Learning Technology

publication of

IEEE Computer Society

Technical Committee on Learning Technology (TCLT)

Volume 6 Issue 3 | ISSN 1438-0625 | July 2004

Editorial board | Subscription | Author guidelines

Contents

From the editor..

Welcome to the July 2004 issue of Learning Technology.

This issue contains special section on "Dynamic Conceptual Representations for Learning Support", guest edited by Prof. Piet Kommers, University of Twente, The Netherlands.

The IEEE International Conference on Advanced Learning Technologies (ICALT2004), Joensuu Finland (August 30 - September 1, 2004) has come out as a very high quality conference. The website of the conference (http://lttf.ieee.org/icalt2004/) contains advance program and other details.

You are also welcome to complete the FREE MEMBERSHIP FORM for Technical Committee on Learning Technology. Please complete the form at: http://lttf.ieee.org/join.htm.

Besides, if you are involved in research and/or implementation of any aspect of advanced learning technologies, I invite you to contribute your own work in progress, project reports, case studies, and events announcements in this newsletter. For more details, please refer author guidelines at http://lttf.ieee.org/learn_tech/authors.html.

Kinshuk
Editor,
Learning Technology Newsletter
kinshuk@ieee.org

4th IEEE International Conference on Advanced Learning Technologies

(ICALT 2004)
August 30 - September 1, 2004
Joensuu, Finland
http://lttf.ieee.org/icalt2004/

Keynotes:

Keynote 1: Crafting Learning within and across Contexts and Communities
(Prof.Chee-Kit Looi, Nanyang Technological University, Singapore)

Keynote 2: Education for All: An Unfinished Revolution
(Prof. David E. Bloom, Harvard University, USA)

Keynote 3: Programming by Building - How to develop IT enhanced artefacts within minutes
(Prof. Henrik Hautop Lund, University of Southern Denmark, Denmark)

Keynote 4:
Designing for inclusivity: Principles of pedagogy, task and assessment design for effective technology based learning
(Prof. Catherine McLoughlin, Australian Catholic University)

Tutorials:

Tutorial 1: Measuring the Acquisition of Expertise: Considering the Possibilities
(Prof. J. Michael Spector)

Tutorial 2: Intelligent Web-based Computer-Supported Collaborative Learning
(Prof. Vladan Devedzic)

Tutorial 3: Implementation of the Shareable Content Object Reference Model
(Dr. Michael W. Freeman)

Workshops:

Workshop 1: Quality in European E-Learning: Designing Tools and Frameworks for Tomorrows Quality Development (Chair: Jan Pawlowski)

Workshop 2: Modelling for Learning Tasks - Approaches, Tools and Implications
(Chairs: Andreas Harrer, Wouter van Joolingen, Ulrich Hoppe)

Panels:

Panel 1: Collaborative Technology and New e-Pedagogy (Chair: Toshio Okamoto)

Panel 2: Doctorate Study in Educational Technology (Chair: Mike Joy)

Panel 3: Different perspectives in the Development Process of Educational Material
(Chair: Juan Manuel Dodero)

Panel 4: Everything that You Always Wanted to Know About Learning Objects
(Chair: Pithamber R. Polsani)

Additional event with ICALT2004 (see ICALT2004 website for details):

- International Summer School on Educational Technology [August 23-27, 2004]

- Kids Club (for participants' children) [August 30 - Sept 1, 2004]

- IEEE 2nd International Workshop on Technology for Education in Developing Countries [August 31, 2004]

- International Conference on Educational Technology in Cultural Context [Sept 1, 2004]

- Business Day (Academics - Industry interaction) [Sept 1 evening - Sept 2, 2004]

- IEEE TCLT Young Researcher Award

- IEEE TCLT Small-scale Research Project in Advanced Learning Technologies

For general information, please contact:

Ms. Kirsi Karjalainen / Planning Officer
University of Joensuu P.O.Box 111
FIN-80101 Joensuu, Finland
kirsi.karjalainen@joensuu.fi
Tel: +358 13 251 4892, +358 50 462 1267
Fax: +358 13 251 2050

Guest Editorial

Special Theme on

"Dynamic Conceptual Representations for Learning Support"

Guest Editor: Piet Kommers
University of Twente
The Netherlands

The excellent theme may not be as clear to you as to many of those who were trying to explore this adventurous field for many years already. Basically its main god fathers were early ontologists like the Persian, Arabic, Greek and Roman philosophers who could not bear that ideas fly in and out, and that perception and observation often cheat us when it comes to essential understanding. Recent theories tell us that the invention of the coin was a trigger for imagining concepts as abstract entities that may be used in various contexts.

Now you question may be: Why do we need these abstractifications for the sake of supporting learning? Especially in this era when multimodality is around, is there still need to focus on nodes and links between keywords?

The answer is YES; exactly because the information ocean gets more and more grip on our thinking, learning and teaching, we need good maps to survive and keep coherence in our knowledge.

Now, why do we need dynamic maps? Well, as you experience many times; maps are only usable if they have just the right amount of details: Not too much, not less. The same holds if we make a map of interconnected concepts; We need to express how deep we want to see beyond the horizon of the first- and second order relations. So every time we mention a new concept and question ourselves how it relates to our prior knowledge, a new map needs to be drawn. Fortunately, the mathematical power of graph computation can help us to draw the map in a rather tidy way; positioning the nodes that are crucial in connecting all other nodes need to be positioned in the centre. Also the interconnections (lines of relational labels) should intersect as least as possible. Clusters of interconnected concepts should be grouped together; etc.

Many of you may already have experience with concept mapping. It is a method to let students sketch their main ideas in a certain topic domain. Its results in terms of meta-cognition (knowing what you know and what you don't know) has been widely confirmed. It is now the challenge for the coming years to find elegant combinations between conceptual networks derived from large linked networks on the WWW and the personal conceptual maps made by students. Seen the valuable contributions in this special issue, I am convinced we will succeed to do so.

Please feel very welcome to feed back your ideas and experiences in this field to the authors, so that they get a better intuition on how to proceed

Enjoy the underlying articles!

Piet Kommers
University of Twente
The Netherlands
P.A.M.Kommers@edte.utwente.nl

An algorithm for comparing labeled graphs

Labeled graphs (LGs) are a common mechanism for illustrating knowledge structures; they are pervasive in the literature of psychology, education and artificial intelligence. The basic structure uses nodes for concepts and arcs for relationships. Interestingly, there are a number of names for these kinds of models, including: nomological nets, semantic nets, concept maps, conceptual maps, coherence nets, frames, schemas and neural networks.

The problem

LGs make for nice diagrams, but what exactly can an educator do with them? Although there are a number of epistemological issues surrounding their meaning, educators sometimes use LGs as an assessment tool. The view is that we should be able to capture the nature of an agreement of terms between any two communicants (i.e., student and teacher) by virtue of comparing their LGs on the subject at hand. In order to do this, we need some definition of a level of "sameness" which applies to a LG.

Graph theory gives us constructs such as isomorphism and homeomorphism as approaches to determining “sameness” for two graphs; however, these do not handle directionality or labeling. A review of the educational literature yields the following three general approaches to comparing LGs: (1) the "holistic" approach, wherein a single value of "sameness" is assigned to a pair of LGs based on the intuition of the rater; (2) each concept in the LG is rated on a scale of zero to n and the total points are added up; and (3) a series of hierarchies, cross-links and other attributes are used, along with rater intuition. McClure, Sonak & Suen (1999) present an analysis of these three methods, finding that the reliability ranged from .23 to .76 – it is important to note, though, that these results show that one can score these maps with relatively little measurement error; it does not provide any evidence that the scores are meaningful. In fact, a case could be made that the more reliable the scoring is, the less valid the test is; for example, one could severely limit the choice of arc labels, thus increasing the reliability of the scoring but restricting the representational power of the LG.

Some of the factors which make comparing LGs complex are: node & arc labels, which nodes are connected by an arc, and the direction of the arcs. I propose a relatively simple, yet automated (and therefore highly reliable) mechanism for comparing two LGs. I make no claim to brilliance here; I am presenting this approach as a baseline for further research, since I have been unable to find similar algorithms in the literature.

Since all of the links in a LG are directed, we can always refer to a source and a target node (bi-directional arcs are represented by two arcs, one going each way). So any LG can be represented or stored as a set of triplets [S, L, D] (source, link, and destination). Two LGs are exactly the same if their triplet-sets are exactly the same – the harder part is how to determine a level of closeness between them.

A proposed solution

For the purposes of this paper, I'm going to assume that there is a focal point to the graph; this would be the concept under discussion. Two factors effect the level of closeness: (1) relevance and (2) differences. The relevance of a node is the shortest distance to the root, without regard to the direction of the arrows. Difference measures how severe a misunderstanding is; such a misunderstanding could be captured in any of the following: missing nodes, extra nodes, missing links, badly named links, or misdirected links. Each of these types of misunderstanding may require a different treatment.

Figure 1 shows a simple reference LG on the subject of vehicles. This would be the “teacher view” which might come from an actual human instructor or an electronic tutoring system. In this example, there are only two possible arc labels: “ako” (a kind of) and “smaller-than.”

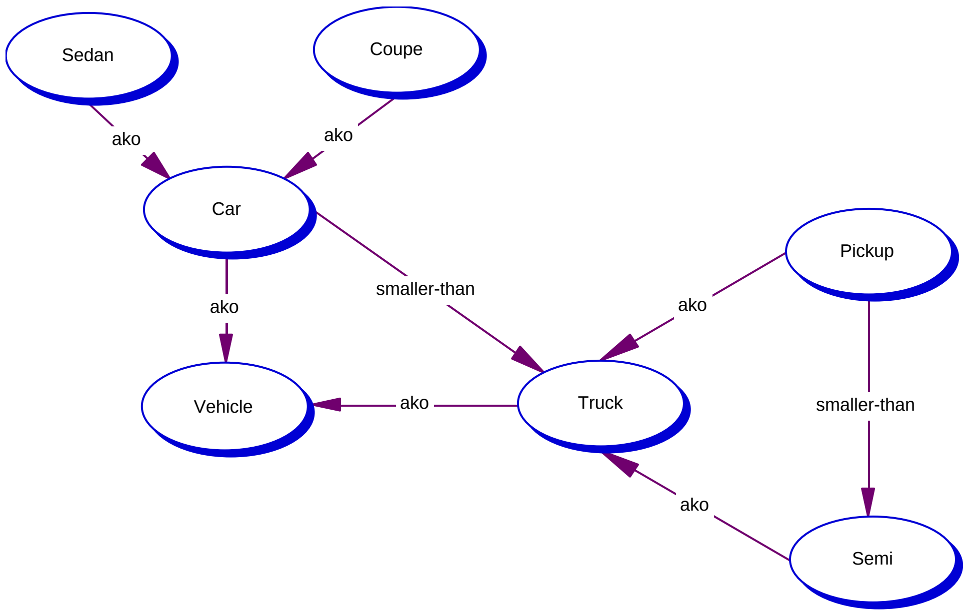


Figure 1

The goal is to turn this diagram into a number which represents the “correct” answer. Chart 1 shows a method for doing this. As stated, the distance is the number of “hops” from the central concept (vehicle) to the relation being measured; thus the relation connecting Vehicle and Truck has a distance of 1 while the relation between pickup and semi has a distance of 3. The next step is to assign weights to the three aspects of the relations: whether it exists, whether it points in the right direction, and whether the label matches or not. It is important to point out that these decisions are either up to the instructor or a matter for empirical study; those chosen here are for explanatory purposes only. Dividing the total “points” by the distance to the core concept gives a weighted importance value for each relation; adding these up gives a reference value for the totally “correct” answer.

Source	Link	Target	Distance	Exists	Direction	Label	Points	Points/ Distance
Sedan	ako	car	2	1	0.5	0.5	2	1.00
Coupe	ako	car	2	1	0.5	0.5	2	1.00
Car	ako	vehicle	1	1	0.5	0.5	2	2.00
Car	s/t	truck	2	1	0.5	0.5	2	1.00
Truck	ako	vehicle	1	1	0.5	0.5	2	2.00
Pickup	ako	truck	2	1	0.5	0.5	2	1.00
Semi	ako	truck	2	1	0.5	0.5	2	1.00
Pickup	s/t	semi	3	1	0.5	0.5	2	0.67
			Reference value:					9.67

Chart 1

Now consider a submitted LG as shown in Figure 2. Notice that the relation between Pickup and Semi is reversed from the reference graph, and that a new concept, Motorcycle, has been added with an inappropriate link to Car.

