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Editorial board | Subscription | Author guidelines

Contents

From the editor..

Welcome to the October 2004 issue of Learning Technology.

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

5^{th} IEEE International Conference on Advanced Learning Technologies (ICALT 2005)

July 5-8, 2005
Kaohsiung, Taiwan

http://lttf.ieee.org/icalt2005/

• Important Dates

February 4, 2004 - paper submission
March 25, 2005 - notification of acceptance
April 15, 2005 - Copyright form submission
April 15, 2005 - final camera-ready manuscript
April 29, 2005 - author registration deadline

** Proceedings will be published by the IEEE Computer Society Press. **

Theme: "Next generation e-learning technology: intelligent applications and smart design"

The conference will bring together people who are working on the design, development, use and evaluation of technologies that will be the foundation of the next generation of e-learning systems and technology-enhanced learning environments.

We invite submission of papers reporting original academic or industrial research in the area of Advanced Learning Technologies. All papers will be peer-reviewed. Complete papers will be required for review process; only abstracts will not be sufficient.

All authors of accepted submissions will be required to complete IEEE Copyright Form.

Authors of selected papers will be invited to submit extended versions for a Special Issue of the Journal of Educational Technology & Society (ISSN 1436-4522).

• Topics of Interest

Adaptivity in Learning Systems
Advanced uses of Multimedia and Hypermedia
Ambient Intelligence and Ubiquitous learning
Application of Artificial Intelligence Tools in Learning
Architecture of Context Aware Learning Technology Systems
Artificial Intelligence Tools for Contextual Learning
Building Learning Communities
Computer Supported Collaborative Learning
Distance Learning
e-Learning for All: Accessibility Issues
Educational Modelling Languages
Evaluation of Learning Technology Systems
Information Retrieval and Visualization Methods for Learning
Instructional Design Theories
Integrated Learning Environments
Interactive Simulations
Knowledge Testing and Evaluation
Life-Long Learning Paradigms
Learning Objects for Personalised Learning
Learning Styles
Media for Learning in Multicultural Settings
Metadata for Learning Resources

Mobile Learning Applications
Participatory Simulations
Pedagogical and Organisational Frameworks
Peer-to-Peer Learning Applications
Practical Uses of Authoring Tools
Robots and Artefacts in Education
Simulation-supported Learning and Instruction
Socially Intelligent Agents
Speech and (Natural) Language Learning
Learning Objects for Personalised Learning
Teaching/Learning Strategies
Technology-facilitated Learning in Complex Domains
Virtual Reality
Virtual Spaces for Learning Communities

- **Program Co-Chairs**

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- **Workshop Chair**

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- **Tutorial Chair**

Nian-Shing Chen, National Sun Yat-sen University, Taiwan

- **Paper Submissions**

Submissions are invited in the following categories:

  - Full paper: 5 pages
  - Short paper: 3 pages
  - Posters: 2 pages
  - Tutorial proposals: 2 pages
  - Panel proposals: 2 pages
  - Workshop: 2 pages

Submission information is available at:
http://lttf.ieee.org/icalt2005/papers.html

- **For general information, please contact:**

Dr. Maiga Chang
Office of e-Learning National Project
P.O. Box 12-162, Chung-Li, 320, Taiwan
Tel: +886 3 4227151-ext 4750
Fax: +886 3 4260120
maiga@ms2.hinet.net

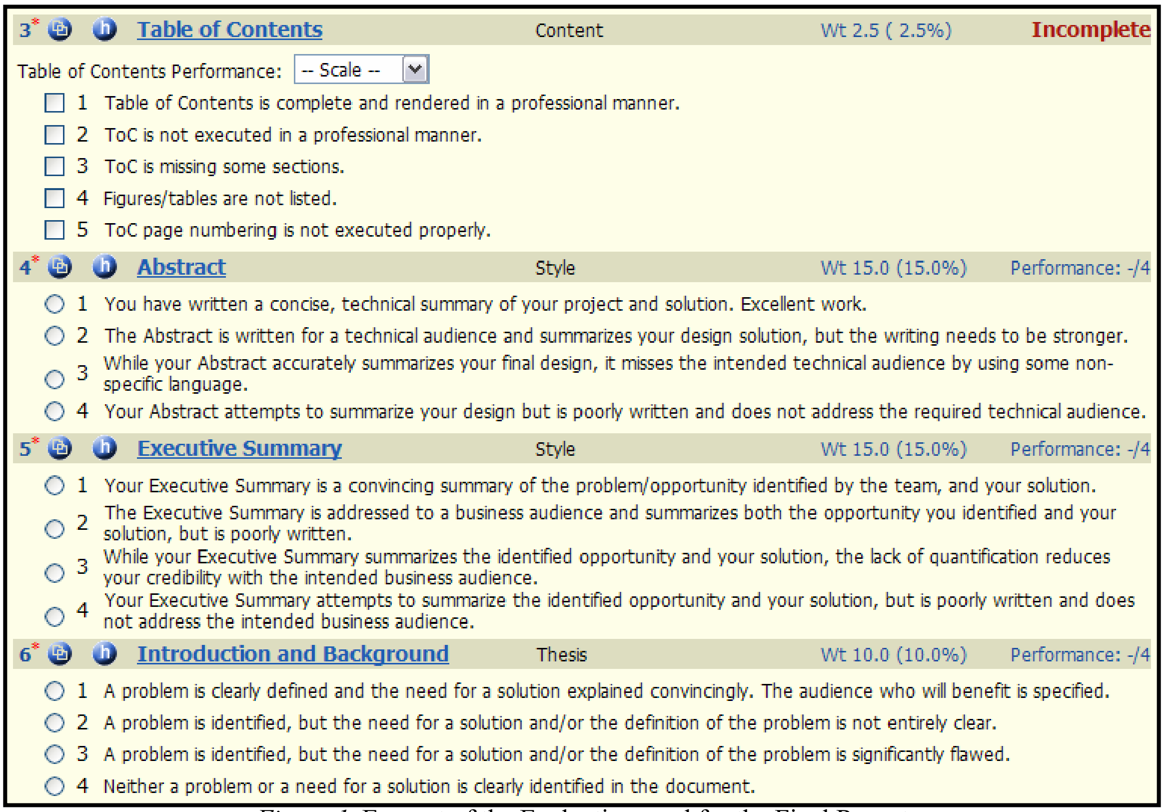
Structured, Online Evaluations and the First-Year Design Process

A key component to the first-year engineering curriculum at Drexel University is an interdisciplinary design project. Students receive credit for both design and English courses in the winter and spring terms of their freshman year. The 600 or so first-year engineers organize design teams, seek guidance from engineering faculty to define design problems, and work with both engineering and English faculty to develop three written documents and an oral presentation.

The projects are often extensive and span the winter and spring terms (Drexel runs on trimesters). Each team has five members and works with an engineering advisor and two English advisors to create a final report, which runs upwards of 20 pages, plus appendices, and includes a formal table of contents, abstract, executive summary, and report body.

This complex undertaking is facilitated by a novel Web-based software tool that allows faculty members to access a database of comments and electronically track teams of five students through the project deliverables: a Problem Definition Statement, Proposal, Oral Presentation, and Final Report. Faculty use the shared database to generate and track both qualitative and quantitative feedback.

Because the students often have different English faculty, two English teachers grade each of the deliverables to ensure consistency and fairness. The English grade reflects specific course objectives that differ in emphasis from those used by the individual engineering advisors. For instance, the English faculty stress the conventions of language, clarity, and conciseness while the Engineering faculty focus more on content and design. It is extremely important to make the language and tone of feedback consistent. The engineering advisor grades the project for a course called Engineering Design and Laboratory, while the two English advisors grade the project for the freshman humanities sequence of courses which includes a technical writing component.



3* Table of Contents — Content — Wt 2.5 (2.5%) — Incomplete

Table of Contents Performance: -- Scale --

1 Table of Contents is complete and rendered in a professional manner.
2 ToC is not executed in a professional manner.
3 ToC is missing some sections.
4 Figures/tables are not listed.
5 ToC page numbering is not executed properly.

4* Abstract — Style — Wt 15.0 (15.0%) — Performance: -/4

1 You have written a concise, technical summary of your project and solution. Excellent work.
2 The Abstract is written for a technical audience and summarizes your design solution, but the writing needs to be stronger.
3 While your Abstract accurately summarizes your final design, it misses the intended technical audience by using some non-specific language.
4 Your Abstract attempts to summarize your design but is poorly written and does not address the required technical audience.

5* Executive Summary — Style — Wt 15.0 (15.0%) — Performance: -/4

1 Your Executive Summary is a convincing summary of the problem/opportunity identified by the team, and your solution.
2 The Executive Summary is addressed to a business audience and summarizes both the opportunity you identified and your solution, but is poorly written.
3 While your Executive Summary summarizes the identified opportunity and your solution, the lack of quantification reduces your credibility with the intended business audience.
4 Your Executive Summary attempts to summarize the identified opportunity and your solution, but is poorly written and does not address the intended business audience.

6* Introduction and Background — Thesis — Wt 10.0 (10.0%) — Performance: -/4

1 A problem is clearly defined and the need for a solution explained convincingly. The audience who will benefit is specified.
2 A problem is identified, but the need for a solution and/or the definition of the problem is not entirely clear.
3 A problem is identified, but the need for a solution and/or the definition of the problem is significantly flawed.
4 Neither a problem or a need for a solution is clearly identified in the document.

Figure 1. Excerpt of the Evaluation used for the Final Report

The design project is a hallmark of the Drexel Engineering Curriculum (tDEC) which evolved from the 1988 curricular experimental project entitled "An Enhanced Educational Experience for Engineering Students" that was funded in part by a grant from the Engineering Directorate of the National Science Foundation.

Responding to student concerns about contradictory feedback from the two English advisors and variation in feedback among the 10 to 12 faculty involved, the English faculty sought a tool to help facilitate the assessment and response process.

In 2003 English faculty members began using an online tool, **waypoint** (www.gowaypoint.com), to evaluate design deliverables. Students still submit hard copies of their papers and faculty still make comments in the margins of the paper. But now faculty utilize waypoint to write the "end comments" - —really the crucial part of the student-teacher interaction that guides the revision process

Before waypoint, students received two sets of feedback, one from each English advisor,. Now, student teams receive a single, unified feedback memo that has been agreed upon by both humanities advisors. Waypoint allows the faculty to decide, in advance, on specific criteria for each assignment and then evaluate student work consistently. Students received an email evaluation that describes, in great detail, the advisors' joint feedback.

Figure 1 shows an excerpt of the evaluation page generated for the Final Report. Every "Element" (in waypoint, an element is simply a criterion used to evaluate writing) was custom generated by these particular faculty to suit the assignment. After deciding on the criteria, faculty can prewrite the basic structure of the comments they would make to students for each performance level of a given element, thus anticipating the kind of work students are known to do. When evaluating, English faculty simply click on the choice that is most applicable and work their way through the evaluation. It is crucial to note that the prewritten text can be modified (see Figure 2) at any step, providing students with advice *specific to their report.* Since waypoint is Web-based, the two advisors can easily collaborate on the feedback and grade at every step in the process.

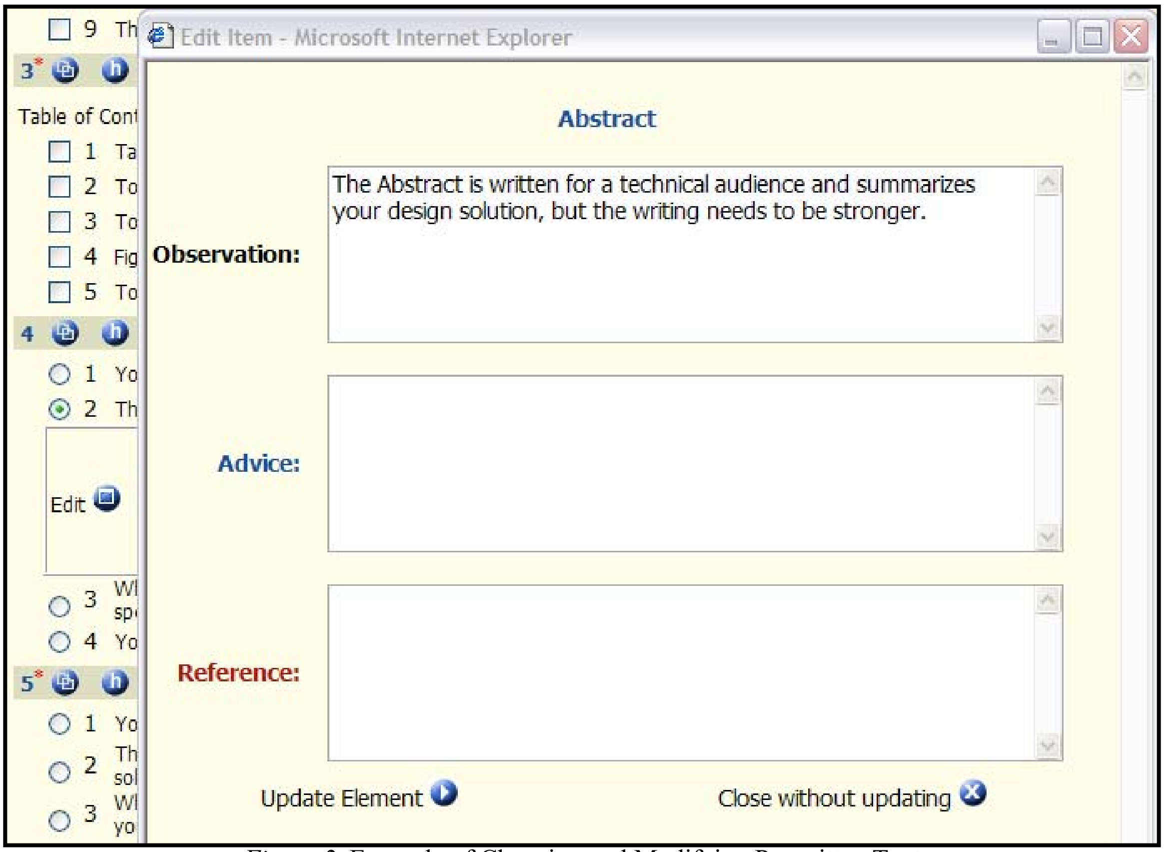


Figure 2. Example of Choosing and Modifying Prewritten Text

English faculty can email or print these clear, detailed response memos back to the first year design team members (see Figure 3 for an excerpt of such feedback).

Cover Letter of Transmittal

The cover letter is formatted properly, has the correct content, and is well written.

Title Page

The title page is complete.

Table of Contents

Table of Contents is complete and rendered in a professional manner.

Abstract

You have written a concise, technical summary of your project and solution. Excellent work.

Writing a little rough in places...see McCann's copy.

Executive Summary

The Executive Summary is addressed to a business audience and summarizes both the opportunity you identified and your solution, but there are some issues.

Opening sentence is awkward.

What do you mean by a "continual market"?

We find it hard to believe that a house could "be run on the same amount of energy it takes to power a single 75 watt bulb." Do you mean "heated"? Even if what you say is accurate, "run on" is needlessly vague. Does this include the boiler etc?

Introduction and Background

A problem is identified, but the need for a solution and/or the definition of the problem is not entirely clear.

Why does someone want 100% dark? What is the total market (info from Exec Summary should appear here)?

Design Criteria

The criteria to evaluate an acceptable solution are clearly specified. Criteria are quantified (defined with numbers).

However, efficiency cannot be defined by voltage. You need a watt number.

Are there any codes that regulate windows? What is 'safe'?

Design Constraints

Constraints are specific and logical (not: "not enough time/not enough money" etc).

Survey of Literature

You discuss the highlights of your research, names sources, and explain what you learned from those sources.

Figure 3. Excerpt from the Feedback Generated for a Design Team

Because every choice reflects a quantitative assessment (if the second of four choices is chosen, the database records the data point of 2/4) data is easily generated to identify strengths and weaknesses across the entire cohort. For instance, all 110 design teams could be easily analyzed against basic core competencies like research (see Figure 4).

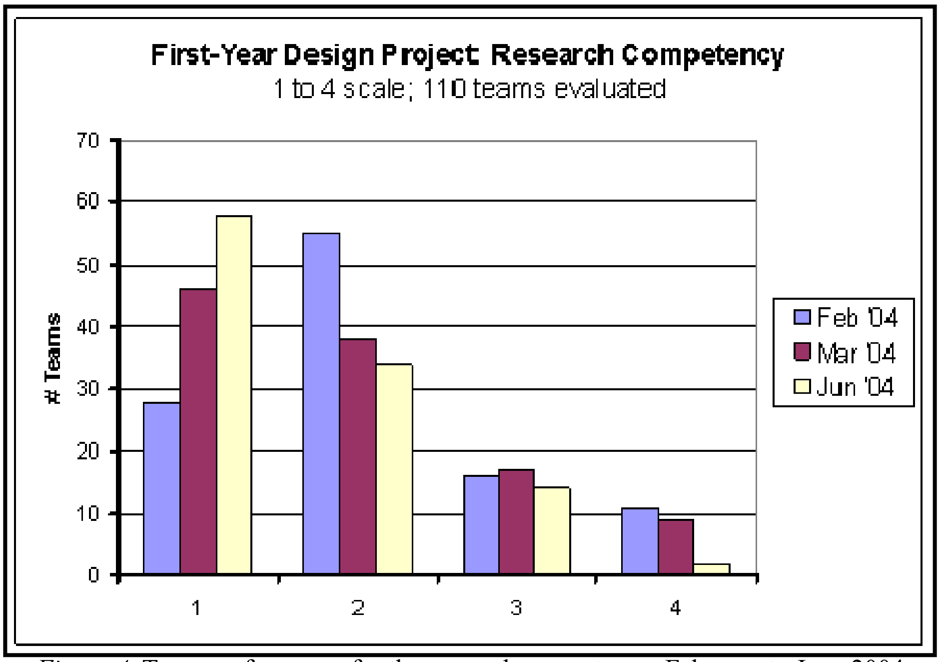
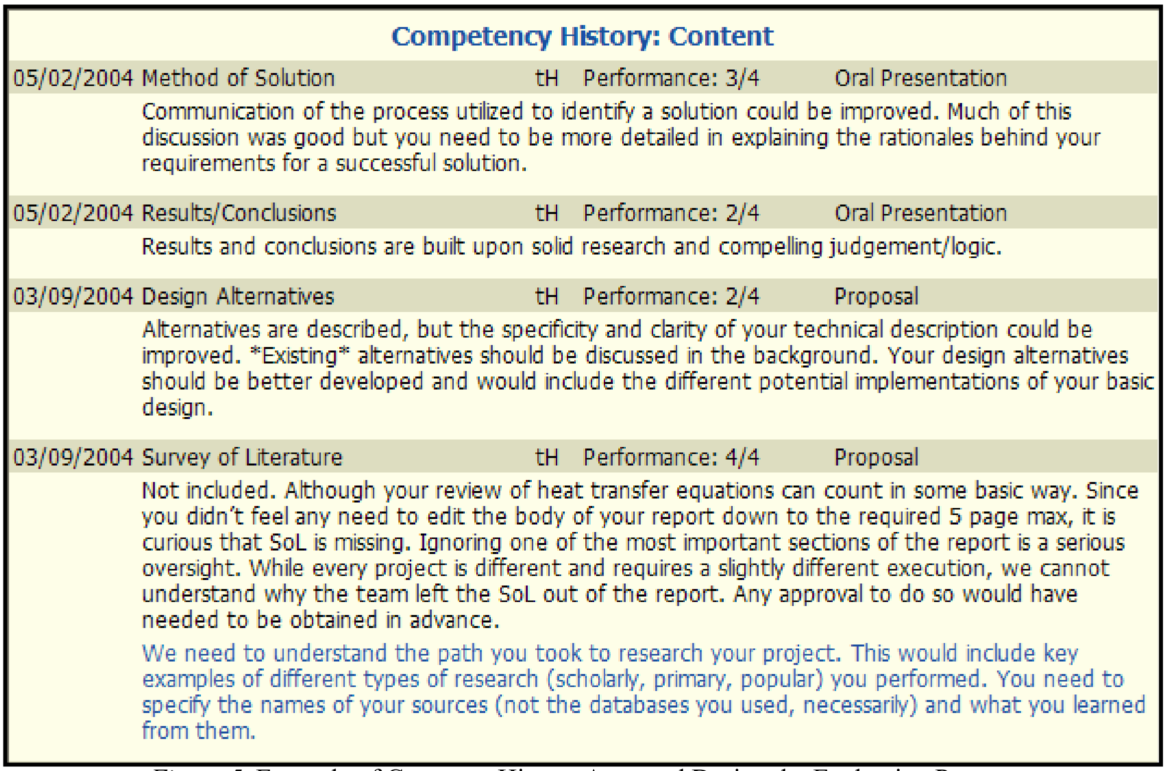


Figure 4. Team performance for the research competency, February to June 2004 (1 is exemplary, 4 unacceptable)

Also, because all responses are stored in a database, accessing comments written earlier in the process is easy, allowing everyone involved to see how a particular team has progressed in a particular communication competency. See Figure 5 for an example of the history of comments.



Competency History: Content

05/02/2004 Method of Solution tH Performance: 3/4 Oral Presentation

Communication of the process utilized to identify a solution could be improved. Much of this discussion was good but you need to be more detailed in explaining the rationales behind your requirements for a successful solution.

05/02/2004 Results/Conclusions tH Performance: 2/4 Oral Presentation

Results and conclusions are built upon solid research and compelling judgement/logic.

03/09/2004 Design Alternatives tH Performance: 2/4 Proposal

Alternatives are described, but the specificity and clarity of your technical description could be improved. *Existing* alternatives should be discussed in the background. Your design alternatives should be better developed and would include the different potential implementations of your basic design.

03/09/2004 Survey of Literature tH Performance: 4/4 Proposal

Not included. Although your review of heat transfer equations can count in some basic way. Since you didn't feel any need to edit the body of your report down to the required 5 page max, it is curious that SoL is missing. Ignoring one of the most important sections of the report is a serious oversight. While every project is different and requires a slightly different execution, we cannot understand why the team left the SoL out of the report. Any approval to do so would have needed to be obtained in advance.

We need to understand the path you took to research your project. This would include key examples of different types of research (scholarly, primary, popular) you performed. You need to specify the names of your sources (not the databases you used, necessarily) and what you learned from them.

Figure 5. Example of Comment History Accessed During the Evaluation Process

The response from students and faculty has been extremely positive. Students appreciate the detailed feedback they receive and are more motivated to read and understand the commentary. The time to evaluate design reports has been reduced, in some cases by up to 50%, and concerns about contradictory advice have been eliminated.

Since each faculty member might be responsible for reading and evaluating 40 design reports, even a 15% reduction in time is a significant achievement. In addition, all the feedback given to design teams is readily available – an ideal resource for analyzing pedagogy and researching the effectiveness of curriculum design.

Scott J. Warnock
Assistant Professor of English
Drexel University, USA
Scott.Warnock@drexel.edu

Andrew J. McCann
Visiting Professor of English
Drexel University, USA
mccann@drexel.edu

Meta-analysis of Technology and Privacy in an Advanced Business Course

The Project

BCOR 4000-006 is a required core curriculum course in the Systems Management major for fourth year students obtaining a Bachelor's Degree in business from the Leeds College of Business at the University of Colorado at Boulder. *Technology and Society: Privacy for Fun and Profit* requires students to closely examine issues of privacy enabled or caused by technology. Furthermore, the course requires students to use various technologies to study and report on a wide range of topics, which particularly focus on the unprecedented aggregation of personal information and the speed of collection, which cannot be matched by social norms or laws. Students dissect the technologies, social trends, and the business and governmental uses of personal information to reap profits or manage society.

