp. 5-29), Mahwah: Lawrence Erlbaum.
- Reigeluth, C. M. (1983). *Instructional design theories and models: an overview of their current status*, Hillsdale, NJ: Lawrence Erlbaum.
- Retallick, J., Cocklin, B., & Coombe, K. (1999). *Learning Communities in Education*, London: Routledge.
- Roblyer, M. D., & Edwards, J. (2000). *Integrating Educational Technology into Teaching* (2nd Ed.), Upper Saddle River, NJ: Merrill, Prentice Hall.
- Ryder, M. (2003) *Instructional Design Models*, Retrieved July 19, 2004 from http://carbon.cudenver.edu/~mryder/itc_data/idmodels.html#prescriptive.
- Van Merriënboer, J. J. G. (1997). *Training Complex Cognitive Skills: a four component instructional design model for technical training*, Englewood Cliffs: Educational Technology Publications.
- Wenger, E. (1998). *Communities of Practice: Learning, Meaning and Identity*, New York: Cambridge University Press.
- Wiley, D. (2002). *The Instructional Use of Learning Objects*, Retrieved July 19, 2004 from <http://www.reusability.org/read/>.

A Template Based System for Automatic Construction of Online Courseware for Secondary Educational Institutes

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ABSTRACT

Many educational sites are static and rarely updated, diminishing the dynamism of the Web. An online learning system should be adjustable, expandable and regularly updated, preferably by educational staff without the direct intervention of computer experts, reflecting the dynamic character of education. To achieve this aim, we propose a system based on three roles: Administrator, Educator and Learner. Each role has a different set of responsibilities and permissions to the system. The model is built around a repository of educational material, vital for its expandability and its dynamism. The repository contains a set of customizable templates, dynamically filled with the educational material, assembling the online course. This paper discusses current difficulties in developing online courses and then presents the development progress of such a system and its anticipated advantages to Secondary Educational Institutes.

Keywords

Learning Technology Systems, E-Learning Tools, Educational Databases, Dynamic Content Generation, Secondary Education

Introduction

Following the popularity of computers, the nature of education has changed significantly, over the last decade. Many researchers and academics predicted that education would rely heavily on technology (Phillips, 1992; Daniel 1996; Crossman, 1997).

Initially the utilization of computers in education created new terminology, where the compound terms Computer Assisted Instruction (CAI), Computer Based Training (CBT), and Computer Assisted Learning (CAL), were extensively recorded in the literature (Grieve, 1992; McDonough et al., 1994; Serdiukov 2000). Soon after, with the appearance and expansion of the Internet and especially its World Wide Web service (Berners Lee et al., 1992), the above terms evolved to Web Based Training (WBT) or Web Based Learning (WBL) or Online Learning (Brahler et al., 1999).

The real power of WWW arises when the results returned to the client are dynamically produced based on a client's request. In education measurement of this potential is vital, as static information would be of little use. Producing customized and rapidly evolving educational material specifically cut to the needs of the learner or educator is essential.

However, most of the online courses offered, are static and infrequently updated, diminishing the real power of WWW. These locations are often developed with MS-Office tools (Tiedemann, 2002) and are sporadic attempts of teachers, therefore increasing significantly the overall development and maintenance time (Golas, 1993; Brahler et al., 1999).

In this paper we present the results of the first phase of an in progress project, aiming at building a system that enables the creation of online courses by the educators themselves. This system could be easily utilized by high schools or other secondary education institutes where funding is limited and technical staff is not available.

Problems of WBT Systems

Academics or school teachers develop online courseware to enable students to quickly gain electronic access to their course material and courses are re-engineered to be technology based (Meier & Simon, 2000). However, most of these attempts are standalone endeavors and trigger new problems.

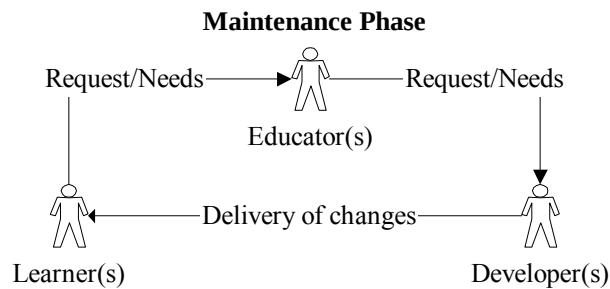


Figure 1: Maintenance phase in WBT development

Development of medium or high complexity online learning sites, as in all information systems, undergoes the phases of analysis and design, implementation, testing and maintenance (Brahler et al., 1999). The individual types of users involved in these phases are the: Educator, Developer, and Learner. These types of users form larger teams which in turn develop the project.

One of the basic problems of this tactic (see figure 1), is that every time an educator or learner needs an alteration (maintenance) of the online learning site, the developer should be contacted. This leads to a series of problems and inconveniences as the maintenance, in reality, initiates a new development cycle. Hence, an online learning project is typically confronted as a new project and starts anew (Kinshuk & Patel, 1997). Obviously, this tactic increases the expenses of development for educational institutes (McCormack & Jones, 1998; Sklar & Pollack, 2000) and frequently is a barrier to further development.

The nature of design of these sites is mostly presentational (Brahler et al., 1999) or the delivery of educational material is typically static, and this is one of the reasons why these systems, according to Carswell and Murphey (1994), fail to fulfill their aims.

In other studies (Golas, 1993; Brahler et al., 1999), it was presented that for every hour of basic level online courseware 30-200 hours of development is needed. For offering 1 hour of online courses of high complexity, at least 200 hours of development are needed. Even though the situation is dramatically improved with the utilization of graphical tools, such as MS-FrontPage or even MS-Word, the time required for medium to high complexity online courses, where the learner interacts, is still high and requires the systematic involvement of computer experts.

Another problem with the current WBT systems is the massive existence of data in Web pages and their personalized style, associated to their creators (Butler, 1995). Even in the same educational institute the web pages retain a quite dissimilar appearance, without cross-reference linking between topics.

In a recent study Markwell and Brooks (2002) monitored 515 nonredundant URLs from educational sites for 14 months and discovered that during this period, 16.5% of the monitored URLs have ceased to function. Clearly, this is a serious inconvenience to both students and teachers, who cannot rely on online content, as there is no certainty that it will be available next time on demand.

More problems in the integration of online learning can be identified in secondary educational systems. The majority of teachers is moderate computer users and use only MS-Office tools and Internet Browsers and do not use computers in the learning process. That is why massive attempts have been done worldwide to increase ICT to schools (Dagiene, 2003; Sudhakar, 2002; Asan, 2003; Key, 2003). Another inconvenience arises from limited funds available to secondary schools. So utilizing one of the commercial online courseware systems is quite difficult (Pavlik, 2000; Jacobs & Meyer, 2001; Godwin-Jones, 2003). Furthermore, there is no technical staff regularly on hand to help teachers develop and maintain their online courses.

A feasible solution to the problems mentioned is the creation of dynamic educational web sites, where educational material is categorized and thus easily retrievable, allowing the association of subjects (Lazarinis, 2002). Additionally, in order to minimize development costs and time, the maintenance should be left mainly to educators, who can promptly update their content without heavily relying on a computer expert.

A Template Based System

System Overview

According to Harbeck & Sherman (1999) online learning sites should be simple with a concrete design. To realize it and to alleviate the inconveniences mentioned formerly courses are categorized in our automated system for developing online courseware. In this layout (see figure 2), learners can easily navigate through the online courses.

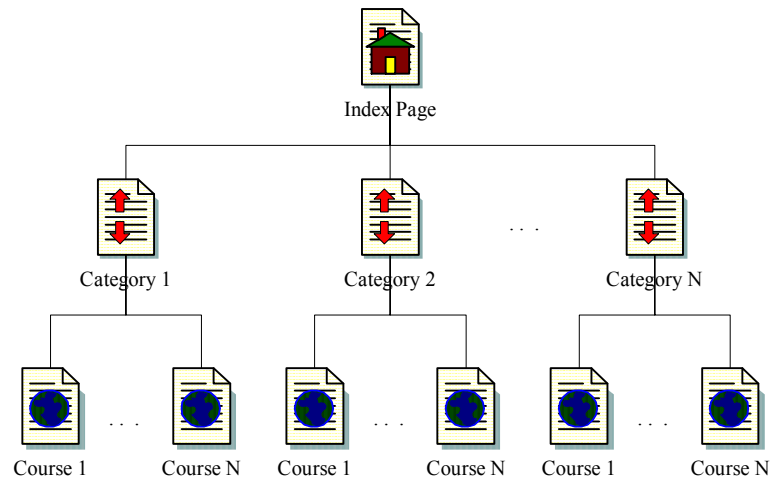


Figure 2: Thematic based structure of the system

Web content is shaped dynamically as the learner traverses down the tree, advancing to the courses. To dynamically create the courses the construction of a database is necessary in which educational material of varying formats exist along with a number of templates. The templates will be dynamically filled with the educational material to structure the courses. In this framework we identify three discrete roles: Administrator, Educator, and Learner.

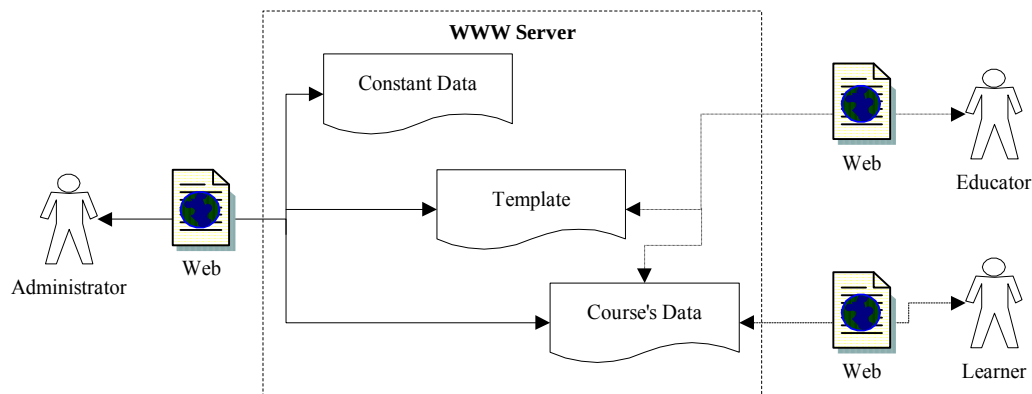


Figure 3: Simplified view of the architecture

These roles (see figure 3) interact with the system through a set of web interfaces, performing their assigned tasks or simply studying the online content.

Administrator

This specific role is responsible for the overall administration of the system. He or she handles the general data, the creations and modifications of other users, and generally the smooth operation of the system.

His or her first and most important function is the creation, manipulation and association of categories of courses and the population of the database with relative information.

Another important administrative function is the translation of the standard headers and messages existing on the system's pages and templates from English to the institute's native language. The main language of the system is English. However, unlike most of the commercial automated systems that support mainly English, we aim to expand our language database through the utilization of an additional database table. This table contains the standard system headers and text. Through a web interface administrators can translate all the standard headers to their native language (see figure 4). These new data are inserted in the database and used automatically on the produced web pages. The selection of the appropriate headers is based on the language and the character set selected by the administrator.

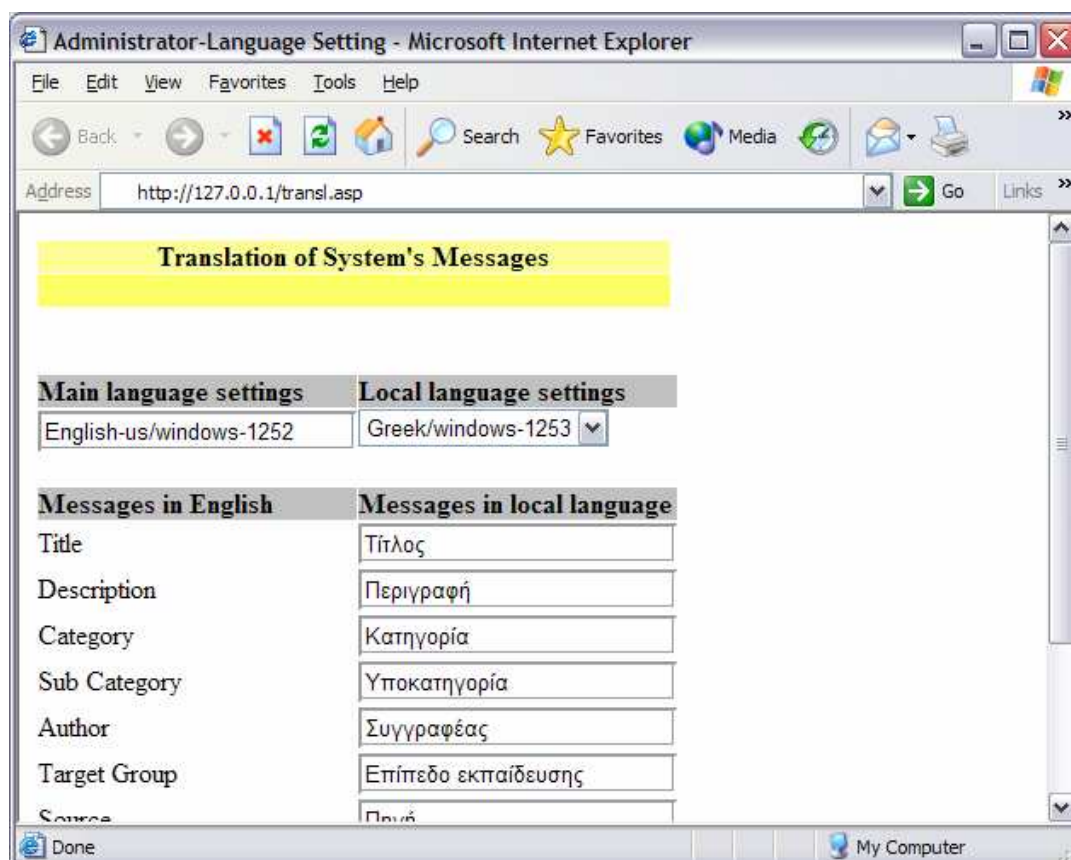


Figure 4: Translation from English to Greek

Other operations of the administrator include monitoring of the system, production of statistics and creation of new templates. An administrator has access to all the repositories of the system in order to perform his or her duties.