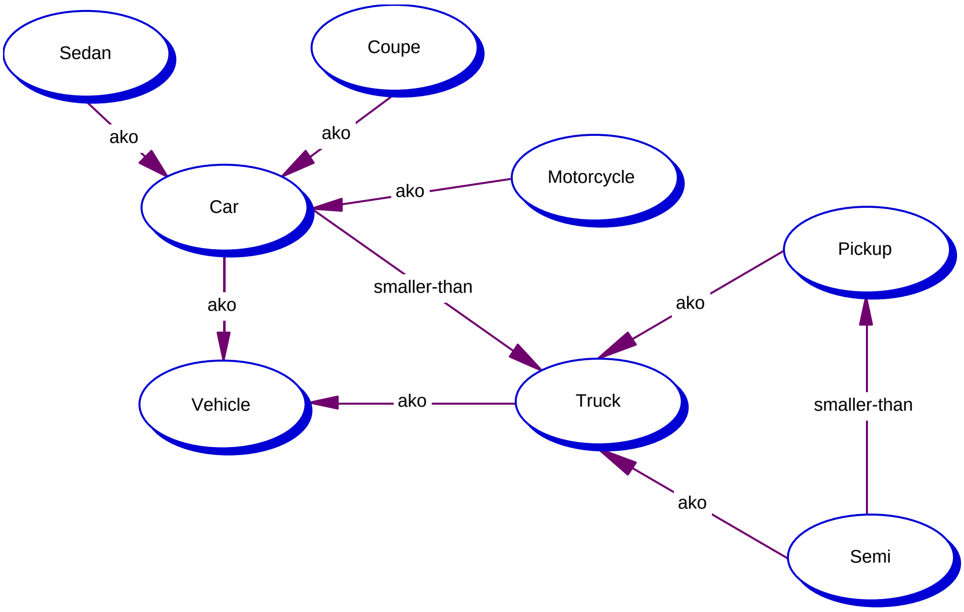


Figure 2

Chart 2 show the calculation of the score for this submission. Note some decisions made with regard to scoring: (1) misdirection of an arrow results in a score of zero (instead of, for example, -0.5); (2) existence of a node which is not in the reference graph results in a score of –1; (3) mislabeling an arc results in a score of –0.5. All of these decisions must be made based either on the policy of the instructor or some empirical study which compares this scoring method to some alternative method (e.g., multiple choice). In any case, I am not here suggesting that this is the perfect scoring scheme.

Source	Link	Target	Distance	Exists	Direction	Label	Points	Points/ Distance
sedan	ako	car	2	1	0.5	0.5	2	1.00
coupe	ako	car	2	1	0.5	0.5	2	1.00
car	ako	vehicle	1	1	0.5	0.5	2	2.00
car	s/t	truck	2	1	0.5	0.5	2	1.00
truck	ako	vehicle	1	1	0.5	0.5	2	2.00
pickup	ako	truck	2	1	0.5	0.5	2	1.00
semi	ako	truck	2	1	0.5	0.5	2	1.00
pickup	s/t	semi	3	1	0.0	0.5	1.5	0.50
motorcycle	ako	car	2	-1	0.0	-0.5	-1.5	-0.75
				Student score:				8.75

Chart 2

Finally, given a student score and a reference value, one can derive a relative score for the student's submission, i.e., 8.75/9.67 or approximately 90%. This must be seen as a relative score and not an absolute one because different scoring schemes might cause large standard deviations in the scores. It is possible that the instructor would create an exponential (sliding) scale for assigning letter grades.

Significance

It is obvious that a number of details still need to be worked out; for example the following factors seem important: (1) transitive relationships and (2) synonyms; both of these should be calculated into the "differences" measurement. Additionally, the entire issue of who gets to decide what the reference graph is has been side-stepped here. My hope is that this simple solution will serve as a starting point for a more vibrant approach to the use of LGs in educational assessment.

References

[1] McClure, J.R., Sonak, B., Suen, H.K. (1999). A concept map assessment of classroom learning: reliability, validity and logistical practicality. *Journal for Research in Science and Teaching*, 36(4), 475-492.

Steven C. Shaffer
Computer Science & Engineering
Penn State University
USA
scs12@psu.edu

Conceptual Representation of Learning Objects

Abstract

The fast development of technologies and vocational demands require specialized skills that need to be renewed frequently. eLearning adopts well for continued education as it can be done in parallel to other work A problem, however, is that finding relevant eLearning objects, from different virtual universities is not easy task as expressing the subject of a learning object as well as expressing learner's information needs are not easy tasks. In this paper we illustrate how this problem can be alleviated by utilizing concept maps.

Introduction

eLearning sets new requirements for universities: they have to build global learning infrastructures, course material has to be in digital form, course material have to be distributed and learners should have access to various virtual universities [1].

As single virtual universities are independently created they may provide vary heterogeneous functionalities and user interfaces. Ideally, the learner should be able to access all the virtual universities in a similar way. Moreover, the functionalities provided by the interface should be intuitive and easy to use. This suggests that the notions of conceptual mapping [2, 3] should be utilized in conceptualizing the functionality of the interface.

Fundamentally, concept mapping is a technique for representing knowledge in graphs. Structurally the graph is comprised of nodes (represented as points or vertices) and links between the nodes (represented as arcs or edges) [2]. Semantically, nodes represent concepts and links represent the relationships between the concepts. Basically, concept mapping can be used for many purposes, including brain storming, to design complex structures and to assess understanding.

An important function of eLearning is the search of appropriate learning objects. Ideally, a learner should easily find all relevant learning objects while retrieving as few non-relevant objects as possible. Unfortunately, the characterization of the learner's information need is not a simple task. Neither the characterization of the content of learning objects is a simple task.

Characterizing learning objects by concept mapping

We have investigated the use of concept mapping in representing learners' information need and in representing the content of learning objects [4, 5]. The specification of the content is comprised of many dimensions. Many of which (e.g., language, and required devices or software) can be expressed without the help of conceptual representation. Instead, in representing the concepts such as the subject and the depth of a learning object some kind of conceptualization is required.

In Figure 1, a subgraph of the concept map representing the concepts related to the subject of learning objects is presented. The links are not labelled as they all have the same semantics, namely they illustrate the clustering of the concepts (nodes).

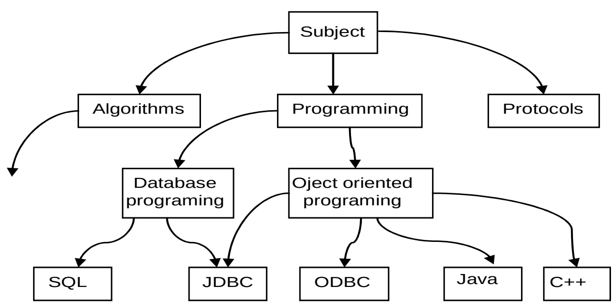


Figure 1. A concept map for learning object's subject

The concept map of Figure 1 is useful for the course provider as well as to the learner. The course provider characterizes the subject of a learning object by marking those nodes of the concept map that match to the content of the learning object. The course provider also gives weights on the marked nodes so that the sum of the weights equal to one. In this way the course provider has defined the subject of the course.

When a learner is looking for courses that satisfy his /her information needs, he/she also marks and gives weights on the nodes that match to his/her information needs. In this way the learner has specifies a searching expression (a query) that represents his/her information needs. After this, the search engine will search the relevant learning objects and rank them according to the similarity with learner's query.

After the search engine has returned to the learner one or more learning objects, the learner may need more information of a learning object. For example, a learner may need information about the preliminary courses of the course as well as of larger learning objects (e.g., examinations) in which the course belongs. This kind of information can be easily represented by concept maps. For example, in Figure 2 a concept map, which illustrates the relationships of the learning object 'Java-programming' is presented.

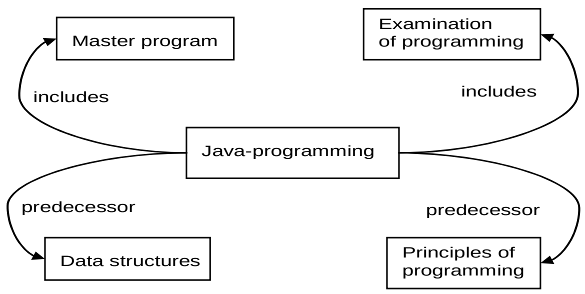


Figure 2. Representing the structure of learning objects

Conclusions

A goal of concept mapping is to provide a shared and common understanding of a domain. In this sense concept mapping has a similar function as ontologies [6, 7] have. A difference, however, is that concept maps are intended for humans while the main goal of ontologies in eLearning systems is to achieve common and shared understanding between communicating computers, and thereby increase the level of standardization and automation. However, as concept maps and ontologies both model the same domain, it is necessary that between concept maps and ontologies there is no contradictions.

References (all URLs verified active at 03/08/04)

[1] P. Pöyry, and J. Puustjärvi. CUBER (2003) A Personalised Curriculum Builder. *Proceedings of the 3rd IEEE International Conference on Advanced Learning Technologies (ICALT 2003)*

[2] The Concept Mapping Homepage. http://users.edte.utwente.nl/lanzing/cm_home.htm

[3] B.R. Gaines, and M.L.G Shaw. WebMap: Concept Mapping on the Web. http://ksi.cpsc.ucalgary.ca/articles/WWW/WWW4WM/WWW4WM.html

[4] J. Puustjärvi (2004) Integrating e-Learning Systems. In the *Proceedings of the International Conference on Web_Based Education (WBE2004)*

[5] P. Pöyry, K. Pelto-Aho, and J. Puustjärvi (2002) The role of meta data in the CUBER system. In the *Proceedings of the Annual Conference of the SAICSIT 2002*, pages 172-178.

[6] OWL –WEB Ontology Language. http://www.w3.org/TR/owl-ref/

[7] A. Gomez Perez, and V.R. Benjamins (1999) Applications of Ontologies and Problem Solving Methods, *AI-Magazin*e, 20(1):119-122

Juha Puustjärvi
Lappeenranta University of Technology, Laboratory of Communication Engineering
P.O. Box 20, FIN-53851 Finland
Juha.Puustjarvi@lut.fi

Towards using concept mapping for math learning

Introduction

Concept mapping is a technique for visually representing the structure of information - how concepts within a domain are interrelated. It is based on theories of meaningful learning which stress that learning new knowledge is dependent on what is already known. More specifically, new knowledge gains meaning when it can be substantively related to a framework of existing knowledge rather than being "processed and filed" in isolation according to more or less arbitrary criteria. Concept mapping supports the visualization of such conceptual frameworks and is an example for “mind tools” that may support learning [1]. We have started an initiative to integrate the collaborative modelling framework Cool Modes [2] with the adaptive tutoring system ActiveMath [3] with the aim of using concept mapping techniques for mathematics learning.

Cool Modes is a collaborative tool framework designed to support discussions and cooperative modelling processes in various domains. This is achieved through a shared workspace environment with synchronized visual representations. These representations together with their underlying semantics can be defined externally by plug-in visual languages and interpretation patterns, so-called "reference frames" [4]. We implemented a number of these reference frames for mathematical concept mapping which bridge the gap to ActiveMath. ActiveMath is is a web-based, interactive learning system for mathematics that employs technology for enhancing learning with instruction as well as constructivist elements and is based on a semantic representation of mathematical knowledge.

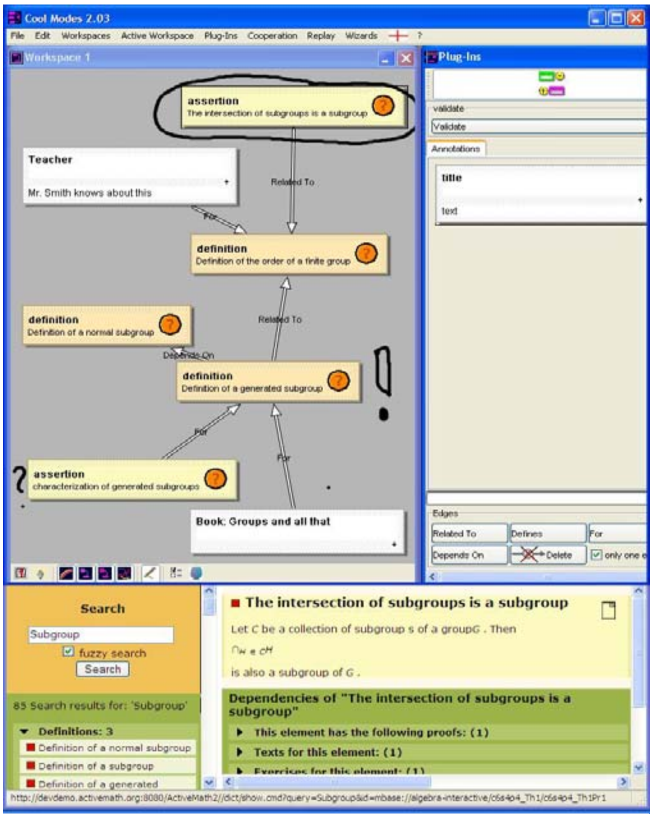


Figure 1: Screenshot

Usage scenarios

The integrated system is planned to be used in two different scenarios:

Concept Mapping Exercises: The learner is asked to create a concept map of his understanding of some part of mathematical knowledge, where some existing concepts and links can be provided as a starting point for the exercise (analogues to fill-in-blank text exercises). It will be possible to provide the learner with system feedback by matching the concept map with the underlying system knowledge representation.

Collaborative Concept Mapping: As Cool Modes has generic support for synchronous cooperation, learners will be able to discuss and integrate their individual concept maps of some mathematical topic into a single concept map that represents their joint understanding of the domain. The interesting part of this scenario is the coordination and negotiation of the different understandings of mathematical knowledge, which might be supported by the system.