The major project of the semester requires student dyads to examine privacy implications of technologies, e.g., microchips embedded in humans, national ID cards, biometrics, and overseas outsourcing of banking and medical records. Each pair chose a topic and is currently engaged in writing a well researched paper of approximately 5000 words on that topic; students collaborate in their research, design, writing and revising/editing online and face to face. The teams present their work orally and in writing to the class in progressive stages: questions and proposal, initial report, interim report, and final report. Students use tools ranging from computers and software, to overhead projectors, to video, CD, DVD, to cell phones, and more to demonstrate the implications of the technology and to provide visual images of the processes and ethics surrounding privacy issues. The final student product will be a book containing all student projects. Each student will receive a copy; additional copies will be used as a course text in future terms.

Students work on committees, of four to six members, that are providing book production processes: editing and revising, determining a budget, obtaining and selecting bids for printing, and publishing the book complete with copyright and ISBN. Primarily systems management majors, the students have found their previous studies in marketing, finance and other fields have many applications to this project.

Several guest speakers also participate: a senior instructor in writing and rhetoric presented conceptual and practical aspects of the writing project, and consults with the editorial and publication teams to polish and complete the manuscript; the CEO of a local information technology firm spoke on eXtreme data warehousing and ethics; an expert presented survey design; and a business librarian discussed library resources and research.

Learning Goals

The course actively engages students in all aspects of information technology, using it, studying it, recognizing the ethical implications of its ability to collect and analyze data, and meta-analyzing both the technology and the students' understandings and reactions to it, and it provides rich experiential learning for these students, many of whom are already employed in systems management. The primary goals for the course, to learn about, appreciate, and understand the privacy implications of information technology in the hands of business and government, are being well met in the class. The students have a vested interest in their topics, e.g., one young man with serious medical problems has found his medical records stored digitally in India, where few privacy regulations exist.

Interesting Findings

One pair of students presented their interim project report about opinions on the Patriot Act and the loss of privacy for individuals should the government determine that they are potential terrorists. They downloaded video clips of the Bush campaign along with clips from *Fahrenheit 9/11*'s treatment of the Act. In their presentation, they proceeded to show images and audio without demonstrating the implications of downloading the video from Kazaa before it was officially released. The professor and class engaged in a lively analytical discussion of privacy violations, piracy, and ethics.

Thus, the course encourages meta-analysis of an original analysis, one of the most constructive forms of critical thinking that can be taught at the university level. And, in this case, the students had employed advanced

technologies, used for teaching and learning as well as for information gathering and entertainment, both as the subject of their thinking as well the tools for analysis. This is, of course, a second meta-process: using the tools to examine the uses of the tools.

A Survey

In addition to their online and library research on privacy, the students are surveying approximately 640 fellow students, to examine the ways in which they use technology, their attitudes toward technology used in learning, and to learn about their attitudes toward privacy with regard to technology. The survey will be distributed approximately ¾ of the way through the course, and should provide useful data for analysis. Examining student attitudes, particularly toward the ways in which technology interfaces with their privacy, is important. Students at a large university are a microcosm of society; they use technology for nearly every possible purpose—and they are "up" on the latest uses in of electronic business communications (credit cards, bank cards, ID cards, etc.). They meet socially in chat rooms, explore the unknown in gaming, and communicate electronically perhaps more frequently than in person. As the survey seeks to understand how students use and learn while using technology, it more importantly seeks to discover whether or not students consider the ethical and social implications of that use.

Conclusion and Implications

This project of examining privacy issues and ethics related to technology involves students who will be working in systems management. The research, writing, oral presentations, and publishing of the students' projects involve many uses of technology as well as the students' meta-analysis of these technologies. Furthermore, the course encourages meta-analysis of the privacy issues, ethics, and social implications involved with the students' own work. This course, already half completed, demonstrates that using advanced technologies for teaching and learning enrich the educational experiences of upper division students. More such projects in related courses should be considered, for these applications of learning technologies as well as advanced critical thinking skills will serve the students well in their future careers.

Two references of interest, as used in class:

Smith, H. J., Milberg, S. J., & Burke, S. J. (1996). Information Privacy: Measuring Individuals' Concerns about Organizational Practices. *MIS Quarterly, 20* (2), 167-196. [Their instrument in addition to self-developed items is used for the class survey]

Mason, R. O. (1986). Four Ethical Issues of the Information Age. *MIS Quarterly, 10* (1), 5-12. [The class uses this reference to examine the four main ethical concerns of the information age; see http://www.misq.org/archivist/vol/no10/issue1/vol10no1mason.html]

Anne Bliss, Ph.D.
Senior Instructor
Program for Writing and Rhetoric
317 UCB -- ENVD 1B27D
University of Colorado at Boulder
Boulder, CO 80309-0317 USA
Anne.Bliss@colorado.edu

Kai R.T. Larsen, Ph.D.
Leeds College of Business
University of Colorado at Boulder, USA

An Examination of a Comprehensive Preschool Curriculum and its Impact on Early Literacy Skills in Newark, New Jersey

Abstract

In this independent 2003-2004 study of high-poverty preschools in Newark, New Jersey (This study was independently conducted. The school district represented in this study is not associated with, affiliated with, or endorsed by LeapFrog Enterprises, Inc.), use of the LeapFrog SchoolHouse *Ready, Set, Leap!* comprehensive and technologically-based curriculum significantly enhanced student performance. Classrooms using the RSL curriculum with a high level of program implementation showed significantly higher scores on tests of blending, initial sound identification, and rhyming than did control classrooms. These findings suggest that explicit, thematic instruction is effective in instructing critical phonemic-based skills, thus positioning preschool children to become successful, proficient readers.

Introduction

Preschool programs are increasingly expected to provide explicit instruction in early literacy skills, which have been linked to successful reading (NICHD, 2000). Research suggests that quality of instruction can further impact performance on outcome measures. The *Ready, Set, Leap!* ("RSL") comprehensive and technologically-based curriculum was developed by LeapFrog SchoolHouse (http://www.leapfrogschoolhouse.com) to provide explicit instruction in crucial early reading skills. The *Ready, Set, Leap!*™ program is a research-based, PreK integrated curriculum that is correlated to state standards.

Award-winning multi-sensory and portable technology is infused into each lesson to engage students and address the needs of all learners. The LeapPad personal learning tool, the LeapMat learning surface and the LeapDesk workstation (all elements of RSL) each use technology to bring the curriculum to life.

- The LeapMat Learning Surface is an electronic device that uses touch, sight, and sound to teach letter-name recognition, letter-sound association, and spelling of three-letter words.
- The LeapPad technology is an interactive, multisensory personal learning tools which provides students with engaging instruction and immediate feedback, appealing to all the ways students learn: it enables students to enjoy stories independently, while developing essential vocabulary and pre-reading skills; helps students develop phonological awareness through hearing sounds, words, and sentences spoken fluently; and provides unlimited repetition and practice.
- The LeapDesk technology delivers instruction in letter names and sounds, phonemic awareness, and concept of word. It also motivates students with high interactivity and immediate audio feedback; enables teachers to assess early literacy skills for the individuals and the entire class; and allows students to practice tracing letters on a lighted writing pad. Through the LeapDesk assessments, teachers can track student progress over time; and the LeapDesk prescribes lessons to each child depending on their individual needs.

This study, conducted by RMC Research Corporation ("RMC") (http://www.rmcres.com) with funding from Leapfrog Enterprises, Inc., assessed the effectiveness of *Ready, Set, Leap!* among public preschools in Newark, New Jersey.

Sample

A total of seventeen high-poverty, inner-city Newark public schools participated, and were randomly assigned to treatment or control groups. Classrooms of students with disabilities were excluded. Twenty-seven classrooms were included in this analysis; pre- and post-test scores for 254 students were analyzed. Groups were matched on age, English-language proficiency, free/reduced lunch, and gender. There was a statistically significant difference in ethnicity (Table 1); more minorities in the treatment than control group.

Table 1. Student Demographic Data

Variables	Control (n =125)				RSL (n = 129)				$F_{(1,253)}$	χ^2(df)
	Mean	(SD)	n	%	Mean	(SD)	n	%		
Age	4.53	(0.30)			4.50	(0.31)			.85	
ELL			14	11			20	16		1.01(1)
Free-Reduced Lunch			100	80			112	87		2.14(1)
Ethnicity										24.60(3) ***
Caucasian			30	24			6	5		
African-Am.			46	37			66	51		
Hispanic			40	32			54	42		
Asian-Am & Other			9	7			3	2		
Gender										
Female			66	53			73	57		0.34(1)
Male			59	47			56	43		

*** $p < .000$

Method

Students were pre-tested in October 2002 and post-tested in May 2003. The assessment battery included:

- DIBELS Initial Sound Fluency (Good & Kaminski, 2002)
- DIBELS Letter Naming Fluency
- Woodcock-Johnson III Letter-Word Identification (Woodcock, McGrew, Mather & Schrank, 2001)
- Woodcock-Johnson III Passage Comprehension
- Woodcock-Johnson III Sound Awareness-Rhyming
- Comprehensive Test of Phonological Processing ("CTOPP") Blending Words (Wagner, Torgesen & Rashotte, 1999)
- Peabody Picture Vocabulary Test III ("PPVT") (Dunn & Dunn, 1997)

Measures were individually administered in two sessions to avoid fatigue; the order of the tests was randomized. Both groups were matched at pre-test on all measures of early literacy skills.

Treatment

Control group teachers used only the High Scope framework, which allows children to control their individual learning. Treatment teachers integrated the RSL curriculum into the High Scope framework, conducting individualized assessments to assess students' learning needs.

Result

Main Treatment Effect

To determine whether use of the RSL program resulted in enhanced academic gains while controlling for differences in pre-test scores, a two-level hierarchical linear model ("HLM") technique was employed, with students nested within teacher and the treatment effect tested at the teacher level. As seen in Table 2, no statistically significant difference was found between treatment and control classrooms on any measure, although the effect was consistently in the desired direction.

Table 2. Two-Level HLM Results
Student Performance on Early Literacy Outcome Measures by Treatment

Measure	RSL		Control		ES[a]	ES[b]	Variance Components[c]		T-ratio[d](*df*)	*p*
	Mean(s.e.)	Adj. Mean[e]	Mean(s.e.)	Adj. Mean[e]			Teacher	Residual		
Blending					0.38	0.35				
Pretest	1.95 (.30)		1.68 (.30)				0.514	6.013		
Posttest	4.36 (.61)	4.24	3.13 (.60)	3.18			3.717	10.538	1.39(25)	0.178
Initial Sound Fluency					0.19	0.21				
Pretest	6.25 (.81)		6.57 (.80)				4.753	34.944		
Posttest	11.01 (.91)	11.03	9.64 (.91)	9.58			5.487	50.347	1.22(25)	0.235
Letter-Word Identification					0.21	0.19				
Pretest	6.88 (.70)		6.42 (.69)				4.473	17.757		
Posttest	13.82 (.94)	13.59	12.86 (.92)	12.94			9.134	21.078	.78(25)	0.443
Rhyming					0.20	0.18				
Pretest	2.00 (.23)		1.78 (.23)				0.234	4.570		
Posttest	5.56 (.67)	5.49	4.91 (.66)	4.92			4.694	10.739	.70(25)	0.493
Passage Comprehension					0.11	0.09				
Pretest	4.98 (.21)		4.87 (.21)				0.235	3.048		
Posttest	5.90 (.32)	5.89	5.68 (.31)	5.69			0.795	4.671	.46(25)	0.647
PPVT					0.06	0.01				
Pretest	39.59 (2.34)		38.42 (2.30)				46.481	226.460		
Posttest	57.20 (2.19)	56.73	56.35 (2.15)	56.59			42.483	181.796	.07(25)	0.948
Letter Naming Fluency					0.02	-0.10				
Pretest	7.65 (1.79)		5.86 (1.75)				31.679	88.816		
Posttest	24.46 (2.28)	23.63	24.26 (2.24)	24.76			48.359	175.601	-.48(25)	0.637

1. Results are based on 2-level HLM analyses, with treatment entered at teacher level.
2. None of the "test of pre-test diffferences" are statistically significant ($p < .05$).
ES[a]: Unadj. post M_{RSL} - Unadj. Post $M_{Control}$/sqrt of pooled within-group variance at student level.
ES[b]: $Mean_{RSL}$-$Mean_{Control}$/sqrt of pooled within-group variance at student level, adjusted for pre test differences.
[c]Variance components for pretests and unadjusted posttest scores.
[d]T value for treatment effect, based on 2-level HLM adjusting for pretest differences.
[e]Adjusted post-test mean based on 2-level HLM adjusting for pretest differences.

Effect of Implementation Quality:

A closer investigation of the data suggested that variance in the quality of implementation may have led to this lack of statistically significant main effects. To investigate the effect of program implementation, RSL teachers were grouped according to level of implementation (5 high and 8 low) and were compared with controls using a two-level hierarchical linear model ("HLM") technique (students nested within classrooms). Pre-test scores and level of implementation were treated as covariates. This model was able to account for variability in student-level pre-test scores and teacher-level implementation ratings. This analysis indicated that students in high-implementing classrooms significantly outperformed their control counterparts on the test of blending ability at post-test ($mean_{high}$=6.46; $mean_{control}$=3.18, Table 3). Students in high-implementing classrooms also significantly outperformed controls at post-test on the test of initial sound fluency ($mean_{high}$= 13.79; $mean_{control}$=9.60), and

rhyming ($mean_{high}$=7.12; $mean_{control}$=4.91). There was no significant difference between low-implementing and control classrooms on any of these measures.

Table 3. Two-Level HLM Results:
Comparison of Means by Level of Implementation

Measure	High RSL		Low RSL		Control		ES[b]	ES[c]	Variance Components[d]	
	Mean (s.e.)	Adj. Mean[a]	Mean (s.e.)	Adj. Mean[a]	Mean (s.e.)	Adj. Mean[a]			Teacher	Residual
Blending							1.09	-0.10		
Pretest	2.31 (.49)		1.73 (.38)		1.68 (.30)				0.545	6.000
Posttest	6.76 (.80)	6.46	2.86 (.62)	2.87	3.13 (.48)	3.18			2.006	10.530
Rhyming							0.71	-0.13		
Pretest	2.29 (.38)		1.83 (.29)		1.78 (.23)				0.215	4.584
Posttest	7.27 (1.01)	7.12	4.51 (.79)	4.51	4.90 (.61)	4.91			3.810	10.773
Initial Sound Fluency							0.60	-0.03		
Pretest	6.17 (1.35)		6.31 (1.05)		6.58 (.82)				5.135	34.936
Posttest	13.69 (1.31)	13.79	9.40 (1.02)	9.40	9.65 (.80)	9.60			3.080	50.604
Letter-Word Identification							0.49	0.01		
Pretest	8.42 (1.08)		5.94 (.85)		6.40 (.65)				3.829	17.792
Posttest	15.97 (1.44)	14.60	12.51 (1.13)	12.98	12.85 (.87)	12.94			7.967	21.098
Passage Comprehension							0.35	-0.06		
Pretest	5.26 (.34)		4.84 (.26)		4.89 (.21)				0.234	3.049
Posttest	6.52 (.50)	6.41	5.53 (.39)	5.57	5.67 (.30)	5.69			0.707	4.678
Letter Naming Fluency							0.28	-0.33		
Pretest	11.41 (2.77)		5.34 (2.17)		5.85 (1.67)				28.242	88.915
Posttest	31.57 (3.26)	27.88	20.08 (2.55)	21.04	24.15 (1.98)	24.70			33.332	175.799
PPVT							0.09	-0.03		
Pretest	46.70 (3.42)		35.20 (2.66)		38.40 (2.08)				33.001	226.332
Posttest	62.20 (3.34)	57.55	54.11 (2.61)	56.25	56.32 (2.03)	56.60			35.315	182.229

1. Results are all based on 2-level HLM analysis, with treatment entered at the teacher level.
2. Among the nine "tests of pre-test differences," only that on PPVT was statistically significant, with high RSL teachers scoring significantly higher than Control teachers ($T_{(24)}$=2.07, p=.049).
3. Tests of group differences on the adjusted post-test means are presented in Table 3 (or Tables 3-11).
[a]Adjusted post-test mean, based on 2-level HLM analysis adjusting for pretest differences.
[b]$Mean_{High\ RSL}$ - $Mean_{Control}$/sqrt of pooled within group variance, adjusted for pretest differences.
[c]$Mean_{Low\ RSL}$ - $Mean_{Control}$/sqrt of pooled within group variance, adjusted for pretest differences.
[d]Variance components for HLM analyses on pretest and unadjusted post test means.

Discussion

This study indicates that students using the RSL curriculum with a high level of fidelity outperformed students in control classrooms on key early literacy skills. High-implementing classrooms outperformed controls on word blending, initial sound fluency, and rhyming. Results of this 2003-2004 study indicate that the use of the RSL program fosters early literacy skill development, positioning emergent readers for greater academic success in future years. After one academic year of implementation, children in high-implementing classrooms performed

significantly better than children in control classrooms on the phonological awareness skills that are considered to be strong predictors of reading success in the early primary grades.

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Anne L. Fetter PhD
Chief Statistician and Research Methodologist
LeapFrog SchoolHouse Research
6401 Hollis Street #150 Emeryville
CA 94608 USA
AFetter@LeapFrogSchoolHouse.com

Learning Objects Recommendation in a Collaborative Information Management System

Introduction

In a distributed learning environment there is likely to be large number of educational resources (web pages, lectures, journal papers, learning objects, and so on) stored in many distributed and differing repositories on the Internet. Without guidance, students will probably have great difficulties in finding the reading material relevant for a particular learning task. The meta-data descriptions concerning learning object representation provide information about properties of the learning objects. However, the meta-data by itself does not provide qualitative information about different objects nor does it provide information for customized views. This problem is becoming particularly important in Web-based education where the variety of learners taking the same course is much greater.

Vice versa, the courses produced using adaptive hypermedia or intelligent tutoring system technologies are able to dynamically select the most relevant learning material from their knowledge bases for each individual student. Nevertheless, generally, these systems can't directly benefit from existing repositories of learning material (Brusilovsky & Nijhavan, 2002).

This paper provides a contribution to this issue. The basic idea is to appropriately gather different agent-based modules which would help students classify domain specific information found on the Web and saved as bookmarks, in order to recommend these documents to other students with similar interests and to notify periodically new potentially interesting documents. The system is developed to provide immediate portability and visibility from different user locations, enabling the access to personal bookmark repository just by using a web browser. Detailed information about technical characteristics can be found in (Bighini & Carbonaro, in press; Bighini et al., 2003).

Recently, learning objects (LO) have been the center of attention in e-learning mechanisms and designated as atomic units of knowledge (Wetterling & Collis, 2003). In particular, learning object metadata tags facilitate rapid updating, searching and management of content by filtering and selecting only the relevant content for a given purpose. Searchers can use a standard set of retrieval techniques to maximize their chances of finding the resources via a search engine (Recker & Wiley, 2001).

Our collaborative filtering approach supports the automatic recommendation of relevant learning objects.

In this context, standard keyword search is of very limited effectiveness. For example, it cannot filter for the type of information (tutorial, applet or demo, review questions, etc.), the level of the information (aimed at secondary school students, graduate students, etc.), the prerequisites for understanding the information, or the quality of the information.

The starting point is the use of statistical information extraction and natural language parsing techniques to automatically derive classificatory and metadata information from primarily textual data (web pages, Word, postscript or similar documents, etc.). While still challenging for large ontologies, text classification methods which semantically categorize an entire document are now relatively well-understood, and provide a good level of performance.

The next paragraphs describe how to extend the described recommender system to address issues like trying to determine the type or the quality of the information presented in the personalized learning environment.

The paper is organized as follows. We introduce the learning objects recommendation process, obtained considering student and learning material profiles and adopting filtering criteria based on the value of selected metadata fields. Following, we present the conclusion of the paper.

The E-Learning Recommendation

The automatic recommendation of relevant learning objects is obtained considering student and learning material profiles and adopting filtering criteria based on the value of selected metadata fields. Our experiments are based on SCORM compliant LOs. For example, we use the student's knowledge of domain concept to avoid

recommendation of highly technical papers to a beginner student or popular-magazine articles to a senior graduate student. For each student, the system evaluates and updates his skill and technical expertise levels. The pre-processing component developed to analyze the information maintained in LOs is able to produce a vector representation based on term weighting that can be used by described collaborative recommendation system.

To obtain the loading of some didactical source and its classification, we analyze the imsmanifest.xml file to extract .htm and .html files and examine the content. We consider the following metadata to provide the corresponding technical level:

- difficulty: represents the complexity of the learning material, ranging from "very easy" to "very difficult";
- interactivity level: represents the interactive format, ranging from "very low" (only static content) to "very high";
- intended end user role: represents the user type (for example student or teacher);
- context: represents the instructional level necessary to take up LO.

The difficulty level is explicitly loaded into our database (in most cases, LMSs use this value). Difficulty and the other values are combined to characterize technical level of learning material ranging from 0 to 1 and representing how demanding is the LO. If some of these fields are not present in the manifest file (they are not required), we consider their average value.

Our system also considers the user's skills to express cleverness as regards different categories. This value ranges from 0 to 1 and it depends initially on the context chosen from the user during his/her registration (primary education, university level, and so on). During the creation of a new category (for example, when a lesson is saved) we consider the user's skill value equal to the resource technical level, presuming that if a user saves a learning material then he could be able to make use of it. The user's skill level is updated when a new resource is saved, taking into account its technical level and the user's skills in that category. Starting value for user's skills parameter, its update frequency, the increment or decrement value and the difference between technical level and user's skills necessary to obtain a recommendation outcome from the following experimental tests. They are easily adaptable, though.

Despite SCORM is widely used in learning environments, it presence in the web is very little; furthermore, most of the LOs that are published are not free. So, we have created a SCORM compliant learning material using the abstract of hundred and hundred of papers in .html version from scientific journals published on the web. We have linked an imsmanifest SCORM file to each paper. Then, we have simulated ten users with different initial profiles (based on the field of interest and the skill level) and saved, in four turns, ten learning resources for each user, obtaining 400 LOs.

The precision of recommendation phase, evaluated considering the resource difficulty and the user's skills, exceeds 80%. It is important to note that the recommendation is made using skill and technical levels (the resource difficulty is one of the parameters, even if the most meaningful); in fact, users rarely know the technical level of a recommended resource; they rather know about its difficulty. Moreover, the categories of recommended learning material correspond to the user's interests, in almost all of the tests carried out.

Considerations

The paper describes how to extend a collaborative recommender system in e-learning framework, addressing issues like trying to determine the type or the quality of the proposed information. The automatic recommendation of relevant learning objects is obtained considering student and learning material profiles and adopting filtering criteria based on the value of selected metadata fields. Our experiments to test the system's functionality are based on SCORM compliant LOs; we use artificial learners to get a flavour of how the system works.