The administrator, communicates with the database through a well defined set of web pages which restrict potentially hazardous access to the database and prevent abnormalities in the system behavior. The role of the administrator does not require advanced computer knowledge, since all operations are available through simple web interfaces. So, this role could be performed by a computer science school teacher.

Educator

An educator provides new educational material (or exploits the existing), selects the templates and constructs a particular course as a set of pages. The educational material may be either theory, in textual or other multimedia format, or exercise in one of the formats supported. Every course is linked with the appropriate category and a general title and a brief description is given. Table of contents can be constructed automatically based on the pages that structure the course.

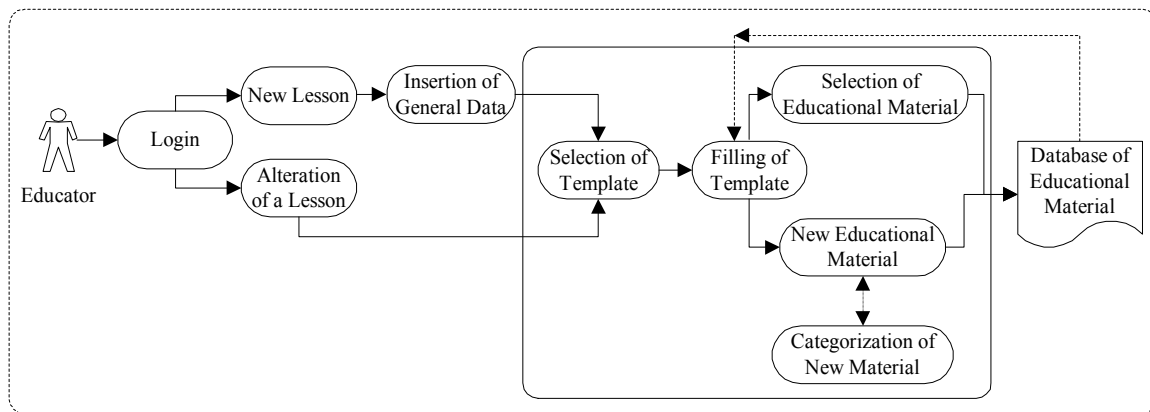


Figure 5: Dataflow diagram of a lesson's creation process

Through a web interface an educator performs the following tasks to construct an individual lesson (see figure 5) consisting of a set of pages:

Task 1:

Login and identification

New Course	
Categorization of the Course	
Category Computer Science	Sub Category Algorithms/Programming
Title	Author
Target Group High School	Source
Description	Additional Comments
Submit Clear	

Figure 6: Selection of general attributes of a course

Task 2 (see figure 6):

Selection of category

Definition of title and author

Definition of metadata, i.e. description, target audience, source of data, etc

Task 3:

Selection of a template for a specific page (see figure 7)

Filling of the template with material

Possible linking to other pages

Repetition of last three steps and completion of tasks (i.e. insertion of the material in the DB).

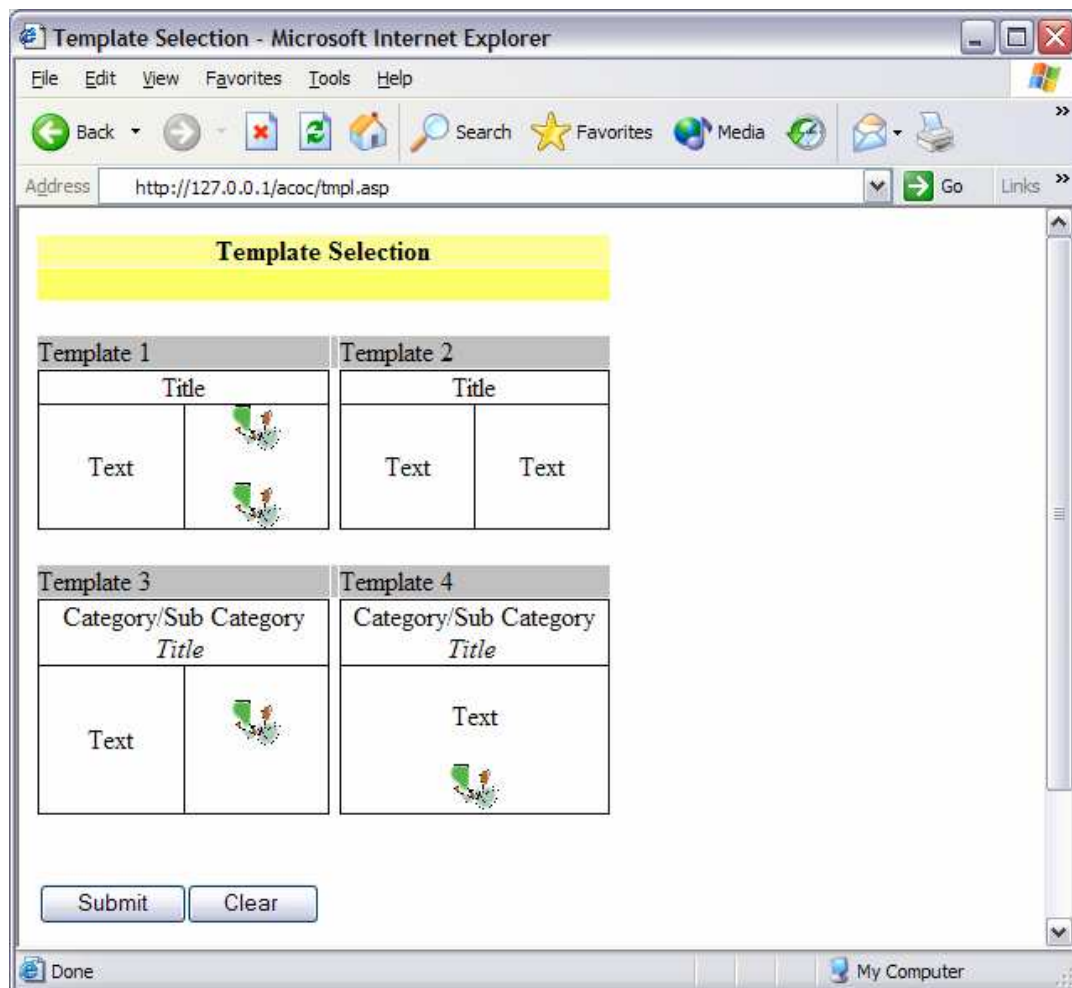


Figure 7: Selection of the template

Thus, educators can create new online courses at any time. In other words the maintenance phase of our system is quite different from that portrayed in figure 1. Here the educator handles the requests of the learners, or their needs for change and promptly adjusts the educational pages. Educators can also associate their online course, with the aid of links, to already available courses, thus enabling cross-reference linking between topics.

Learner

The final user type identified is called learner. This particular user type can connect via Internet and through a Web interface may follow one of the available courses. First the category is chosen and then the desired course based on the title and the possible brief description.

From that point on, the respective sequence of web pages is presented to learners and it can be followed linearly or in the order of their choice. Pages will contain either theory or exercises which should be completed by the learner. If the exercises are multiple choice, or short calculations, then the assessment is instant. When the exercises require extensive answers, then these replies will be sent to the appropriate educator and a respond will be sent after the marking process.

The data presented and the layout of the information are based on the template chosen by the educator. For instance figure 8 shows a sample template. The information in curly brackets will be replaced by actual data when “executed” in the server and projected back to the client, as shown in figure 9. The information is dynamically filled as retrieved from the database. The parameters pass from one page to the other as attributes via URLs.

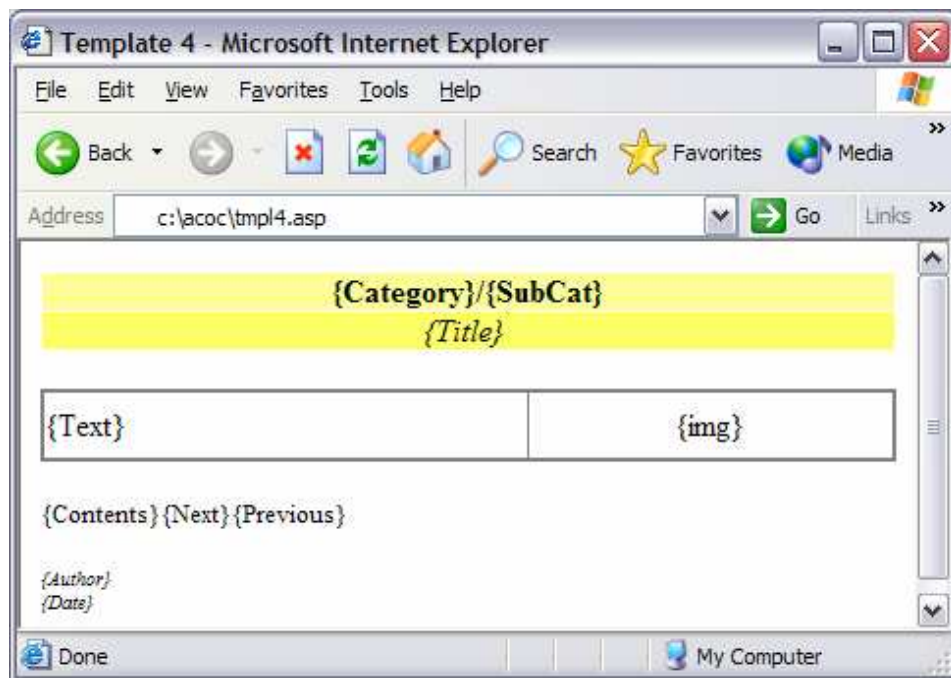


Figure 8: An example of a template

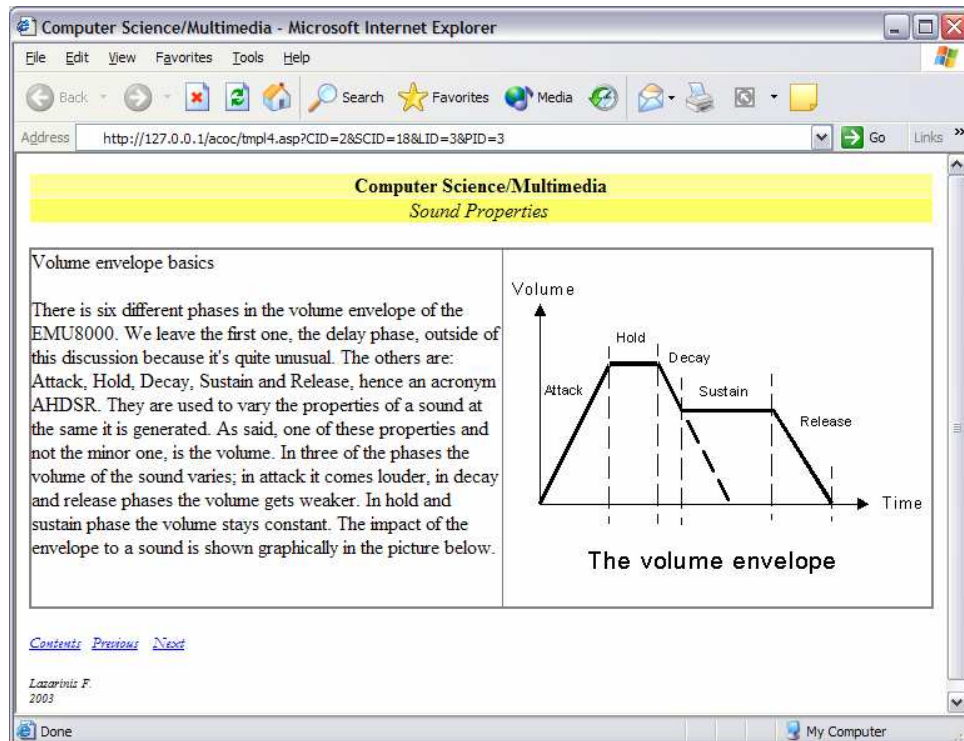


Figure 9: A page of a course based on the template of figure 8

Database Scheme

All the constant and variable data resides to a repository, implemented as a single database in this first phase of the project’s development cycle.

In this context we identified the following entities: Educational Material, Type of Educational Material, Category, Sub Category, Template, Page, Course, User, Rights. An elementary Entity Relationship Diagram (ERD) (Yourdon & Constantine, 1979), as perceived during the analysis, would be as in figure 10.

Clearly, to form a course an educator must create a set of pages, which in turn is a set of educational material. When the learner navigates the online site, the courses will be constructed dynamically based on the implementation rules and strategies.