System architecture

Cool Modes and its plug-ins are implemented in Java and can therefore be started on demand via Java WebStart from the ActiveMath web environment. Within the ActiveMath integration, Cool Modes offers three reference frames to the user: one for exercises, one for exercise authoring, and one for collaborative concept mapping. As visible in figure 1, the user interface consists of a workspace, where the concept map is edited, and a palette (one per reference frame), which provides the available objects and relations as well as controls for extra functionality, like validation of the map. An MBaseConnector class provides the interface to the semantic mathematical knowledge base MBase of ActiveMath, fetches the available items, like theorems and definitions, from the MBase and provides verification of the map.

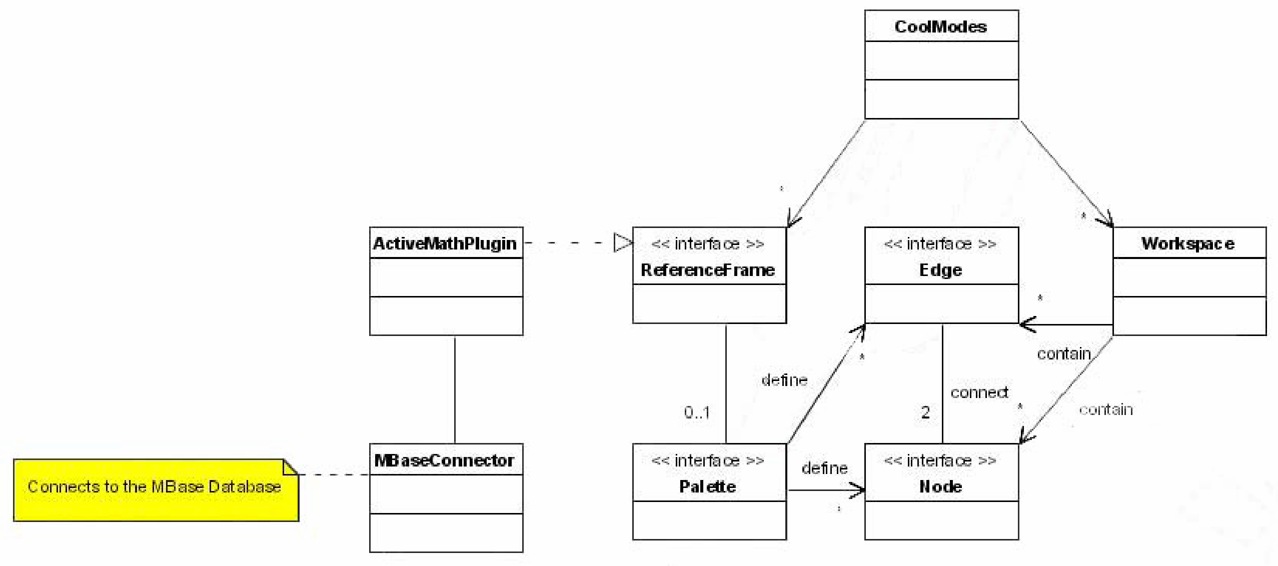


Figure 2: System architecture

First prototypes of the three reference frames have been implemented and tested on Workstations, Tablet PC's and interactive whiteboards. All mathematical items from the ActiveMath system, i.e. definitions, theorems, examples etc. can be used as nodes in the concept map by simply dragging them from the browser and dropping them into the workspace. Furthermore, annotation nodes are available where the learner can edit headline and body, for example to make annotations or refer to books etc. Handwriting nodes are also planned to facilitate interaction with Tablet PC's. Edges of the type "for", "related to" and "depends on" can be created between nodes. The concept map can be validated against the semantic knowledge representation with a preliminary simple mechanism: each edge between two mathematical items is checked against the database whether this relation exists there. If not, it is highlighted with a question mark.

Further work

We faced both technical and conceptual problems in implementing the prototypes. From the technical point of view, drag&drop support in different operating systems posed problems, as the rendering of the concepts in nodes (mathematical formulae), and the restriction that each concept should be available in a workspace only once. Other problems concerned system integration– however, most of these technical issues are solved. On the conceptual side, it seems still unclear exactly what kinds of nodes and edges are useful and needed by the learner, as well-known techniques like concept mapping are interlinked with entities from a particular domain, mathematics.

There are two main topics to investigate: Concept mapping exercises and computer supported collaborative concept mapping. For the exercises, the pedagogic usefulness of the proposed exercise types has to be evaluated, and for the collaborative use case, we would like to investigate in how far the computer with a semantic representation of the domain knowledge can support groups of learners in their concept mapping tasks. Tracking and analysis of interaction data, both from exercises and collaborative sessions, may provide valuable information for the user model of the tutoring system, but it is still unclear what information is useful for the user model and how it can be used.

References

[1] Jonassen, D.H. (1992). What are cognitive tools?. In Kommers, P.A.M., Jonassen, D.H. & Mayes, J.T. (Hrsg.), *Cognitive tools for learning*. Berlin: Springer Verlag.

[2] Pinkwart, P., Hoppe, H.U., Bollen, L. & Fuhlrott, E. (2002). Group-Oriented Modeling Tools with Heterogeneous Semantics. In Cerri etal (eds.): Lecture Notes in Computer Science 2363, Intelligent Tutoring Systems, pp. 21-30. Springer.

[3] Melis, E. et al. (2001). ActiveMath: A Generic and Adaptive Web-Based Learning Environment, *Artifical Intelligence in Education*, vol 12, no 4, winter 2001.

[4] Pinkwart, N. (2003). A Plug-In Architecture for Graph Based Collaborative Modeling Systems. In Hoppe, Verdejo &Kay (eds.): Shaping the Future of Learning through Intelligent Technologies. *Proceedings of the 11th Conference on Artificial Intelligence in Education*, pp. 535-536. Amsterdam, IOS Press.

Jörg Müller
ActiveMath Group
German Research Center for Artificial Intelligence
Saarbrücken, Germany
joerg.mueller@dfki.de

Martin Mühlenbrock
ActiveMath Group
German Research Center for Artificial Intelligence
Saarbrücken, Germany

Niels Pinkwart
Collide Research Group
Duisburg University, Germany

Utilising and Representing Knowledge in Multimedia Teaching-Learning Contexts

Introduction

An important aim of the instructional process is to stimulate and develop student learning techniques and interactions which are effective in a variety of educational situations, eg. reacting to classroom presentations, developing knowledge through questioning and searching of sources, reasoning and self-explanation, and engaging in collaborative problem solving and project work.

In these contexts it is useful to construct external knowledge representations which encourage reflection and indicate structural relations of content and process. The use of conceptual graphs, semantic nets and mindmaps in this regard is well documented. However, constructing such representations is not easy since the relations, which essentially link and drive the content, are expressed at a more abstract level—which is how they gain generality and are useful in knowledge development. Further, the representations are usually declarative and have to be navigated and transcribed, as it were, into dynamic presentations of responses to serve particular functions that suit the learning tasks in hand.

The Aims and the Context

A collaborative project between the University of Leeds and the Bolton Institute is investigating these issues within teaching-learning contexts that employ what we term Active Multimodal Presentations. The specific contexts of the research span science and mathematics topics which cause conceptual difficulties within the 14-19 age group in schools, and particularly in multi-ethnic inner city community centres which provide out-of-school learning supports.

In these contexts knowledge representations usually arise from an understanding of the rhetorical relations used in teacher presentations and which may include concept descriptions, explanation of effects and interactions within processes and systems, and arguments which seek to justify claims and procedures. Active Multimodal Presentations (AMP) seek to make such relations more salient by incorporating the use of hand-gestures to (i) interlink the visual and verbal materials; (ii) assist the semantic contouring of the narrative; and (iii) indicate more clearly the intentions and reactive expectations of the presenter. The AMPs show an over-the-shoulder view of the workdesk on which the visual material and gestures are seen, with an audio commentary, thus mimicking an at-the-desk tutorial session. The AMP usually lasts about 5-10 minutes and also includes in the content, priming comments, some rhetorical questions, and follow-up what-if situations.

The research is examining the nature and roles of gesture and their effects on student understanding, specifically if students show better performances in expressing their understanding via structural knowledge maps.

Methods

The classifications schemes for gestures and their visual-verbal anchors are not the focus of this paper, except to note that a semiotic framework is used. This distinguishes the form of the gesture ICON (eg. pointer, holder, open hand, pusher) which is perceived; its dynamic trajectory and referents (visual, verbal, and presenter indicating affective and empathic state) which, in context, helps to activate associated knowledge (the SIGN network) and the resulting thoughts/actions (the INTERPRETANTS). In brief, we hypothesize the gesture assumes a functional role in directing attention, illustrating relations (eg. tensions in cables, equilibrium) and process (eg. rhythmic beating or tapping) and empathy (eg. open-hand invitational movement). In a Speech Act Theory analogy, the gesture illustrates the content (locution), clarifies the intention (the illocutionary force) and stimulates (perlocutionary) effects.

The main interest in this paper is how these AMP features assist students' understanding, particularly in ways which result in external representations that enable knowledge development through reasoning, questioning, and self-explanation in response to follow-up issues and mini-problems.

The AMP modules include topics such as suspension bridges, hot air balloons, heart-lung and respiratory systems and pumps with descriptions and explanations of how they operate and with justifications of value judgements and arguments. In order to stimulate a genuine student viewpoint rather than one which is conformist, the learners first provide an informal representation. Then they are asked to reflect and produce a more structured form, which can be helpful in explaining the topic to others and in dealing with the follow-up issues.

Comments

The system itself can provide some supports for these activities since the verbal content of the AMPs undergoes a rhetorical predicate analysis to produce a knowledge net following the principles of the DISCOUNT scheme developed at Leeds. However, these predicates are also rearranged and stored in skeletal forms (as active document fragments) which are linked to their functional roles in the presentation, eg. descriptions, explanations and arguments. Thus, the system has metalevel structures which show the types of predicates that are used, and are expected to be used, in descriptions (eg. function, components/parts, properties, class membership, comparatives), explanations (eg. cause-effect, condition-consequences, action-achievement) and arguments (claims, warrants, backings, quantifiers, and counters). Clearly, not all predicates are used for each description or explanation, and the relational links also interconnect.

If judged useful, these functional clausal skeletons, which do not deliver direct content, can be accessed by students for checking for omissions or extending their own knowledge representations. They invite learners to consider what their intentions are, and what descriptive, explanatory or evaluative roles (and knowledge structures) they are using within their current tasks. The predicate structures can also be used for question asking in case of difficulty and for searching AMPs within the system.

A series of experiments is examining the effects of gestures in AMP on knowledge acquisition, retention and the structuring of students' explanations; the value of using functional clausal skeletons as a meta-level framework for seeking and organizing knowledge from Internet sources; and as a preparatory aid to improve student argumentation in on-line synchronous discussions. Also, the project has a strong technical arm in terms of design specifications, open standards and in building support tools so that teachers can become an integral part of the design-implementation-evaluation process.

Roger Hartley
University of Leeds
United Kingdom
J.R.Hartley@education.leeds.ac.uk

Adel Elsayed
Bolton Institute
United Kingdom

Milena Pesheva
Bolton Institute
United Kingdom

Dynamic Learning Communities through Web-based Communication

The Initiatives in Educational Transformation (IET) experience is a two-year, non-traditional, school-based Master's program for practicing teachers in K-12 positions. IET is a learner-centered community that centers on reflective practice, critical dialogue, teacher classroom research and collaboration with the aim of continuous improvement. Learner-centered principles construct a framework that supports individual teachers' ways of knowing and their ability to learn from their peers. Within a learner-centered curriculum, teachers' are encouraged and supported to develop ownership of their learning (Weimer, 1992).

We support working teachers with a unique schedule, two, 2-week intensive summer sessions, 16 eight-hour classes over two years with a final 1-week summer session. Because of class design the amount of time teachers interact is expanded through WebCt. Teachers participate and interact with their peers once a week through a web-based internal university program called WebCt. Integrated technology is used to support and enrich course curriculum in ways that are personally meaningful to program participants.

Within the WebCt framework we organize course content and instructional opportunities using a variety of pedagogical strategies to address diverse learning styles while students grapple with constructing meaning from content and applying it to their experience, perceptions and work in schools. WebCt provides a space for purposeful dialogue, which crafts a dynamic learning community. Dialogue enhances and enriches teachers' understandings of the content.

We recognize the value and importance of collaboration (Cole & Knowles, 2000). Collaboration combats isolation and alienation many teachers face within schools. Teachers gain the perspectives of others and construct positions on crucial aspects of teaching and learning. The learning community is diverse in many ways: ethnicities, age, years of teaching experience, gender, elementary and secondary backgrounds all working within a variety of educational contexts.

WebCt supports teachers through a variety of capabilities or features. All teachers create individual and team home pages for the purpose of displaying their school and community culture, post synthesis of teamwork and contact information. Teachers are able to use the internal e-mail for correspondence and course assignments are managed through the use of an electronic drop box.