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Antonella Carbonaro
Department of Computer Science
University of Bologna
Mura Anteo Zamboni 7
I-40127 Bologna, Italy
Tel.: +39 0547 338830
Fax: +39 0547 338990
carbonar@csr.unibo.it

Designing Learning Objects in Electronics Engineering Education

1. Introduction

Internet and related technology have been used engineering education. Many of these institutions also supplement regular classroom teaching with additional Web based material [1-5]. Engineering education have a complex structure. Teaching these concepts with scarce sources to students is difficult for instructors as well [6]. To address problems in teaching of electronics engineering, we have developed a many learning objects have been prepared for teaching fundamental topics in Operational Amplifiers. In this study, we will present the learning objects prepared for electronic engineering education. In addition, others animations that can be found on the Internet will be shown.

2. Designing Learning Objects in Operational Amplifier

Operational Amplifiers (Op-amps) are a basic building block in many linear and non linear signal processing operations. Therefore both electrical engineers and electronic teachers must know the basics of them, going from circuits based on op-amps modelled ideally to circuits with op-amps using more realistic non ideal models. Unfortunately, many electrical engineering undergraduate curricula do not have a full course devoted to teaching op-amp circuits. There are many reasons that account for this fact. The number of topics to teach at the undergraduate level has increased considerably during the last several years. Thus, educators have to squeeze or leave out some topics. This is the case with op-amps, which are now taught within the linear electronics course.

This application covers the main topics on operational amplifiers (op-amps). These main topics cover only some applications of op-amps. This is so because there is a great deal of applications available for op-amps. Basic Configurations; The three basic op-amp configurations, namely, the inverting amplifiers, the non-invert. amplifier, and the difference amplifier (see Fig 1-3).

Macromedia Flash software is a tool for creating Learning objects. Interaction is achieved through the use of Flash's scripting language. This language makes it possible for LO to detect user input such as mouse or keyboard events and respond with scripted actions. This tool was the primary technology we used to create interactive components [4].

The module on operational amplifier provides a practical solution to learning problem. This module includes six simulations illustrating the different configurations operational amplifier (inverting, noninverting, follower, multiple input, differential, and instrumentation amplifier).

On learning objects, Op-Amp's input voltage feedback and input resistance can be adjusted with the arrows on it. After all, a test page which consists of questions related to random values assigned and having various connections operational amplifier circuits comes next (see Figure 1-3).

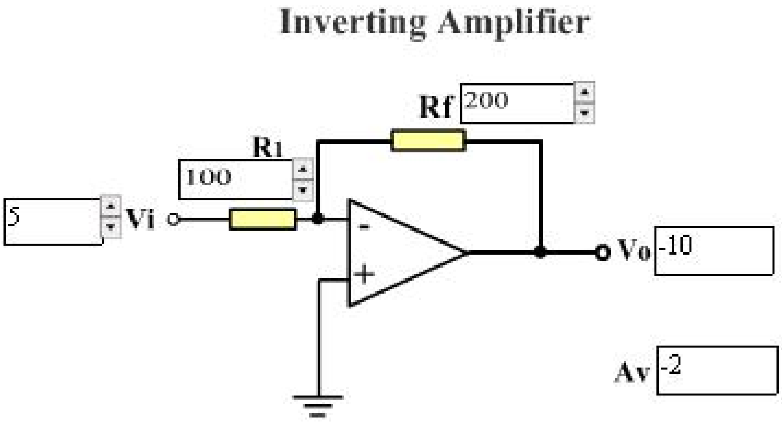

Figure 1. A screen shot of inverting amplifiers

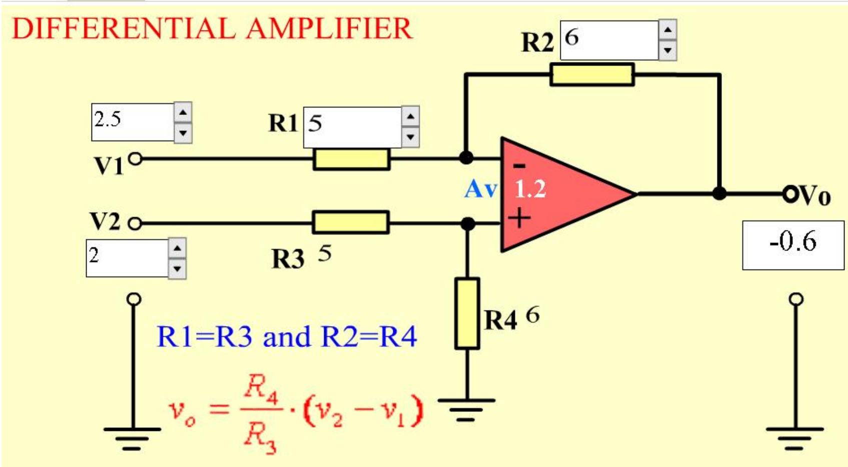

Figure 2. A screen shot of differential amplifier

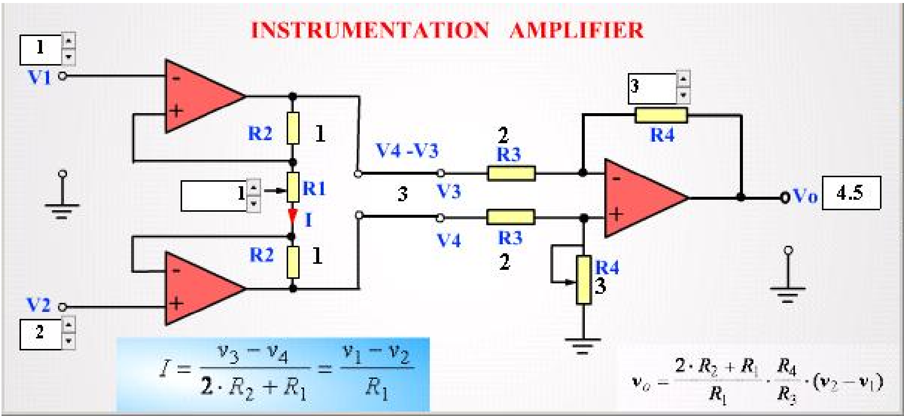

Figure 3. A screen shot of Instrumentation amplifier

In Figure 4 shown that one of the most used connection types on Instrument is the instrumentation amplifier.

3. Conclusion

These learning objects enable educators to provide a learning environment beyond the bounds of the classroom either to supplement their in-class teaching or as part of a distance learning course. These applications include the inverting amplifier, the noninverting amplifier, the follower, multi input amplifier, differentiator amplifier, and instrumentation amplifier. Thus, what was unreasonable in class is now very reasonable through animation technology.

We believe the learning objects improve the effectiveness of learning is the opportunity for greater student engagement during study. Many of the lessons in the LO present the material with interactive components that are more engaging than traditional textbook reading. The LO modules improve the effectiveness of learning is the informal responses we have received from students using the modules. Nineteen undergraduate students enrolled in Operational Amplifiers Course (Department of Electronic and Computer Science, Mugla University,) were asked for their opinion of the Learning Objects which was accessible from the class web site. The students unanimously agreed that the lessons and animations explaining the operational amplifier and the inverting amplifier model were more helpful than reading the textbook alone.

For more information these Learning Objects http://www.mu.edu.tr/private/ayhan/lo/opamp/

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Ayhan İstanbullu
Department of Electronics and Computer Education,
Faculty of Technical Education, Mugla University, Mugla, Turkey
iayhan@mu.edu.tr

İnan Güler
Department of Electronics and Computer Education,
Faculty of Technical Education, Gazi University, Ankara, Turkey
iguler@gazi.edu.tr

When schools closed: teacher experiences using ICTs

Introduction

In 2003, a sick physician from mainland China brought to Hong Kong a deadly virus that was to spread fear throughout the territory and the rest of the world. By May 2003, the Severe Acute Respiratory Syndrome or SARS had infected 1755 people in Hong Kong and claimed 304 lives. It spread rapidly via international air travel from China to many cities across the world, resulting in over 8000 cases of infections and 774 deaths.

Schools in Hong Kong were closed suddenly to prevent the spread of SARS. Teachers had to re-think their teaching strategies and provide their students with new and different opportunities to work through curriculum requirements. This paper focuses on how some teachers coped with the schools' closedown and their use of ICTs to support student learning.

The participants

Sixty teachers were asked in a survey to describe what happened in their schools over the period of school closures and what use, if any, ICT played in the continuation of student learning during this time. Eight teachers were then purposively selected for interviews to gain insights into the participants' experiences of ICT use during the school closure and to discuss possible longer term impacts SARS has had on their schools.

The participating teachers interviewed held widely differing attitudes towards new technologies and their role and impact. Their views ranged from enthusiastic 'technophiles' through cynics to 'technophobes' and many stances in between (Bruce, 1997; Fox & Herrmann, 2000). In general, there was some unease and a sense of insecurity caused by a lack of familiarity with technologies and their purpose in education and the impact of change itself, creating doubts and suspicions about new technologies.

Interview outcomes

The sudden closure of the schools during SARS, left most teachers unprepared. 'Due to timetable commitments on the final day before closedown, form teachers did not see all their students. … some parents had already kept their kids at home, fearing SARS infection at school … .' said one teacher. Few schools offered clear directives to teachers and few teachers felt they had the necessary skills or experience to successfully switch from everyday face-to-face teaching to alternative environments (distance education strategies, the Internet, phone, ordinary post, etc.). Several teachers noted that they felt 'stunned' by the sudden change of events. "We just weren't prepared for this emergency … and we had not had appropriate training to use the Internet …' Though all teachers in Hong Kong had attended training courses on using ICTs, most felt unable to use this digital environment as the dominant medium to work with. 'We'd had some experience of using ICTs in class, but this situation was totally new and threw us into a totally different way of thinking about teaching and learning'.

For some teachers interviewed, new technologies offered new opportunities to 'warehouse' content, a strategy not often used prior to SARS. From comments made in the interviews, it was apparent that there was a tendency to try to do too much during this period and to use the new digital technologies to deliver large amounts of additional study materials, resources and information for students.

It is clear from the interviews that handling new ways of communicating between staff and students during SARS was not straightforward. All teachers interviewed, whether they saw the new ICTs as an opportunity or a threat, agreed that the SARS closedown had highlighted the fact that there was much that still needed to be learnt about using the technologies appropriately.

Out of the eight teachers interviewed, most felt that there were advantages in working with the new technologies, though the kinds of opportunities available differed greatly between longer term experienced users of ICTs and novice users, and from subject to subject. The SARS induced close down was certainly an opportunity for those willing to experiment with using ICTs to do so intensively, but the fact that the schools closed down so quickly meant that proper preparation time for ordered use of ICT was limited.

Discussion and conclusions

The SARS crisis provided a catalyst for intensive ICT use. Teachers were inducted faster than they liked or thought possible into ways of using ICTs. This period highlighted both the problems and the potential of different ICTs as channels for teaching and learning. Teachers who used the technology during SARS were forced to think differently about ICTs. Discoveries made during SARS have continued to shape and inform subsequent ICT use. This period of ICT use brought to teachers' attention that these technologies are not pedagogically neutral nor necessarily passive (Idhe, 1990; Levy, 1997), nor are they necessarily appropriate for substituting one form of delivery for another (Bromley, 1998).

Most of the teachers interviewed wished to build on their experiences with using ICT's during SARS and identified the provision of a school based, on-the-spot level of technical support as key to their continued motivation to do so in an already packed working schedule. This type of technical support is essential to teachers in terms of setting up and maintaining collaboration via the Internet for example, and making sense of and remembering procedures at a time when they genuinely need to apply them. They need to learn technical strategies for using ICTs to maximize students' participation and making better use of class time. Clear guidelines need to be set and made explicit and routines established for viewing and responding to emails so that expectations are realistic and can be met without overloading teachers.

In addition students need also to be inducted into the use of ICT's in order to optimize the potential of their learning experiences in this mode and their efficiency in using it. Consistent with current curriculum directions the use of ICT's provides an imperative for guiding students towards developing more independent learning strategies in terms of how to set their own goals in relation to those defined by their teachers, how to search for and select information appropriate to achieving those goals, how to work collaboratively using ICT's with peers and teachers and how to evaluate their own progress and edit outcomes. This impacts also on the current, very exam orientated system of assessing students which compels teachers and students to cover a lot of content, often at the expense of leaning how to learn. In line with current curriculum directions the use of ICTs provides a context for moving away from the examination system towards a more holistic, ongoing form of assessment of work done online or otherwise as well as in portfolios etc. thus putting emphasis on the process as well as the product of school work and in turn freeing teachers and students from the imperative of covering the content of the exam syllabus to focusing on more developmental, student friendly ways of working in the classroom and online. This would allow teachers and students more time for the 'radical ways of teaching and learning', described by one teacher in this study, " that this technology seems to support well".

The interviews with these teachers revealed conflicting views and beliefs, and varied experiences and concerns about the new technologies in educational settings. There is no single level of knowledge or ability in using new technologies, and there can be no single voice from those teachers interviewed. What did became clear as a result of ICT use by teachers and students during SARS was a more intense and reflective examination of the opportunities the technology offered, and its impact on education in Hong Kong.

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Robert Fox
Associate Professor
Division Information & Technology Studies
Faculty of Education, University of Hong Kong
Pokfulam Road, Hong Kong, SAR
China
bobfox@hku.hk
Tel: +852 2859 8014
Fax: +852 2517 7194

E-CaD: A New Curriculum Model at the University of Phoenix

Introduction

Distance educators are always interested in major instructional developments at the University of Phoenix (UOP). Recently, UOP has launched a new online educational design model know as E-CaD (Enhanced Curriculum & Delivery Model). My discussion will highlight the major features of E-CaD as it relates to the teaching and learning process.

Educational Background

The University of Phoenix (UOP) is recognized as a leader in adult education. The institution was established in 1976 and serves a student population of over 213,000 students who are involved in on-ground and online classes. The consolidated enrollment of its educational programs makes it the largest private higher education organization in the United States. Students can attend classes online and on-ground at 151 campuses that are located in 25 states, Canada and Puerto Rico. The average student age is 34 years old and 56% are females and 44% are males (UOP Fact Book, 2004).

A core of 347 full-time faculty members provides essential leadership by establishing academic standards and supervising curriculum development. Approximately 17,000 adjunct teachers (4, 000 online) are actively engaged in teaching a diversity of undergraduate and graduate degree programs (UOP Fact Book, 2004). The University is considered an innovative institution that has increased access to higher education while reducing the costs of developing online degree programs by:

- using a centralized course development process to ensure quality control and reduce development costs;
- effectively using educational technology to deliver the same curriculum to more students;
- providing flexible access to classes (Twigg, 2001).

The University of Phoenix has been criticized for using a curriculum based on uniformly prepared instructional materials. Educators are concerned that the curriculum restricts teacher creativity and lacks intellectual rigor (Breen, 2004; Farrell, 2003). University leaders respond to this issue by stressing that the curriculum is carefully developed for their degree programs. UOP utilizes a team of faculty members, curriculum managers and instructional designers who develop courses based on the latest theory and practice. Teachers can integrate their subject expertise into their courses through lectures, handouts and online discussion comments which help to personalize the learning environment.

Rationale For Implementing E-CaD

The University of Phoenix strives to be innovative in their online design and delivery of online education. UOP educators and administrators have been studying how to make their delivery model more efficient without sacrificing academic rigor. A real issue became one of scalability because the institution had to find a better way to accommodate more students. Additionally, it is a for profit organization which has to be sensitive to stockholder concerns about the potential for future growth in their online degree programs.

UOP has frequently promoted their small class sizes in their literature. Swenson (2001) states “the low student/faculty ratio and class sizes that average 13 students facilitate active learning and collaboration, encourage time-on-task, and foster high student-faculty interaction” (p. 5). University officials relate that the majority of today’s major distance education schools often have at least 20 or more students per class. Therefore, the curriculum changes represent a major response to market factors which have help to prompt these changes. E-CaD is an instructional format that has been created to enable instructors to facilitate a class size of 20 students (E-CaD, 2004).

The University has been testing various online delivery systems and E-CaD represents the culmination of their research and pilot studies. It is a creative design that has retains an emphasis on essential student skills and subject knowledge but enables instructors to handle larger classes. E-CaD has the following key features:

Student Academic Expectations

- students actively participate with substantive remarks in online discussions 4/7 days a week (previously 5/7 days)
- final week of class has optional student participation in online discussions (previously students participated all weeks of course)
- weekly summaries are optional (previously these were required)

Faculty Academic Expectations

- provide detailed syllabus (change only in specific E-CaD details)
- share two weekly online discussion questions (previously 3-6 questions)
- freedom to assign weekly online discussion questions to learning teams (previously dialog questions created only for individual students)
- share weekly lectures can be optional if course has weekly overview of material in rEsource
- respond to student comments 5/7 days in online discussions (no change)
- share weekly grade reports with students (no change) (E-CaD, 2004).

The E-CaD model is currently being phased into the various online classes which will require careful modification of the curriculum to fit this new format. UOP facilitators are naturally a little anxious about increased class sizes and the impact that it will have on their work load. The author has taught two online classes (US history & film studies) under the new model and has found that students are actually sharing at least five days a week. Also, grading papers and responding to students online has been quite manageable and no more time consuming. Instructors must be careful to sustain good online presence with more students in their classes. The key is to daily share relevant messages in the main newsgroups and relate to all of the students during each week of class.

Conclusion

E-CaD represents important changes in the delivery of online courses at the University of Phoenix. It affirms a distance education trend of having larger classes to meet the growing demand for online degree programs.

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Brent Muirhead D.Min., Ph.D.
Lead Faculty, Area Chair
GBAM Business Communications (Atlanta, Georgia)
University of Phoenix, USA
bmuirhead@email.uoiphx.edu

Teamspace: An Innovative Workspace for Collaborative Academic Computing

Abstract

As personal computer ownership among university students has increased in recent years, university administration are now faced with the challenge of providing value-added computing facilities for their constituents beyond basic access.

Enter the group workspace aiming to promote teamwork and collaboration across machines, location, and time. Unfortunately, many such group workspaces developed thus far have been impractical either due to cost or difficulty of use. Teamspace is a prototype for a public interactive learning workspace designed to be easy for novice users to understand and learn. It addresses the challenges of economics, installation, recovery, robustness and reliability in a way that simplifies and empowers the group work user experience.

Introduction

In many environments, such as universities, widespread individual laptop ownership has fundamentally changed how and when individuals use computers, thereby transforming the notion of a public computer space from that offering computer access to one that provides group workspaces involving a number of diverse devices, operating platforms, and media. The challenge, then, is to provide infrastructure for collaboration among team members using data and computing resources on separate computers working together on a single task.

Building further on our previous Interactive Room Operating System (iROS) [2,5], the Stanford University iWork Research Group has developed Teamspace, an innovative workspace for collaborative learning. Teamspace facilitates collaboration through one or more large displays visible to all group members, representing the notion of a "public desktop," together with two iROS components, PointRight [3] to control the public desktop from any connected laptop computer, and Multibrowse [4] for filesharing, all in a relatively simple software program that is easy to both install and use.

Modes of Collaboration

Traditional efforts at collaboration using traditional paradigms generally result in one of two outcomes: 1) group members crowd around a single computer where only some can view the screen and only one can control input devices, or 2) group members divide the workload, then proceed to work in isolation on their own computers, sending results to a single person designated to compile the disparate results. In contrast, an effective system provides both shared and private spaces. IROS achieves this with the following:

(a) *Event Heap*. General framework for managing events.

(b) *PointRight*. Pointer redirection that enables a pointing device on any machine to serve as a pointer on any other. In the context of Teamspace, PointRight is used to control the public desktop from any connected laptop computer.

(c) *MultiBrowse*. Multibrowse enables any file or URL from one machine to be actively "pushed" onto the display of another.

Transforming the User Experience

The original iROS framework require extensive and expensive installation and maintenance by highly technical staff, which can be a prohibitive overhead for widespread adoption. Teamspace builds upon iROS, extracting key components in a simple, easily configurable, cross-platform end-user application requiring little or no technical administration or maintenance.

Installation and configuration

The user experience of installation is designed to be straightforward and simple.

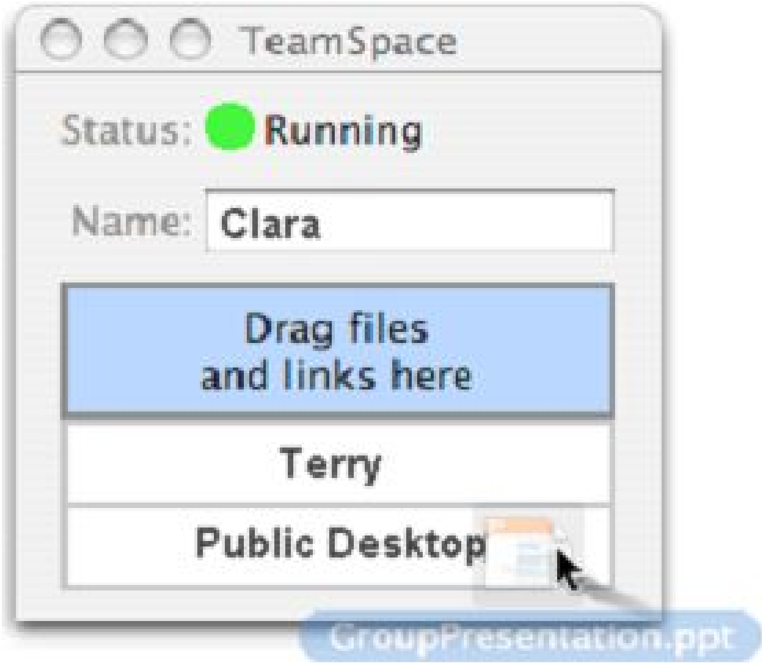

Figure 1. Dragging and dropping file or URL icons into the Teamspace window will cause them to be multibrowsed to the corresponding destination machine, which may be one of laptops connected to the space or the public desktop itself

User Studies

In order to learn how university student users utilized and responded to Teamspace, we conducted user studies on fifty undergraduate students representing a wide range of technical and non-technical majors, all with no prior experience using iROS:

i) "Random." Teams of three to four paid volunteers were arbitrarily formed and given a specific group task

ii) "Existing." Previously formed student teams working on real, existing group projects for courses, student clubs, etc.

Random Groups

We were surprised at the quantity of time participants spent offline getting to know one another and formulating ideas verbally. Users tended to work relatively independently, only collaborating at the beginning (to divide the work) and end (to compile the work) of the study session. During these moments of collaboration, they tended to multibrowse to the public desktop (and not each other) only.

Existing Groups

Participants from existing groups, sharing a common external purpose and already familiar with one another, were much more apt to collaborate, not only on the project at hand but also in learning the Teamspace technology. These users tended to multibrowse throughout the session both to the public screen and to one another's laptops. One unexpected result was that multiple sends from different sources sometimes resulted in loss of information or communication.

These participants felt considerably more comfortable vying for the group screen pointer, resulting in increased collaboration on the group display and a more frequent switching between private and public workspaces.

Figure 2. Stanford students using Teamspace

Conclusion

Based on these preliminary studies and public student use at Stanford, we believe Teamspace has great potential of serving as a viable next-generation application for academic computing facilities. In particular, we believe Teamspace's zero-administration operation, low cost, ease of use, and compelling interaction modes make it ideal for collaboration especially in academic learning environments.