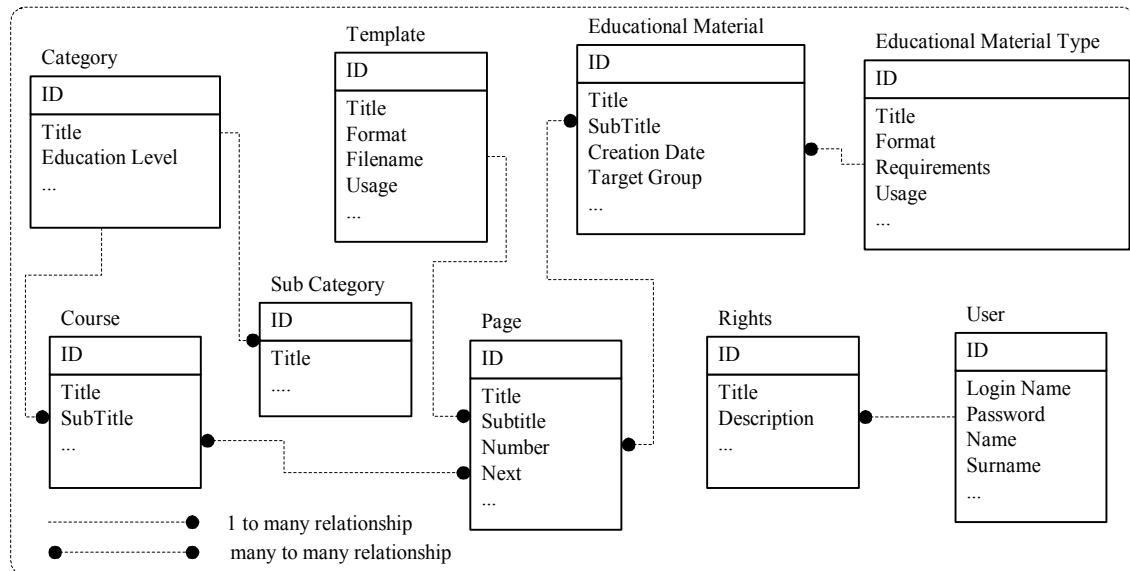


Figure 10: Database scheme

Implementation Details

Suitable technologies for implementing such a system are Active Server Pages (ASP) or Java Server Pages and an ODBC or JDBC compliant database. ASP and MS-Access are preferred. MS-SQL Server could be used as an alternative but costs more and also strong DBMS administration skills are required. All textual data reside on the database and templates and graphical information reside on the disk, referenced in the database fields.

To set up the system, a clean copy of the MS-Access database (as it is administered easier than SQL Server and costs less) needs to be copied to a folder on a Web Server's disk. Secondly a virtual directory on their Web Server Software, e.g. Internet Information Server, must be set up and an ODBC connection to the database should be created. Finally, an additional folder on the Web Server machine is needed. In this folder the produced html files are to be stored.

Evaluation

An alpha version of the system is developed under Windows 2000 and is available only on the intranet of the institute so that to avoid potential security problems that would be caused from the direct Internet access of an in progress project. The system was tested only against MS-FrontPage, which is the tool of choice of many institutes worldwide when it comes to online courseware and the only available tool in the institute's native language. Our goal was to reach some initial conclusions that could be incorporated in the development and we aimed at identifying the anticipated advantages of such a system.

The prototype interface of the system (see figures 5 to 9) was demonstrated to a dozen of high school teachers, for 20 minutes. Then, the teachers, acting as initial evaluators, used a series of interfaces so to construct a web page with a title, some text as theory and one image. Teachers could then access their page from the automatically produced URL added on the index of the site, under the category they had chosen (e.g. computer science, physics etc).

Most of the participating teachers were beginners and not advanced computer users (table 1). The task assigned to the subjects was the creation of a page containing a heading, one small paragraph of text and one photograph. 83.33% (10/12) of the subjects completed the task in less than 20 minutes. Most of the time spent in typing the text. The remaining 16.67 (2/12) completed their task in 30 minutes.

Table 1: Computer knowledge of the 12 teachers

Computer handling capability	
Beginner	9
Intermediate	3
Advanced	0

During the evaluation only three teachers faced a problem and we had to help them. The problem had to do with the insertion of the photograph. Teachers could choose between three template alternatives. 91.67% chose the template where the heading is centre aligned with a larger font and the photograph is on the right side of the text.

In the course of the process the administrator had to create 10 new categories and subcategories to enable users to categorize their courseware. Category and subcategory were then displayed automatically in the produced page. Also the heading (lesson's title) was automatically centre aligned and emboldened, based on the template used.

The 12 participating teachers were asked to complete the same task using the MS-FrontPage. Initially teachers had to be trained for 1 hour. So the training time was substantially greater in this case. Subsequently they tried to create a web page containing simply a title, some text and an image. First they had to type, embolden and centre align the title. So they needed to be more competent users.

The second step was to type the text and thirdly, following the same procedure as before, to insert a picture. They could only insert the picture below the text and not on its right side. To fulfill such a request the insertion of a table is needed, a technique not taught to the teachers. In order to publish their results on the intranet they had to save the file as an html file, to name it and to put it in a specific directory in the hard disk.

The average time required for the completion of the task was approximately 45 minutes. The problems raised during the process related to the formatting of the text, the saving of the file and the publishing of the final outcome on the institute's intranet. The insertion of the picture was dealt in the previous experiment, so in this case the necessary steps were easily accomplished. Finally, another issue that troubled 83.33% of the participants, was the placement of the picture on the right side of the text.

In table 2 we quantify the results of the comparison of the two applications. As is can be concluded more competent users needed in the second case.

Table 2: Results of the comparison of the system

Our system		MS-FrontPage
Training time	20 min	60 min
Average time for task completion	22 min	45 min
Actions	Login Category selection Sub category selection Template selection Typing of title Typing of text Insertion of the picture	Create a blank page Font size selection Type the title Embolden the title Centre align the title Typing of text Insertion of the picture Naming the file Saving it to a specify directory Insert a link on the index page
Problems	2 [Creation of categories, insertion of a picture]	5 [Text formatting, saving of the file, publishing of the created picture, insertion of a picture, placement of a picture]
Administrator's interventions	2	5

After this small scale evaluation, the main conclusion drawn is that our system is far simpler compared to MS-FrontPage. The only technical capabilities required were using the mouse, typing text and inserting images from the hard disk. On the contrary, utilizing MS-FrontPage was more difficult as they had to learn a completely new environment, save the file to a specific directory and work with a computer expert to publish it. Almost all of the actions performed in the second mode of developing the page required technical knowledge, whereas in our system the process is a sequence of one step actions.

Using MS-FrontPage, links on the index of the institute's site should be manually inserted so as to access the new pages. Another point resulting from this short assessment is that the produced page was more appealing in the first method. Background color and layout, associated with the chosen template, made the automatically produced page more attractive than the one constructed using the MS-Office tool. Applying layout and colors is obviously a feature of MS-FrontPage but requires more actions and knowledge on behalf of the users.

Another major advantage of our system is that navigation buttons are added on the fly and thus navigation is not a source of worry for the creator. Broken links are not an issue as every page is constructed dynamically and is definitely present. Pages consist of objects which are named reusable entities while in a static html file information is unexploited.

In order to be fair we compared the capabilities of our software with a commercial learning management system as well. We preferred WebCT (2003) which has powerful capabilities and an international established base of users. Many academic institutes rely on its power to re-engineer their distance learning courses. If we compare these two systems solely as systems that offer automation of the online learning process, then WebCT is the unquestioned winner.

However, it must be taken into account that our endeavor, at this point, concerns only secondary educational institutes where the online learning requirements are not as heavy as in the case of Universities. So it must be simpler than WebCT, more affordable and with fewer capabilities in order to be easily mastered. These are the mainstays of our work.

Another plus point of our work is the dynamic generation of content material. Through the use of the centralized repository and the structured data, courseware is dynamically assembled and thus the material is reused. Moreover, another advantage over other automated learning systems is the ability to adjust to various languages without the need to be re-developed.

Concluding, the evaluation proves that our software is able to meet the needs of the secondary educational schools wishing to offer course materials online so that students can continue their classroom studies at home. The prospect of remote teaching and assessment is possible at a fraction of the cost, with respect to time and money, of a commercial tool. However a more rigorous evaluation is needed in order to realize the real gains and pitfalls.

Synopsis and Future Work

In the previous sections we presented briefly some of the problems in the development of online learning systems and we recommended a framework where teachers could construct their own courses, without the constant involvement of the development team. In this framework, courses are organized as a set of pages which could be followed in the order of his or her choice. Each page is a combination of educational material presented dynamically to the learner based on the template used. All the required information is amassed in a database which is projected back to the learner.

Within this "PowerPoint like" system, most of the problems and inconveniences confronted in the development of other online learning systems, as presented previously, can be resolved. The learning material may be constantly updated, links function regularly and association between different subjects is feasible. Moreover, its maintenance is a straightforward procedure, reducing the development costs and time. Finally, the style of the pages is uniform and the learning process can be interactive.

Our implementation attempts, at this first phase, focus on constructing a system that would be usable and easily mastered by high school educational personnel. Teachers would be able to create lessons that contain theory, images and questions of false/true type. We tested a prototype of the system using a dozen of teachers of various specialties and we reached some useful conclusions, which were taken into consideration.

However, it is our conviction, that to implement all functions of the system, the analysis and design phase should be extensive and various categories of educators should participate. Thus, the analysis and design stage would be the most resource intensive in terms of human effort. But, in this way, the maintenance stage will involve less effort and consequently the delivery of new courses would be rapid.

In the analysis and design phase, aside from the creation of the database and the set of the initial templates, it is necessary to confront a series of other issues. These issues regard the permissions and responsibilities of the three roles. Also it is important to establish rules for the various operations of the system. Especially this final requirement is of critical importance as it will allow the unproblematic implementation of the system and prohibit conflicts during the population of the database.

Another issue to be addressed is the documentation and ownership of the educational material, possibly though the utilization of metadata (BECTA, 2001), and the construction of rules for future alterations of the educational material. These issues should be dealt with in the second phase of the development.

Nevertheless, the system should balance simplicity of use and wealthy of features so that it will not require extensive efforts in order to be utilized rendering it complicated and eventually not practical.

References

- Asan, A. (2003). Computer technology awareness by elementary school teachers: A case study from Turkey. *Journal of Information Technology Education*, 2, 153-164.
- BECTA, (2001). *Metadata in Education*, Retrieved July 19, 2004 from http://www.ictadvice.org.uk/index.php?section=te&rid=1788&catcode=as_int_pub_03.
- Berners Lee, T., Caillau, R., Groff, J., & Pollermann, B. (1992). World wide web: The information universe. *Electronic Networking: Research, Applications and Policy*, 2 (1), 52-58.
- Brahler, J., Peterson, N., & Johnson E. (1999). Developing on-line learning materials for higher education: An overview of current issues. *Educational Technology & Society*, 2 (2), 1-8.
- Butler, B. (1995). Using WWW/Mosaic to support classroom-based education: opportunities and challenges for is educators: an experience report. *Interpersonal Computing and Technology: An Electronic Journal for the 21st Century*, 3 (1), 17-52.
- Carswell, L., & Murphy, M. (1994). *Pragmatic methodology for educational courseware development*, Retrieved July 19, 2004 from <http://www.ulst.ac.uk/cticompcarswell.html>
- Crossman, D. (1997). The evolution of the world wide web as an emerging instructional technology tool. In B. H. Khan (Ed.), *Web-based instruction* (pp. 19-23), NJ: Educational Technology Publications.
- Dagiene, V. (2003). Focus on the pedagogical dimension in ICT literacy for teachers. In McDougall, A., Murnane, J. S., Stacey, C. & Dowling, C. (Eds.), *Proceedings of the ICT and the Teacher of the Future - Selected Papers from the International Federation for Information Processing Working Groups 3.1 and 3.3 Working Conference* (pp. 27-29), Melbourne, Australia: ACS.
- Daniel, J. S. (1996). *Mega-universities and knowledge media: technology strategies for higher education*, London: Keegan Press.
- Godwin-Jones, B. (2003). Emerging technologies. Tools for distance education: towards convergence and integration. *Language Learning & Technology*, 7 (3), 18-22.
- Golas, K. C. (1993). *Estimating time to develop interactive courseware in the 1990s*, Retrieved July 19, 2004 from http://www.coedu.usf.edu/inst_tech/resources/estimating.html.
- Grieve, C. (1992). Knowledge increment assessed for three methodologies of teaching physiology. *Medical Teacher*, 14 (1), 27-31.
- Harbeck J., & Sherman T. (1999). Seven principles for designing developmentally appropriate web sites for young children. *Educational Technology*, 39 (4), 39-44.

- Jacobs, G., & Meyer, D. (2001) *Online testing without the overheads – a computer-mediated solution for smaller players*, Retrieved July 19, 2004 from <http://www.icce2001.org/cd/pdf/p07/NZ008.pdf>.
- Key, P. (1999). Teaching teachers to be computer literate. *Philadelphia Business Journal*, Retrieved July 19, 2004 from <http://www.bizjournals.com/philadelphia/stories/1999/06/28/newscolumn2.html>.
- Kinshuk, & Patel A. (1997). A conceptual framework for internet based intelligent tutoring systems. In A. Behrooz (Ed.), *Knowledge Transfer* (Vol. II) (117-124), London: pAce.
- Lazarinis, F. (2002). Proposing a discrete role architectural model for categorized online learning sites. *Paper presented at the 3rd International Conference on Information Technologies in Education ICICTE'2002*, July 17-19, 2002, Samos, Greece.
- Markwell, J., & Brooks, D., (2002). Broken links: the ephemeral nature of educational www hyperlinks. *Journal of Science Education and Technology*, 11 (2), 105-108.
- McCormack, C., & Jones, D. (1998). What's it all about? In T. Hudson (Ed.), *Building a web-based education system* (1-28), New York: Wiley Computer Publishing.
- McDonough, D., Strivens, J., & Rada, R. (1994). Current development and use of computer-based teaching at the University of Liverpool. *Computers & Education*, 22 (4), 335-343.
- Meier, P., & Simon, B. (2000). Reengineering undergraduate education by introducing internet-based information systems. *Paper presented at the 8th European Conference on Information Systems*, July 3-5, 2000, Vienna, Austria.
- Miller, J., & Tittenberger, P. (2001). *Integration of WebCT into the distance education administrative model at the university of manitoba (one year later)*, Retrieved July 19, 2004 from <http://naweb.unb.ca/proceedings/2001/P7Miller.htm>.
- Pavlik, P. (2000). Collaboration, sharing and society - teaching, learning and technical considerations from an analysis of Webct, Bscw, and Blackboard. *The Educational CyberPlayGround*, Retrieved July 19, 2004 from <http://members.fortunecity.com/pgp5/Collaboration.Learning.and.Society.htm>.
- Phillips, R. L. (1992). Opportunities for multimedia in education. In S. Cunningham & R. J. Hubbard (Eds.), *Interactive Learning through Visualization: The Impact of Computer Graphics in Education* (pp. 25-35), Berlin: Springer-Verlag.
- Serdiukov, P. (2000). Educational technology and its terminology: new developments in the end of the 20th century. In J. Bourdeau & R. Heller (Eds.), *Proceedings of ED-MEDIA* (pp. 1022-1025), USA: AACE.
- Sklar E., & Pollack J. (2000). A framework for enabling an internet learning community. *Educational Technology & Society*, 3 (3), 393-408.
- Sudhakar, S. (2002). Technology partnership with K-12 schools. *The Technology Source*, Retrieved July 19, 2004 from <http://ts.mivu.org/default.asp?show=article&id=942>.
- WebCT (2003). The structure of WebCT. *WebCT Conference Technical Report*, Retrieved July 19, 2004 from <http://www.infodiv.unimelb.edu.au/telars/lms/>.
- Yourdon, E., & Constantine, L. (1979). *Structured design*, Englewood: Prentice Hall.