Electronic surveys are used to gather data regarding teachers' experiences and perceptions about each class day. Brookfield's (1995) critical incident survey has been implemented and modified to elicit teachers' reflections. For example, teachers may be asked to reflect upon a particular theme, activity or discussion. The survey elicits teachers' responses regarding their most engaged and distanced moments, what they found most affirming or helpful, puzzling, and what surprised them the most (Brookfield, 1995, p.115). We analyze this data and the feedback is shared each class day as a way to build community and shared understandings of others' experiences in the program. The process of sharing this data is threefold. First, is the importance of modeling and valuing participants' feedback to inform the teaching and learning. Second, the survey feedback illustrates to teachers that there are many different learning preferences, styles, and ways to construct knowledge. Third, we also use this data to inform and shape future curriculum and class designs. All three aspects ideally shape teachers ways of thinking about their own teaching practices and implications for learning. WebCt technology is integrated to support the principles of reflection, alternative perspectives, teacher classroom research and critical dialogue.

WebCt discussion groups network individuals and school teams beyond classroom experiences. We configure discussion groups of approximately 8-10 members. WebCt discussion groups are purposely configured so that school team members are not together. School context, grade levels, and diversity guide the formation of discussion groups to provide a range of perspectives. This arrangement extends conversations across teams and schools to the broader peer group enhancing team discussions.

Teachers' are encouraged to integrate and connect course readings, classroom experiences, and responses to colleagues' within their postings. Teachers post weekly discussion entries and read the entries of others in the discussion group. We monitor but do not participate in these discussions to guard against faculty voices drowning out the voices of teachers. The goal is to both build community within the program and to foster discussion beyond the school team. On-line discussions, classroom experiences, and readings provide the raw materials for class exercises, teacher classroom research papers and other course requirements. Regular engaged participation in WebCt discussions enhances teacher understanding, provides multiple perspectives and opportunities for critical dialogue and reflection.

Classroom teachers have specialized knowledge and expertise from their lived experiences and work in schools. Sharing this expertise can enrich the lives of teachers with support and provide practical solutions to classroom issues. IET values teachers' voices and experiences and through WebCt teachers are provided with multiple and authentic learning opportunities. The work of teachers is difficult as they work to meet the learning needs of their students. WebCt discussions validate successes, provides hope and support as teachers seek solutions and work towards improvement.

Teachers' personal and professional backgrounds provide a basis for their learning and interpretations. Through WebCt teachers are able to explore alternative perspectives, grapple with the tension between educational theory and practice, and thus assimilate knowledge through critical dialogue. The alternative perspectives gained from classmates working in a variety of positions and school environments provide a spectrum of ideas and solutions. This process is the springboard for developing a vocabulary and teacher agency. Teachers also support each other as they share successes and wrestle with new teaching innovations.

Teachers' engaged in a learning community that meaningfully integrates technology into a learner-centered curriculum affords practicing teachers multiple opportunities for self-reflection, critical dialogue, collaboration and sharing of expertise. WebCt enhances the cognitive learning through the integration of pedagogy, text and experience. WebCt supports teacher autonomy as they choose what to discuss and when to enter into an existing discussion topic. Teachers become self-directed learners as they share unique personal and professional experience, self-assess and seek out solutions. WebCt allows teachers an opportunity to explore new ideas and perspectives.

Bibliography

[1] Brookfield, S.D. (1995). Becoming a critically reflective teacher. Josey Bass: San Francisco.

[2] Cole, A. & Knowles, G (2000). Researching teaching: Exploring teacher development through reflexive inquiry. Allyn and Bacon: Boston.

[3] Weimer, Mary Ellen (2002). Learner-centered teaching. Five key changes to practice. Jossey-Bass: San Francisco.

Dr. Mary Kayler
George Mason University
Manassas, Virginia 20110
mkayler@gmu.edu

Dr. Karen Weller
George Mason University
Manassas, Virginia 20110
kweller@gmu.edu

User-centred Knowledge Representation in e-Learning Based on Semantic Context

Introduction

Learning has always been a personalized dynamic issue, which is noted as a pedagogical process in professional education research. The performance of learning process can be affected by many aspects, such as the content presentation form (i.e. text, image, video, audio), the content delivery form (i.e. in-class lecture, distance learning on TV or on PC), the interaction between instructors and learners, prior knowledge before learning, psychological preparation for learning (i.e. motivations, enthusiasm), and many other issues. People can naturally expect an ideal e-Learning solution to have the advantages of both traditional in-class learning and distance learning. But without fully developed computing technologies in AI, HCI and Multimedia, it is hard to reach an ideal stage of e-Learning in the near future. However, there is still some work we can do from the knowledge management point of view, which could help bridging current information-based learning stage with the future knowledge-based intelligent learning stage.

This paper intends to introduce the semantic context awareness into knowledge representation in e-Learning. The proposed context-aware approach aims at providing a practical way to integrate semantics of heterogeneous multimedia resources and conceptual use experience in learning process, and consequently construct an architecture for knowledge retrieval and management in e-Learning.

What is Semantic Context in e-Learning

The concept of context has been widely used in many computing areas such as pervasive computing [1] and contextual logical reasoning [2]. In this paper, we define the concept of semantic context as follows:

> *Definition: Context of an entity (i.e. an object, an event, or a process) is a collection of semantic situational information that characterizes the entity's internal features or operations and external relations under a specific situation.*

One of the intentions of introducing semantic context to e-Learning is to use knowledge representation approach to bridge concrete objective information in teaching/learning and conceptual knowledge to users. In a semantic context description scenario, existing learning metadata information as well as users' profile information will be integrated and re-structured. In addition, content-related literal information in learning processes such as free annotations of multimedia resources (e.g. images, audio, video and presentations, etc.) is also expected to organized in the same description scenario. Other than flexible links among concrete description elements in the same scenario, semantic context representation also allows interlinks with other scenario or even other knowledge domains. Furthermore, centered on structured semantic context information in scenario, learning activities are to be diagrammatized and monitored in process in order to assist learners in self-review and self-evaluation.

A simple example of semantic context description is the interpretation of term "Context" in the reference item 1 (Ref.1) and item 2 (Ref.2). As mentioned above, there are difference applications of context, so the same literal term "Context" can have different meanings in different areas [3]. To represent computer-understandable knowledge of the term in two different items within the same document, we can use related ACM category descriptors I.2 Artificial Intelligence to help describing the subject of item Ref.2, and use H.5 Information interface and presentation (e.g., HCI) and C.2.4 Distributed Systems to describe the subject of Ref.1. Note that this is a simple example, and flexible contextual information other than LOM[1] or DC[2] (as stated above) could be used for context description in real practice.

---

[1] IEEE P1484.12 Learning Object Metadata Working Group, http://ltsc.ieee.org/wg12/.

[2] Dublin Core Metadata Initiative, http://dublincore.org/.

An Agent-assisted e-Learning Architecture based on Semantic Context

Managing semantic context in pedagogical e-Learning processes is more complicated than basic one-stop resource access in traditional e-Learning, aiming at building learner-centric learning environments, the diversity in resource description and users' learning styles in modern e-Learning requires sophisticated and intelligent assistance to users. This is how intelligent agents in e-Learning differentiate themselves from traditional mechanical passive web browsing (or even Web Services) for their autonomy and pro-activity. This paper presents an agent assisted e-Learning architecture based on semantic context (see Figure 1). By using personal agents to contact service agents to access context descriptions of raw educational resources, users will be able to enjoy more accurate learning services such as searching semantic-related lecture slides and video online. As mentioned above, by tracking the actions of agents, the user's learning experience could be recorded into the use experience repository, where the experience knowledge is also modelled under the same generic knowledge representation model along with context knowledge of resources. The use experience is to be used for learning performance evaluation and as the profile for learners or instructors to improve teaching/learning strategies.

The core operational component in this architecture is the context-based description framework that consists of service descriptions and content descriptions. By distinguishing the two parts in description, the same content could be accessible to various semantic aware services, for example, the same annotation as a comment to a textbook in a lecture could be even used on eBay for audition and on Amazon for selling recommendation as well. The content semantics parser plays the real information-processor role by referring to ontologies in order to help agents understand the words in descriptions automatically. One of the content parsers in development is Jena[3], which is an RDF (Resource Description Framework) –based Semantic Web [4] framework.

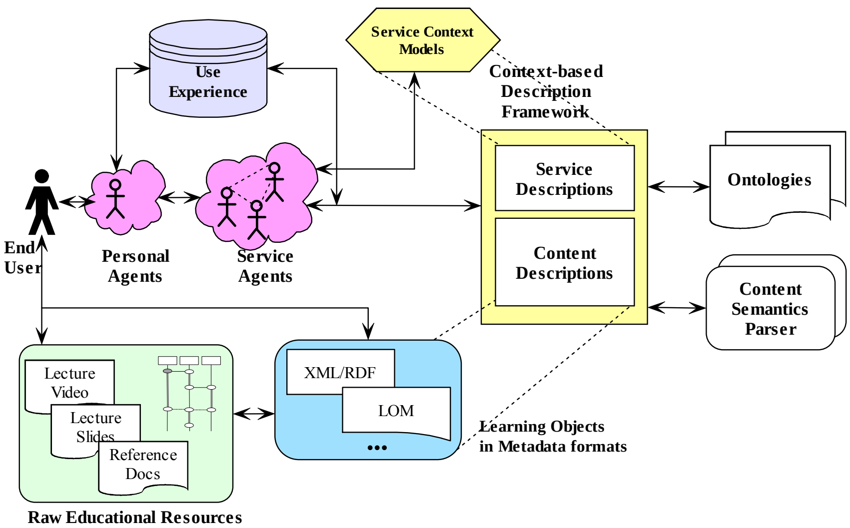


Figure 1. An Agent-assisted e-Learning Framework based on Semantic Context

Discussion and Conclusion

This paper presents a semantic context aware knowledge representation approach together with an agent-assisted enabling service architecture. This work aims at bridging the current e-Learning technologies with more intelligent e-Learning solutions in the future. Related previous work includes context-based e-Learning support includes contextual knowledge management framework [5] and agent-based context understanding [6]. On the practical development side, a LOM-compatible context description model has been developed for knowledge manipulation of e-Learning resources. By extending the e-Learning context model, more semantic knowledge other than LOM framework could be included in knowledge representation and consequently retrieved by agents.

---

[3] Jena, A Semantic Web Framework, http://jena.sourceforge.net/.

Reference

[1] T. P. Moran and P. Dourish (2001) Introduction to this special issue on context-aware computing. *Human-Computer Interaction*, 16
[2] V. Akman (1982). Context in Artificial Intelligence: A Fleeting Overview. McGraw-Hill, Milano, 2002.
[3] L.W. Barsalou. Context-independent and context-dependent information in concepts. *Memory & Cognition*, 10, 82-93..
[4] T. Berners-Lee, J. Hendler, and O. Lassila. The Semantic Web. *Scientific American*, May 2001.
[5] W. Huang and M. S. Hacid. Contextual knowledge representation, retrieval and interpretation in multimedia e-learning. In *Proceedings of the Fourth IEEE International Conference on Information Reuse and Integration*, Las Vegas, USA, October 2003.
[6] W. Huang and D. Webster. Enabling Context-Aware Agents to Understand Semantic Resources on The WWW and The Semantic Web. In *Proceedings of the IEEE/WI/ACM Conference on Web Intelligence (WI04),* Beijing, China, September 2004.

Dr. Weihong Huang
Centre for Internet Computing
The University of Hull
United Kingdom
W.Huang@hull.ac.uk

Embedding Human Memory Structures in Dynamic Representation for Tailored Tutoring Strategies

Learning tools effectiveness closely depends on how user's information is represented. We describe an experimental validation of our knowledge dynamic representation model. This model is embodied within an interactive virtual learning environment that demonstrates a problem solving organisation which attempts to model the learner cognitive activity during task accomplishment. Our subject-matter domain is the algebraic boolean expressions and their simplification by means of reduction rules, which are generally taught to undergraduate students. Within the lab, preliminary notions and explanations constitute a necessary knowledge background to approach the boolean reduction problem. In addition, examples are given. Those are generated randomly with variable difficulty degree chosen by the learner. Students can also enter, by means of a visual keyboard, any boolean expression they want and ask the system to solve it (see Figure 1).