Acknowledgements

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Clara C. Shih, Armando Fox and Terry Winograd
Computer Science Department, Stanford University
Stanford CA, USA
Tel: +1 847 722-9542
cshih@cs.stanford.edu
fox@cs.stanford.edu
winograd@cs.stanford.edu

Field-Report of the Java Intelligent Tutoring System

Abstract

The Java Intelligent Tutoring System (JITS) was designed and developed to support the growing popularity of the Java programming language and to promote web-based personalized education. While most ITS require the teacher to author problems with corresponding solutions and navigate the student towards specific pre-determined solutions; the Java Intelligent Tutoring System fully supports individual student development by "intelligently" guiding the student as s/he pursues a solution. JITS is designed with a revolutionary user-modeling system and an embedded logic module called JECA (Java Error Correction Algorithm) [1]. JECA determines the "intent" of the student's code submission by rigorous scanner-parser analysis [2]. JITS was designed for entry level College and University students and is currently being field-tested at the Sheridan Institute of Technology and Advanced Learning by students in the School of Applied Computing and Engineering Sciences, Ontario, Canada. This paper presents the findings of the field-report including qualitative and quantitative investigation results.

Introduction

JITS is a fully implemented web-based multi-user multi-threaded distributed ITS. Figure 1 depicts the significant components of the infrastructure. JITS models the user and tracks all interactions between the ITS and the student to an ORACLE database [3]. This information is examined by JITS to develop a precise cognitive model for each student in the system [4]. This in turn provides information that JITS can use to effectively tutor the student.

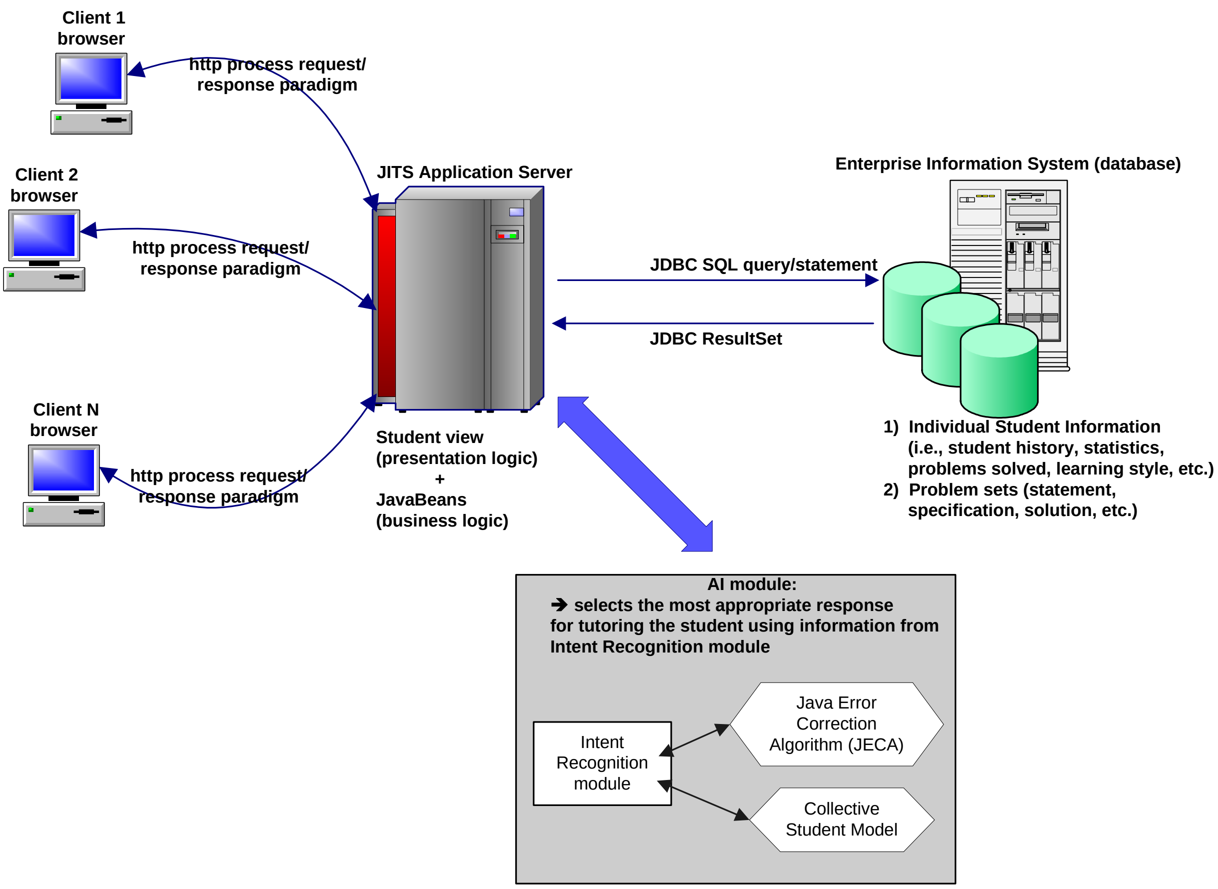

Figure1. JITS multi-threaded distributed web-based infrastructure

The user interface is based on a presentation format implemented in many popular Integrated Development Environments used by professional programmers (e.g., Visual Café, JDeveloper, etc.). The JITS user interface is presented in Figure 2.

The core module for analysis is the Java Error Correction Algorithm (JECA). This unit provides the necessary information the ITS to model the user and to effectively tutor the student. The goals JECA are to:

i) intelligently recognize the 'intent' of the student;
ii) analyze the student's code submission;
iii) 'auto-correct' where appropriate (e.g., converting "While" into the keyword "while", "forr" into "for", etc.);
iv) learn individual students' misconceptions, and categorize the types of errors s/he makes;
v) produce a 'modified code' that will compile (or bring the code closer to a state of successful compilation);
vi) produce a 'modified code' that will meet the program specifications (or bring the code closer to meeting program specifications); and
vii) prompt the student programmer for information when necessary via well-defined hint support structures.

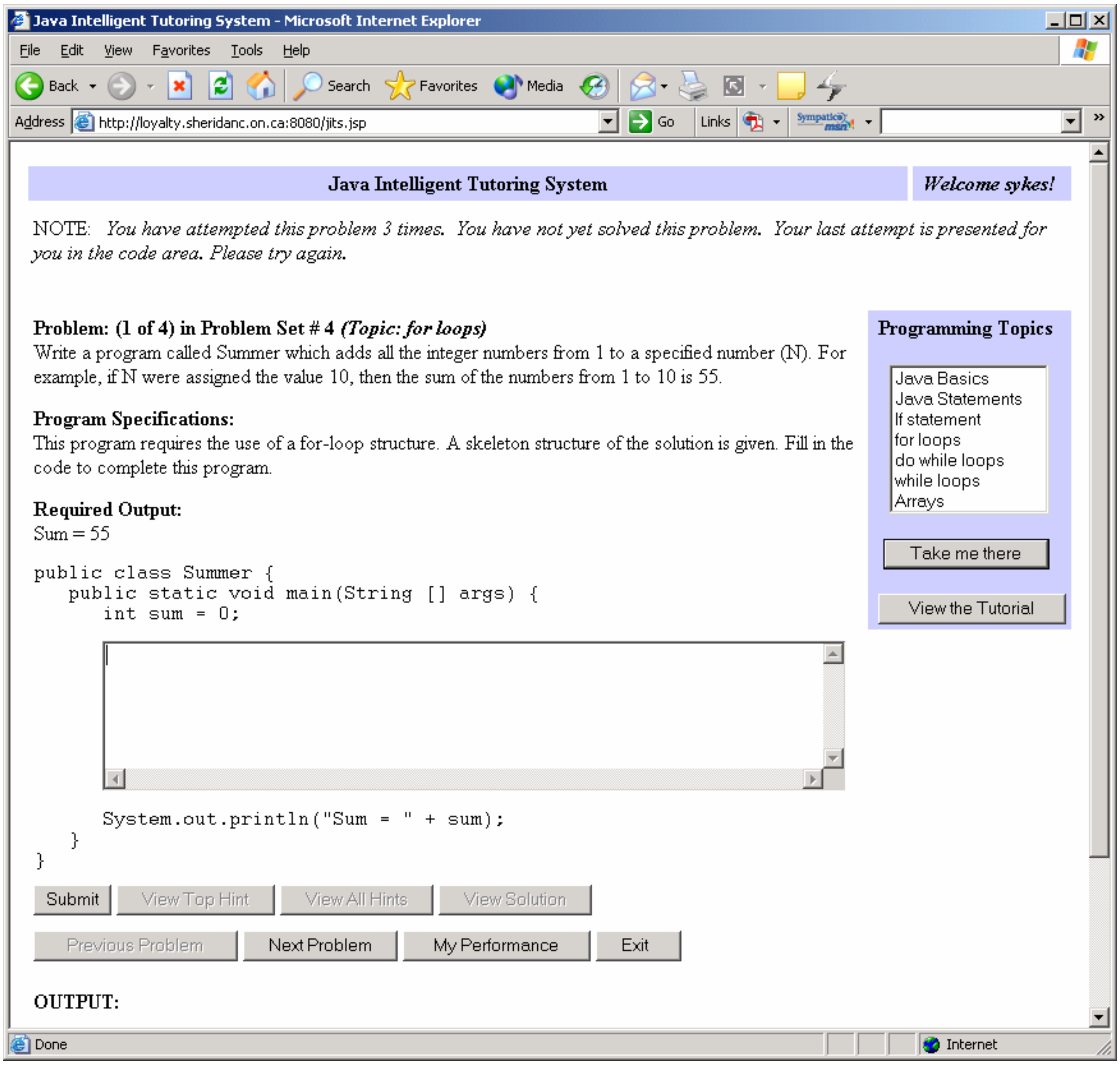

Figure 2. JITS User Interface

JITS intelligently examines the student's submitted code and determines appropriate information that needs to be used by the ITS feedback mechanism based on a number of factors such as the student's skill, the cognitive model of the student, collective student model and problem details.

Methodology

The methodology employed in this research project is supported by two distinct research components. The first component is related to the manner in which JITS was designed and constructed. In this research section, students and professors using the prototype JITS offered suggestions and comments for the improvement of JITS. The new knowledge was fed back into the re-design and re-construction of JITS. Beyond the initial development of JITS a cyclic process was used: design, develop, test, modify, re-design, re-develop, etc. This research methodology involved qualitative instrumentation including observation, surveys and personal interviews.

The second component of the methodology is related to the manner in which JITS was evaluated. In order to determine the degree and quality of learning that took place by students using the Java Intelligent Tutoring System, a quantitative investigation on performance scores was conducted. The research methodology for this section involved performing a pre-test for the Control Group (i.e., C) and the experimental group (i.e., JITCS) at the beginning of the term and a post-test to both groups at the end of the term. Thus, the methodology was an experimental design with repeated measures. Participants in the JITS class also served as their own controls. As a result, the researchers were able to compare pre-test and post-test performance differences as well group differences (i.e., C versus JITSC).

Participants

The population of this study were students in their first year of College taking a beginner Java programming course at Sheridan College. From May to September 2004, there were two classes of this course. The experimental group was located at the Davis campus (i.e., JITCS). The control group was located at the Trafalgar Road campus (i.e., C). Fourteen students consented to try the Java Intelligent Tutoring System. Every week ½ to 1 hour long sessions were conducted to elicit specific information about their experience while using JITS. JITSC students had continuous access to JITS as it was available 24/7. Additionally, four professors were selected for this study to offer their opinions on JITS.

Conclusions

Table 1 presents the descriptive statistics for C and JITSC. The students who used JITS outperformed the students in the traditional classroom. A two-way ANOVA with repeated measures was conducted confirming these results, $F(1,35) = 4.162$, $p = .049$, indicating there was a significant statistical difference in performance scores between the two groups. Table 2 presents these statistics. Figure 3 represents a visual plot of the differences between C and JITSC. Both researchers are very excited about the success of JITS to increase student performance in this field-test. Ongoing field-tests are being conducted and others are scheduled for January 2005.

Table 1. Descriptive Statistics for C and JITSC

	Group	Mean	Std. Deviation	N
Pre_Test	C	61.91%	12.52	23
	JITSC	64.93%	15.17	14
Post_Test	C	66.25%	16.79	23
	JITCS	80.73%	6.75	14

Table 2. Two-way ANOVA with Repeated Measures: Between-Subjects Effects for C and JITSC

Source	Type IV Sum of Squares	df	Mean Square	F	Sig.
Intercept	326268.963	1	326268.963	1020.396	.000
Group	1330.710	1	1330.710	4.162	.049
Error	11191.161	35	319.747		

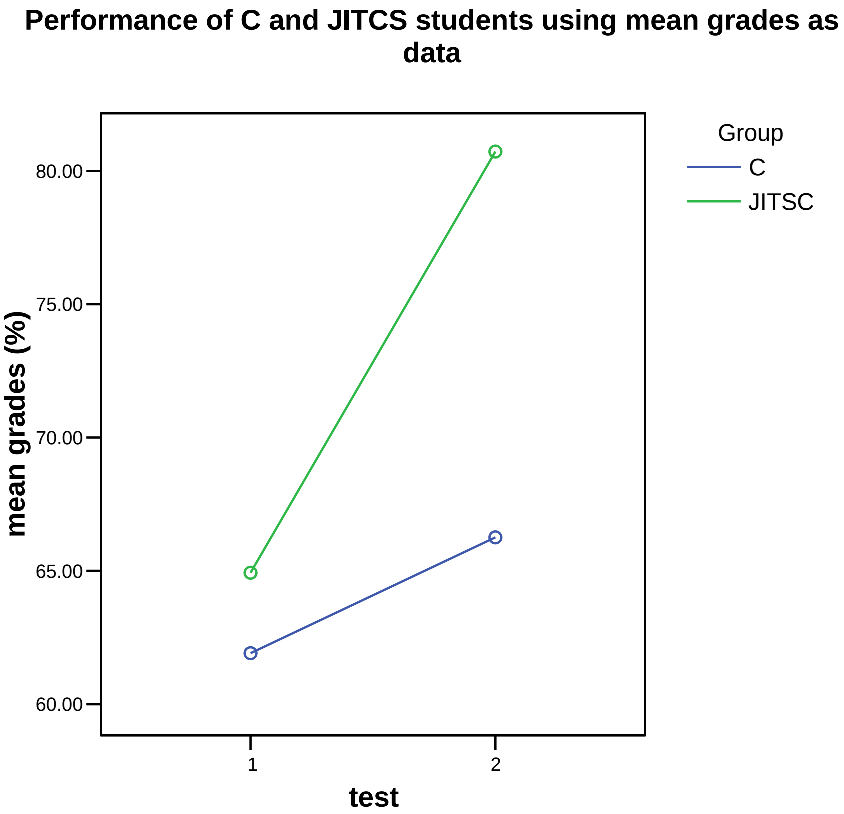

Figure 3. Performance of C and JITSC students using mean grades as data

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Edward R. Sykes
School of Applied Computing and Engineering Sciences
Sheridan College, Ontario, Canada, L6H 2L1
ed.sykes@sheridanc.on.ca

Franya Franek
Department of Computing and Software,
Faculty of Science,
McMaster University,
1280 Main Street W., Hamilton,
Ont., Canada, L8S 4L8
franek@mcmaster.ca

Use of synchronous Virtual Class in industrial environments to contrast Web-Based Training (WBT) drop out rate

eLearning (intended in particular as WBT) has, since its appearance, been regarded as the "magic" solution for employees training in a fast changing and challenging Global Economy environment.

In fact eLearning can respond very well to the following strategic needs:

- Reach vast employee population
- Allow Just In Time and Just Enough training experiences
- Maximize efficiency in the training delivery (logistics and time)
- Standardization of content
- Consistent tracking and reporting of training results

However, after the first wave of enthusiasm, eLearning initiatives have often suffered high drop out rates compared to the traditional classroom training.

The problem, for companies willing to utilize eLearning, is therefore to make sure that the investment made to deploy eLearning is utilized effectively.

In our experience we found two main issues causing high drop rate for eLearning within an industrial/enterprise environment: Time and Motivation.

Time

Time is nowadays a critical asset for both employees and company; the increased working efficiency necessary to fight the challenges of the Global Economy, doesn't leave much time free for training; it is also very difficult, in general, to find suitable time to access eLearning material during the work time (urgent activities or disturbances by colleagues and telephone calls easily disrupt people's focus from training).

Does this mean that eLearning will never be effective in a working environment?

I believe that, in order to overcome the Time issue, Learning must firstly become a recognized and visible value across the full "chain of command" of the Enterprise. Time for training can only be found when Top Management recognizes in public that employee development is a strategic activity for the Company and when Middle Management promotes the value of the training by setting objectives and goals for the people which also include the development of personal skills.

Motivation

Motivation for training can be mainly defined as two types:

- Self motivation, when a person is willing to develop himself further for attaining job or personal related objectives
- Environmental motivation, meaning that the environment where one lives or works requires the acquisition of new skills or update of present ones

eLearning and WBT in particular, can work well with people bearing the first type of motivation as it requires a lot of self responsibility and a very good management of one's own time. The person who is self motivated will be willing to use even available free time to access learning material and will be focused to reach the learning objectives.

The second type of motivation is, unfortunately, of wider occurrence when dealing with employees training; examples of needs could be new processes to be applied in the Company, Project Management, People management, deployment of new software tools and so on.

In this case we have to design the eLearning experience very carefully in order to reach the desired effectiveness.

How can eLearning, with adequate support, become more effective

We have noted that people have a natural preference for traditional classroom training mainly for the following reasons:

- Time off the job: The training experience is rewarding as it is detached from the daily routine; people like to join a class, and concentrate on learning in a comfortable environment
- Social environment (Classmates and Instructor) boost motivation to learn and share experiences: people learn that other people might face similar problems and can be guided and motivated in learning by skillful instructors

These considerations have led us thinking that if we could in some ways "Socialize" the eLearning experience we could attain an increase of motivation for the students to reach completion of their training programs.

We have therefore focused on 2 main subjects:

- The concept of Class as a social environment (the group)
- The need for an effective communication tool that takes into account natural interactivity among people (social interaction)

The use of a synchronous Virtual Class has proven to be a very good solution; we have chosen specifically a tool that supports Voice over Internet in order to reproduce the kind of natural interaction that develops among the students and with the teacher in a traditional classroom environment.

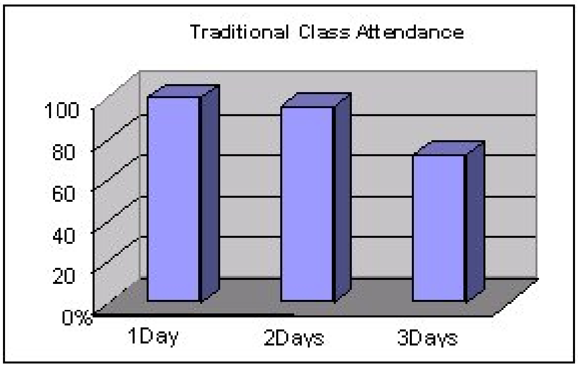
The sense of belonging to a group can be obtained by gathering all the people together, at the beginning of the course, in a session where they can get in touch with the instructor and eventually with personal tutors; they can also introduce themselves and interact with classmates.

WBT can be used more effectively after the group is formed and when reference figures or Subject Matter Experts are associated to them. (Experts from inside the Company are very welcomed as they can continue to be a reference point when the course is over.)

Instructors and "Experts" can then organize Virtual Class sessions where they re-group the class and discuss or reinforce specific subjects of the Course.

The Virtual Class also constitutes an ideal tool for tutors to setup personalized sessions with students and motivate the ones who are loosing momentum.

We have employed this technique for a structured program composed of four courses; the results have been very promising and attendance to Virtual Class sessions has been comparable with attendance to traditional classrooms.



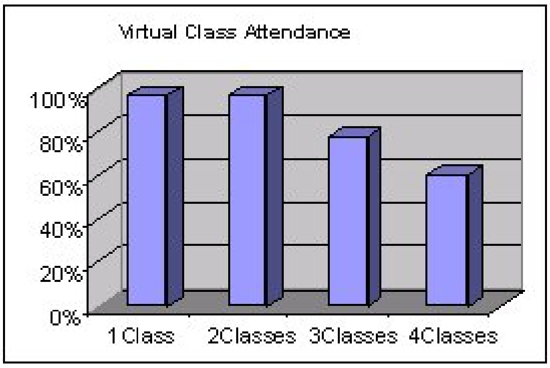


Figure1. Attendance comparison between Traditional and Virtual Class

Conclusions

Social interaction can play an important role in decreasing the drop out rate that is often registered when assigning eLearning access (pure WBT) to employees.

Synchronous Virtual Classes can be used to simulate the interactivity among students and with instructors comparable to the interactivity available in traditional classrooms, it can also be used to create and reinforce the role of the group.

A Virtual Class can keep the flexibility of an online environment and, at the same time, increase social contact; a good design of the training experience including Tutoring and internal (thus reachable) Subject Matter Experts also plays a vital role for the success of the initiative. Support by Top and Middle management is a key factor for increasing the motivation and self-responsibility of employees when using an eLearning approach in training.

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Giorgio Agosti
ABB Process, Solutions & Services SpA
via Lama 33, 20099 Sesto S. Giovanni (MI), Italy
giorgio.agosti@it.abb.com

Analyzing Empirical Evaluation of Advanced Learning Environments: Complex Systems and Confounding Factors

Researchers of learning technologies have dedicated substantial endeavors to the design and implementation of *advanced learning environment* (ALE) which are based on various technologies at the front edge, such as multimedia and mobile communication technologies. These novel designs or implementations are given profound expectations to be influential upon learners' learning outcomes by practitioners of this field. Empirical evaluations are therefore necessary steps for appraising these systems in terms of learning outcomes.

Nevertheless, just as previous studies in the field of intelligent tutoring systems (ITS) have revealed, to evaluate the educational impact of ITS, a representative example of ALE, is a costly affair [4]. One obvious issue to be confronted with would be the inherent ambiguity and uncertainty of human learning. Besides, if the evaluation is undertaken as the form of an experiment or a quasi-experiment, *validity* and *reliability* of the quantitative evaluation are essential issues that should be soundly addressed [3]. Fortunately, ALE evaluation is neither the single nor the first case to encounter these concerns. Several long-developed research areas, including educational measurement and experimental psychology, have accumulated plenty of knowledge during past decades dealing with most of these issues.

Even so, it is still not yet the happy ending of the story. A reliable and valid evaluation of ALE remains challenging. The cause is not only due to the classic issues mentioned above, but ALEs are themselves complex artifacts in which a number of sub-components interact in a nonsimple means. It is likely that more confounding factors would be introduced into the evaluation. This scenario is a threat to classically ideal evaluation design that all variables are well controlled, except the treatment. The *complexity*, of the *evaluation task*, the *to-be-evaluated ALE itself* and the *interaction between these two systems* would be the key issue worth to be analyzed in order to dispel the fog.

We take Simon's insightful anatomy of *complex systems* as the basis for analyzing this issue [7]. The *hierarchical model* proposed by Simon to explain the complexity prevailing among natural phenomena and human-designed artifacts, though may be aged and imperfect 0, can nicely model the complexity embedded in the affair of ALE evaluation. In the rest of this article, this point of view will be further described by employing the evaluation task of adaptive educational hypermedia systems as an example for analysis.