Modeling Educational Content: The Cognitive Approach of the PALO Language

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ABSTRACT

This paper presents a reference framework to describe educational material. It introduces the PALO Language as a cognitive based approach to Educational Modeling Languages (EML). In accordance with recent trends for reusability and interoperability in Learning Technologies, EML constitutes an evolution of the current content-centered specifications of learning material, involving the description of learning processes and methods from a pedagogical and instructional perspective. The PALO Language, thus, provides a layer of abstraction for the description of learning material, including the description of learning activities, structure and scheduling. The framework makes use of domain and pedagogical ontologies as a reusable and maintainable way to represent and store instructional content, and to provide a pedagogical level of abstraction in the authoring process.

Keywords

Educational Modeling Languages, Learning Technologies, Instructional Design, Domain Modeling, Learning Ontologies

Introduction

The definition of formal specifications and representational frameworks for modeling educational material in such a manner as to provide reusability and achieve a reasonable level of abstraction is a major topic of current research in the field of Learning Technologies (LT). Despite the increasing demand for distance education and training (Murray 1999, Mizoguchi 2000), distance education and the emerging industry of e-Learning have faced, as far as the technological perspective is concerned, a lack of formal specifications and robust technologies to develop interoperable and reusable learning content for Learning Management Systems (LMS). In this particular context, the current situation has progressed mainly due to research carried out by several standardization committees (i.e. IEEE, CEN/ISSS), some college researchers and Universities, as well as international consortiums (IMS, ADL) which have resulted in a collection of LT specifications, providing a first layer of abstraction between authoring and delivering processes.

On the other hand, from an instructional point of view, research based on the use of computer-based instruction has evolved to an increasing richness of learning environments (Cronje 2001, Moallem 2001, Bradley et al. 2002), involving different instructional approaches, pedagogical interactions and models that cannot be fully expressed or applied by just using existing formalisms. This is especially remarkable in the description of learning processes and activities.

As a result of this situation, there is a gap between the capacity of LT specifications to describe learning material, on one hand, and the pedagogical needs on the other. This leads to a variety of implications derived from a lack of expressiveness and abstraction in the existing representational formalisms (Mizoguchi and Bourdeau 2000, Murray 1999, Maglajlic et al. 1998). Three main consequences should be pointed out: a) Firstly, current specifications do not provide authors of learning material with a pedagogical authoring layer based on instructional elements, causing, therefore, a tight dependence between the learning content and the final delivery format, mainly internet-based technology; b) secondly, specifications themselves are currently isolated representational frameworks, which provide a fragmented view of certain aspects of learning material; c) thirdly, there is no room for cognitive approaches or instructional and pedagogical knowledge representations; for example, metadata specifications only provide a syntactic formalism and specific vocabularies in some of the fields are recommended.

This paper is rooted in the emerging paradigm of educational modeling languages (Koper 2002, Wilson 2001) to develop a representational framework for learning content that could accomplish current requirements of

learning technology standards. At the same time, it aims to combine them with knowledge modeling mechanisms in order to improve the description of learning content and processes, at a pedagogical level of abstraction (Rodriguez-Artacho et al. 2000). We face the problem of extending the notion of learning content to overcome the current content-centered approach, at the present time shaped as an aggregation or sequence of learning objects (LO). It includes instructional processes and methods, providing, at the same time, a pedagogical level of abstraction -in the description- that facilitates the authoring process. In this respect, our objective is to propose a language based on a representational framework to describe larger units of educational material as a proposal of educational modeling language. Moreover, the aim is to enhance the actual view of learning objects as isolated components, providing a cognitive view of educational material structured in instructional ontologies. We will also focus on cognitive models of educational content, as richer representations involving semantically-linked themed knowledge bases and stressing the importance of ontological modeling in the design of educational systems (Breuker et al. 1999, Mayorga et al. 1999, Scott 2001).

This paper is broken out into the following parts: Section 2 examines the current proposals for representing and creating learning material. Section 3 proposes a representational framework based on the paradigm of educational modeling languages. Section 4 describes PALO language and its authoring cycle of learning material. Finally, conclusions and further developments are presented in Section 5.

Issues in Learning Content Modeling

Before LT standards and specifications were developed, the authoring of learning material deeply depended on delivering technology, compromising maintenance, interoperability and interchangeability. In recent years, there has been a great effort to correct the unbalanced situation between the development of learning content specifications and the design of LMS architectures by focusing on the following topics:

- Separating and formal specification of learning content and learning management systems.
- Structuring learning material into reusable components.
- Providing a framework of interoperability between different LMS's as well as a standardized architecture.
- Creating description formats to search and retrieve distributed and reusable learning material (metadata).

As a consequence, the interest in creating formal models to represent learning material has led to the creation of a set of initiatives and working groups (Robson 2000, Ritter et al. 1997, Collier et al. 2002) that have developed a variety of proposals to formalize different aspects of learning material, mainly content aggregation and packages, sequencing, repositories for learning content objects, all of them have been proposed as standards for Learning Technologies.

LT Standards and the Learning Objects Approach

Learning Technology standards are being developed by a variety of institutions and regular standardization forums. The majority of the initiatives that are being carried out are related to specific Learning Technologies (LT) standardization workgroups, such as IEEE LTSC, CEN/ISSS LTWS, and ISO SG36 that have helped in the coordination of standardization proposals. Moreover, some international initiatives such as the IMS project have developed relevant e-Learning specifications to model learning content, sequencing, quizzes and repositories while the ADL initiative in the U.S. has developed its own proposal named SCORM, which has a learning-content packaging format, with additional sequencing extensions, that solves training demands of the Department of Defense (DoD).

Parallel initial steps to create learning content as a separate component of LMSs focused on designing a repository of content with independent reusable pieces of learning content that could be searchable and retrievable through meta-description (Forte et al. 1997). Coincidentally, there has been a development of standardized Metadata specifications like LOM (Hodgings, 2000) and Dublin Core, among others, which have developed learning objects metadata schemas and proposed guidelines for the creation of application profiles, and is mostly used as a catalogue system for learning objects.

The concept of learning objects is, currently, the main issue being studied and researched in e-Learning and learning technologies (Gibbons et al. 2000, Wiley 2001, Barrit 2000, Duval et al. 2001), although its definition and scope is, surprisingly not yet quite well defined. The best known definition is the one provided by the IEEE LTSC group (Reigeluth and Nelson, 1997). According to this definition, a Learning Object (LO) is "a digital or non-digital entity which can be used, re-used or referenced during technology supported learning" (Hodgings,

2000). There are other approaches, which simplify the scope to “any digital resource that can be reused to support learning” and that criticize the lack of a specific instructional design paradigm that is based on them (Wiley 2001, Wiley 2000b). They exclude non-digital resources, while other definitions include pedagogical objectives. Despite these differences, all definitions are focused on the notion of reusability, and they imply the attachment of metadata descriptors to facilitate search and retrieval.

So far, researchers share the notion of LOs as a “brick” to build learning content through aggregation. They are classified according to a hierarchy of aggregation levels, which is based on its size and the pedagogical information attached, according to the granularity.

Notwithstanding the fact that most of the current research projects on LT are based on LO repositories, the main drawback of this model are the trade-offs between granularity, cataloguing effort and suitability to reuse (Merrill 2001, Wiley 2000a). Despite the fact that the smaller the granularity, the more suitable for reusing, it is also well known that it might not preserve its pedagogical context, without compromising the need to catalogue it. In fact, this might only be one of the drawbacks of a representational model that does not distinguish how to represent different kinds of instructional information and make it explicitly different from the learning content itself contained in the LO. Moreover, many criticisms of LOs are based on the inability to model the learning processes and methods of the learning material in a flexible way, and on the lack of a pedagogical context (Koper, 2001). It is also worth mentioning the difficulty of coherently combining different LT specifications along with the use of LOs as components for building tailored educational material.

In connection with this idea, there are no pedagogical mechanisms left to authors when elaborating a course based on an aggregation of learning objects. Some of its aspects (mainly methods, internal sequencing and structure) are embedded and hardwired in the LO itself, taking for granted that the suitable component will surely be found in our LO repository. In these objects, activities and methods are not explicitly described. Although components are reusable, there is a lack of formalism to express structure, sequencing, and pedagogical uses of this content as well as the learning processes involved in it. The creation of learning material with learning objects and packages of content as a succession of clip-arts, does not provide authors with a layer of abstraction that would allow them to create reusable learning material at an instructional level (Wiley 2001). Moreover, this model is not rich enough to express a complex course, which, eventually, would include: (i) pedagogical features, (ii) meaningful structured parts and conditions for sequence, (iii) prerequisites and (iv) a variety of learning processes to be carried out by teachers and learners (Koper 2001).

Modeling Learning Content and Processes: The Educational Modeling Languages Approach

A new representational framework has been developed under the generic definition of Educational Modeling Languages. Different approaches to said representational framework have been studied in the scope of the CEN/ISSS LT working group (Wilson 2001, Koper et al. 2002). These proposals aim to solve the representational problem by establishing a layer of abstraction to describe learning material, thereby improving the model of content packaged simply as a collection of learning objects (Rodriguez-Artacho 2002, Süß et al. 1999, Koper 2001).

According to Wilson (2001), EMLs and learning objects actually represent opposite approaches to the interoperability question. As far as the learning objects approach is concerned, interoperability for content is hampered by the contextual “baggage” of the object; an object can only truly be reusable by stripping the content of all its external referents such as teaching methods, student roles, and activities. EMLs take an opposite approach. We can only conclude that components are truly shareable and reusable if all units include complete lessons, hands on work, or entire courses and all contextual information. Moreover EML's incorporate the definition of pedagogical aspects and learning processes that make interoperable courses or units of study, so they provide appropriate instructional elements at its adequate abstraction level.

The advantages of such a definition framework of learning content are mainly centered on the following ideas:

- Defining an abstract specification format to represent learning content that could raise the level of abstraction in the authoring process.
- Providing abstract representational mechanisms to describe learning processes.
- Providing a way to describe pedagogical behaviors, based on abstract representational mechanisms.

Accordingly, our proposal extends current specifications and focuses on a broader variety of instructional information which is structured in a common representational framework specific for learning material.

A Proposal for a Reference Framework to Describe Educational Material

We hereby propose a classification that scaffolds heterogeneous information so it will allow elaborating learning material by means of a formal specification. In order to reach such an objective, the following considerations shall be taken into account, as assumptions:

- Learning material is composed of pedagogical and instructional information that can be represented using an abstract information model and following a specification.
- The different elements of the specification are classified into categories called layers.
- As a formal specification, each element has an associated pedagogical meaning or operational semantics that require a process of interpretation or compilation by the LMS.

The representational framework, rather than just being a model of aggregation or a combination of learning objects, introduces instructional information associated with formal specifications. This way, it is capable of turning the former view based on a plain package of content into a variety of components of instruction (processes, sequencing, prerequisites, scheduling, etc.), and educational content.

As a result, a classification of the different types of information that make up learning material appears, scaffolded in a certain number of categories of elements called layers. A layer expresses information about specific components, processes or functionalities, providing coverage of a variety of aspects that are involved in describing learning activities to be carried out by a computer-supported learning environment.

Table 1: Representational Framework of an Educational Modeling Language

Layer	Functionality
Management	LMS interoperability
Sequencing	Scheduling, prerequisites, dependences
Structure	Navigational model, Table of contents
Activity	Activity, community, Roles, resources, tools
Content	Learning content, Learning Objects Ontology-based instructional Knowledge
RIO, RLO's	
Conceptual Domains	
Multimedia Assets	

Table 1 illustrates our proposed classification. In the left column each layer represents a categorized type of information related to any particular educational media. The right column explains the operational implications of the elements of the information models for each layer. Subsections describe each level of the representational framework.

Layer 1: Content

Learning content at this level basically refers to any information contained in a given course, without any assumptions regarding its pedagogical use. Paradoxically, a layer called '*learning content*' seems to be redundant in the specification of learning material. However, the notion of learning objects poses a serious problem that needs to be solved when considered as a plain self-contained piece of information for instructional purposes. In our model, the classification distinguishes more than one unique level of '*learning material*', thus separating content from other aspects of the learning material such as structure, learning activities, sequencing, scheduling or pedagogical model.

As a consequence, the content level is only related to expositive information, from a technical point of view. This makes a distinction between (i) passive content, which can be simply delivered as it is, using any technology, and (ii) more complex learning material, such as learning processes or instructional functionalities, which require more meaningful and complex LMS services. This last case specification corresponds to the upper levels on the hierarchy.