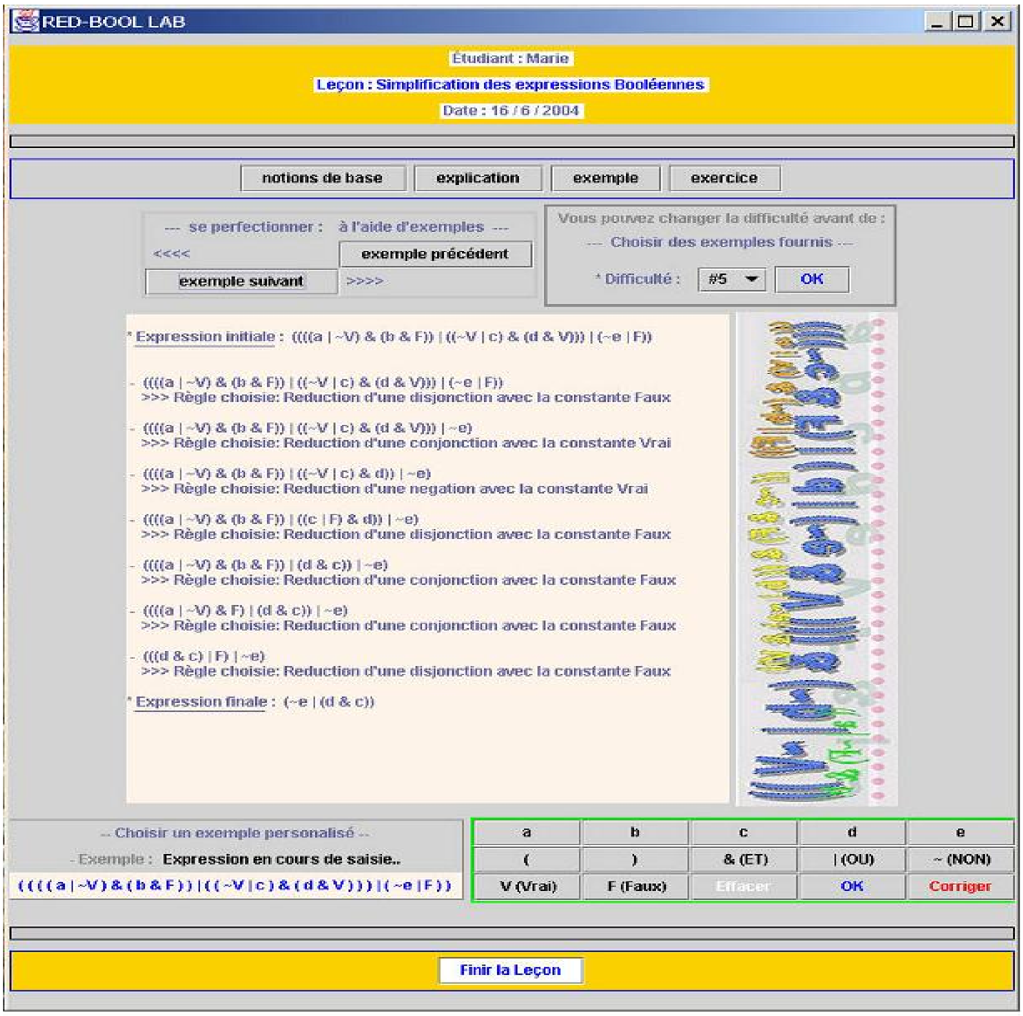


Figure 1 : A complexity level 5 example, proposed by a learner, in the examples section.

Examples show optimal solutions to simplify boolean expressions and are provided to guide learner during the problem solving in the exercise section. Exercises, also with variable complexity levels, give opportunities to students to practice tasks. Via the visual keyboard, they reduce an initial boolean expression (generated randomly) by choosing suitable simplification rules to apply in the order they want. In the case of erroneous rule choice (or application) on any of the sub-expressions, forming the initial given expression, the system notifies the learner and shows her/him (i) the selected sub-expression, (ii) the applied rule to reduce it, (iii) the resulted simplified sub-expression and (iv) the global expression current state (see Figure 2).

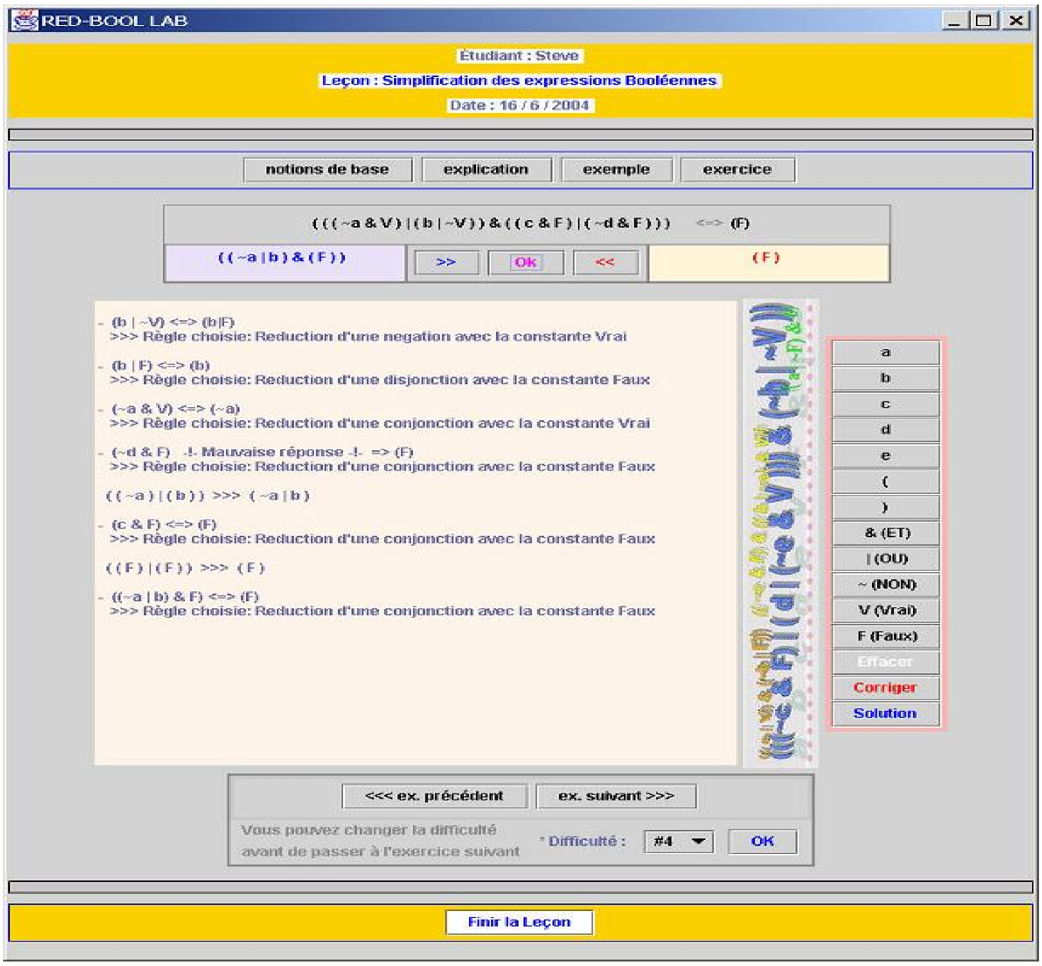


Figure 2: A complexity level 4 exercise, done by a learner, in the exercises section.

Our knowledge representation structures are inspired from those of the human memory. According to cognitive psychology theories, it has been argued that knowledge is encoded in various memory subsystems depending on the way in which their contents are used and/or handled. Each subsystem presents particular type of knowledge such as, semantic, procedural and episodic knowledge. Semantic knowledge is seen as concepts or goals that students want to achieve by means of procedures which handle instances of concepts. Goals realisations are stored in episodes that preserve temporal concepts-procedures relations and allow reconstruction of previously experienced events.

Experimental validation

To test and experiment our model, we asked students in computer science and in mathematics to practice the reduction of boolean expressions by using our software (see Table 1). We have stored the trace of resolution, adopted by each student.

Complexity	1	2	3	4	5
Number of exercises	4	4	5	6	6
Number of students	10	10	10	10	10

Table 1: Main data of the experiment

Empirical results confirm that, in practice, if the task is relatively complex, there can be various correct manners to do it. This engenders different behaviours in achieving the same task. In addition, when a student makes an error, satisfying the goal that s/he wished to accomplish was realised by means of an erroneous procedure. This error results from bad interpretation of the situation, causing a choice of procedure which (i) can be correct but whose application cannot be done in the current context or (ii) is invented and completely false. As the episode containing the erroneous procedure comprises an instance of the goal, the set of valid procedures which satisfy it will be deduced starting from the goal prototype. This last also contains the didactic resources necessary to teach these procedures which, if they are complex, specify subgoals whose each one contains its own didactic resources. In this way, the tutor easily conceives an ordered sequence of valid procedures allowing to accomplish correctly any goal. Particularly, those for which the learner has failed. Storing erroneous procedures and the results of their applications in episodes allows the tutor to recognise the non mastered knowledge and to exploit this to build examples and hints well adapted to each learner. These suggestions are built from specific and quite detailed cognitive elements that the learner has.

Discussion

The dynamic aspect of our representation is seen in the non-predefined combinations between occurrences of concepts and the procedures handling them. In fact, primitive units of semantic and procedural knowledge, chosen with a small level of granularity, are used to build complex knowledge entities which are dynamically combined – to create a new knowledge – in order to represent the learner cognitive activity. The stored traces of this activity represent a content formed by episodic knowledge which is specific to each student. In other words, The episodic knowledge analysis allows to retrieve the semantic and procedural knowledge and to establish their level of acquisition (for each learner) in function of their context of usage.

Since there are multiple correct ways to solve a complex problem, it would be more effective to tailor a tutorial strategy – for a specific learner – which is based on the particular way chosen by that learner. This specific strategy will allow to retrieve and recover the knowledge that s/he handled when attempting to achieve her/his goals. However, learner motivation has been shown to be a critical factor in goal formation, and strategy selection. More specifically, intrinsic and extrinsic motivation lead to different strategy selection and subsequent levels of learning and mastery. In this sense, an effective tutoring could both assess and influence learner motivation. We claim that the learner correct acquired knowledge can help the system to determine the learner's mastery level. However, we think that it would be more powerful to determine if this learner has a deep or superficial understanding of the material. This point is important when one wants to design a knowledge model that has the potential to serve as a basis for selecting suitable pedagogical activities. Certainly, it is already significant to determine what the learner knows and what s/he does not know. But it is still better to determine, via a percentage or a qualitative value, at which point s/he masters its acquired knowledge. This takes part of our current work.

Mehdi Najjar
Computer Science Department
University of Sherbrooke
mohamed.mehdi.najjar@usherbrooke.ca

André Mayers
Computer Science Department
University of Sherbrooke
andre.mayers@usherbrooke.ca

Some Potential Benefits of Sharing Graphical and Dynamic Representations of Pedagogic Strategy for Learning Support

Introduction

This short project report represents some emerging conclusions and results from the Learning to Learn project (http://www.stir.ac.uk/departments/daice/l2l/). We have been investigating the feasibility of getting lecturers to articulate and share their pedagogic strategies for using learning objects that they are helping to design as part of the project.

For us 'learners' constitute:

- lecturers as novice instructional / educational designers
- students enrolled on courses (face to face and online) designed by the lecturers

One of the key activities of the project is to try to introduce and use a common vocabulary to describe pedagogic strategies in the use of learning resources by an existing community of practice – that of study skills tutors. The vocabulary is based on the concept of 'learning functions' as described in the work of Thomas Shuell (1992) who advocates building a descriptive cognitivist bridge between instructional design and constructivism. Initial results show that this is a useful support and communication tool for the tutors to share their pedagogic practice and designs – although a great deal depends on how the vocabulary is introduced to start with. This approach also looks like having the potential for providing a useful shared pedagogic analysis and design tool for use both between teachers and teachers and content media designers.

The Higher Education Teaching Context in the UK

In UK higher education, teaching activities and the learning content produced to support them are usually very contextualised and deeply embedded in institutional procedures. In this pedagogic environment lecturers feel most at ease developing content and delivering it to their students. Conceptualising learning activities for their students is not a particularly common activity (Koper, 2003), and sharing these conceptions with colleagues is even rarer. As Allison Littlejohn (2003) observes:

> "Designing for reuse means designing with multiple users in mind and this is a new experience for most teachers in all sectors of education."

The arrival of the IMS Learning Design and Learning Object specifications (http://www.imsglobal.org/specifications.cfm) are serving to highlight this aspect of the pedagogic culture of higher education in the UK and the shortage of instructional / educational design skills in the academic workforce to take advantage of these new technologies. This has been one of the major findings of our project and others in the JISC funded X4L programme. Finding ways to support busy lecturers in developing and sharing their pedagogic strategies has been a problem our project has focused on. In this context the use of graphics to represent pedagogic strategies is an attractive one for us.

Our approaches to creating and using graphical and dynamic representations of pedagogic strategy

We felt no need to add to the many different and sometimes conflicting theories of learning that already exist and Shuell's seems to offer a good balance of openness (to other theories), common sense, and detail. Shuell's work is particularly useful as it seeks to merge the rigorous approach of the Instructional Design tradition (teaching aims, learning objectives, performance criteria etc.) with the more learner-centred positions taken by cognitive and constructivist approaches. This makes it particularly suitable for the pedagogic culture of the UK.

What Shuell's model gives us is a convenient vocabulary to describe the cognitive processes involved in learning that can be shared and act as a 'scaffold' to support descriptions and discussions about teaching and about the design and use of learning resources.

There are many models and theories of learning and instructional design from which we could choose, Laurillard's Conversational Model (Laurillard, 1994) and Merrill's Component Display Theory (Merrill,1988) spring to mind. It would be a very interesting experiment to 'mix and match' different models and their graphical expressions for different purposes within the same course. For our project we have chosen the model developed by Shuell (1992) and mapped it onto the very old, simple and intuitive teaching model that might be summarised as: 'Prepare – Teach – Review'.