Two Levels of Complexity: the Evaluation-wide System and the Intra-Artifact System

In the task of ALE evaluation, we identify two distinct complex systems: the *evaluation-wide system* and the *intra-artifact system*.

On the one hand, the evaluation-wide system is the abstraction of the evaluation task in accompany with various variables. These variables include the ALE to be evaluated, human participants using the ALE, and the experimental instruments such as questionnaires or psychometric tools employed to assess learners' responses. On the other hand, the intra-artifact system implicates the to-be-evaluated ALE itself such as an intelligent tutoring system for algebra, a learning management system with course sequencing rules and a museum guide system build upon handheld computing devices.

Notice that these two levels of complexity are not irrelevant to each other. There could be interactions and latent linkages between these two worlds. For example, participants of the evaluation, although are part of the evaluation-wide system, participants' usage and response are likely to be captured and modeled by some ALEs as user models to actuate the artifact's particular function. Such kind of linkage exactly reflects the complex nature of ALE evaluation.

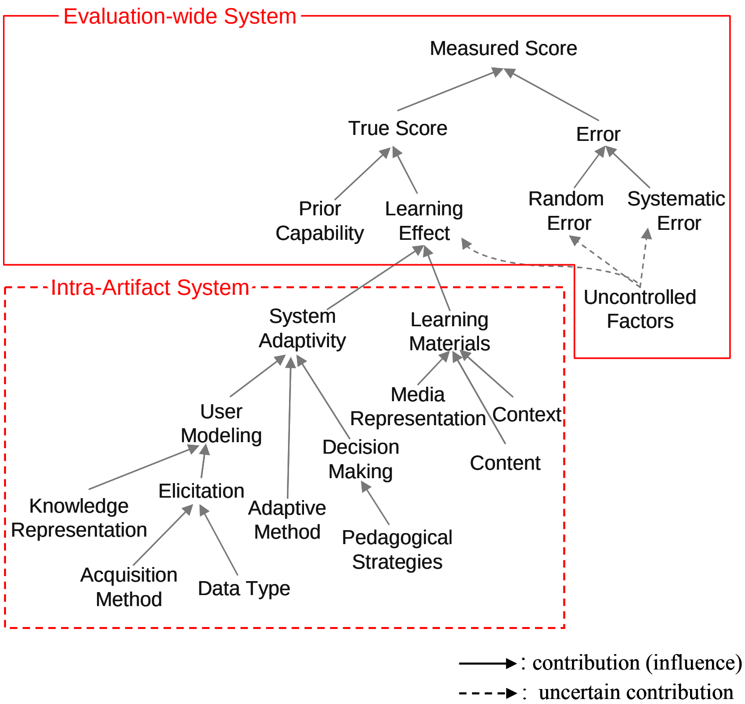

Figure 1. The hierarchy of underlying factors for AEHS

An Example of Analysis: Evaluating Adaptive Educational Hypermedia Systems

Adaptive Education Hypermedia Systems (AEHS) are user modeling-based systems that can offer learners fit-to-needs learning experience. To achieve this feature, AEHS is constituted by several sub-components which have their own distinct behaviors and properties. Figure 1 conceptually depicts the hierarchical model of this scenario. The AEHS as the intra-artifact system shown in Figure 1 can be decomposed into sub-components by considering the influence of sub-components on the performance of ones at the higher level.

On the other hand, by moving the focus to the part of evaluation-wide system, the hierarchy of the evaluation task is shown in the upper part of Figure 1. Since the evaluation affair can be treat as a kind of measurement, there is *no* so-called errorless evaluation [6]. By taking the view of classical test theory, the observed scores of learners' learning outcomes could be decomposed as:

$$S_{observed} = S_{true} + E$$

where $S_{observed}$ is the observed score derived from the measurement, S_{true} is the unknown true score and E is the measurement error. It can be observed that the construct of interest to be evaluated, learning effect, locates at the bottom of the evaluation-wide system, therefore, is not observable directly. Thus an adequate experimental design (e.g., between-groups random assignment experiment) is essential to control the influence of non-focused factors of the measurement, such as participants' prior capability and other possible covariates. It is worth noting that in Figure 1, the dashed arrows are edges representing uncertain influence. In this hierarchical model, uncontrolled factors are identified and linked to other sub-components in the system with dashed arrows.

The unique obstacle that ALE evaluation meets is the interaction and linkage between these two complex systems. Sub-components inside the intra-artifact system can also play the role of uncontrolled factors in the evaluation-wide system if the experiment is not well designed. For example, it may be possible that the user modeling modules cannot effectively capture user's information, and the AEHS may function in the way of non-adaptive manner which is less different to typical hypermedia systems. For this situation, the validity of an experimental design of with- or without- user modeling for comparative evaluation would be questionable.

Conclusions

In this article, we propose to employ hierarchical models and the conception of complex systems to realize confounding factors and their relations inside the evaluation of advanced learning environments. The complexity of the measurement and the artifact introduce more uncertainties into the evaluation affair. The approach of layered evaluation shown in [5] would be a noteworthy research direction regarding the analysis we have shown.

The analysis framework shown by this article is believed to be improvable. The theme this article disclosed, ALE evaluation as a complex system, is worth to be further investigated. The dynamics inside the complex systems 0, the concern of modern test theory [2] and the uniqueness of advance learning environments are topics to be studied as future works.

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Hao-Chuan Wang
Institute of Information Science
Academia Sinica
Taiwan
haochuan@iis.sinica.edu.tw

Tsai-Yen Li
Computer Science Department
National Chengchi University, Taiwan
li@nccu.edu.tw

Chun-Yen Chang
Department of Earth Sciences
National Taiwan Normal University
Taiwan
changcy@cc.ntnu.edu.tw

The Possibilities for Digital tools for Writing

Most children find learning to write to be a difficult task; in order to construct a piece of writing, the child has to decide on a storyline, select appropriate vocabulary and grammar, arrange the words with respect to punctuation, decide how to spell words (sometimes making substitutions of words at this point when a spelling is perceived to be too difficult), and finally, he has to physically commit the words to paper.

When children learn to write, they traditionally use a pencil and paper for this physical process and, as they gain competence, they are then encouraged to enter their work into word processing software so it can be edited. Most children eventually become able to construct writing directly at the keyboard as well as on paper. It can be argued that keyboard competence is necessary for mature writers, however, contrary to the view of many technology enthusiasts, the keyboard is not be a particularly good tool for young writers who are still learning all the processes. There are problems with the layout of the keys, possible ergonomic problems that have not been fully researched and the presentation of the writing (in a computer font) may have an affect on the child's understanding of plot and form. One advantage of writing with a pen rather than typing at a keyboard is that for children who are learning to write, the movement involved in forming letters with a pen supports the development of good spelling

Recent technologies including Tablet PCs, Personal Digital Assistants (PDAs) and Digital Pens all offer interesting alternatives to traditional pen and paper; preserving the use of the pen for input whilst allowing for some digital manipulation of the writing once the story has been written. These technologies have not been especially well researched with respect to their usability in classroom environments (surprisingly, neither has the QWERTY keyboard!) and so we have carried out a small investigation of their relative usability with children aged seven and eight in a UK Primary School.

The Tablet PC

This was set up to work just like pen and paper, that is, the child was able to write using the stylus (pen) on the screen (paper) that was lined and scrolled down if there was too much writing to fit on the page. Children who used this method seemed to have no problems in using the device to write although watching them, they adopted some strange writing positions as they attempted to see the screen and reach the tablet at the same time. They were able to use the device with very little instruction and only needed help to save their work once they had finished.

The Personal Digital Assistant

We looked at two PDA applications, a cut down version of Microsoft Word® which uses a transcriber tool to change each handwritten letter into ASCII text, and a note-taking tool that saves the handwriting as an image. The children found using the application that ran Microsoft Word® very difficult to use as they were unfamiliar with the transcriber tool and its' functions. They had problems in editing the text they had written as it was unclear how to delete any mistakes that were made. The handwriting recognition struggled with the children's handwriting and quite frequently got the letters they entered wrong. In addition, because the children wrote quite slowly, the software kept putting extra spaces in their words. While this was amusing at first to the children, it soon began to irritate them, again especially because they had such problems repairing the mistakes.

The note-taking tool was the preferred choice of software on the PDA because the children could simply write. However, this application was not without problems; with such a small screen being used, the children found that they had to mostly write one word to a line, which did not help them when trying to write a story. This was not helped by the need to do a lot of scrolling to see what they had previously written.

Using either application, the children struggled to write any kind of stories due to the difficulties they had with the device. One major problem with the PDA was that as the children had such small hands, it was hard for them to write without leaning on the PDA and as the PDA is a touch screen device, whenever the screen is touched unintentionally, additional marks appear on it; the children found this confusing and irritating.

The Digital Pen

The children wrote their stories with digital pens in exactly the same way as if they were using normal pen and paper. This meant that the story quality was unchanged and the children had a paper copy of the story they had written. Using the digital paper, at the end of every page, the user had to tick two boxes to send the writing to a computer and to say that they had finished the page. The children had no problem with this. Once a child had finished their work, the pen was attached to a PC and their story was downloaded from the pen giving them an exact digital replica of what they had written on the paper.

Implications for Learning and Teaching

The PDA was generally unsuitable for the task; there may be other applications for which it can be used by children use but story writing is not one of them! The tablet PC and the digital pen were both very easy to use, the text was highly visible and the potential for later recognition of the writing, and the possibilities for investigation of the writing processes, make them both attractive. We are currently carrying out a large study into the extended usability of these two devices in the primary writing classroom.

Janet C Read and Matthew Horton
Child Computer Interaction Group
University of Central Lancs
Preston, UK
jcread@uclan.ac.uk

Tablet PC: an Enabling device for Teaching and Learning Process

Abstract

The paper describes the use of Tablet PC in “Strength of Material” course, where a Tablet PC was used as a replacement of a blackboard to deliver the live lectures. The lecture material was created during the lecture session by writing on the tablet of the PC that was connected to a video projection system to display the lecture content to the students attending the class. The lecture files were saved and later on placed on a web server for student to have a complete access to the lecture notes through the course web site..

Introduction

The Engineering reading and lecture material consists of text, pictures, sketches, mathematical symbols and equations. It is difficult to create engineering content in digital form using a PC through a mouse and keyboard interface during a live presentation. This problem can be solved through the use of Tablet PCs [1]. It offers a more natural user interface.

The Tablet PC Essentials

The Tablet PCs are available in various form factors: as standalone tablet or as a combination of laptop PC and Tablet. The second form factor allows smoother transition from the use of a laptop to a pure tablet. In the tablet form the screen of the laptop PC acts as a writing pad where user can use their natural writing and drawing abilities with the help of a pen that comes with these devices. They also allow switching the screen display mode from portrait to landscape depending upon the user’s need.

The MS Journal program that comes with the Tablet PCs provides all the necessary tools for controlling the pen movements and the resulting drawings. The line width and color can be adjusted through the program menus. It also provides erasure as well page numbering functions. The author can flip through the pages by simply pressing on the arrows located at the bottom right corner. The intuitive program interface emulates a writing pad and it is very easy to use. The hand written text can be converted to regular typed text through a hand writing recognition program that is part of it. It is very easy to master the use of this program.

Use of Tablet PC in Teaching and learning Process

In the traditional lecture delivery mode the instructors usually use the chalk and blackboard or they prepare PowerPoint slides. It is a very time consuming process to prepare the learning modules that are highly math and graphics oriented. Therefore, the use of digital content within engineering teaching practice has not penetrated as highly when compared with other disciplines such as management. Tablet PC with pen based computing offers a way to solve this problem.

The “Strength of Materials” is a required course that is taken by Civil and Mechanical engineering students in their sophomore year. The course was delivered in the traditional lecture mode with the help of a Tablet PC that was connected to a video projection system. The instructor sat facing the students and wrote the required lecture material on the tablet as if it was being written on a black board. This approach allowed the instructor to face the students during the delivery of the lectures, an improvement over the use of the blackboard. The projection screen served the purpose of the blackboard without obstructing the student’s view from the instructor leading to a better visibility of the lecture material. Using different colors the instructor also had a choice of highlighting the lecture material for added emphasis and clarity. It shows that a combination of Tablet PC with a video projection system provides an improved alternative to a chalk and blackboard.

In the presentation method that uses chalk and blackboard the lecture material is erased after the blackboard is full or at the end of the lecture session resulting in the loss of lecture material. By using the Tablet PC, the entire lecture sessions was saved in the form of a computer file. A course website was created that contained the links to these files pointing to the specific lectures. An example of this approach for creating a course website for the

“Strength of Materials” course is provided in reference [2]. The hyperlinks within the course website link to the computer files that were created during lecture presentations. These files have a special format, therefore, to view them the “Windows journal Viewer” a freeware program is used and it can be downloaded from the Microsoft website [3].

The course web site provides anywhere access to the class material on a 24/7 basis to the students who missed the class. It also benefits the students who were present in the class because they can pay more attention to the lecturer’s spoken words due to the availability of lecture notes online after the class is over.

Conclusions and Future Recommendations

The suggested approach provides a method to quickly create live digital lecture presentation material that does not require an instructor to significantly alter his existing mode of teaching. The digital content produced during the lecture can easily be used to create a course website with minimal required skills.

The laptops are becoming very common these days and the cost of a Tablet PC is slightly higher than a regular laptop. A combination of networked Tablet PC with a wireless projection system would eliminate the need to purchase expensive electronic blackboard system. The suggested combination could also be used in a portable mode to convert any regular classroom into an electronic classroom.

The lecture notes created using this process lack the instructor’s voice due to the missing capability of the program to include the digital audio files. There is a need to improve the suggested process to provide a richer multimedia experience.

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Javed Alam, Ph.D.
Professor
Civil/Environmental/Chemical Engineering Department
Youngstown State University
Youngstown, Ohio 44555
USA
jalam@cc.ysu.edu

A quality approach for collaborative learning scenarios

Introduction

New electronic educative tools aim at supporting collaborative learning activities. When a teacher wants to experiment such an activity, s/he must define and set out clearly the rules: *e.g.*, "*The goal of the exercise is to present the topic X, in a structured way. For that purpose, the first step is to form teams in order to collect information. Then, you must select and classify the most interesting information and send it to me. When I agree on the content, you can prepare your presentation***.**" We call these rules and their sequencing "collaborative learning scenarios". Most of the time, teachers themselves define these scenarios, but sometimes, didactical organisations (*e.g.* TECFA) provide us with generic ones [1]. Enacting these scenarios into different contexts or different platforms suggests frequent modifications of the scenarios and therefore an easy way to adjust them. We believe that exchanging such pieces of information will become usual. National programs for sharing the educational resources [2] corroborate this idea, pointing out the **quality** of collaborative learning scenarios as central in this approach.

The Capability Maturity Model

The quality aspects of e-learning objects are currently being explored, resulting in the definition of "eQuality Learning Standards" [3]. However, these standards qualify educational contents but nothing is said about the qualification of the scenario itself.

The Capability Maturity Model (CMM) was introduced several years ago to characterize organisations through their development process [4] and to assess their quality level. A maturity scale (five levels) is proposed in this model. The general statement is: the more the organisation matures; the better its development process is. These levels are briefly described in figure 1. At the highest level, the process is always reconsidered in order to be optimised.

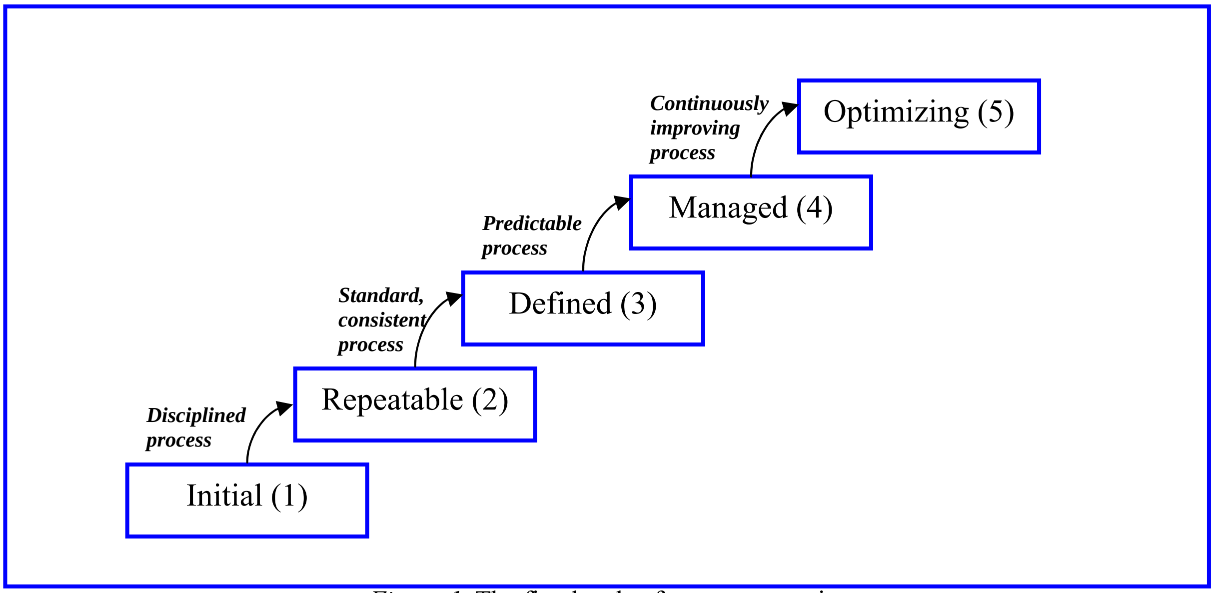

Figure 1. The five levels of process maturity

A pedagogical scenario involving different participants can be seen as an ideal process where teachers and students act to reach a given goal. The CMM is therefore suited to qualifying the collaborative learning scenarios. According to process assessment rules, we can state that an observation of what is going on during the pedagogical activity is necessary to reach the highest levels.

The different steps for pedagogical scenario improvement

The CMM approach is a long-term approach where the highest quality for pedagogical scenarios can only be reached after their observation during execution. We must consequently follow three main steps to make this quality improvement possible: the modelling of pedagogical scenarios; their enactment; their observation during performance.

Modelling a pedagogical scenario requires a good understanding of the educational process itself: the different sub-activities must be identified, as well as the actors, and the synchronisation between these sub-activities must be clearly established (activity dependence, parallelism). A modelling language could be IMS Learning Design specification [5] since it has been suggested as a flexible way to represent and encode such pedagogical scenarios [6].

Enacting a scenario consists in setting the environment and performing the scenario itself. For instance, the designation of actors (the teacher is John) or the instantiation of tools (the search engine in this context is 'Google') are part of the setting phase. Most of the time, this enactment is facilitated by the use of a pedagogical platform.
Observing the scenario consists in gathering information about what is really done in the execution of the pedagogical task. Results obtained from the analysis of the collected information can comfort the teacher in the use of this scenario: every action is realised in accordance with what was expected and the results obtained from the pedagogical scenario execution are acceptable. On the other hand, the analysis may suggest reconsidering the scenario: this is the case when we discover that students always do additional subtasks (not mentioned in the scenario) or skip some recommended subtasks to succeed in their activity.

The observation phase: how to do it?

Gathering information concerning the activities performed by the participants is a difficult task that can be achieved during or at the end of the scenario. Methodologies exist in order to collect and analyse these data at the end of the work through interviews and questionnaires [7]. However, the need to compare the actions completed by the actors with those expected in the scenario led us to use log file analysis [8].

One of the existing difficulties in such an approach is the low level of the logs. They usually represent a basic interface action done by a user. In order to match actions described in the scenario, we must change the level of granularity of the logs, transforming them into more abstract data (*e.g.* actions). The granularity of the logs can be changed via intelligent techniques like case-based reasoning or pattern recognition.

Current Experiments and Conclusion

At the University of Savoie, we have developed the "electronic schoolbag", a digital workspace [7]. This online environment is dedicated to the educational world: it offers the pupils, students, teachers, school staff, or parents, personal and group workspaces in which individual or collaborative activities can take place. Today, nearly 20 000 people at the University of Savoie and in French secondary schools use this workspace. New pedagogical practices emerge from the use of the e-schoolbag and we need to establish regulation of the collaborative activity, following pedagogical scenarios.

Increasing the level of quality for pedagogical scenarios requires an observation step. It is possible to ask users to analyse their actions after their performance in an educational scenario. A complementary approach is to observe the users' actions directly through a log file. The interpretation of these logs is difficult and requires different levels of abstraction on the log files. The analysis at the correct level of what the actors have actually done in the pedagogical scenario provides the teacher with significant indications for reconsidering her/his scenario. The level of maturity of pedagogical scenarios is thus increased.

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Jean-Charles Marty
Syscom Laboratory,
University of Savoie, France
Jean-Charles.Marty@univ-savoie.fr

Jean-Mathias Heraud
Computer Science Department, ESC, Chambéry, France

Thibault Carron
Syscom Laboratory,
University of Savoie, France

Laure France
Computer Science Department, ESC, Chambéry, France

A Case Study by Applying Web-based Laboratory into Natural Science Courses in Taiwanese Elementary Schools

Introduction

This paper presents a case study by applying a web-based virtual lab for teaching natural science in Taiwanese elementary schools. Based on Kolb's *Learning-Style Inventory* (1985), in the experimental group, learning achievements of different learning styles are not different significantly. That is, the web-based virtual learning environment is suitable for various learning styles. However, students with the "accommodator" learning style differed most significantly in the learning achievement between the experimental group and the control group. The learning achievement of "accommodator" students in the experimental group is much better than that in the control group. In addition, all students in the experimental group achieved better grades than those in the control group, and most of the students surveyed indicated that they would rather be willing to use the web-based learning environment than read textbooks. The results of the teaching experimentation and questionnaire survey demonstrate the practicality and effectiveness of the web-based learning environment being studied, and thus encourage further development of that environment.

Usage scenarios

LINUX Redhat 7.X is selected as the operating system for the platform of the web-based virtual lab for primary school natural science courses. Moreover, Apache is used as the Web Server, MySOL is used as the system database, and JAVA and PHP serve as system programming techniques. Students can access the natural science lab website via the relevant browser software.