Additionally, the specific type of content will include learning objects among others. In particular, we can also include references to conceptual domains and any other forms of knowledge organization based on learning ontologies. These repositories are structured into a knowledge domain with relationships between elements based on a pedagogical and instructional ontology, rather than containing isolated '*learning objects*'.

Layer 2: Activities

The ability to specify learning processes is the main conceptual difference between educational modeling languages and the rest of the learning content specifications. This layer provides an abstraction level to define educational processes, embedded as part of the learning material.

Theoretical models for learning activities are related to learning theories. Consequently, they consider different conditions for learning and events of instruction (Moallen 2001). However, our aim, rather than providing a generic model, is to test abstract mechanisms in order to describe a learning task while stressing the importance of dialogues and feedback and carrying out work-based activities, discussion and a formative assessment (Cronje, 2001, Moallem 2001, Bradley 2002, Rodríguez-Artacho 2001).

Layer 3: Structure

Instructional designers have long recognized the importance of analyzing a certain content of a given subject for the purpose of facilitating learning through appropriate knowledge selection and organization (Merrill 2001). The structure layer addresses the organization of learning materials. In this layer, structure is described as a meaningful part of the learning material, allowing the LMS to associate pedagogical properties in terms of:

- Grouping components of layers 1 and 2 in a meaningful structure, providing an information model to implement pedagogical mechanisms. (*i.e.* prerequisites, sequencing and scheduling)
- Associating partial assessment (some parts could be assessed separately from others)
- Providing a table of contents and a navigational model that goes over the material

At the same time, this approach is different from current LT specifications such as Content Packaging format of IMS and SCORM because, even though SCORM defines a framework to package and structure learning content, no explicit semantics are associated with structure elements.

Layer 4: Scheduling and Sequencing

This level models instructional workflow, pedagogical dependences, sequencing and time dependences between different parts of the learning material. Current specifications, such as IMS Simple Sequencing and SCORM also provide time restrictions and pedagogical dependencies associated to certain components of the learning environment.

Scheduling includes the following issues:

- Pedagogical prerequisites between the different parts of the components
- Deadlines, time constraints or any other scheduling
- Schedule to perform specific activities

This layer aims to integrate these features as part of a single specification, associating these mechanisms with parts of the learning material, rather than proposing an alternative information model to perform sequencing.

Layer 5: Management

This level considers the information necessary to manage the description in order to provide interoperability with the LMS. Management information is handled by the processing or delivery tool of the EML. It is later connected with the domain knowledge repository's location, resources or tools described in the specification, and metadata associated with any of the learning contents embedded in the course.

The PALO Language

PALO is an educational modeling language based on the aforementioned classification and developed in the LSI Department of UNED University. The PALO Language allows the definitions of courses or units of study structured in modules. Each module includes (i) a declaration of the structure, (ii) activities to be undertaken by students and tutors and (iii) the schedule of activities and content. The sequencing of modules is scheduled through deadlines and dependence between modules, based on different types of prerequisites.

Table 2 summarizes the information model of PALO and its location on the reference framework. Entities and attributes of each layer are detailed below.

Table 2: PALO language entities and attributes

Layer	Entities	Attributes			
Management Layer	management objectsDB taskDB metadata	— sgbd,location sgbd,location —			
Sequencing Layer	none	Associated to MODULES module-prerequisite prerequisite-condition deadline Associated to TASKS task-prerequisite			
Structure Layer	course module part subpart essay	title traceable —id— —id— —id— —id—			
Activity Layer	task essay qualifier simulation tool	assessed editor-type type weight name type			
Content Layer	element <table><tr><td>LO's</td></tr><tr><td>Conceptual Domains</td></tr><tr><td>Multimedia Assets</td></tr></table> relation glossary as_is hint	LO's	Conceptual Domains	Multimedia Assets	domain name category —id— —id— format —
LO's					
Conceptual Domains					
Multimedia Assets					

Description Levels in PALO

According to the sections above, there is a language subset that allows proper configuration within the components of the learning content for each of the different layers. The following sections will describe how different elements of the language are responsible for creating specific layers.

The Content Layer

PALO has a content model based on a cognitive approach, which means that rather than encompassing a set of local or distributed "knowledge objects", PALO involves creating a course-specific repository of semantically linked material (Mayorga et al. 1999).

We agree with the hypothesis that the greatest impact on learning results from the representation and organization of the knowledge to be learned (Merrill 2001). In this respect, the importance of the use of conceptualizations in the process of learning (Breuker 1999) and these classifications made by learning theories is well known (Henze 1997, Mayes 1995, Schank 1999).

However, in order to take advantage of these capabilities, it is necessary to have previously created a course-specific repository of semantically linked material, based on an explicit conceptualization. Some of these conceptual models will be applicable to different subject matters, for instance, those relations producing taxonomies such as *part-of* or *class/subclass*, while others would be domain-specific. In order to provide the flexibility necessary to cope with different domains, our approach allows the defining of the type of entities and relations in a meta-level using the same formalism: entities and relationships. In this meta-description, each specific domain model is generated as an instance of a generic model. Such a library of generic models (meta-descriptions) provides a variety of simple to complex ontologies in which a model can be selected whenever a new description for a particular domain needs to be made. Therefore, the type of objects, properties, and relationships to describe a domain can be modified at the meta-level, facilitating the building process and maintenance (Verdejo et al. 2000).

Figure 1 shows a simplified learning ontology taken from a generic scientific matter (actually used to create a course in logic and program verification). The ontology is represented using Entity-Relationship formalism. Entities are described by a category like *concepts*, *examples* and *explanations* in the field of study, and linked using the semantic relationships *illustrates* and *prerequisite*.

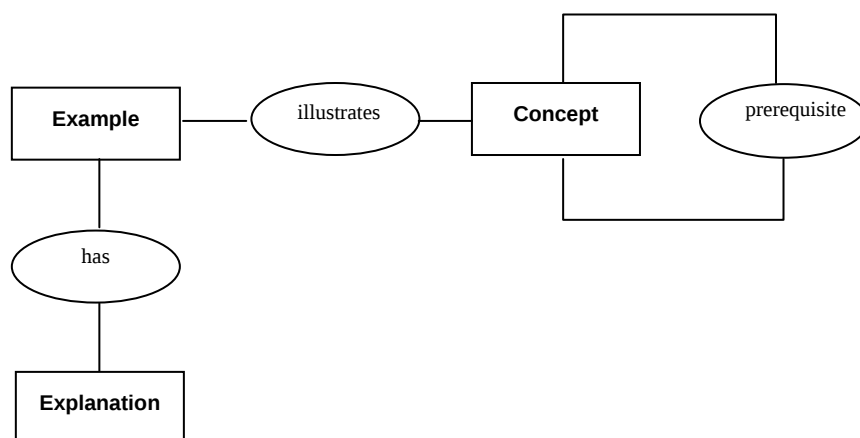


Figure 1: A basic learning ontology for a generic scientific matter

To illustrate PALO capabilities for retrieving educational content from an ontology-based conceptual domain, we can make use of PALO's `relation` tag in the context of the ontology of Figure 1. Assuming that we are creating a lesson related to the concept *invariant* and that in some part of the learning material we would like to insert "*examples that illustrate concept **invariant***", we would compose the PALO fragment of Figure 2.

```

...
Here you can find more <relation
Name="Illustrates" Domain="Conceptual"
Subject="invariant"
Category="Example">examples</relation>
of the concept invariant.
...

```

Figure 2: Accessing domain knowledge using PALO

When the PALO rendering process parses the `relation` tag, it retrieves all the *example* entities related to the concept "*invariant*" from the knowledge base and it builds the appropriate environment in the delivery format (i.e. a web page), which includes the sentence "Here you can find more examples of the concept invariant" where the term examples is rendered as a link to the corresponding list of examples.

These specific uses of a conceptual domain model facilitate the authoring process of complex learning environments at a pedagogical and instructional level, and they provide a higher level of abstraction in the description of course learning content. In the example of Figure 2 the `relation` tag can serve to retrieve elements from the knowledge domains according to a given pedagogical relationship (e.g., "easy" examples).

Single elements can be also retrieved on an individual basis (using the `element` tag, as shown later in the activity section), or one can retrieve an alphabetical list of elements to create a glossary (`glossary` tag). We focus on this last tag with another PALO example. In Figure 3 we describe the ontology to represent chemical compounds and concepts. Based in this conceptualization, we can create a multiple nested glossary rooted in the "*compound*" entity using the `glossary` tag.

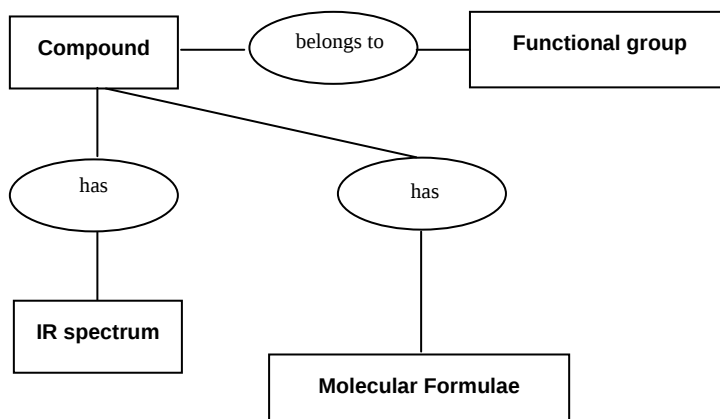


Figure 3: A chemistry-related ontology

Figure 4 shows the PALO fragment to create an alphabetical glossary of compounds with their respective Infra-red spectrums, molecular formulae and associated functional groups. The resulting environment is shown in Figure 5.

In all cases, the construction of this themed knowledge base is a core aspect of course development, and it highlights the important role of learning ontologies to facilitate authoring learning material.

```

< GLOSSARY CATEGORY= "Compound" DOMAIN= "Conceptual"
ATR-LABEL= "Name" ORDER= "alphabetical">

  Glosario de compuestos

  < REFERENCE NAME= "has" DOMAIN= "Conceptual"
CATEGORY= "Spectrum" ATR-CONTENT= "Name"
LOCATION= "antecedent">
  Ver Espectro
</REFERENCE>

  < REFERENCE NAME= "has" DOMAIN= "Conceptual"
CATEGORY= "MolecularFormulae" ATR-
CONTENT= "Content" LOCATION= "antecedent">
  Ver Formula molecular
</REFERENCE>

  < REFERENCE NAME= "belongs to" DOMAIN= "Conceptual"
CATEGORY= "FunctionalGroup" ATR-CONTENT= "Name"
LOCATION= "antecedent">
  Grupos Funcionales a los que pertenece
</REFERENCE>
</GLOSSARY>

```

Figure 4: Creating a nested glossary

At the same time, ontologies can contain different multimedia components, as shown in Figure 5, where molecular formulae are rendered using a Java applet, while spectrums are GIF files.

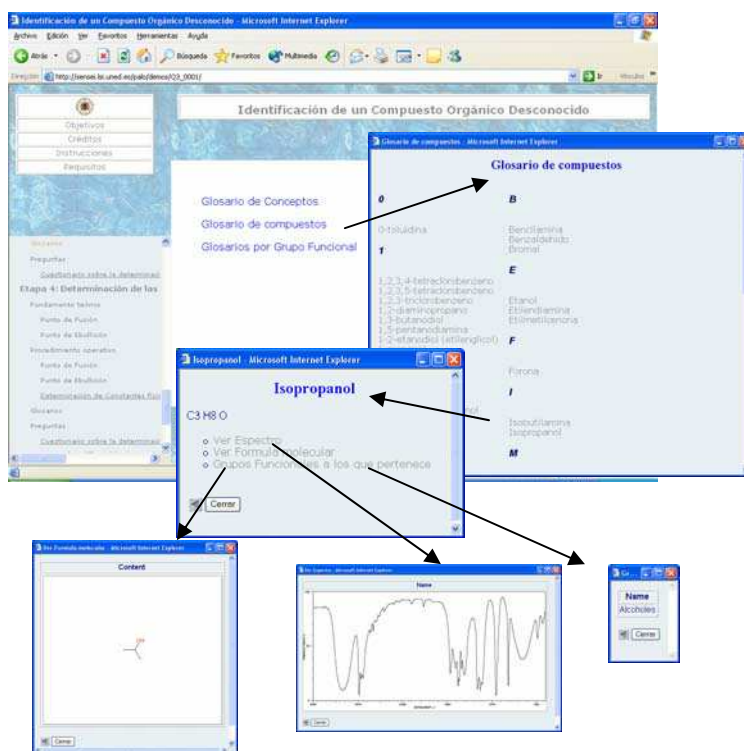


Figure 5: Nested glossary in a chemical-related learning environment

The Activity Layer

Learning processes are defined using the **task** tag. PALO can specify individual tasks involving two roles by default: student and teacher. Figure 6 shows a definition of an experimental essay to be carried out by learners in the UNED Engineering School (Verdejo et al. 2001).

```

<ESSAY NAME="Ensayo del Azufre A">
  Se toman en un tubo de ensayo 2 ml de
  <ELEMENT DOMAIN="conceptual" NAME="d001"
  CATEGORY="Concept" ATR-LABEL="Name" ATTRIB-
  CONTENT="Content" FAQ="no">solución alcalina</ELEMENT>. Se
  acidula con ácido acético, añadiéndose después una disolución
  de acetato de plomo. Un precipitado negro de sulfuro de plomo,
  indica la presencia de azufre.
  <AS_IS TYPE="html">
    S <SUP>= </SUP> + Pb <SUP>+ </SUP> ---- <SUP>
    H <SUP>+ </SUP> </SUP> ----> Pb S (Sólido Negro) </AS_IS>
  <TASK NAME="Q3_m2t01" TYPE="simulation" LABEL="Simular
  Ensayo del azufre A" ASSESSED="yes">
    Simulación del ensayo del azufre A
    <SIMULATION NAME="simulation">Incoloro</SIMULATION>
  </TASK>
  <TASK NAME="Q3_m2t02" TYPE="text" LABEL="Comentar
  Ensayo del azufre A" ASSESSED="yes">Comenta el resultado de
  esta observación en la tarea adjunta. ¿Qué puedes
  deducir?</TASK> </ESSAY>

```

Figure 6: A PALO fragment with activity definitions

The essay includes two tasks in the PALO file fragment: task **Q3_m2t01** performs a simulation process (notice the value of the **type** attribute of the task is **simulation**) and the task **Q3_m2t02** defines a workspace with a text editor (**type** attribute value set to **text**) to comment on the simulated chemical process. An example of the use of the domain model using the **element** tag, as described in the previous section, is also provided, including the link to the retrieved element.