Shuell argues that every successful learning episode involves certain learning functions and that a learning function may be activated by the teacher, the learner or by a resource acting as an instructional agent.

Below is a list of these learning functions, with a short description:

- Define Learning Expectations
  the learner has some idea of what he or she is trying to accomplish

- Motivation
  willingness to persist and contribute effort to the task in which he or she is engaged

- Prior Knowledge Activation
  ensure that both cognitive and affective prerequisites (including the needs, goals, and everyday experiences of the learner) are available for use by the learner

- Attention
  important for the leamer to pay attention to important features of the instructional task and to ignore features that are irrelevant

- Encoding
  the process by which information is prepared so that it can be manipulated in short-term or working memory

- Comparison
  in order to acquire a body of knowledge involves understanding rather than rote memorization, the learner must compare facts and concepts in a search for similarities and differences that permit the formation of those higher-order relationships that comprise understanding

- Hypothesis Generation
  the active, constructive nature of meaningful learning requires the learner to generate various hypotheses as he or she seeks a more adequate understanding of the material being learned

- Repetition
  it takes time, and multiple exposures, to find meaningful ways of relating the various parts of a complex body of knowledge

- Feedback
  for the learner to determine if he or she is on the right track, feedback must be received on the accuracy and/or appropriateness of what was done — either overtly or covertly

- Monitoring
  an effective learner keeps track of the progress being made toward achieving the instructional goal

- Evaluation
  simply receiving appropriate feedback is not sufficient; the learner must interpret and evaluate the feedback and determine how it can best be used in the learning process

- Combination, Integration, Synthesis (CIS)
  As information is acquired, the more-or-less isolated pieces must be combined in ways that permit the learner to integrate and synthesize information from several sources. Meaningful learning, as already noted, involves a complex network of interrelated concepts, facts, and procedures.

Shuell's functions mapped onto the Prepare – Teach – Review Model

Preparation Activities

- Motivation
- Defining Learning Expectations
- Prior Knowledge Activation

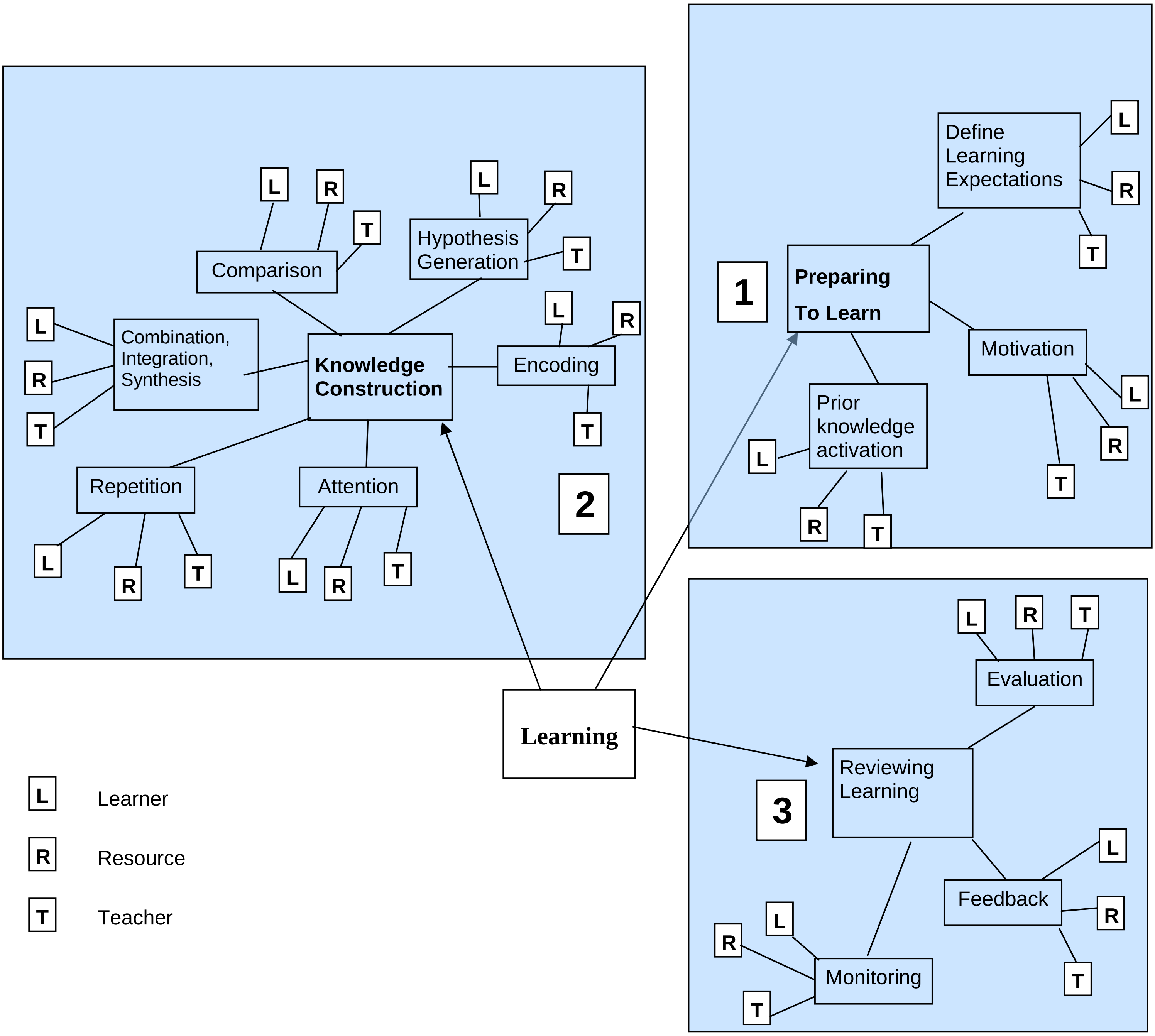
Teaching /Knowledge Construction Activities

- Attention
- Encoding
- Comparison
- Repetition
- Hypothesis Generation
- Combination, Integration, Synthesis

Review Activities

- Feedback
- Monitoring
- Evaluation

3.2 Graphical Representations of Shuell's Model



Some Suggestions for Different Graphical Descriptions of Shuell's Model

This and other pedagogic models and strategies could be applied and 'viewed' from different perspectives such as:

- Linear Timeline
- StoryBoard (Branching structure)
- Concept Map

The graphical representation of Shuell's Model shown in Fig. 1 seems particularly suitable as a case for the application of concept mapping software such as CmapTools (http://cmap.ihmc.us/Index.html) produced by the Institute of Human and Machine Cognition based at the University of West Florida.

Different Graphical Views of the Granularity of Shuell's Model

Pedagogic models and strategies could be applied and 'viewed' from different levels of granularity such as:

- Lesson
- Module
- Semester
- Complete Course

This would provide the conceptual and logical basis of a 'zoom' function for Pedagogic Strategy (although different models might be suitable for different levels of granularity).

Some Potential Benefits of This Approach:

- It can complement and simplify a textual description of pedagogy – which can be semantically dense and time consuming to produce
- As an aid to developing course design skills Littlejohn (2003) suggests using storyboards and other graphical techniques, she also makes the point that such storyboards are useful tools to support reuse – allowing lecturers to easily identify where activities and content resources can be changed or substituted.
- Perhaps most importantly storyboards and other graphical tools provide ways of capturing a lecturer's conception of the processes and activities in a course, that they might find otherwise difficult and time consuming to articulate. Using graphical representations of pedagogic strategies in this way could be very valuable to allow a multi-disciplinary course development team access to the information. This appears to be a typical use of 'boundary objects' to transfer and negotiate meaning within and between communities of practice as advocated by Wenger (1998).
- This use of graphical representations of pedagogic strategy seems to have a particularly good fit with the ideas surrounding the use of design patterns for educational design and the need for richer design tools as advocated by Bartolucci et al (2003).
- Depending on the type of pedagogic model chosen it could be possible to 'zoom' the graphical view of the course to different levels of granularity – something that is particularly attractive for course design activities and as an aid in visualising the use of learning objects.
- For the student experience we can envisage different views of the course using the pedagogic strategy as the basis for generating the view combined with system tracking information. Such views of the course might include individual location on a timeline, or cohort positions mapped onto learning outcomes achieved, or a representation of the subject knowledge domain produced by a lecturer.

Conclusions

Based on our project work experience we have come to these tentative conclusions:

- graphical representations of pedagogic strategies are potentially valuable staff development tools and may help support groups involved in course design

- graphical representations could provide a useful bridge to the more abstract activity of generating Learning Designs
- sharing graphical representations of pedagogic strategies with students is potentially a valuable learning support aid and may encourage the development of meta-learning skills
- adding dynamic components to such graphical representations could add to the richness of learning support available
- useful dynamic graphical representations of the pedagogic strategy in terms of time, student progress and cohort activity etc could be generated with the aid of web services
- a fundamental question to consider is what risks may be associated with sharing a conception of pedagogy with students

References

Bartolucci, S. et al 2003. E-LEN project: Working towards an e-learning design pattern language. In Learning Technology, October 2003. http://lttf.ieee.org/learn_tech/issues.html

Koper, R. 2003. Combining reusable learning resources and services with pedagogical purposeful units of learning. In Reusing Online Resources: a sustainable approach to e-learning. Ed. Littlejohn, A. Kogan Page, London.

Laurillard, D. (1994) Rethinking University Teaching, London: Routledge.

Littlejohn, A 2003. An incremental approach to staff development in the reuse of learning resources. In Reusing Online Resources: a sustainable approach to e-learning. Ed. Littlejohn, A. Kogan Page, London.

Merrill, M.D. 1988. Applying Component Display Theory to the Design of Courseware. Chapter 3 (pp61-96) in Jonassen, D. (ed.) Instructional Designs for Microcomputer Courseware, Lawrence Earlbaum, London

Shuell, T. (1992) Designing Instructional Computing Systems for meaningful Learning, in P. Winne & M. Jones (eds) Adaptive Learning Environments: Foundations and Frontiers, Springer Verlag, New York,

Wenger, E. 1998 Communities of Practice, Cambridge University Press, Cambridge.

John Casey
Project Officer
Learning to Learn - an X4L Project
University of Stirling
Stirling
Scotland
john.casey@stir.ac.uk

Kevin Brosnan
Project Manager
Learning to Learn - an X4L Project
University of Stirling
Stirling
Scotland
k.d.r.brosnan@stir.ac.uk

Regular Article: Development and evaluation of a course support environment based on the Blackboard Learning System at the Aristotle University of Thessaloniki

Abstract: - Course-support environments are an important technical development relating to computer communications in education that involves the linking of a Web-compliant user interface and Web-compliant tools and applets with an underlying database. This paper presents a course-support environment that was designed in the Blackboard Learning System in the Media Informatics Lab of the Journalism & Mass Communication Department, at the Aristotle University of Thessaloniki, Greece. Special issues relating to the development of the environment are reported, along with an initial evaluation from the students.

Introduction

Since the beginning of 1998, the Media Informatics Laboratory of the Department of Journalism & Mass Communication (J&MC), at the Aristotle University of Thessaloniki (AUTh), Greece, started to develop and publish material on the Web for its conventional courses (Veglis, 2000). The laboratory web site can be reached at http://pacific.jour.auth.gr (in greek). The purpose of this effort has been mainly the support of the media informatics courses and the preparation of a future distance-learning course. Initially we have developed a course support environment with the help of commercial application that creates and manages web sites. This solution gave us a lot of experience about designing course support environment. Results of our effort were published in several papers (Veglis, 2002; Veglis and Barabrgires, 2001; Veglis and Barbargires 2003). But of course this solution had many limitations. Last year the Aristotle University of Thessaloniki has purchased and installed a commercially software tool, namely the Blackboard Learning System (http://www.blackborad.com). Thus we were able to transfer and enrich our course support environment to this new platform that offers us many new possibilities (http://blackboard.lib.auth.gr). This paper presents the development of a course support environment for teaching internet search courses with the help of Blackboard Learning System.

Course support environment

In a course-support environment a database is integrated with Web-based tools and applications, and used to generate a course-support environment accessed via a standard Web browser. In its simplest form, a course-support environment is a Web site that accompanies an existing course and contains some information about the course. The purpose of such sites is to enrich or increase the efficiency of some aspects of course participation, and/or make some aspects of course participation more flexible to better meet the needs of individual students. Flexibility can also allow the extension of traditional courses to nontraditional audiences, including those who could be described as distance-education students (Collis, 1999). Course-support sites can be created and maintained by the individual instructor, but increasingly such sites are maintained as part of an integrated system serving an entire department or faculty (Remmers and Collis 2000).