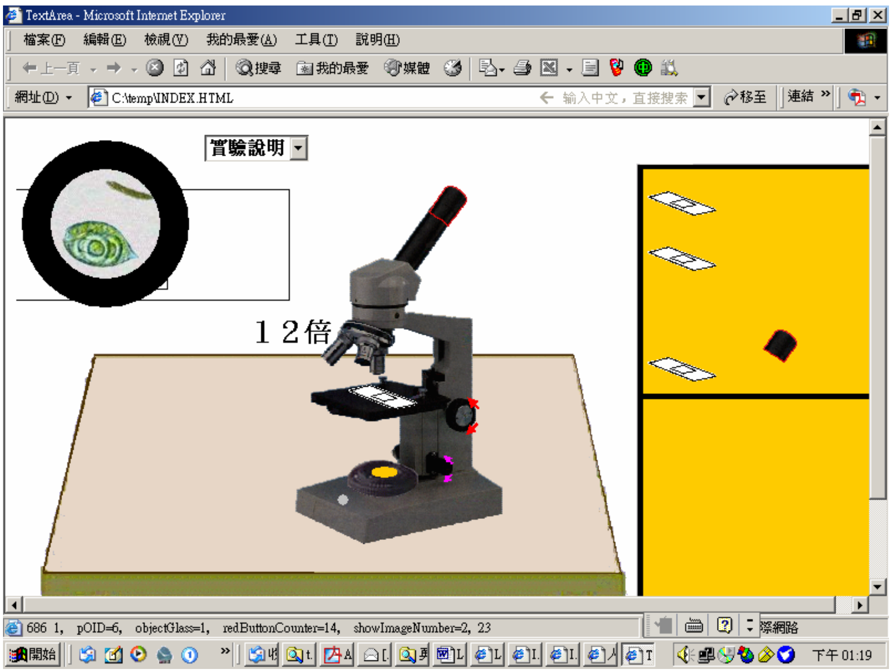

Figure 1. Students can operate the microscope and observe results through the Internet

The left half of the virtual lab comprises the experimentation desktop, on which the experiments are conducted. Moreover, the right half of the virtual lab comprises cabinets storing lab tools and instruments. The cabinets contain various tools and instruments, such as microscope, thermometers, alcohol burners, burning cups, test tubes, and so on. Every tool or instrument is an object, which a user can move at will or take to the desktop for an experiment. Users can operate each lab tool at will and observe the experimental process (see Figure 1.). The system records each step of the operating process, and this information can be provided to teachers to enable them to observe and analyze and thus correct any student errors during the experiment. Teachers also can examine the functions of recorded files, and complete operating records enable them to monitor student lab-use,

and realize individual student learning status. Teachers thus can help students understand their mistakes and help them make necessary corrections.

Experimental Research

A learning style describes a relatively stable response mode cultivated in the wake of learner perceptions of their interactions with the learning environment, generally including personal cognitive patterns, affective characteristics, and physiological habits. Kolb's *Learning-Style Inventory* [1] groups experiential learning behaviors into two dimensions and four learning modes, that is, diverger, assimilator, converger, and accommodator. A two (teaching methods) × four (learning styles) ANOVA then is conducted to examine the interactive relationships between learning styles and teaching methods. The analytical result indicates that only students with the "accommodator" learning style differed significantly between the experimental group and the control group: the scores obtained by the experimental group are markedly better than those achieved by the control group. The web-based virtual lab thus is extremely suitable to this style of learners. However, the interactions between learning styles and experimental treatments are not significant, indicating that after undergoing different experimental treatments, students with different learning styles do not display significant differences in natural science learning achievement. That is, learning styles do not significantly influence effectiveness of learning activities when using the "web-based lab system." Regardless of learning style, all students benefit from using the web-based lab.

Comments

From the results of the experimental research, the learning effectiveness achieved by the experimental group is higher than that of the control group, and moreover the difference is significant. The experimental group that received the natural science web-based lab teaching thus achieved better learning effectiveness than their control-group counterpart that received traditional teaching. That is, the web-based lab system presented here is helpful in improving natural science learning achievement among primary school students. This study verified the usefulness and practicality of the proposed web-based lab. This finding is encouraging for the development of additional web-based nature science courses.

Acknowledgments

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Koun-tem Sun
Institute of Computer Science and Information Education
National University of Tainan, Taiwan, ROC
ktsun@ipx.ntntc.edu.tw

Yuan-cherng Lin
Natural Science Mentor, Tainan City, Taiwan, ROC
sunny@mail.tn.edu.tw

Yen-Jui Lai
Institute of Computer Science and Information Education
National Tainan Teachers College, Taiwan, ROC

Chia-jui Yu
Institute of Computer Science and Information Education
National Tainan Teachers College, Taiwan, ROC

Laptop use in teaching practice: Current research in the Quinn School of Business, University College Dublin

Introduction and Research Outline

Current research is underway to explore the impact of mandatory student use of laptops on teaching experiences and practice in The Quinn School of Business, University College Dublin (hereafter The Quinn School). One year of exploratory fieldwork has already been completed and funded by Intel (Ireland), which has identified a need for more in-depth work into laptop use in teaching practice. The project is entering its second year and will pay particular attention to how the use of laptops in teaching has changed curricula content and working practices, in order to obtain a deeper insight into the experiences of staff use of laptops in teaching.

The Quinn School is in its third year of bringing laptops into undergraduate educational programs, incorporating their use into student curricula activities. Field research in 2003/2004 used focus groups, interviews and meeting minutes to build a picture of current uses of laptops in teaching practices. Based on the findings of this research, which identified a variety of areas of investigation, a second phase of research is now underway using an interpretivist case study approach (Cresswell, 1998; Walsham, 1993) to capture the emergent experience and use of laptops in teaching over time.

In light of pilot work completed so far, there is a need for more research, to explore the impact that laptops have on undergraduate business education, especially on teaching practices. This paper briefly summerises discussions in the literature and provides an overview of research in progress on the role of laptops in teaching practice.

Literature

Laptop use in teaching practice in undergraduate business education prompts interesting questions on their appropriateness of use as instructional tools in different teaching contexts. Part of the problem is that establishing appropriate use of laptops in teaching practice is a complex process.

In the context of teaching students with "ubiquitous" or "mobile" technologies in schools, Windschitl and Sahl (2002: 165) observe that *"teachers often change instructional practices over time when using technology with students"* stressing a need for more research into how laptops change teaching practices.

Palincsar et al (1998: 17) suggest that learning is social in nature, reminding us that *"sharing our* (teaching) *experiences in terms of* (the) *principles and practices"* is important if we are to broadly understand the best use of laptops in teaching activities. Palincsar et al take "sharing further," by creating an academic community of practitioners, in order to see how community based learning supports development amongst academics.

One important finding in Palincsar et al's research is that participants in the community experience *"make connections between being learners and being teachers,"*(Palincsar et al., 1998 : 14) in order to further their own learning and development and provides us with a useful insight into how learning can be shared and developed amongst peers. This is of particular importance for teachers who use laptops in their teaching, where academic and professional communities (and their support) are often geographically dispersed or inaccessible when needed.

Little (2002: 918) states there is a lack of research, which *"examines specifically how professional communities supply intellectual, social and material resources for teacher learning and innovations in practice*." In using laptops in teaching, we take on dual roles: sometimes we are learners and sometimes we are teachers of others, stressing the need for teachers to participate in social communities of practice where working experiences can be shared in order to understand how laptops aid us in teaching and learning. Theory and research methods, which investigate the use of laptops in teaching practice, will now be discussed.

Theory, Research Methods and Current Status

The authors are involved in research, which is exploring staff experiences of the use of laptops in teaching in The Quinn School. In gaining an in-depth understanding and interpretation of the impact that laptops have on teaching practices, we can obtain a greater understanding of how laptops influence pedagogical practice, change our situations of learning (Lave & Wenger, 1991) and our engagement in communities of practice (Wenger, 1998) in undergraduate business education teaching.

Research conducted over the academic year 2003/2004 used a grounded theory approach to gathering data on teaching practice, through participation in faculty meetings, exploratory focus groups with staff and the observed use of instructional technologies and laptops in teaching. Specific course data was collected from Business Statistics, Marketing, Management Information Systems and Managing Employee Relations undergraduate courses, taught in The Quinn School over 2003/2004 academic year.

The research team were given permission by faculty to contact lecturing staff and students during 2003/2004 participating in the aforementioned courses. Qualitative data was processed using thematic analysis techniques (Miles, 1994) and highlighted a need for further research which explored unique curricula development change, practical use of laptops in teaching and further understanding of teaching engagement in support communities of practice.

A research framework proposed by California State University Sacramento (2000) was used in field research over the academic year 2003 / 2004. This looked at the use of laptops "between faculty and students, among students and finally between the student and a rich array of media and other learning resources". Initial results suggested that lecturers used different approaches to the use of laptops in teaching practice guided by the appropriateness of course context. By using the framework above, we were directed to investigate further the impact of laptops on teaching practices.

The following summary points were abstracted from a series of exploratory interviews and focus groups with staff members from 4 courses over the academic year 2003/2004. Results from research presented key themes (obtained from data analysis and transcripts) in which is was identified that:

1. of the four courses studied, one course implemented a customised and content related "**laptop policy**" which was used to mediate interaction and use of laptops in class between lecturers and students engaged in learning.
2. all four courses had **different implementation plans** for the use of, and inclusion of, laptops in class and for assignments. In conversation all staff members mentioned the use of office tools extensively in assignments.
3. the use of small group teaching classrooms were conducive to a more intimate and **"interactive learning environment."** Teaching staff also supported this trend and felt there was more interaction and communication in small group settings.
4. lecturers learned **"through experience"** when to use and when not to use laptops in class for teaching activities, reflecting instruction to use laptops at "**appropriate**" points in the curricula and learning process.

To conclude, research for 2004/2005 is using an interpretive ethnographic methodology to obtain a more in-depth analysis of use of laptops in teaching experiences and practices, though a series of exploratory interviews using a process of legitimate peripheral participation (Lave & Wenger, 1991) to explore teachers involvement in using communities of practice (Wenger, 1998). Taking this approach will enable us to explore applied practical skills in the use of laptops in teaching. Finally, our research approach has been refocused to investigate "experiences" of The Quinn School staff use of laptops in teaching and learning, and explore the impact of mandatory student use of laptops in teaching and learning practice. We feel Lave & Wenger provide us with a vehicle from which to explore this area in more depth.

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Lorraine Fisher
Department of Management Information Systems
University College Dublin
lorraine.fisher@ucd.ie

Martin Butler
Department of Management Information Systems
University College Dublin
martin.butler@ucd.ie

Peter Keenan
Department of Management Information Systems
University College Dublin
peter.keenan@ucd.ie

Geraldine O'Neill
Director
Centre for Teaching and Learning
University College Dublin
Geraldine.oneill@ucd.ie

An Exploration of the Distance Learning Classroom (Virtual Classroom)

Abstract

In this exploratory study, the effectiveness of the virtual classroom is compared to the face-to-face classroom. It is proposed that the lack of social presence in the virtual classroom would result in significantly different learning experiences. Students use a previously validated teaching instrument for each learning environment. Very few differences are noted.

Introduction

In 1997 over $1 billion was spent on distance learning programs (Chute et al., 1999). To meet the increasing demand for education by those furthering their education while maintaining full time jobs, distance education has become a big challenge for universities (Hawkridge, 1995). Access to lifelong learning is a priority for many policy makers (Gibson, Newton, and Dixon, 1999).

Hiltz (1988, p. 282) defined the virtual class as, "a teaching and learning environment located within a computer-mediated communication system (CMCS)." This virtual environment with no bricks and mortar has taken many forms but the prevalent one today is one in which the class interactions are enabled by the Internet and the World Wide Web. Accessibility to this WWW enabled virtual class, allows learners to access their course forums from the office, from home, or while traveling. The challenge of the virtual classroom "is to have a location-independent class which is as effective as a face-to-face class or where the other benefits achieved are worth some small sacrifices in effectiveness" (Neal, p. 81).

Tu (2000) posits that social presence is one of the most significant factors to examine in distance education. Social presence has been discussed as the degree to which a person feels in touch with the sensory impressions of another person where in a face to face interchange this would involve facial expressions, body language, etc. (Rice, 1993). Further this social presence has been discussed as information richness and attributed to the medium of exchange or communication channel used between the parties interacting (Daft, Lengel, and Trevino, 1987; Carlson and Davis, 1998). Social presence can be manipulated in the face-to-face or virtual classroom by the instructor's interaction skills (Short, Williams, and Christie, 1976; Johansen, Valee, and Spangler, 1988; Gunwardena, 1995).

Further Daft et al. (1987) showed that task type and social presence must be congruent for effective work to occur. For example a highly structured task, characterized by many rules and procedures, would need less social presence than a task that entails less structure where the methods are not know in advance to solve the task. Typically the less structured tasks involved more face-to-face interaction between those involved. So can a virtual classroom result in the interaction needed for less structured topics or is it more suited to structured problem solving?

Research has shown that computer mediated communications that filters out the face-to-face communication cues, can break down barriers of gender, age, and race for members of the class (Lind, 1999). Also many of the new web based media can affect the learning process (Tucker and Cordiani, 1998). Burke and Chidambararm (1999) found that in group work that initially face-to-face groups rated their face-to-face communication medium as more effective than synchronous groups but by the end of the study no significant differences in performance were noted and in actual measures of performance the synchronous groups performed better. Needed are comparisons of class effectiveness in the virtual mode (asynchronous) versus the face-to-face mode. Gilroy, Long, Rangecroft and Tricker (2001, p. 14) state, "judging whether a course delivers to its promise is a particular challenge when the course is delivered by distance learning and there is not regular face-to-face contact with students."

The Study

The type of virtual instruction examined in this study is asynchronous interactive where the student participates with an instructor and fellow students but not at the same time. The class is structured around learning activities and the student can visit the class whenever needed (Kathawala, Abdou, and Elmuti, 2002). Regular

assignments are given and evaluated with interaction between the student and teacher via an online course room where the interactions are saved and time and date stamped. The other type of instruction examined is a face-to-face classroom environment where the students convene weekly with assignments given regularly and assessed regularly.

Brightman, Eliott, and Bhada (1993) developed an instrument for a student evaluation of college level courses. There are six factors associated with the course evaluation instrument items: organization and clarity, communication ability, grading and assignments, interaction with students, intellectual/scholarly, and student motivation. The items for each factor are shown in Table 1.

Table 1

Organization and Clarity	**Traditional Class (n=77)**	**Distance Learning (n=48)**	**T-test Value**
The course was clearly organized	4.57	4.52	0.45 ns
The course work was clearly explained	4.21	4.15	0.53 ns
The teaching materials were easy to follow.	4.26	4.15	0.89 ns
The teaching components of this course were easily understood.	4.13	4.25	-1.08 ns
The course instructor carefully and quickly answered my questions.	4.39	4.49	-0.76 ns
The course instructor knows if each student understood the material.	4.08	4.02	0.42 ns
The course materials summarize the major points.	4.45	4.51	-0.59 ns
The objectives of this course were clearly stated.	4.49	4.41	0.83 ns
Communication Ability			
The course instructor was enthusiastic.	4.51	4.05	4.16 ***
The course instructor enjoyed teaching.	4.54	4.64	4.49 ***
The course instructor conveyed a dynamic presence via the distance learning technology.	4.23	3.88	2.68 **
The course instructor was self-confident.	4.63	4.36	2.75 **
This course was presented in an interesting style.	4.03	4.04	-.01 ns
The assignments vary in terms of content.	4.24	4.08	1.41 ns
The class was interesting.	3.86	4.24	-2.53 ns
The instructor cared about the quality of learning in the class.	4.56	4.26	2.64 **
Grading and Assignments			
The graded assignments were returned quickly.	4.86	4.46	4.68 ***
The grading of assignments was done fairly.	4.20	4.44	-2.01 *
The grading system for this course was clearly presented.	4.41	4.18	1.74 ns
The course plan was followed.	4.60	4.63	-0.33 ns
The assignments were of reasonable length.	4.26	4.42	-1.31 ns
The assignments related to the goals of this course.	4.60	4.52	.84 ns
The instructor is accessible electronically to the students.	4.77	4.51	2.80 **
Interaction with Students			
The instructor invited criticism of course ideas.	4.06	3.60	2.82 **
The instructor encourage class discussion.	4.49	4.46	1.97 ns
The instructor related well to the students electronically.	3.99	4.18	-1.46 ns
Intellectual/Scholarly			
The course covers major developments in its field.	4.61	4.12	4.55 ***
The course presented contrasting approaches.	4.06	3.75	1.95 ns
Student Motivation			

Did this course encourage you to work harder than other classes you have taken?	4.24	3.80	3.35 **
Did the course evaluation require of you original thinking?	4.53	4.19	2.62 **
Were you motivated to do your best work in this course?	4.05	4.17	-0.85 ns

* $p < .01$, ** $p < .001$, *** $p < .0001$

This same instrument was administered to students in the same class taught face-to-face and taught via online instruction. The instrument items are compared across the two groups: face-to-face versus online. There was little difference in the class sections for the ratio of males to females or for size of the class. In most cases the online students were nontraditional students, however.

In terms of the items for organization and clarity there was no significant difference in any of the items across the traditional class versus the distance learning class. The items dealt with objectives of the course, course materials, understandability of the teaching components, materials were easy to follow, and the work clearly organized and explained.

Interestingly, quite a few differences can be seen in Table 1 for communication ability. The traditional class felt that the instructor was more enthusiastic, instructor conveyed a dynamic presence, the instructor was more self-confident, and that the instructor cared about the quality of learning in the class. The distance learning group felt the instructor enjoyed teaching more than the traditional class. For the grading of assignment items, the traditional class felt that the assignments were graded more quickly while the distance learning group felt the assignments were graded more fairly than the traditional class. Ironically, the traditional class felt the instructor was more accessible electronically than the distance learning class. In the traditional class the instructor responded to students' questions via email and accepted and graded their assignments electronically.

For interaction with students, the traditional class felt that the instructor invited criticism of course ideas more than the distance learning group. There was not a significant difference in how the instructor encouraged class discussion nor in how the instructor related to the students electronically.

For the intellectual/scholarly items, the traditional class felt that the course covered major developments in its field significantly more than the distance learning group while there was no significant difference for presenting contrasting approaches across the two types of classes. This difference in major developments may be due to the nontraditional students having more advanced knowledge of the subject.

In terms of student motivation, the traditional class felt significantly stronger than the distance learning class that the course encouraged them to work harder than other classes they had taken. Also the traditional class felt that the course evaluation required of them more original thinking than the distance learning class.

The factor that resulted in the most significant differences of opinion across the traditional and distance learning groups was communication ability. In all the factors connoting social presence (enthusiasm, enjoyed teaching, dynamic presence, self confident instructor, and instructor cared) the traditional classroom rated higher than the distance learning classroom.

Discussion

Given that distance learners are not going to have access to high bandwidth connections, teleconferencing is not the answer. Additionally with learners living in different parts of the world, synchronous communications is not a workable solution. Needed are ways to make asynchronous interactive classes to convey more social presence. Chat rooms have the obvious time zone problems while the email or bulletin board medium is written and lacks the richness of interpersonal communication. Would streaming video of the professor promote social presence? The problem with streaming video is that it is one directional and not interactive. Are we with the time zones differences limited to class settings that cannot be synchronous?

Needed is further research to determine if the learning achieved via distance learning merits the lack of social presence. Distance learning is particularly helpful for the nontraditional learner who cannot be present in a classroom setting on a regular basis. Also distance learning eliminates the constraints of geography and allows the learner to take classes anywhere in the world. Increasingly, firms are encouraging their employees to take

distance learning classes and classes given internally by firms are using this distance learning format. While distance learning is here, the question is how to increase the social presence experience for the learner?

Another issue for distance learning is team collaboration. While team collaboration is often used in a face-to-face environment, needed is information on how best to support teams in a distance learning environment. Graveline, Geiler, and Danchak (2000) found that patterns of media use (email versus chatting) emerged over the course of their task work in an industry work environment. Additionally group outcomes have found more knowledge sharing and higher group quality for electronic work groups as compared to face-to-face groups (Knock, 2001; Fulk, Schmitz, and Steinfield, 1990). Needed are studies to address group work in a distance learning environment using various media.

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Mary R. Lind
North Carolina A&T State University
School of Business & Economics
Greensboro, NC 27411, USA
Tel: +1 336-549-6549
lindm@ncat.edu

The Full Life Cycle of Adaptation in aLFanet eLearning Environment

1. Introduction

Adaptation in the context of eLearning is about creating a learner experience that purposely adjusts to various conditions (e.g. personal characteristics, pedagogical knowledge, the learner interactions, the outcome of the actual learning processes) over a period of time with the intention of increasing pre-defined success criteria (e.g. effectiveness of e-learning: score, time, economical costs, user satisfaction).

Adaptation is not an idea that can be plugged in a learning environment, but it influences the full life cycle of the learning process. For the last two years and a half, we have been researching how to improve the existing learning environments with adaptation capabilities and we have come up with aLFanet eLearning environment.

aLFanet (IST-2001-33288) is the result of the join effort of four developer partners (Software AG España, Universidad Nacional de Educación a Distancia (UNED), Open Universiteit Nederland (OUNL) and ACE-Case) and two user partners (Ernst Klett Verlag GmbH and Electricidade de Portugal Mudança e Recursos Humanos S.A.). Two prototypes have already been delivered, and we are currently working on the final one (expected by the start of 2005).

We describe below the two key points of aLFanet. First, how adaptation in aLFanet is supported by standards and second, how the full cycle of course creation, usage and maintenance is achieved in aLFanet.

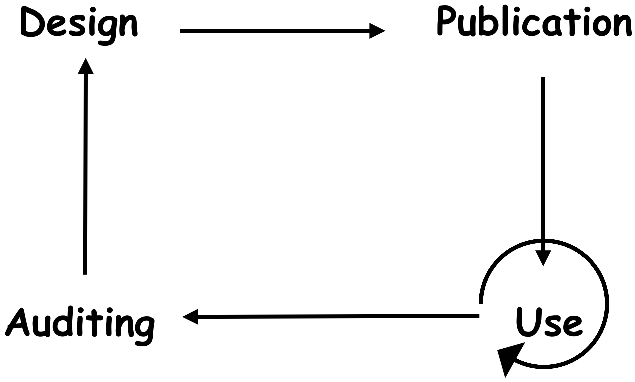
2. Adaptation supported by Standards in aLFanet

To meet the requirements of extensibility, portability and reusability the use of standards is mandatory. However, broad use of standards is still limited and systems usually stick to the use of a single standard or even only partially follow one.

Adaptation in aLFanet deliberately builds on a combination of e-learning standards. This has increased the initial investment in development but has allowed us to build an open architecture composed by re-usable components. aLFanet applies important standards in e-learning. The central standard is IMS LD. It enables the design of a variety of pedagogical models and separates the design of the pedagogical model from the content. Thus, it allows to dynamically select from the available learning objects the content to be provided depending on the associated metadata. To complement this standard, IMS Metadata (IEEE LOM) to deal with the knowledge of the contents, IMS LIP for the knowledge of the user and the IMS QTI to compute the formal progress are used. On top of them, everything is delivered in IMS CP.

3. The full life cycle of adaptation in aLFanet

aLFanet distinguishes four phases in its adaptation life cycle.



3.1 Design

Central in the adaptation process is the design created in LD. The design contains the logic for the pre-designed adaptations and provides the hooks and the information upon which the runtime adaptation bases its reasoning.

In order to design the course, the author can select one or more pedagogical models templates and apply them for the course at hand. These templates are a translation of the results of research in learning and instructional design. Their objective is to ease authors the complex task of designing their courses.

Since the author's design is to be applied in runtime, norms to be monitored during the execution of the course and metadata to the activities and to the learning objects are needed to compare the real interaction with the author design and to provide the appropriate material according to the design.

3.2 Publication

Publication includes the storage and management of all data in a way that it can be retrieved by all components. It takes into account the required interoperability of the applied standards.

In this phase, students (or tutors) get assigned the roles, their group and personal profiles and the rights they have in the course.