When rendering this PALO definition, two different workspaces are built up for each one of the roles. Figure 7 shows the student view where he has to carry out a simulated chemical reaction of a sulphur-based essay (A) and comment on the results (B). The teacher's environment offers a group view of student tasks and a functionality to assess and give feedback to the students with a dialogue option.

The Structure Layer

PALO provides a hierarchy of Courses divided in modules, parts and subparts. Each PALO description must only contain one course, which can be divided into one or more modules. In PALO, the difference between the tags **module** and **part** and **subpart** is that a module is the unit that can be assessed globally, serving as a partial assessment of the course as a whole. Any of these elements may contain a combination of content and tasks as defined above.

Creating meaningful structure tags is useful (i) to organize a table of contents, like the one in the learning environment (See C in Figure 7) and (ii) to provide explicit dependencies between different parts of the specification, as shown in the next section.

The Sequencing Layer

Scheduling and sequencing are provided through a set of attributes associated with structure and process levels. Two mechanisms are implemented:

- **Deadlines:** The attribute **deadline** that is associated with a module indicates the corresponding tasks within the module have to be carried out before the deadline.
- **Prerequisites:** The attributes **module-prerequisite** and **prerequisite-condition** are associated with the module. The first one controls the need to carry out the module indicated on the attribute before going on to the next one. The second one controls what conditions need to be achieved (completed, assessed or passed) in the module in order to go on to the next one.

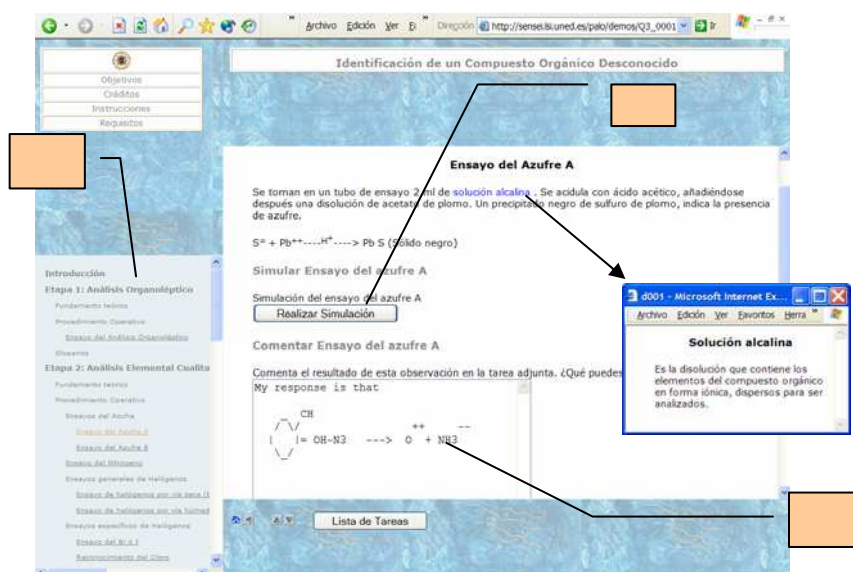


Figure 7: A PALO-based learning environment with task definitions (Student view)

The rendering of these elements of the language causes the appropriate behavior of the learning environment, which may or may not allow going through a given module, depending on whether or not prerequisite conditions have been achieved.

The Management Layer

The management level in PALO describes location and type of the domain knowledge repositories. Since this information depends on the LMS, it is not relevant to go into details for this specific language. Currently, the most important issue in connection with this level is the fact that PALO provides elements to define the location (the `location` attribute containing an URL) of the conceptual domains and to name the repositories (`sgbd`).

Authoring Cycle and Learning Experiences Using PALO

Learning environments are generated through a compilation process of a PALO file. In the present implementation, the PALO template is defined with a DTD file, from which a PALO file is generated.

The authoring process (Figure 8) is based on the creation of the learning material using a PALO specification and a processing tool (a PALO parser).

The authoring process has three steps:

- Create or copy the ontology and instantiate it with a domain model of the content matter
- Create the learning material using PALO and eventually make use of the language features to access the cognitive repositories
- Launch the PALO parser to generate the corresponding web based learning environment

A desirable interoperability with an LMS should be provided by means of rendering processes in PALO compatible LMS's. This would result in a facility to import and export learning environments among different e-Learning platforms, similar to some initiatives that have been made by commercial e-Learning management systems such as WebCT and others who have been able to integrate IMS, SCORM, LOM and other learning technology specifications.

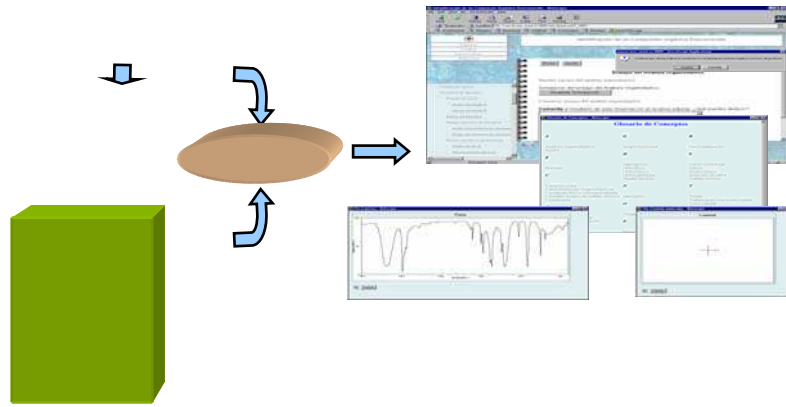


Figure 8: The PALO authoring process

Conclusions

This paper describes a representational framework for learning material as well as its application to the definition of PALO as an educational modeling language. We have shown that PALO allows the creation of complex learning scenarios, which include the adoption of pedagogical models using a terminology familiar to the designers. The adoption of pedagogical theories using elements of the language shows that a more complex specification can easily provide an extended variety of pedagogical interactions and models, and serve as an authoring reference framework for computer-based learning material.

Current trends in learning technologies are focused on creating specifications to describe different aspects of learning material while the emerging paradigm of educational modeling languages enhances the application scope and provides pedagogical mechanisms to describe learning environments at a higher level of abstraction. At the same time, the use of instructional ontologies shows that we can create and maintain separate instructional knowledge bases from the authoring process of learning material, and reuse them in different courses or units of study.

Ongoing research is aimed towards the definition of collaborative tasks based on activity theory in an enhanced specification of PALO called “Active Documents” (Verdejo et al. 2002), which incorporates tools to quickly parse documents, thus allowing a dynamic framework to develop adaptive material.

Finally, the PALO language has been successfully used in the description of open courses at UNED University. It currently supports more than 1,500 students using a variety of material which includes 4 open courses, a didactic guide and self assessment environments for a program verification course as a part of the Computer Science degree.

References

- Bradley, C., & Olivier, M. (2002). The evolution of pedagogic models for work-based learning within a virtual university. *International Journal of Computers & Education*, 38, 37-52.
- Barrit, C., & Lewis, D. (2000). Reusable Learning Objects Strategy. *Technical Report v 3.1*, Cisco Systems Ltd.
- Breuker, J., Muntjewerff, A., & Bredewej, B. (1999). Ontological modeling for designing educational systems. *Paper presented at the AIED 99 Workshop on Ontologies for Educational Systems*, July 18-19, 1999, Le Mans, France.
- Collier, G., & Robson, R. (2002). e-Learning Interoperability Standards. *White Paper*, Sun Microsystems Inc.
- Cronje, J. R. (2001). Metaphors and models in Internet-based learning. *International Journal of Computers & Education*, 37, 241-256.

Duval, E., Forte, E., Cardinaels, K., Verhoeven, B., Van Durm, R., Hendrikx, K., Wentland-Forte, M., Ebel, N., Macowicz, M., Warkentyne, K., & Haenni, F. (2001). The Ariadne Knowledge Pool System. *Communications of the ACM*, 44 (5), 73-78.

Forte, E., Maria, H., Wentland, F., & Duval, E. (1997). The ARIADNE project: Knowledge pools for computer-based and telematics-supported classical open and distance education (I/II). *European Journal of Engineering Education*, 22 (1).

Gibbons, A. S., Nelson, J., & Richards, R. (2000). *The nature and origin of instructional objects*, Retrieved July 19, 2004 from <http://www.reusability.org/read/chapters/gibbons.doc>.

Henze, N., & Nejd, W. (1997). *A Web-Based learning environment: Applying Constructivist Teaching Concepts in Virtual Learning Environments*, Retrieved July 19, 2004 from <http://www.kbs.uni-hannover.de/paper/97/ifip97/paper15.html>.

Hodgins, W. (2000). *IEEE LTSC Learning Objects Metadata*, Retrieved July 19, 2004 from <http://ltsc.ieee.org>.

Koper R. (2001). Modeling Units of Study from a pedagogical perspective: The pedagogical metamodel behind EML. *Technical Report, Open University of the Nederland (OUNL)*, Retrieved July 19, 2004 from <http://eml.ou.nl/introduction/docs/ped-metamodel.pdf>.

Koper, R. (2000). From change to renewal: Educational technology foundations of electronic learning environments. *Technical Report, Open University of the Nederland (OUNL)*, Retrieved July 19, 2004 from <http://eml.ou.nl/introduction/docs/koper-inaugural-address.pdf>.

Koper, R., Rodríguez-Artacho, M., Rawlings, A., Lefrere, P., & van Rosmalen, P. (2002). Survey of Educational Modeling Languages. *Technical Report of the CEN/ISS Learning Technologies Workshop*, Retrieved July 19, 2004 from <http://sensei.lsi.uned.es/palo/eml-version1.pdf>.

Maglajlic, S., Maurer, H., & Scherbackov, N. (1998). Separating structure and content: authoring Educational web applications. In T. Ottmann & I. Tomek (Eds.), *Proceedings of the ED-MEDIA & ED-TELECOM 98* (pp. 880-884), USA:AACE.

Mayes, T., & Neilson, I. (1995). Learning from Other peoples dialogues: questions about computer based answers. *Innovate adult learning with innovate Technologies* (pp. 31-48), A61, IFIP series, North Holland: Elsevier Science.

Mayorga, J. I., Verdejo, M. F., Rodríguez-Artacho, M. Calero, Y. (1999). *Domain Modelling To Support Educational Web-based authoring*, Retrieved July 19, 2004 from <http://sensei.ieec.uned.es/%7Eesteed/papers/tet99.pdf>

Merrill, M. D. (2001). *Knowledge objects and mental-models*, Retrieved July 19, 2004 from <http://www.reusability.org/read/chapters/merrill.doc>

Mizoguchi, R., & Bourdeau, J. (2000). *Using ontological engineering to overcome common AI-ED problems*, Retrieved July 19, 2004 from <http://www.ei.sanken.osaka-u.ac.jp/pub/miz/JAied.pdf>.

Moallem, M. (2001). Applying constructivist and objectivist learning theories in the design of a web-based course: implications and practice. *Educational Technology and Society*, 4 (3), 113-125.

Murray, T. (1999). A model for distributed curriculum in the WWW. *Journal of Interactive Media in Education*, 5, Retrieved July 19, 2004 from <http://www.jime.open.ac.uk/98/5/murray-98-5-t.html>.

Qin, J., & Finneran, C. (2002). Ontological Representation for Learning Objects. *Paper presented at the Workshop on Document Search Interface Design and Intelligent Access in Large-Scale Collections*, JCDL'02, July 18, 2002, Portland, OR, USA.

Reigeluth, C. M., & Nelson, L. M. (1997). A new paradigm of ISD? In R. C. Branch & B. B. Minor (Eds.), *Educational media and technology yearbook* (Vol. 22) (pp. 24-35), Englewood, CO: Libraries Unlimited.