Blackboard Learning System

The Blackboard Learning System has been designed, since its inception, for institutions dedicated to teaching and learning. Blackboard technology and resources power the online, Web-enhanced, or hybrid education programs at more than 2,000 academic institutions. It features an award-winning environment for online teaching and learning and is designed to complement traditional instruction or power pure distance learning through the following utilities (Yaskin):

- Content management and content sharing
- Assessment management
- Gradebook and assignment management
- Collaboration and communication
- Student and instructor portfolio management

Environment description

The main sections of the web site are depicted in figure1 and their contents are described in the following. The first page that each user access when entering the course-support environment is the course announcements; in reverse chronological order, i.e. the most recent one resides on the top of the page (figure 2). We must note that the navigation buttons are still in english but Blackboard Inc and the university of Thessaloniki are working together in translating the course support environment.

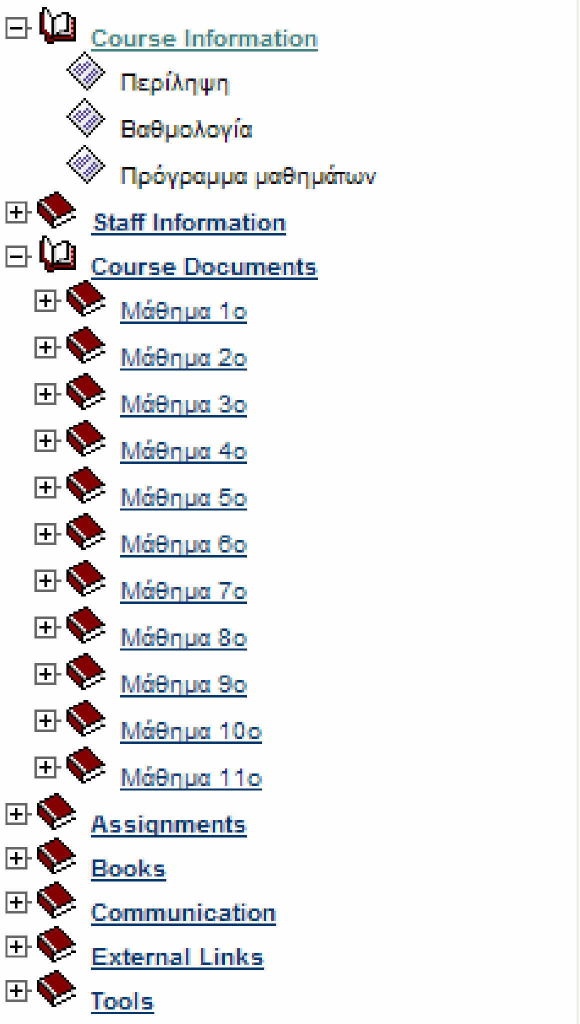


Figure 1: Course map.

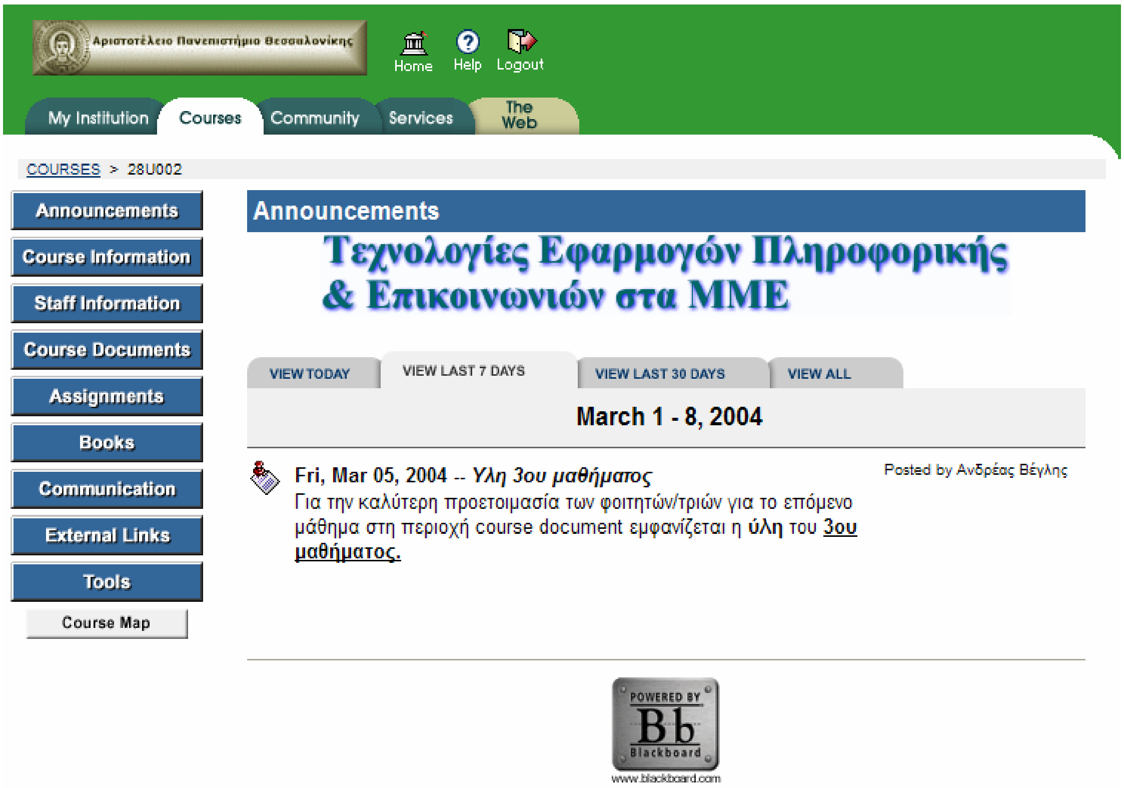


Figure 2: Announcements.

Course Information: This section provides an overview of the course objectives and a brief listing of the course contents. It also includes information concerning the course grading rules and also the dates of the course during the semester.

Staff Information: It contains the name of the course instructor along with the telephone number, the e-mail address, and the location of his office.

Course Documents: This is the main section of the course support environment. It includes the course syllabus in a weekly basis, along with various documents (PowerPoint presentations, PDF, etc) that are used in the course. There are also links in quizzes for the evaluation of the students. Each week the students can access the documents of the current and past courses (figure 3).

Assignments: This section includes assignments that the students have to complete during the semester. Students complete their assignments and deliver them in the digital dropbox of the instructor, accessible through the tools area.

Books: This section includes a full listing of the proposed bibliography, comprising of Greek and mainly international book editions.

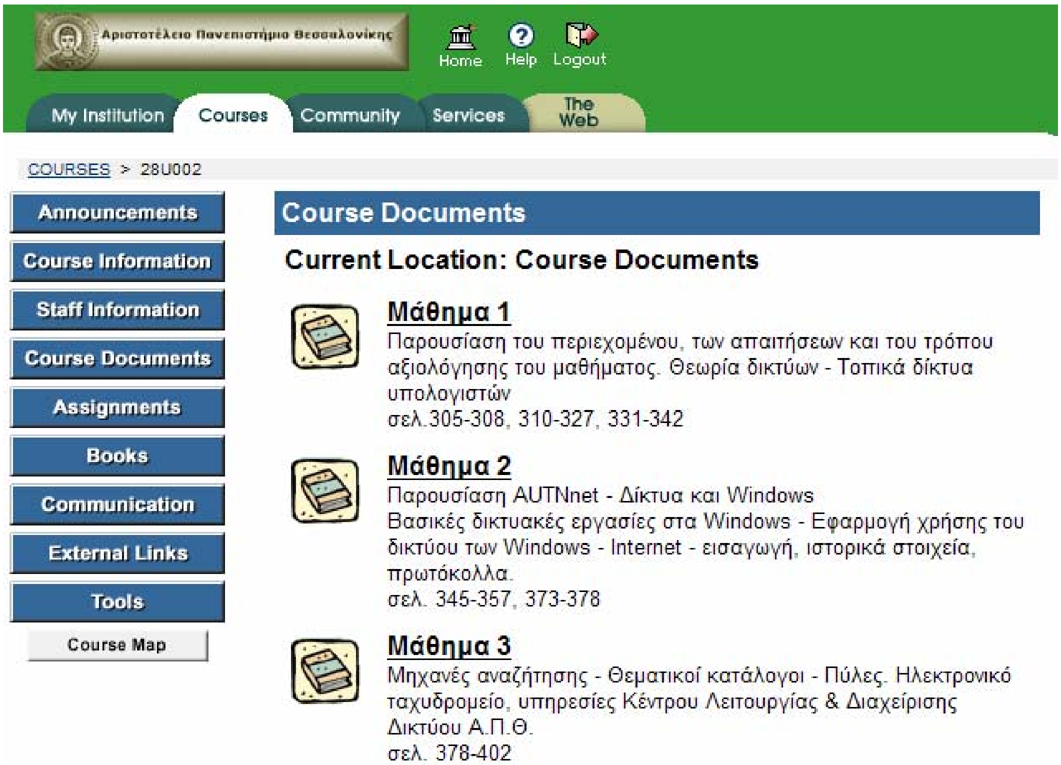


Figure 3: Course Documents.

Communication: This section facilitates various communication tools such as e-mail, discussion Board, Collaboration, etc. with which students can communicate with the instructor and with other students (figure 4).

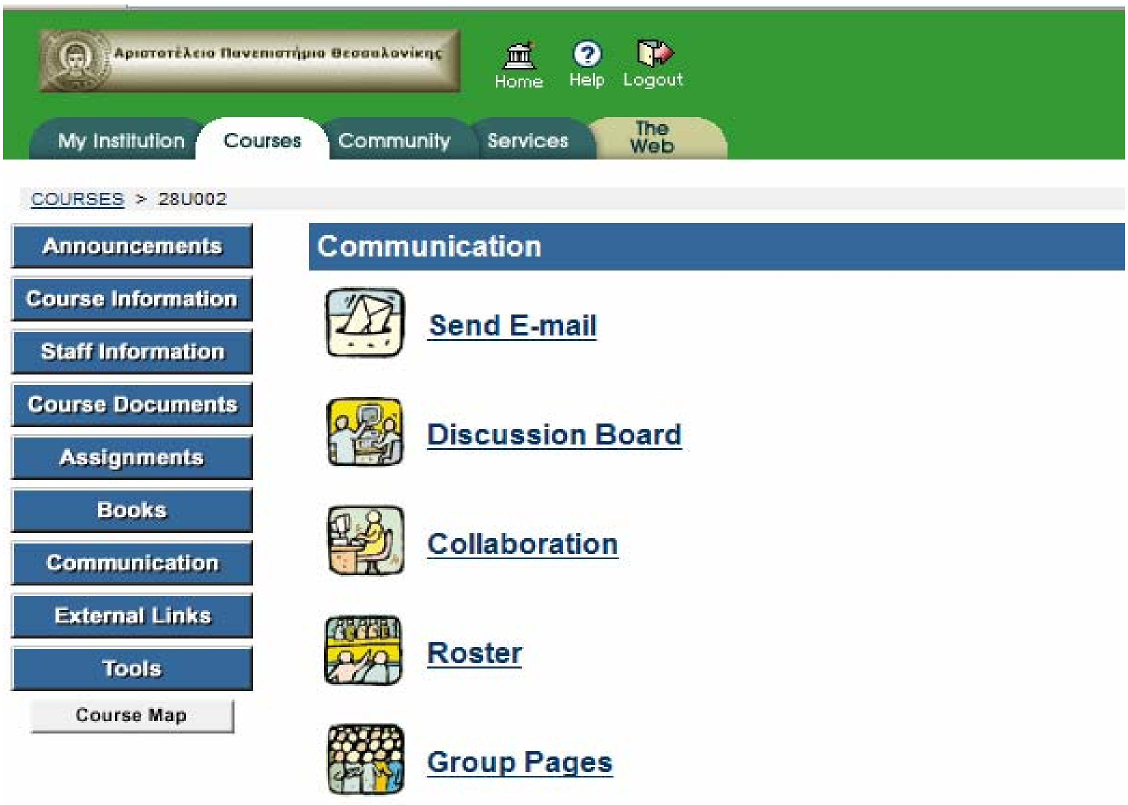


Figure 4: Communication Tools

External links: This section facilitates the student's access to supplementary on-line material, through links to various international web sites.

Tools: This section provides a list of available tools such as Calendar, gradebook (figure 5), manual, digital dropbox, address Book, etc.