3.3. Use

This phase focuses on the environment and tools available for the student and tutors while active within a course. This environment is built upon an architecture that integrates a number of components. From the perspective of adaptation the following components are of particular importance:

- Presentation layer. It offers the possibility to adapt the interface to the user needs (personalised presentation based on presentation templates and adaptive presentation based on a rule interpreter of LIP attributes and other metadata).
- LD-engine. It reads and executes the pedagogical design as made by the author in LD including the maintenance and follow-up of LD-properties.
- Adaptation agents. They monitor the interactions and the results of the interactions of the students. Based on this process, the agents forward their recommendations to the users.
- QTI server. It dynamically generates questionnaires that adapt to the learners evolution in the course, to the learners interest, etc. It interoperates with data from other standards (IMS-LD, IMS-LOM and IMS-LIP).

3.4 Auditing

Auditing closes the cycle. It collects data depending on the author's requirements on the actual use of the course and presents them to the author in a clear way (e.g. study hours for a given learner and activity). The author gets reports showing how successful the course design has been. Therefore, depending of the outcome he or she can decide if there is a need to reconsider the design.

4. Conclusions

aLFanet is the first (and up to now the only) eLearning environment developed on 5 e-learning standards to provide adaptation in the full life cycle of the learning process. Each of the phases is influenced by the requirements of the adaptation capability provided by the system. The author provides at design time all needed metadata to provide adaptation. This information is properly stored at publication time and used to adapt the course during the execution, adapt the presentation to the learners interests, present the user a more focused learning path, provide the user with adaptive assessments (use phase) and to identify critical issues of the actual usage to the course authors that can be used to update the course (auditing phase).

Acknowledgement

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Peter van Rosmalen
Educational Technology Expertise Centre
Open Universiteit Nederland
peter.vanrosmalen@ou.nl

Jesús G. Boticario
aDeNu Research Group
Department of Artificial Intelligence
Computer Science School.
Spanish National University for Distance Education (UNED)
jgb@dia.uned.es

Olga C. Santos
aDeNu Research Group
Department of Artificial Intelligence
Computer Science School.
Spanish National University for Distance Education (UNED)
ocsantos@dia.uned.es

The proposed schema evolves around the notion of the e-questionnaire with the aim of detection of the learner's learning preferences and ICT level, with respect to a specific learning topic. So the learner adaptation to the proper learning topic and course can be achieved using an e-questionnaire. Our proposal could be considered as an extension of the IEEE LTSA draft 0, adding two stores, the Questionnaire and Learner Profiles, two processes, the E-survey and the Experts Group and enriching all modules that the IEEE LTSA contains with new functionalities with the purpose of effective collaboration between them (Figure 1).

In our case, the Learner entity represents a teacher who works in the special educational needs sector [4], [8]. The Experts' Group process is represented by a variety of people, such as teachers, teachers of the Special Education sector, experts in e-learning, data analysts, psychologists and software engineers. The Experts' Group have designed and illustrated e-questionnaires, which are addressed to the teachers in special educational needs sector and are intended to collect information for teachers' educational background, as well as their background in the Information and Computer Technologies (ICT). In addition, information concerning teachers' opinions about pedagogical utilisation of ICT and the amount of using ICT in teaching procedure is also extracted from these questionnaires.

It is noticeable, that, the Experts' Group is responsible for determining the learning issue that the e-learning schema can provide and for the learners' group in which this learning subject is addressed.

The Questionnaire Store is a database, which contains various questionnaires, which are designed for diverse education needs and types of learners. Each of these questionnaires has limited number of questions; these may be of various types, such as multiple choices, which include the appropriate values for the answers of each question. The questionnaire texts are defined and are stored in the Questionnaire store by the Experts' Group who have decided for the learning subject, which the questionnaire will negotiate.

The layout of the questionnaire is automatically illustrated [5] (by software that has been produced by the Experts' Group) though the Delivery process taking as input the questionnaire texts which are stored into the Questionnaire store and it is provided to the learner though Multimedia flow (Figure 1) as hypertext which contains a form schema.

Likewise, statistic experts whose belong to the Experts' Group assign the values of the answers of each question that the e-questionnaire contains. The emphasis is on questionnaire, the answers to which can be processed in an automated manner and can be leaded to learner's classification [7] and also to an E-Survey [6].

In this way, the Delivery process sends the value of the questions from this questionnaire to the Evaluation process via the Interaction Context flow. So, the flow Interaction Context has been assigned with this function.

Once a learner replies the e-questionnaire, his/her reply is submitted to the Evaluation process via Behaviour flow. This is necessary for the computation of the values that each learner has given taking under consideration the Learners' Profile store. The proposed schema needs this computation in order to find out the learner's level of knowledge in a specific subject and classify the learner's profile, which is then stored in the Learner Records.

The new store, Learner Profiles, contains the current profiles that the e-learning system provides. The way, in which, these profiles are accumulated in the store, have be analysed in [7].

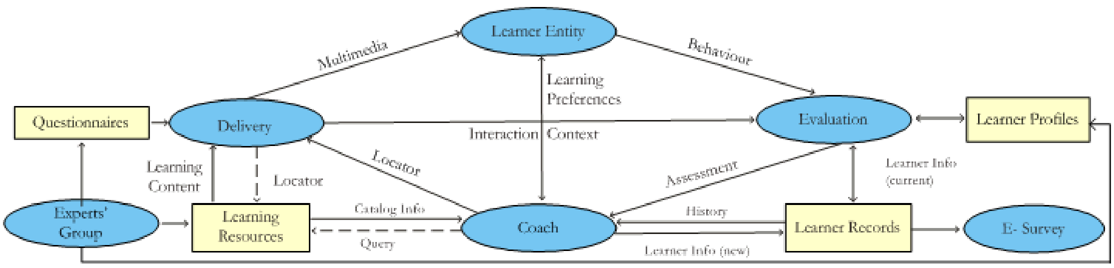

Figure 1. Proposed System Components

In the proposed scheme, the Coach process of the IEEE LTSA draft has been improved so as to select the proper Learner Resources for learners according to their profile; which is stored in the Leaner Records. If the learners have already accessed the specific e-learning system, they will not be asked to answer the questionnaire but they will receive the proper learning material according to their profiles, stored to the Learner Records. Otherwise, if the learners access the specific e-learning system for the first time, they will receive the questionnaire, which is proper for the learning topic that they will take.

The E-Survey process can provide statistics over the learners' answers taking as input the Learner's Records, where the Learner's answers to the e-questionnaire are stored, as well as and provides a statistical analysis in these records. The e-Survey process is added for statistical reasons and the results of this procedure can be useful for the scientific section that the questionnaire has as subject.

For example, if the questionnaire includes questions about Computers and the Internet, as it happens to our case study, a statistical analysis for learner's familiarity to the Internet and Computer Technologies (ICT) can be carried out [6].

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Paraskevi Tzouveli and Stefanos Kollias
Image Video and Multimedia Systems Laboratory
Institute of Computer and Communication Systems
School of Electrical and Computer Engineering
National Technical University of Athens
tpar@image.ntua.gr

A Model for Designing Computer-Supported Cognitive Tools

Abstract

We present here a model for designing computer-supported cognitive tools. This model uses Popper's theory of knowledge, which is suitable for the design of knowledge-oriented tools. Three levels are successively considered in the design of such tools: the material world 1, the artefactual world 3, and the cognitive world 2. This three-level model can be used either beforehand for designing new cognitive tools or a posteriori for analyzing them.

Introduction

A cognitive tool, either material or immaterial, is aimed at facilitating actions by amplifying or restructuring cognitive processes [1]. Cognitive tools are commonly non-electronic (e.g., multiplication tables), although research pays recent attention to computer-supported tools (e.g., word processing, LOGO, CSCL, etc.). There is a large literature about cognitive tools and the way they affect human cognition during teaching or learning [2]; but little is known about the way to build new ones. We present here guidelines serving this purpose.

The main goal of such tools is to manage knowledge per se. Thus a theory accounting for knowledge and its relations to human beings is needed. We use here Popper's theory of knowledge [3], which can be detailed as follows. The entire human experience can be categorized into three worlds. The first one, called "world 1" is the physical world (i.e., the world of matter and energy, including all living and inert forms). The second is the world of conscious experiences, called "world 2" (i.e., our perceptual experiences as well as our intentions). The third is the world of "objective knowledge" or "world 3", the objective content of scientific, theoretical, or cultural thoughts. This framework, as researchers pointed out [4], provides a useful way to think about the relations between knowledge content taught and learner experience.

Presentation of the Model

The common purpose of computer-supported cognitive tools is to simulate or assist some cognitive processes involved during teaching or learning a given domain. We claim that Popper's theory can be adequate for our goal of characterizing cognitive tools, because computer-supported cognitive tools in instructional contexts are functionally a blending of three kinds of objects: material objects on which human action can be performed (e.g., a computer), theoretical (e.g., the course content, cultural procedures used in action), as well as cognitive objects (e.g., learning, comprehension, knowledge construction). Let us detail these levels.

The first one is the world 1 level, and represents the material grounding of cognitive tools (see Figure 1 below). The most common object encountered in such tools at this level is the paper sheet, but some more complex material extensions are encountered as well (e.g., microworlds, school environment). The second is the world 3 level. Once the material background is chosen, artefactual schemes or cultural recipes supported by this material are necessary, because the sole background would be insufficient to provide adequate assistance for teaching or learning. Specific immaterial cognitive artefacts, like checklists, tables, grids, content to be taught, etc., have to be determined. The third level is about world 2. Once specified, the very goal of artefacts has to be in accordance with cognitive processes (i.e., amplifying or restructuring them). The specific role of artefacts is not only to represent objects pertaining to world 1 (material) or world 3 (cultural), but also to implement or help some events of the human world 2 (in our case, events about learning and teaching). A large list of instructional events can be drawn, including course planning, student assessment, classroom management, etc.

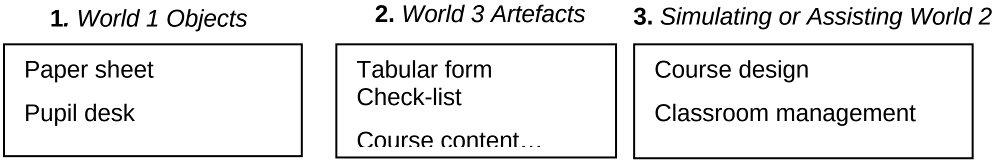

Figure 1. A Model for Constructing Computer-Supported Cognitive Tools

An Application of the Model

This three-level model can either be used beforehand for the design of new cognitive tools or a posteriori for analyzing them. First, it is being used in an instructional design university course at master level. Second, we worked out our model by analyzing two systems we implemented (see Table 1 below): *Look Cum* [5], a system for observing and capturing on the fly instructional moves in classrooms and *Apex* [6], a distance-learning system that automatically assesses the semantic content of student course summaries. Both systems rely on Latent Semantic Analysis [7], a statistical method accounting for semantic relations between words or actions.

We plan to design a more comprehensive framework using this model in order to teach it in instructional design courses.

Table 1. Two Examples Instantiating the Model.

Level/System	*Look Cum*	*Apex*
World 1 Level	Classroom map (students' location)	Paper sheet for writing out texts
World 3 Level	Keyboard shortcuts representing the main instructional events	Outline of the course to be summarized
World 2 Level	Automatic detection of patterns in observed classroom events	Automatic assessment of the semantic content of texts by Latent Semantic Analysis

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Philippe Dessus
Laboratoire des Sciences de l'Education
1251, av. Centrale, BP 47
Université Pierre-Mendès-France & IUFM
38040 Grenoble Cedex 9, France
Philippe.Dessus(AT)upmf-grenoble.fr

Teaching Hebrew to Adults at an Advanced Age

The issue of mastering a second language by new immigrants of advanced age is important in several countries which are trying to absorb highly qualified immigrants that lack the knowledge of the local language. Such is the case in Israel, a state which absorbed more than a million of newcomers (with total population of less than 5 millions) during the last decade.

In an attempt to absorb them quickly a study of teaching them Hebrew using courseware in an asynchronous mode was performed.

The study covered 10 persons within the 73 to 81 age range (3 males and 7 females). The courseware (that is not available on the market because it was heavily subsidized) which is called *"I love Israel"* contains 92 pages. Each page has a simple drawing and several lines of dialogue that is read by leading artists. The entire text was learned by heart with little effort and all the words and expressions were both passively and actively mastered within two months, allowing most of the learners to get jobs.

The obvious problem was posed by the different alphabet, different direction of writing and especially lack of vowels. The courseware helped in overcoming these difficulties.

The next study will be devoted to teaching adults two languages simultaneously (e.g. Hebrew and English) in order to overcome the prejudice that the two languages "will mix up".

I am convinced that facilitating learning of languages by extensive use of the modern computer is of great importance. Traditional methods of teaching languages did not prove to be efficient in most cases, and it is rare that those who leave school master the language with fluent knowledge of speaking and writing.

Scheidlinger Zygmunt M.Sc.E.E.
zscheidl@zahav.net.il

Hybrid-Electromagnetics Computational Techniques in Learning for Higher Education

Abstract

The demands of sensitive and accurate modelling of a system by electromagnetic field solver is a central problem in design and plays an important role due to the continuing development of the Computational Electromagnetics (CEM) methods. This paper gives an overview of suitable methods and then presents several practical applications. The power and requirements of hybrid methods is shown. These methods are also needed for the design of antennas e.g. for cellular phones and the related Electromagnetic Compatibility (EMC) impacts on human beings.

Introduction

Electromagnetic studies for research can be classified into three main categories. These studies are the analytical, measurement or numerical. The analytical one is available for simple geometries and is restricted in their application to real life models. The measurement method might be excellent for real radiating structures to expose anatomically shaped phantoms of the realistic model, but for the human body it is unable to represent the complexity. Finally, numerical methods are very accurate and realistic. For example the human body can be easily modelled but these studies have great challenge and difficulties in modelling complex radiating structures and scatterers. These difficulties can be overcome by adopting appropriate numerical techniques.

The numerical methods for CEM are either time domain methods or frequency domain. These methods can be stated as a solution of differential equations or integral form formulations. Each of which has its ability and application to design or model a realistic problem with accurate accuracy. The combination of these methods in some application is the ultimate solution for complex electromagnetic problems such as that found in hybrid methods. Restricted hybrid methods have been reported in the literature [1-4], but this paper is more general. The problem is divided into separate regions (see Fig. 1), each of which may be modelled by the most suitable method (e.g. Method of Moments: MoM, Finite Elements: FEM, Finite Difference Time Domain: FDTD). The coupling between regions is accounted for by employing the Equivalence Principle. To test the concept, the authors' frequency-domain version of MoM [5-6] was used in this hybrid method. This employs Galerkin's solution with polynomial basis functions in the analysis of structures consisting of wires, strips and conducting surfaces of arbitrary shape, combined with small regions of inhomogeneous dielectric. In the hybrid method equivalent sources were used to account for the coupling between regions. The number of iterations required for the solution to converge was investigated.

Summary of the Hybrid Method

The geometry shown in Figure 1 can be subdivided into n regions provided there are no physical attachments between them. The regions may or may not be highly coupled. Each region can be represented as a source or a scatterer. Since the problem space is divided into n regions, n subdomains can be created by introducing closed surfaces S_i (for i=1,...,n), enclosing each region. Each subdomain can then be treated separately as follows. Initially, each source region is solved (using a preferred method) for the induced current, assuming the region to be in free space. The induced currents in that particular region are used to evaluate the fields on the enclosing surface. The fields due to all source regions are then used as excitation sources for the scattering due to all regions. The induced currents in each scatterer region are used to compute the back-scattered fields on the closed surface surrounding that region.

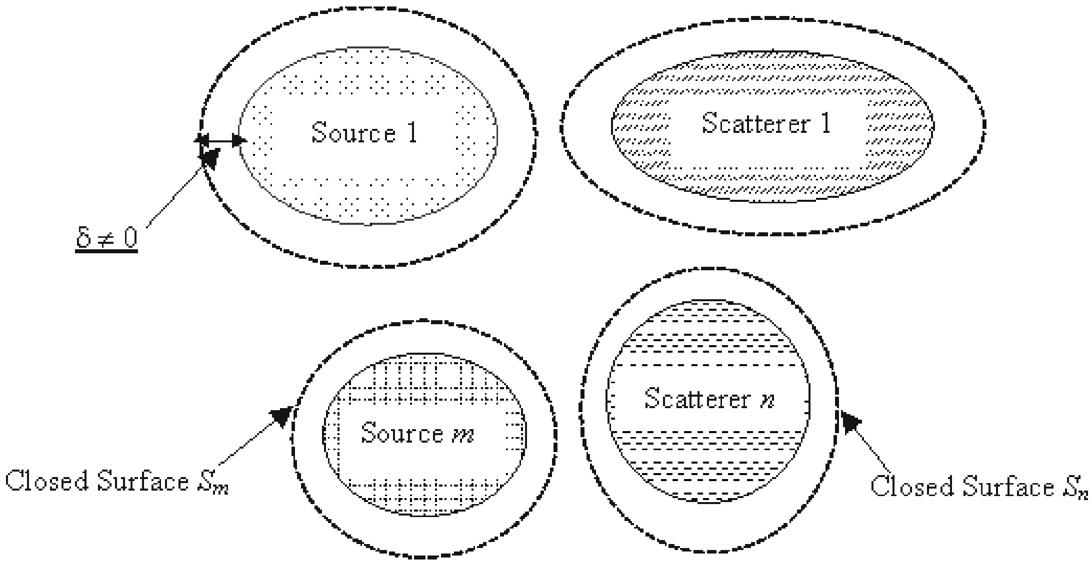

Figure 1. Basic structure of the problem

The effect of the back-scattered fields on a region containing a source was accounted for as impressed excitation fields in that source region. The new induced currents in this source region were used to obtain excitation fields in all other source and scatterer regions. Scatterer regions were dealt with in the same way. An iterative procedure was then used to obtain convergence of the results for the interaction between the regions. This multiple reaction iteration scheme can be stated in mathematical form, taking as an example the MoM expression for the current in terms of the induced electrical currents.

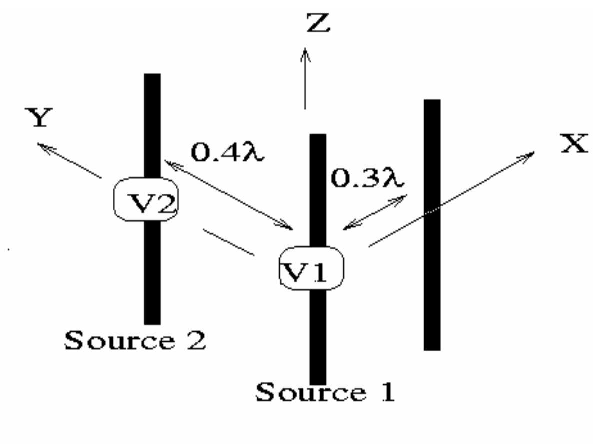

Figure 2. Basis geometry of example 1

The induced currents in the region p at the ith iteration are given by:

$$\mathbf{J}^i_p = -<\mathbf{J}_{tp} \bullet \mathbf{E}_{tp}>^{-1} \sum_{k \neq p}^{n} <\mathbf{J}_{tp} \bullet \mathbf{E}_{tk}> \mathbf{J}^{i-1}_k + \mathbf{J}_{pfree} \tag{1}$$

where $\mathbf{J}_{pfree}$ is the free space current of region p. This current is zero if this region is considered to be a scatterer region. $\mathbf{J}_{tp}$ is the current test function on region p. $\mathbf{E}_{tp}$ is the scattered field due to the test function $\mathbf{J}_{tp}$. $\mathbf{E}_{tk}$ is the field due to the test function $\mathbf{J}_{tk}$. $\mathbf{J}_k$ is the induced current in region k. i is the iteration number and <**A•B**> is the inner product of **A** and **B**.

The current, $\mathbf{J}_{p,}$ due to the fields on the surface enclosing region k can be expressed as follows:

$$\mathbf{J}_p^i = -<\mathbf{J}_{tp} \bullet \mathbf{E}_{tp}>^{-1} \sum_{k \neq p}^{n} <\mathbf{J}_{tp} \bullet \mathbf{E}_k(\mathbf{J}_{sk}, \mathbf{M}_{sk})> + \mathbf{J}_{pfree} \quad (2)$$

where $\mathbf{J}_{sk}$ and $\mathbf{M}_{sk}$ are the equivalent electric and magnetic currents on the surface k. The second inner product of Eqn. 1, is the excitation vector due to the region k. This method is used here to justify the results that might computed from hybrid methods such as MoM/FDTD or FEM/FDTD or MoM/FEM/FDTD techniques.

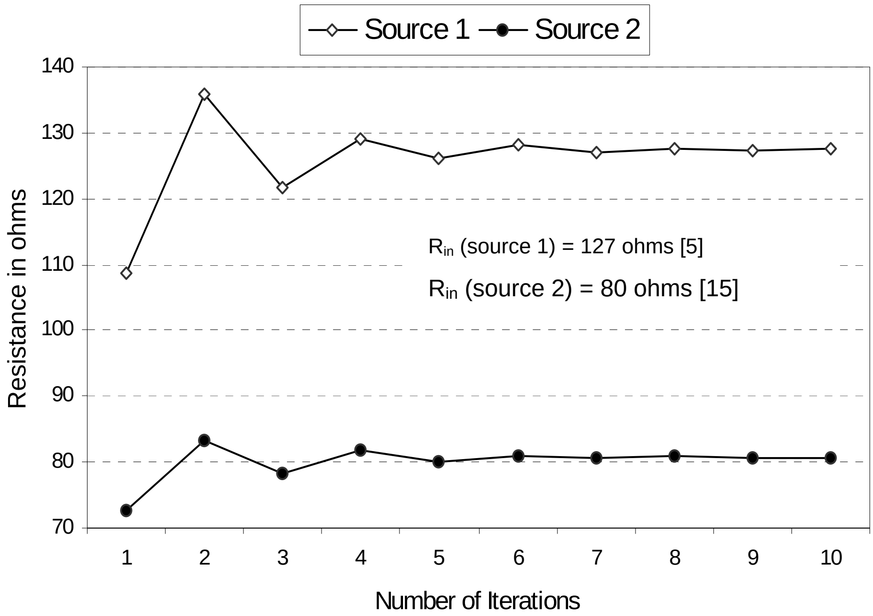

Figure 3. Iteration convergence of the input resistance of the source dipoles for example 1

Simulation and Results

Example 1: (MoM/MoM) Three parallel dipoles of length 0.47λ and radius 0.0045λ as shown in Fig. 2, were considered in order to test the validity of the hybrid method. Each of them was treated as being within a separate domain and two of them were excited by delta source generators of (1+j0) V. The input impedances versus the number of iterations are shown in Figs. 3 and 4. Rapid convergence is observed within a few iterations.