- Ritter, S., & Suthers, D. (1997). *Technical Standards for Education*, Retrieved July 19, 2004 from <http://www.eoe.org/FMPro?-db=Objects.fp3&-token=libraryPapers&-format=/library/paperdetail.htm&-recid=35179&-lay=all&-Find>
- Robson, R. (2000). Report on Learning Technology Standards. In J. Bourdeau & R. Heller (Eds.), *Proceedings of ED-MEDIA'00* (pp. 971-976), USA: AACE..
- Rodriguez-Artacho, M. (2002). PALO Language Overview. *Technical Report, STEED Project*, Retrieved July 19, 2004 from <http://sensei.lsi.uned.es/palo>.
- Rodriguez-Artacho, M., & Verdejo, M. F. (2000). High level design of Web-Based environments for distance learning. In M. Ortega & J. Bravo (Eds.), *Computers and education in the 21st century*, Kluwer Academic Press.
- Rodriguez-Artacho, M., & Verdejo, M. F. (2001). *Creating Constructivist Learning Scenarios Using an Educative Modeling Language*, Retrieved July 19, 2004 from <http://fie.engrng.pitt.edu/fie2001/papers/1161.pdf>.
- Schank, R. C., Berman, T. R., & MacPherson, K. A. (1999). Learning by doing. In C. M. Reigeluth (Ed.), *Instructional Design Theories and Models* (pp. 161-181), Mahwah, NJ: Lawrence Erlbaum.
- Scott, B. (2001). Conversation Theory: A constructivist dialogical approach to educational technology. *Cybernetics & Human Knowing*, 8 (4), 1-25.
- Süss, C., Freitag, B., & Broessler, P. (1999). Metamodeling for Web-based Teachware Management. *Paper presented at the ER '99 Workshops on Evolution and Change in Data Management, Reverse Engineering in Information Systems, and the World Wide Web and Conceptual Modeling*, November 15-18, 1999, Paris, France.
- Verdejo, F., Barros, B., & Rodriguez-Artacho, M. (2001). A proposal to support the design of experimental activities. *Paper presented at the Euro CSCL Conference*, March 22 - 24, 2001, Maastricht.
- Verdejo, M. F, Barros, B., Read, T., Rodriguez-Artacho, M. (2002). A System for the Specification and Development of an Environment for Distributed CSCL Environments. *Paper presented at the 6th International Conference, ITS2002*, June 2-7, 2002, Biarritz, France and San Sebastian, Spain.
- Verdejo, F., Rodriguez-Artacho, M., Mayorga, J. I., & Calero, M. Y. (2000). *Creating Web-based scenarios to support distance learners*, Retrieved July 19, 2004 from <http://eee.uci.edu/programs/ifipconf/papers/verdejo/>.
- Wiley, D. A. (2001). *The Instructional Use of Learning Objects*, Retrieved July 19, 2004 from <http://www.reusability.org>.
- Wiley, D. A., & Gibbons, S. (2000a). *A reformulation of the issue of learning object granularity and its implications for the design of learning objects*, Retrieved July 19, 2004 from <http://www.reusability.org/granularity.pdf>.
- Wiley, D. A. (2000b). Learning Objects. In A Kovalchick & K. Dawson (Eds.), *Educational Technology: An Encyclopedia*, Santa Barbara: ABC-CLIO.
- Wilson, S. (2001). Europe Focuses on EML's. *Report from CETIS Research Centre, UK*, Retrieved July 19, 2004 from <http://www.cetis.ac.uk/content/20011015103421>.

Instructional Designer (Job Announcement)

Integrating computer-based instructional design principles & methods, instructional technology skills, & adult learning theory, implement design steps & design technical training reqs in industrial setting, from needs analysis thro evaluation of new & existing training programs for U.S. & 2 China offices & factories, for a total of over 300 employees & over 30 various types of machinery. Perform research in human resources productivity, statistical data analysis, eval & drafting of training programs, manuals, instructor's guides, participant's guides & other support tools. Create instructional creative strategies, design & author course content. Conduct front-end analysis & assess performance problems to identify training & non-training interventions. May deliver training to ad hoc trainers or end users as needed.

Must have Bachelors in Instructional Technology or similar field; bilingual Chinese; exp in statistical analysis; able to use instructional design methods successfully & research productivity in human resources; able to work independently, manage multiple projects, meet commitments; thorough understanding of adult learning theory, instructional technology skills & computer -based instructional design principles; able to teach, foster a cooperative env; able to develop, implement strategic plans.

Send resume to Hillary Lin, Manager, Lin Manufacturing & Design, P.O. Bo 6127, N. Logan, UT 84341.

Online Collaborative Learning: Theory and Practice

(Book Review)

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Textbook Details:

Online Collaborative Learning: Theory and Practice

Tim S Roberts (ed)

2004, Idea-Group Publishing

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321 Pages

This is an important book. Its collection of excellent chapters addresses theories of learning, collaborative learning, and computer supported collaborative learning (CSCL) that reflect current thinking and research. It is also a precious resource for those with an interest in how the online medium is affecting the evolution of language. Elsebeth Korsgaard Sorensen's contribution is especially valuable on this topic.

There is a primary difficulty with online collaborative learning. Collaborative learning assumes that students who are asked to engage in this practice have the necessary skills to do it well. But as Dirkx and Smith (Michigan State University) imply in their chapter on Learning to Learn in Collaborative Groups, being able to function effectively in a collaborative learning environment involves a set of life skills that centre around effective communication – resolving conflict, being assertive, reaching consensus, willingness to take risks and disagree with other group members - all skills which many of us lack. To be successful in collaborative learning environments, on or off line, people need to be confident and competent communicators. These skills need to be taught for true collaborative learning to occur, and this is rarely the case. Students need a communicative skill set, and online facilitators need to know how to impart them. (Kukulska Hulme)

Revealing too is the data on whether or not CSCL is actually any more effective or valuable than individual learning. Cases to support both sides are presented here. Treleaven (University of Western Sydney) has found that students enjoy CSCL when “equity and group dynamics are appropriately addressed.” Dirkx and Smith caution that “learners hold tightly to individualistic, subjective conceptions of learning.” Important distinctions are made between cooperative learning, collaborative learning, and other forms of group work (Graham and Misanchuk; Roberts and McInnerney) and the point is made more than once that many learners prefer to study alone. Effective collaborative learning requires a great deal of interdependence between group members, and “the greater the interdependence, the greater the communication overheads.” (Graham and Misanchuk)

Sorensen argues in her chapter that the nature of communications online requires a different approach to the design of online learning environments, and that instructional design premised on traditional face-to-face notions of communication will be thwarted by the effect of the distance in time and space on online communications.

Chapters 2 (Muukkonen, Hakkainen and Lakkala) and 3 (Bonk, Wisher, Yeon-Lee) focus in part on the creation of new tools to support the use of CSCL, and address the inadequacy of existing tools to foster collaboration (Bonk et al argue that existing course management systems tend to reinforce behaviourist models of learning), while Ingram and Hathorn from Kent State University present a very useful working model, albeit labour intensive, for analysis of online communications that helps determine the degree of collaboration present in a given online event. And not surprisingly perhaps, this has no connection with quantity of postings. In fact in their study it was a group with fewer postings that evidenced a greater degree of collaboration.

This is an instructive and for the most part enjoyable read. There is plenty here for the lay educator, and as well as online aficionados. It will be especially valuable for students and teachers of online pedagogies. Those with an inherent fascination in language usage will have much to digest. The collective insight in these chapters provides

a way forward to promote effective collaborative learning. It is a complex process. Students and teaching staff need to acquire the skills to maximize the potential of elearning environments to foster collaborative learning, and not just pay lip service to a troublesome ideal that we were all told in teacher training programs is a 'good thing'! Kukulska Hulme, quoting Laurillard, states that computer mediated communication's value is based on the "assumption that students learn effectively through discussion and collaboration.... However this is not a well tested assumption as far as the literature is concerned." Editor Tim Roberts suggests in his preface that "online collaborative learning is an idea whose time has come." This may well be, and the advent of the Internet as a medium for educational instruction may well have prompted a paradigm shift towards a more student-centred model of learning *in theory*, but *in practice*, in the hands of the unskilled, it may provide no greater advantage than students learning alone.

E-Education Applications: Human Factors and Innovative Approaches

(Book Review)

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Textbook Details:

E-Education Applications: Human Factors and Innovative Approaches

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Overview

This is a most worthwhile book, although, in two ways it is less topically integrated than are some presentations of its kind. However, this is in not a problem. In fact, it lends itself to reading or study using relatively short "serendipitous opportunity" time periods, a circumstance that hectic professional schedules have made more common.

The text's 20 articles vary significantly in the nature of their utility. Certain articles provide a broad, but not deep, survey of their topic's historical development. Others provide a tightly focused and penetrating analysis of their topic's developmental vanguard. The first category is most useful to the novice or beginner, while the latter is most helpful to the experienced professional. If the book is intended for a library or a large office, that is, if the purchasers -intent is that the text be a resource for a wide range of professional development, then this variability is quite a good thing, offering "something for everyone." Any professional in the broad middle spectrum of development, personal ownership of the text is clearly desirable.

Moreover, the text's unifying themes are so broad ("Human, Models, Systems, Courses, Intuitive, Social, and International") as to be more semantic systemics than substantive subjects. Consequently, it is very reasonable to consider the chapters as independent essays. This represents no practical difficulty whatsoever, as each chapter stands alone quite well and by itself represents a matter of significant interest and relevance. In fact, the collection almost borders on the eclectic, but this is unimportant as it is genuinely an excellent collection.

However, this text offers, completely unheralded, a *special serendipity*. It has the informative, entertaining advantage of truly varied cultural viewpoints. (This particularly desirable aspect of the text's inventory is not even suggested in its title.) That is, the text offers an impressive cross-cultural survey of interests and concerns. Its first section *Models, Systems and Courses* contains 11 chapters that present authors from Australia, Britain, France, Germany, Greece, Japan, Turkey, and Poland. Its second section *More on Intuitive, Social and International Issues* contains 9 chapters that present authors from United States, Canada, Britain, Germany, Japan, Mexico, and Portugal.

For all of these reasons, it seems useful and appropriate to present a chapter by chapter summary:

Section I Profile

In the first chapter, authors from Germany present a "virtual community platform" that allows "distributed teams to enjoy mutual support" and special editorial facility with "a variety of information services in a shared workspace". This portal is named UseWorld.net. It is operated by an independent open incorporated society.

In the second chapter, an author from Poland describes the Postcourse project, which "allows authorized students to create and work with their own database, placed on a University server".

The system is particularly original in that it was created without an authoring package. A post two-year evaluation indicated that project is especially valuable for self-paced work.

In the third chapter, authors from France present a collaboration model where synchronous groups are supported by PLATINE software, "a shared whiteboard and a session manager, developed in JAVA." Two experiments have tested the system. The first concerned Cyberlicense training and the second concerned professional training. Results are discussed.

In the fourth chapter, authors from Britain present a virtual university "that is the simulation of the real-world learning experience". The system is suitable for online learning or distance learning and is intended to interact, at all stages, with changes in the learner's profile.

In the fifth chapter, authors from Greece assess "the expert-based approach in evaluating Open and Distance Learning (ODL) environments". A selective review of important contemporary research is presented, and from this significant concerns and probable trends in future research are extracted.

In the sixth chapter, authors from Japan present "the collaborative workplace", a learning management system designed to "encourage interactions among lecturer/learners". This offers a new kind of "cooperative link between a university and an industry". The system pioneers an ingenious, and ambitious, statistical processing device that analyzes and summarizes natural language data discussion logs in ways that may facilitate interactions between human learners and automatic processors.

In the seventh chapter, authors from Japan present research suggesting that learning support systems consisting of personal computers and wired local area networks are not superior to traditional classrooms but that learning support systems consisting of personal digital assistants and wireless local area networks are superior. These results are established specifically for SEGODON and SEGODON-PDA systems, but could be generalized to others.

In the eighth chapter, an author from Australia describes two different e-learning projects. The first is a university based pilot program designed to facilitate the transition of students into the university. The second is an online career planning project designed to facilitate students' transition from the university. Both projects attempt to develop students' independence when they are deciding what transition information is needed.

In the ninth chapter, authors from Britain describe the steps of a protocol for student participation in the design of a university course (Modern Greek) and an assessment of the strength of the online community so established. Student involvement in design incorporates steps that "build bridges with the intended users, map user needs and suggestions for the system, develop a prototype, and integrate feedback while continuing the iteration."

In the 10th chapter, authors from Britain describe the structure of a protocol for student participation in software development and design which allowed students to select their own roles in the design process, and to strongly assert preferences regarding the teaching staff they would like to work with. "Participating students represented the cross-section of the entire ability range." An analysis of how different student types related to this approach is included. "Relationships between students and teaching staff exhibited changes in the power structure, which were often difficult to redress outside of the pilot study."

In the 11th chapter, authors from Turkey review e-learning's history as it develops into "a major Instructional force in the world" then employ diffusion theory and "expected technological developments" to predict future trends in e-learning. This is done in a manner intended to "show different aspects of e-learning environments and their impact on related individuals or institutions."

Section II Profile

In the 12th chapter, authors from Britain "explore the potential for developing artificial intelligence and adaptive methods into online learning applications." "The role of search engines, browsers, and virtual learning environments" is broadly examined and "existing and newly developing technologies" receive focused attention, both are treated "in the context of intelligent systems."

In the 13th chapter, authors from Portugal speculate on perfecting the "black art" of "predictive models for e-learning" and note that the "review literature highlights a lack of reliable results describing the interplay between

e-learning context, Web usability, cognitive styles, motivation, learner performance, and satisfaction". A holistic framework, which might guide future research, is proposed as a mechanism for relating "Business-Process, People and Information-Systems."

In the 14th chapter, authors from Mexico examine the effectiveness of informal interactions supporting collaboration and the amplification of such interactions through "CENTERS" designed by the authors for that purpose. Research was focused to assess these interactions from a "socio- academic perspective. Results showed that the CENTERS helped to reduce the student's feelings of isolation and facilitated a greater degree of interpersonal interactions within the course participants".

In the 15th chapter, authors from Britain "explore how students may be orientated and disorientated toward online learning". Desirable and undesirable procedures are candidly discussed. It is suggested that "the disorientation experienced by students in online learning is part of a positive transformative experience leading to greater learner independence".

In the 16th chapter, an author from Britain offers an extraordinarily penetrating analysis of the usability of Web based e-learning systems as moderated by cultural differences .Theories and generic models are considered in detail. It is made unarguably clear that "In relation to product of development cultural differences in signs, meanings, actions, conventions, norms or values, etc., raise new research issues ranging from technical usability to methodological and ethical issues of culture and information systems" and that "in relation to the process of development, cultural differences affect the manner in which users are able to participate in design and to act as subjects in evaluation studies". Suggestions and predictions are made.