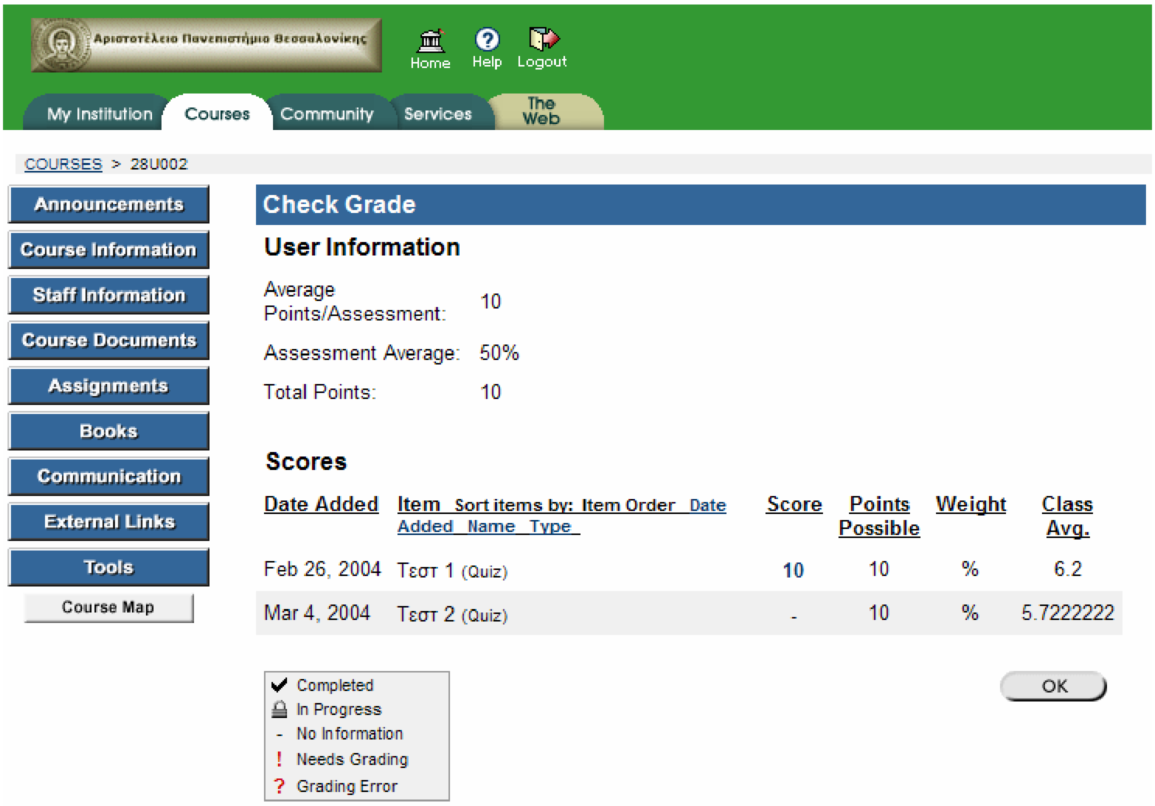


Figure 5: Student’s gradebook.

Evaluation

Following the development and use of the course support environment, a formative evaluation was conducted. The aim of this formative evaluation was to assess the students’ attitude towards the blackboard course support environment. Students, that had just completed an elective course on internet search, in January 2004, were asked to supply feedback about the effectiveness of the course-support environment, by expressing anonymously their opinion. A total of 42 questionnaires were returned.

Initially students were asked to rate their computer knowledge. A high percentage of 86% claim to have very good or good computer knowledge. Only 7% of the responders believe that their computer knowledge is insufficient. The majority (86.5%) of the students report that they have access to a computer with Internet connection. The rest of them own a computer but without an internet connection. Surprisingly all students admit that they own a personal computer. Based on the above it is obvious that the majority of the students have enough knowledge and the appropriate hardware to fully exploit the potentials of a course support environment. Of course we must note that all students have attended four courses related to information technology in the previous semesters and posses a substantial computer experience.

Next we investigated the students’ attitude towards the blackboard environment. All the students admit a positive attitude towards the blackboard environment. 36% of the students report no navigating problems in the course support environment, and 64% admit to have some difficulty. The easy adoption in the Blackboard environment can be easily explained by the fact that the majority of the students can be characterized as heavy internet users.

Next we investigated the effects that the use of the course support environment had on the course. 50% of the students believe that the use of the Blackboard environment made the course more attractive, 36% say that it made the course easier and 14% does not find any effect on the course. All students welcome the introduction of the course support environment to all the courses that are taught in the department of Journalism & Mass Communication. Currently we are in the face of developing course support environments for the majority of the courses that are being taught in the department of Journalism & MC.

Following the above we investigated the use (not during the course) of the course support environment by the students. 21% of the responders stated that they used the environment many times, 21% two-three times, 29% only once and 29% never.

Table 1

	Many times	**2-3 times**	**Once**	**Never**
Course Information	7%	50%	21%	21%
Course document	64%	14%	21%	0%
Books	7%	0%	14%	79%
Quiz	71%	29%	0%	0%

Finally we studied the use of the environments' sections by the students. Table 1 summarizes our findings. Course documents and quizzes were the most popular sections with course information and books receiving far less attention. That was expected since quizzes were obligatory and offered students a chance to improve their grades, and course documents contain all the documents used during the teaching process. It is obvious that we must motivate our students to use more often the course support environment.

Conclusion and future work

The web-based environment that was designed and implemented for the support of the internet search courses has been proved an invaluable tool for the students. The results from the overall process were very encouraging. The students seem to be able to cope well with the integration of the Web as a tool to enhance traditional classroom lectures, and also encourage the adoption of similar course support environment in all the courses they attend. Its gradual integration into the teaching and learning procedure makes its adoption from both sides – instructors and students – a natural consequence of the information age we all experience, and has already attracted some useful suggestions for its future improvements. Also the majority of the students can access the course support environment via dialup connection, and that offers us the possibility to offer distance learning courses in the near future. Future extensions of this effort will be the further exploitation of the possibilities offered by the Blackboard Learning System, namely the communication tools that allow the synchronous interaction between students and instructors.

References

Collis, B., Applications of Computer Communications in Education: An Overview, IEEE Communications Magazine, Vol. 37, No. 3, 1999, pp. 82-86.

Remmers, E., Collis, B., Didactical Activities and Strategies in the Use of WWW-Based Course-Support Environments: Design Guidelines for Instructors, in J. Bourdeau & R. Heller (Eds.), ED-MEDIA 2000: World Conference on Educational Multimedia, Hypermedia & Telecommunications, Charlottesville, VA, 2000, pp. 898-903.

Veglis, A., Design of a Web-Based Interactive Computer Lab Course, in Proc. 10th Mediterranean Electrotechnology Conference (MELECON 2000), Cyprus, Vol. I, 2000, pp. 302-305.

Veglis, A., "Web based teaching systems", IEEE Distributed Systems on Line, April 2002.

Veglis, A., Barbargires, C., A Web-Based Course-Support Environment, in Proc of the International Conference on Communications 2001.

Veglis, A., Barbargires, C., Development and evaluation of a Web-based environment for supporting office automation courses in undergraduate journalism and mass communication studies, IEEE Learning Technologies, October 2003.

Yaskin, D., Blackboard Learning System (Release 6), Product Overview White Paper, Blackboard Inc .

Andreas Veglis
Dept of Journalism & MC
Aristotle University of Thessaloniki
Thessaloniki
GREECE
veglis@jour.auth.gr
http://pacific.jour.auth.gr/veglis

Andreas Pomportsis
Dept of Informatics
Aristotle University of Thessaloniki
Thessaloniki
GREECE

Regular Article: Strategy of Adopting E-learning Environment - A Case Study in Taiwan

Introduction

E-learning is a hot topic nowadays. There are many studies concentrating on pedagogy and effectiveness of e-learning. Yet a practical issue that how to adopt e-learning in the teaching environment is the least explored. This article reports the result of a case study for adopting e-learning environment in Taiwan. The objective is to investigate the strategy for how to overcome the barriers to adopt e-learning, and increase the efficiency of teaching and learning.

Impact of adopting e-learning in colleges/universities

E-learning brings in reformed pedagogy and information technology into universities. The innovation makes a twofold impact on the universities. Not only result in efficient teaching and learning, but the reformed pedagogy and information technology also have great influences on the stakeholders (including policy-makers, administrative staff, teachers and teaching assistants, students, and technicians and software engineers). The stakeholders have different positions on education reforms, and, as shown in Table 1, there are various views and considerations for respective stakeholders.

Table1. Views and Considerations of Various Stakeholders

Stakeholders	Views and Considerations
Policy-makers (e.g. president, the board of directors)	▪ long-term goal ▪ return on investment
Administrative Staff	▪ system development cost ▪ rewarding rules ▪ administrative process ▪ manpower
Teachers and Teaching Assistants	▪ instructional objectives ▪ intellectual property rights ▪ teaching load ▪ computer anxiety ▪ user interface
Students	▪ learning efficiency ▪ user interface
Technicians and Software Engineers	▪ stability of the platform ▪ compatibility of legacy systems

Because of the limitation on school funding, manpower, and other related resources, the phenomenon of resource competition tends to be a serious problem. Therefore, to overcome the barriers and adopt e-learning successfully is highly attributed to collaborative manners of involved members. The study aims for seeking a strategy which resolves the conflicts among stakeholders and facilitate the adopting of e-learning.

Strategy of adopting e-learning environment

The stakeholders can be classified into three categories: executive group (including policy-makers and administrative staff), teaching group (including teachers, teaching assistants and students), and technical group (technicians and software engineers). The ways of interaction among the three groups can make the difference between success and failure of adopting e-learning. There are two remarkable strategies noted from the study:

(a) Pull strategy: The adopting of e-learning is initiated by technical group. It is worth noting that most failed cases are resulted from this strategy. The most likely reasons of the failure are: (1) technical group is not supported by executive group, and (2) technical group just promotes new technologies that are not tailor-made for teaching group.

(b) Push strategy: The adopting of e-learning is initiated by executive group. Executive group encourages teaching group in e-learning, and urges technical group to support teaching group. Observing from the study, we note that the push strategy can achieve good results with half the effort. On the other hand, the pull strategy may get half the result with twice the effort.

To sum up, the push strategy is preferable to the pull strategy in implementing e-learning and several remarkable notes for adopting e-learning with the push strategy are elaborated as follows.

1. **National education policy**: Government's policy on education is a prime mover in adopting e-learning. Ministry of Education is responsible for formulating education policy, as well as for overseeing the operations of all universities and colleges. Thus the guidance and support from Ministry of Education is the key factor for successfully adopting e-learning.
2. **Support from policy-makers**: Most works for adopting e-learning environment require the support from policy-makers. These includes establishing the rewarding rules, setting up the administrative process, allocating manpower, holding seminars and discussions, conducting investigations, and purchasing equipments.
3. **Survey of current status**: Before adopting e-learning environment, it is necessary to conduct an investigation into teaching group's needs and attitude about e-learning. It will help executive group realize the gap between the goal and the current status, and then develop an adopting strategy and action plans.
4. **Administrative support**: Teachers care deeply about the issues of extra load and reliance on system. Most teachers who have used e-learning technology agree that the need of producing computerized materials and the dependence upon Internet become higher as compared to conventional teaching. Also those who intend to use e-learning are anxious about that the load of producing computerized materials and manipulating the system. Therefore a supporting team is required to assist teachers to deal with extensive overhead. The team is composed of administrative staff and teaching assistants. A few universities in Taiwan set up an e-learning division within administration affairs office, which directs the operations of setting up rewarding rules to teachers who offer e-learning courses, executing the administrative process, and resolving teachers' doubts about school's policy. The teachers are commonly rewarded with a grant-in-aid or an additional teaching assistant for extra expense or load from teaching e-learning courses.
5. **Technical support**: The capability to cross temporal and spatial boundaries is the key characteristic of e-learning. This can not be achieved without a reliable system. That is, reliability is the primary concern for developing and maintaining an e-learning system. In addition, the user interface is the essential issue to the end users. Technical group is responsible for developing and maintaining a reliable system, and instructing users and resolving operational problems.
6. **Training courses**: Three types of training courses are required: system operating instruction for end users, pedagogy and technology for teachers, and basic computer skills for students. First, the operating instruction course is subdivided into three sections for administrative staff, teachers and teaching assistants, and students, respectively, to help them properly use of the functions offered by the system. Secondly, the pedagogy and technology course is for enhancing teachers' network teaching skill and cognition. Finally, the basic computer skills course is offered by the center of general education to reinforce the students' computer capabilities.
7. **Consultation with the experienced cases**: Experiences from other universities are valuable, no mater successful or failed ones. Consulting with the experienced universities help us avoid repeated mistakes and find an efficient and effective way to adopt e-learning environment.

Conclusion

This article explores the problems encountered while a university tries to adopt in the e-learning environment. Putting together the interviews, questionnaires, participatory observation, discussions and file analysis from the study, it can be concluded that the adopting strategy is not only a technical nature but also an administrative and teaching ones. It has to move in proper sequence and manage deliberately issues of administration, teaching, and techniques. The essential strategy, executive group promotes teaching group and urges technical group which supports teaching group, is helpful to solve the barriers at beginning stage and brings ultimate efficiency.

This study probates on a single case in Taiwan. There exist various organizations and cultures in universities. The variety influences the outcomes of the strategy significantly. We have to examine the organization and culture of a school deliberately and to refine the push strategy to fit its own to achieve the goal of adopting e-learning.

Acknowledge

This work was supported in part by Ministry of Education and Chang Gung University under the grants H048 and EARPD2C37, respectively.

Shu-Maan Chang
Center of General Education
Chang Gung University

Ta-Wei Shih
Center of General Education
Chang Gung University

Cherng-Min Ma
Department of Information Management
Chang Gung University

Shiow-Ying Wen
Department of Business Administration
Chang Gung University

Her-Kun Chang
Department of Information Management
Chang Gung University
hkchang@mail.cgu.edu.tw