In the 17th chapter, authors from Germany explore creative, but pragmatic, media based models for teaching and learning. Arguments and supporting experiences are presented for four "Knowledge Spaces": Information, Exploration, Participation, and Mediation. Using this framework, prominent members of the Media Arts Research Studies group share significant experiences.

In the 18th chapter, authors from Japan described a new HTML browser design that provides students suffering from poor vision with easier and greater access to reading materials. This employs viewer generated CSS layout data for each student, a significant individualization. The system represents "a novel method combining Web-related technology and recent advancements in visual science".

In the 19th chapter, authors from Japan describe an ingenious "glove based input device" that translates gestures into Japanese characters and sentences. This might represent a major breakthrough for languages and circumstances where communication between the hearing and the non-hearing are difficult. A preliminary evaluation is presented.

In the 20th chapter, authors from the United States revisit the work of Skinner, Crowder, and Bloom. They explain linkages between these theories / practices and currently developing Web - based learning systems. They argue that Bloom's Taxonomy might be a particularly useful tool in developing online instruction and that, for e-learning, cognitive and affective hierarchies might be especially effective as closed loops.

Conclusion

A fascinating variety of e-learning and e-teaching approaches, and variables moderating them, are clearly and informatively presented in this worthwhile text. Although developmental levels vary, virtually all of this collection merits study rather than casual reading. Pick the text up with note taking equipment in hand.

Developing Innovation in Online Learning: An Action Research Framework (Book Review)

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Textbook Details:

Developing Innovation in Online Learning: An Action Research Framework

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Structure and Content

The main premise of this book is that educational informatics, the study of information and communication technologies applied in a learning and teaching context, is best understood and developed through an action research methodology. The argument is made by painstakingly examining each component of educational informatics, and placing it in an action research framework developed specifically for an educational context.

The book starts by explaining the driving forces behind the upsurge in online learning and the challenges posed by society to produce graduates with the higher order skills of critical thinking and problem solving. To meet this challenge, the authors argue that a pluralist research methodology is needed to progressively develop, evaluate and refine online learning courses. Such a methodology must be compatible with current educational theory, specifically constructivism, be iterative for incremental improvements to the system and be able to utilise feedback from all stakeholders including educationalists, students and administrators. While action research meets these criteria, the authors assert the need for a methodology specifically contextualised for the education domain. Throughout the remainder of the book they unfold the educational informatics action research framework they have developed for their own online learning programme.

Each chapter in the book begins with a detailed summary of the history and theoretical basis of components for their framework. The application of these components is then illustrated in a case study that describes an online learning project the authors had been instrumental in developing.

Audience

For a slim volume this book has extraordinary depth and breadth. This is both a strength and a disadvantage. On the positive side, the wealth of detail will be invaluable to any educational researcher or student. Every major concept is given a potted history (learning, for example, started pre the printed word) and covers most of the major researchers in each field. However, the sheer volume of information blurs the focus and main purpose of the book, that is, to provide a practical and effective research framework for investigating and improving online learning. Additionally, the presentation of so much information reduces the authors to writing at a generalised abstract level rather than an applied concrete one. This makes it more difficult for the reader to translate the ideas proposed directly into practice.

The innovative strategies discussed in the book would be more accessible to practitioners if the historical aspects and much of the theory that was critiqued, but not used as part of the framework, were removed. This would allow for the practical advice to be elaborated and more examples to be given. The case study, which was discussed at the end of each chapter, would also benefit from some pruning. Much of the case study involved reiterating the theory that had been explained in the early part of the chapter and also included many unnecessary

details related to the internal administration and management of the online project that would be of little interest to most readers.

The academic writing style, with every major assertion heavily referenced, will suit educational researchers, but may be off-putting for practitioners. The language is heavy with jargon and acronyms and this slows the flow of reading without adding to the quality of the ideas. There is also a strong tendency to reiterate statements, not once but several times, both within and across chapters. This gives the feel of a collection of journal articles rather than a coherent whole.

Overall, these minor flaws are outweighed by the substantial contribution this text makes to the online learning endeavour. It is a treasure trove of information, provides the promised framework and is an excellent reference book that should be on the shelf of anyone with a serious interest in online learning.

Learning Technology in Transition: from Individual Enthusiasm to Institutional Implementation

(Book Review)

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“In April 2003, The Association for Learning Technology (ALT) celebrated its tenth anniversary and this book has been produced in order to commemorate this landmark achievement.” So speaks the Editor of this panoramic of articles by authors primarily from the United Kingdom, but also from The Netherlands and Australia, as she begins the first of eleven chapters that chronicle the evolution of learning technology in ALT’s first decade. As the book’s title indicates, the articles relate how the uses of learning technologies in higher education and further education began with individuals who enthusiastically promoted their use. Then, at about the mid-point of this ten-year time period, with the help of several government based funding initiatives, the use of learning technologies began to become embedded into institutional structures and strategic plans. The individual enthusiasts who had been working in advance of the institutions became leaders on related committees and in departments dedicated to the use of learning technology.

The Chapters

Chapter 1. Enthusiastic Implementation: Setting the Scene for Evolution and Revolution, by Jane Seale. In this chapter the author introduces the various themes of the following chapters: technological developments, funding initiatives, responses to those funding initiatives and the pedagogy and content of technology oriented learning, all of which are said to have evidenced a dynamic evolution from 1993-2003.

Chapter 2. Reconsidering Content: Technology, Learning and Learning Technology, by Gayle Calverley. The author asserts that early in the decade technology was used to merely present content, whereas at the end of this decade the work focused on the production of reusable and interoperable content to use with technology. She discusses how content and learning technologies are now merging into a type of flexible learning arrangement.

Chapter 3. Learning Objects, Pedagogy and Reuse, by Tom Boyle and John Cook. This chapter furthers the discussion of content and learning technology by introducing several definitions of learning objects and their purposes. The authors credit the attributes of reusability resulting from decoupling, and pedagogical effectiveness as most critical. The justification for the use of learning objects is stated to be a need for educators to work together for reasons of efficiency and quality.

Chapter 4. Experiences of National Projects in Embedding Learning Technology into Institutional Practices in Higher Education, by Jaqueline Dempster and Francis Deepwell. The authors report on technology-related national projects regarding the embedding of technology into institutional learning and teaching. They cite an evolution of purpose in these projects leading from a push for innovations (adding technology) to instruction, to a push to embed technology priorities into the organizational structures of institutions of higher education. These two purposes showed a reciprocating effect, in that when innovation was emphasized, embedding was likely to occur as well, and when embedding was emphasized, innovation resulted.

Chapter 5. Embedding Learning Technologies into Institutional Practices: A Further Education Perspective, by Joe Wilson. The author reports on several funding initiatives in the UK that targeted the technological advancement of Further Education. Initial funding efforts served to produce an Information and Communications Technology (ICT) development strategy, while later efforts lead to the creation of Managed Learning Environments (MLE). He states, “The expectation is that learning technology will move from being the domain of the few to being embedded in good practice, part of entry-level qualifications and continuing professional development for teaching staff and part of the culture and fabric of learning in the 21st century” (p. 74).

Chapter 6. From Pioneers to Partners: The Changing Voices of Staff Developers, by Allison Littlejohn and Susi Peacock. This chapter considers this ten year history of learning technologies and the resulting impact on related staff development efforts in higher education. The authors divide this issue into five “eras”: pioneering, practice, policy, pedagogy, and partnership. In addition, the authors question whether staff development efforts have fully addressed the needs of teachers and learners, the changing roles of staff, ways to embed technology into teaching and learning, and links with national initiatives. In projecting for the next ten years, the authors see a need for staff development that is interspersed at multiple levels within institutions in systematic fashion.

Chapter 7. Institutional Implementation of ICT in Higher Education: A Dutch Perspective, by Wim de Boer, Petra Boezeroy, and Petera Fisser. This chapter provides an interesting contrast to the history of learning technologies over the past decade in the UK by providing an account of a similar history in the Netherlands. The authors detail national initiatives, such as the SURF Foundation and the Dutch Digital University, which on the one hand promoted advanced uses and embedding of ICT in higher education, but on the other evidenced a strikingly conservative focus and expectation. The authors see Dutch institutions as ‘stretching the mould’ by blending the traditional ways of teaching with technologies in line with institutional goals in the near future.

Chapter 8. Institutional Implementation of ICT in Higher Education: An Australian Perspective, by Ron Oliver, John O’Donoghue, and Barry Harper. The Australian account of the historical approach to learning technologies in higher education focuses on two, sometimes contradictory, themes: pedagogical integrity and market competition. Understandably, the authors equate the use of learning technologies in higher education with distance education. They cite a movement related to the convergence of computer-mediated distance education and on-campus teaching methods leading to the emergence of flexible learning. However, the pressures of the market for providing distance education courses is reported as antithetical to the success of targeted government initiatives for optimal learning.

Chapter 9. Facing the World Challenge: Risk, Resistance and Collaboration, by Gabriel Jacobs. The author establishes the Dearing Report of 1997, which presented an ambitious vision for e-learning, as the starting point for a discussion related to the shortcomings of e-learning initiatives. In effect, she continues the discussion introduced in the previous chapter related to the conflict between the distance education market and the educational value of online courses. The quasi-failures of e-learning initiatives at Harvard Business School and Stanford, as well as the refusal of the American Bar Association to recognize online degrees are mentioned. She cites the muted successes of UK initiatives as a caution before predicting that e-learning will experience gains in the next ten years of ALT’s existence.

Chapter 10. Understanding Enthusiasm and Implementation: E-Learning Research Questions and Methodological Issues, by Gráinne Conole. This chapter undertakes to summarize the current status of the character and practice of research on e-learning. The author maintains that e-learning research has not yet attained an established niche and protocol in the larger theater of educational research and that the diversity of research interests associated with e-learning relates to the several “feeder cognate disciplines” that offer different venues of consideration.

Chapter 11. Looking Backwards, Looking Forwards: an Overview, Some Conclusions and an Agenda, by Martin Oliver. This chapter describes the themes of the previous chapters in terms of an emerging self-awareness of the role of learning technologies in higher education. The author reiterates the ongoing concern related to the conflict between learning and e-learning, between pedagogy and the market, by stating, “If learning technology is to be recognized as a professional activity, its practitioners must be able to consider their work from an ethical *as well as* an economic perspective” (p.159).

Conclusion

Learning Technology in Transition: from Individual Enthusiasm to Institutional Implementation is a rich compendium of articles that truly commemorates the tenth anniversary of the Association of Learning Technology. Editor Jane Seale has included contributions that relay both the facts and the spirit of the history of learning technology initiatives in higher education in the United Kingdom, the Netherlands, and Australia.

The book's shortcomings relate to the fact that some chapters end up covering similar topics and drawing the same conclusions in the guise of expert opinion. The strength of this book is wisdom, which serves to inform and inspire professionals who are looking to the next ten years with positive expectations for the field.

Simulations and the Future of Learning: An Innovative (and Perhaps Revolutionary) Approach to e-Learning

(Book Review)

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Simulations and the Future of Learning: An Innovative (and Perhaps Revolutionary) Approach to e-Learning
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The Clark Aldrich's book: "Simulations and the Future of Learning : An Innovative (and Perhaps Revolutionary) Approach to e-Learning" is about new educational ways that are tightly connected to computer games and simulations. Clark Aldrich has created a detailed study how to design and realize an e-learning simulation that is both educative and similar to a modern computer game.

The book describes the author's new software package, called "The Virtual Leader". Although it does not seem so at the first glance (because of the rather formal cover design), this book attracts you like a good novel and as you start to read it then you read it every evening till you are through. In the book after the description of his earlier professional functions the author describes his way of thinking (and of course the contributions of his working team) that led him to the idea and the project described in the book. This is especially interesting for us, who are working on similar topics. You can compare his experience with your own and often they are strikingly similar in spite of the fact that we live in different parts of the world.

After you have nearly expected that such a demanding and sophisticated project like the Virtual Leader would terminate unfinished, you are almost surprised to see at the end that the work has been done successfully and the Virtual Leader now lives and tries to get more world attention. Here are described the difficulties one meets when he presents something really new. Many of us tend to accept well known things we are familiar with, but if there is really something definitely new, it often gets rejected by us at the first glance. One instantly thinks here of great music composers or other artists that were in their time much less popular as nowadays (at that time there were no computer simulation programs so I couldn't mention them). The author says: "there is needed a lot of hand holding" - before his Virtual leader gets the attention it deserves.

The Virtual leader is a simulation computer "game" that deals with virtual meetings. I have only read the book and I had not have the opportunity to test the program itself – when I do, there comes another review... There are several persons modeled in the virtual reality worlds that show a couple of meeting places and you can interact with the actors during the game. The persons are employees of different ranks and functions and they were very carefully animated in order not only to talk, but to show also their body language. After you have finished the game session the program tells you how successful you were in this "community".

In order to produce such a simulation, there was needed to develop a whole new philosophy and know- how about the relations among the people. So this book is also in its first third a very interesting and educative description of the laws that govern the social relations in a company. When you want to understand some process, then the final step of understanding is to make a computer simulation about it. If it works, then – congratulations – you really understand the topics! Because computer algorithms are unforgiving – they let you no freedom. The opinions of a philosopher or social scientist in his book remain his opinions, but if such opinions are followed by the related computer simulation, like it is the case in this book, then the opinions get a very convincing proof of the theories.

There is a lot of very straightforward and detailed descriptions of the logical structure of the program package. Very nice, but it I missed here also some technical descriptions – what were the software tools used, how were technically optimized difficult scenes etc. This would give to these chapters more weight and interest. And finally, I found in the book no internet links to the product the book tells about. I think that this was deliberately omitted and if one performs a simple web search, he soon finds it.

Summary: If you are interested in modern ways of computer aided education, or if you just want to have some interesting reading about somebody who has made a demanding software project, then this is the book for you!