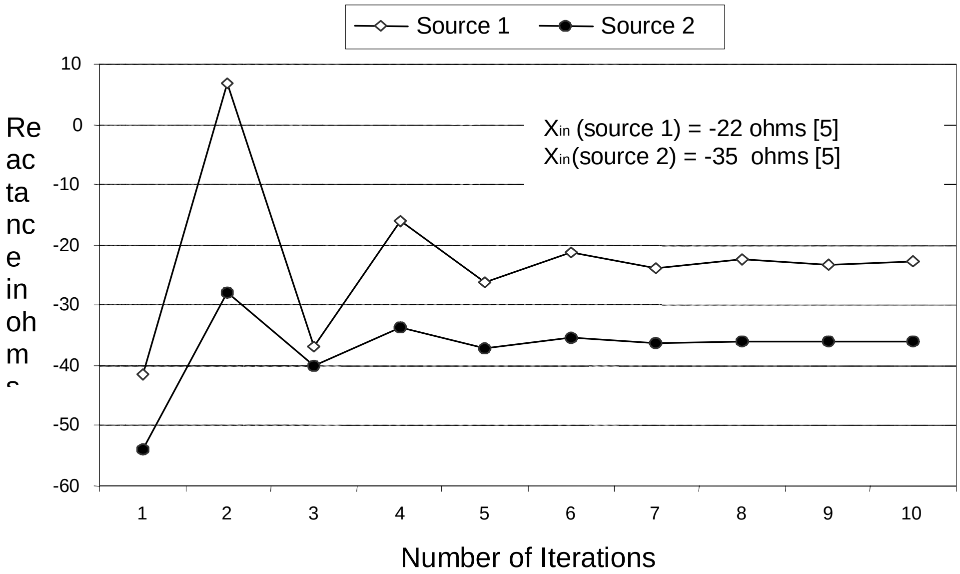

Figure 4. Iteration convergence of the input reactance of the source dipoles for example 1

Example 2. (MoM/FDTD) In this example the field induced in a thin dielectric of simulated brain material is studied, having dimensions 0.12λ, 0.06λ and 0.51λ, inserted into the scatterer region. As shown in Fig. 5, the separation distance between the dipole and the dielectric is chosen to be 0.3λ. Figs. 6 and 7 show good agreement for the MoM/FDTD hybrid method with the standard MoM, which uses volume polarisation currents to represent the dielectric cells.

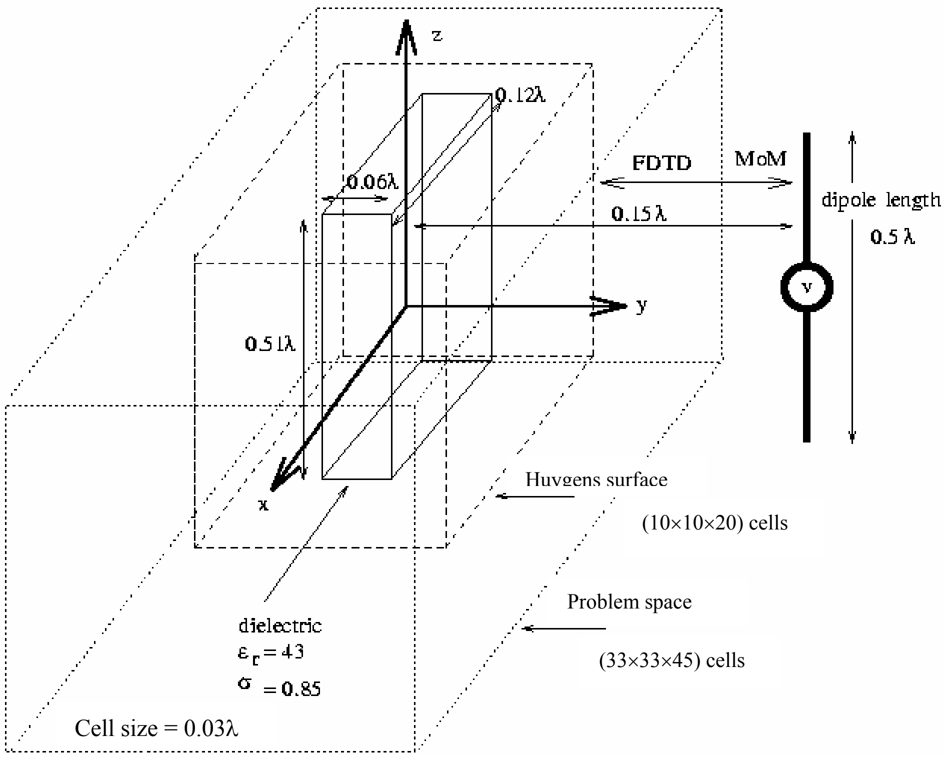

Figure 5. Hybrid MoM/FDTD model for a half-wavelength dipole adjacent to a dielectric slab with dimensions 0.12λ×0.06λ×0.51λ

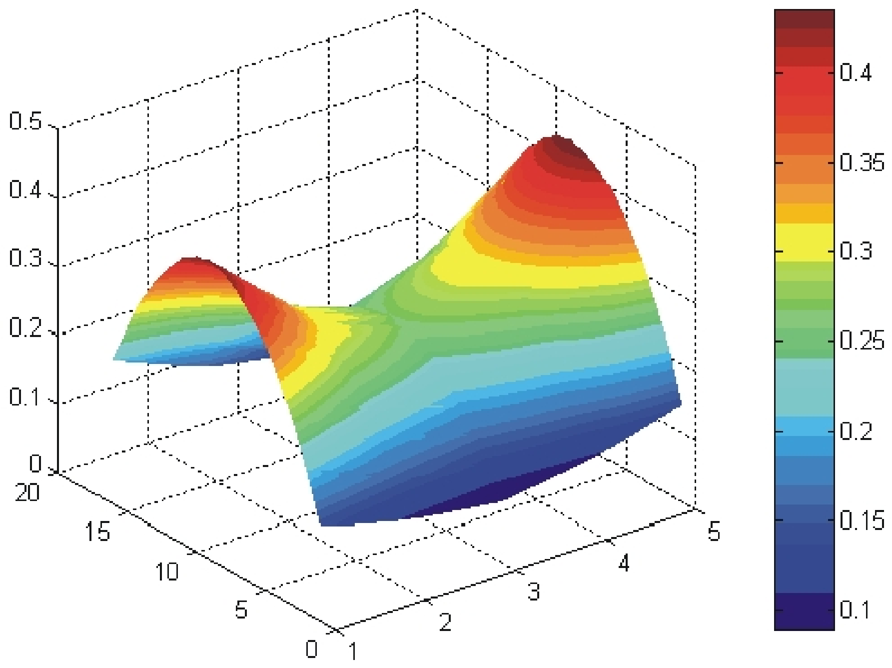

Figure 6. E_z field distributions for *x-z* planes inside the dielectric slab at y=0.03λ, using MoM/FDTD

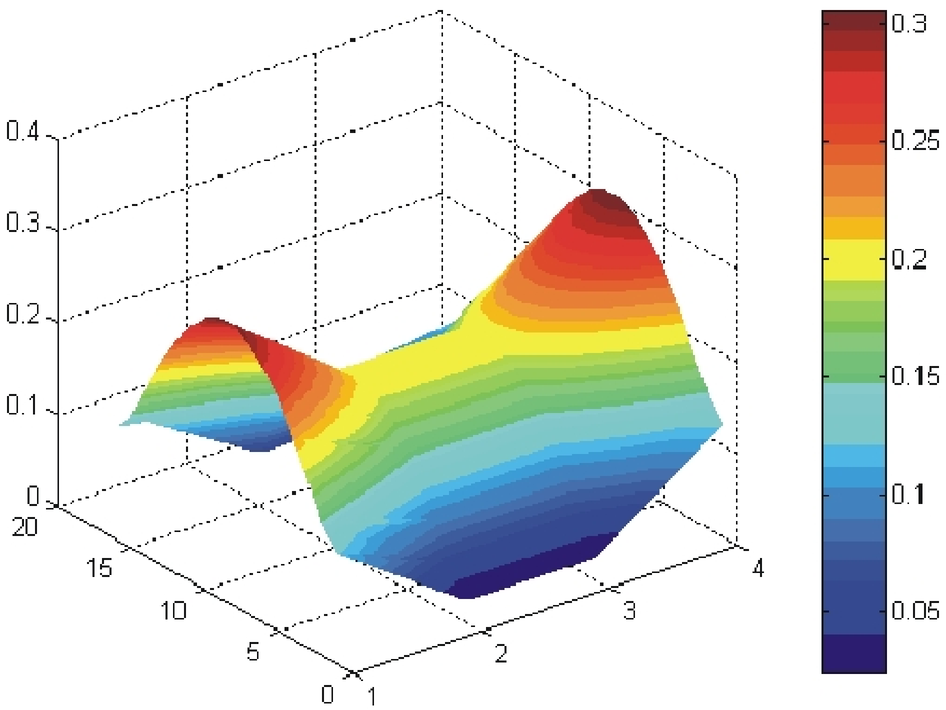

Figure 7. E_z field distributions for *x-z* planes inside the dielectric slab at y=0.015λ, using MoM

Conclusions

The hybrid treatment of the electromagnetic behaviour of multiple regions using hybrid MoM / FDTD simulations gave stable and accurate results. The results of test cases were in excellent agreement with published results and physical expectations. The number of iterations required to account for the multiple reactions between regions was investigated: rapid convergence was found for structures consisting of two or more regions. The method is particularly useful for analysing complex problems involving coupling between antennas and dielectric volumes.

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R. A. Abd-Alhameed, P. S. Excell, M. A. Mangoud and A Ghorbani
Telecommunications Research Centre, University of Bradford, UK
r.a.a.abd@Bradford.ac.uk

Improving the Integration of Hypermedia into the Teaching and Learning Environment Utilizing Databases as Intermediaries

Introduction

With recent increases in the use of hypermedia applications for teaching and learning, it is important to consider both the beneficial and constraining factors associated with this relatively new educational tool. Research has provided evidence that the structure and navigational freedom associated with hypertext environments possess various benefits to the learning process (Dillon & Gabbard, 1998; Jonassen, 2000). First, providing non-linear access to information allows students more freedom in the learning process (Reed & Oughton, 1997). Second, allowing students to access information in depth affords complex representations of basic concepts and comprehensive illustrations of more abstract concepts (Collier, 1987). Third, hypermedia applications address many of the attributes that foster meaningful learning, such as being engaging to the learner, allowing for active learner participation, involving complex, contextual situations, and promoting reflection (Jonassen, 1989; Landow, 1992).

Unfortunately, hypermedia may not necessarily be beneficial for all learners or learning scenarios. For example, issues such as learner type, level of learner activity, and learner ability all influence the effectiveness of integrating hypermedia into the learning environment. Dillon and Gabbard (1998) state that, while hypermedia "can offer techniques that can help the less able student perform better" (p. 345), lower ability learners often have more difficulty effectively utilizing hypermedia. Lee and Lehman (1993) suggest that the level of activity the learner engages in affects the learner's achievement in the hypermedia environment. Reed and Oughton (1997) found that more experienced hypermedia users take more nonlinear, and fewer linear steps through the hypermedia environment, thus increasing the effectiveness of the hypermedia application as a learning tool. They also suggest that the structure and freedom associated with hypermedia environments, while providing some benefits, can also act as constraining factors (Reed and Oughton, 1997).

Other limitations of hypermedia applications involve navigational and experiential issues. Inexperienced users, where inexperience refers to both hypermedia environments and the content area, encounter various problems including goal attainment, in which inexperienced users can often overlook important information; spatial disorientation, in which users can be overwhelmed and have a sense of being lost in the information; and knowledge acquisition, in which students feel cognitively overloaded due to having to perform multiple tasks such as information storage, restructuring, transfer, and evaluation (Astleitner & Leutner, 1995). Finally, due to the environment or content being too new, hypermedia structures can often be too advanced for many inexperienced learners, initially. Beaufils (2000) states that students would benefit from some sort of pre-structuring activity to the hypermedia.

Databases as Intermediaries

While hypermedia can be a powerful tool for learning, it is critical to be careful with the manner in which it is used. In order to ensure growth in the ability to teach or learn, the constraints associated with hypermedia must be appropriately addressed. One solution that addresses the constraints of hypermedia is the use of hypermedia-integrated databases. A number of problems associated with the design of hypermedia systems can be addressed using database systems. For example, databases can be used to address complexity issues related to navigation, flexibility, and organization of information, by reducing the sense of being overwhelmed. Database structures can also help low ability learners and those not experienced with hypermedia applications or the specific content area, as well as other issues presented by hypermedia structures (Jonassen, 2000).

This may occur in three ways. First, database applications allow instructors to sort information, influencing user control over the learning environment. As a result, the user has less control over the environment, and experiences less cognitive overload. More experienced and proficient users can be provided more control in the environment to enhance the learning experience. Having experienced database structures in the learning environment, the user is better prepared for information presented via other hypermedia applications. Second, databases are effective as pre-structuring tools. This is because database applications can be structured to involve similar tasks as hypermedia (information storage, restructuring, transfer, and evaluation), but in a manner that is less overwhelming to the learner. Third, Jonassen (2000) argues that the "greatest problem related to using hypermedia to facilitate learning is how learners will integrate the information they acquire in the hypertext into

their own knowledge structures” (p. 210). Database applications address this issue by helping students make their own content relationships, and then relate those relationships to their knowledge structures.

In sum, using web-based database structures in hypermedia applications assists teaching and learning processes. In doing so, they act as intermediaries between the learner and the hypermedia environment.

Conclusion

Integrating hypermedia into the learning environment presents a number of potential benefits. It allows for more complex learning environments, deeper learning to occur, and more learner control in the learning process. However, being thrust into this new learning environment can often overwhelm the learner. Because database structures are familiar to many learners, using them as intermediaries can dampen the effect of the learner being overwhelmed by a novel tool, and ultimately improve the effectiveness of hypermedia applications for many different learner types, especially the ‘new learner’.

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Richard Hartshorne
Assistant Professor, Instructional Systems Technology
Department of Educational Leadership
University of North Carolina at Charlotte, USA
rhartsho@email.uncc.edu

Richard E. Ferdig, Ph.D.
Assistant Professor, Educational Technology
School of Teaching and Learning
University of Florida, USA
rferdig@coe.ufl.edu

English Vocabulary in Context: A Software Program to Teach EFL Reading Strategies to University Students in Argentina

The present paper includes a report of a research project done at the National University of Río Cuarto (UNRC), in Córdoba, Argentina. The project involved the design, development and evaluation of "English Vocabulary in Context" (ISBN: 950-665-249-X), an interactive software program that aims at providing elementary / pre-intermediate students with modeling and guided practice on the use of strategies applied to reading in English as a foreign language.

Design and development stage

The design of this software was informed by contextual needs and by a theoretical study of related topics. Contextual needs were determined by classroom experience and by a previous exploratory research in English for Specific Purposes (ESP) courses at the University.

Teaching experience in ESP courses allowed to identify an often problematic aspect of reading for these students: the successful application of word-treatment strategies (Nation, 1990; Oxford,1990) to process unknown words when reading in English as a foreign language. In addition, previous research in the course for which the program was later developed provided a better understanding of how students were using word-treatment strategies, and of which strategies they needed to practice systematically (Loyo and Picchio, 2001/2002; Picchio and Loyo, 2003).

Apart from helping to determine what strategies would be taught in the program, classroom needs also influenced the choice of reading materials and tasks. Considering that most of the students enrolled in the course pursued teacher degrees, the texts included in the program were about concepts and theories related to the fields of pedagogy and educational psychology. The reading tasks were similar to the ones students in the mentioned course are generally asked to solve, focusing on both global and specific aspects of texts. Table 1 below illustrates the software contents:

Table 1. Contents in "English Vocabulary in Context"

UNIT	TEXTS	TASKS	STRATEGIES
1	Constructivist Theory Social Development Theory Multiple Intelligences	Skimming to get the main idea	Recognizing cognates
2	Social Development Theory Gestalt Theory Operant Conditioning	Scanning to answer true/false statements Matching words/meanings	Identifying the purpose of the task to focus on relevant words
3	Constructivist Theory Experiential Learning Cognitive Flexibility	Scanning to answer questions Translating in context	Guessing from linguistic and contextual clues
4	Dyslexia Paulo Freire Cognitive/Learning Styles Motivation	Scanning to answer questions	Guessing from linguistic clues
5	Montessori Materials and Learning Environments	Skimming and scanning to answer global and specific reading questions	Revision of those in 1, 2, 3 and 4

The theoretical guidelines for this development were found in Chapelle (1998), Hoven (1997) and Keirns (1999). Following these authors' suggestions, English Vocabulary in Context was created as a self-access program that supports classroom instruction by providing students with: (a) modeling and guided practice on the use of reading strategies, (b) the opportunity of interacting with the content and of integrating information in an autonomous manner, (c) formative feedback on their reading performance, allowing self-correction and stimulating the learner's metacognitive awareness. Figures 1 and 2 show the design of two lessons from the

program, in which students are presented with the same text, but with a different reading task (reading for specific information in 1 and for global meaning in 2). The figures also illustrate how strategy-based instruction is embedded in the program and accessed by students by clicking on links and icons.

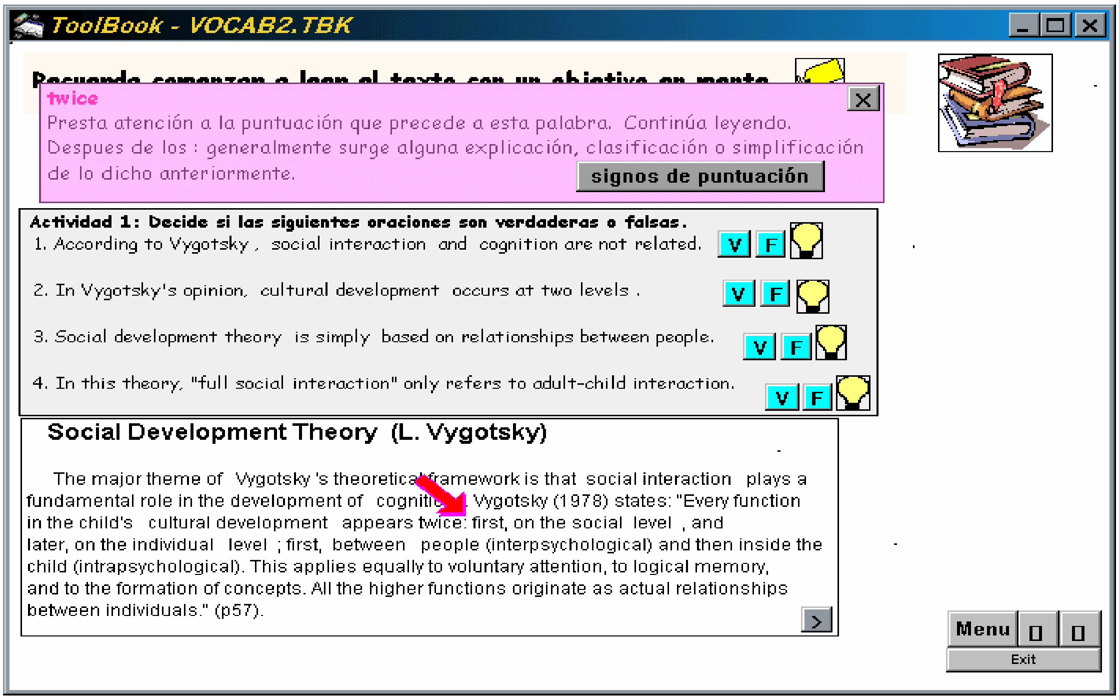

Figure 1. English Vocabulary in Context: (Lesson 1, Unit 3)

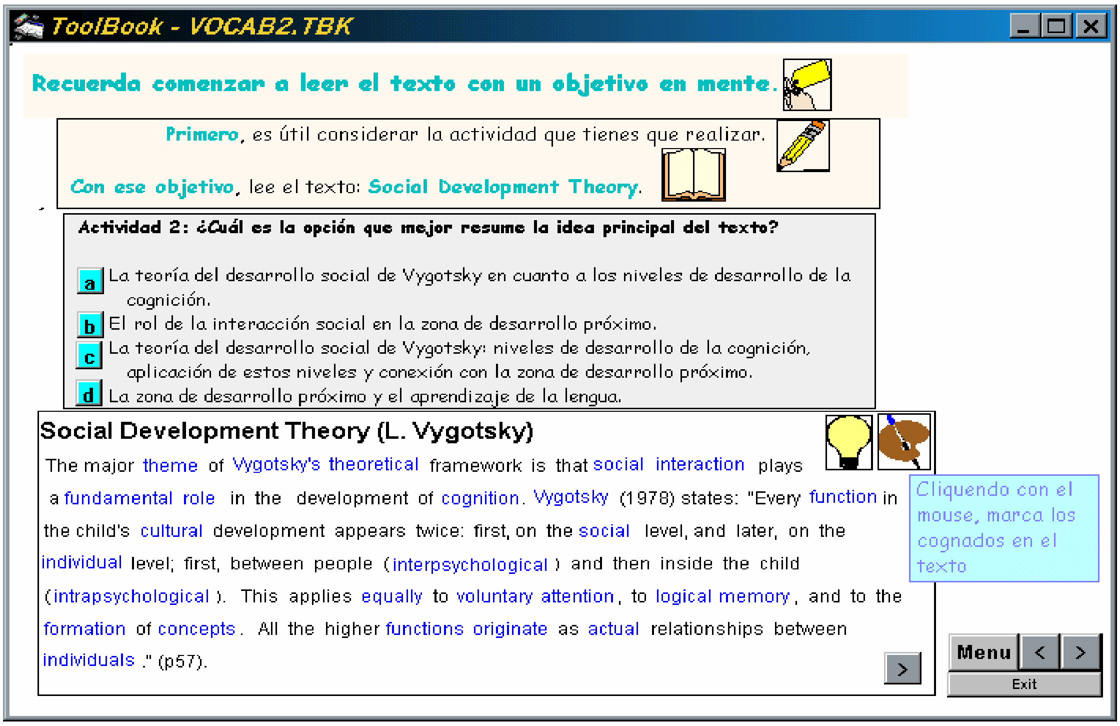

Figure 2. English Vocabulary in Context: (Lesson 2, Unit 1)

Evaluation stage

Two research experiences were carried out with the aim of evaluating the effect of English Vocabulary in Context to teach the intended content and to increase students' motivation to read in English as a foreign

language. Three students from the population of the ESP course for the Humanities were invited to participate in two case studies. In the first one, a student interacted with the program individually over a period of time, completing all its lessons (Picchio and Loyo, 2003). In the second experience, two students worked with the program in a collaborative manner, doing pair work. Pre and a post reading tests were used to determine changes in the students' reading performance; an observation guide and a structured questionnaire helped to evaluate students' reactions when working with each lesson in the program. The findings of both studies showed a positive effect associated with using the program as far as both the readers' performance and affective factors. These results suggest that the program should be incorporated as part of the instructional materials of the ESP course, and stimulate further development of interactive software to be used in the same context.

Note

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Romina B. Picchio
Department of Languages
National University of Río Cuarto
Argetina
Agencia Córdoba Ciencia
rpicchio@hotmail.com

Simple Web-based Adaptive Learning Technology

Abstract

This report gives the developmental process of architectural design of a simple Web-based adaptive learning system. The research in such systems has advanced significantly in recent years but there are few attempts to report the development process that could be useful for practitioner community. The system described in this project is divided into four modules that allow for various didactic, tutoring and student styles. In particular, the system adapts to knowledge differences between students and the changing knowledge of a particular student. The system considers cognitive traits of individuals at the heart of the adaptation process.

1. Background

This paper reports the development work of a Simple Web-based Adaptive Learning Technology (SWALT), arising out of the IEEE Workshop at the International Summer School on Educational Technology.

At the summer school, discussion was around the importance and need of adaptivity in learning systems and *how* adaptivity could be applied.

The delegates in the summer school were concerned about how a minimalist system could be developed. What was its architecture? The aim was to consider how to design or develop a SWALT to assist e.g. *adult* learners in learning a *sample* subject. The summer school discussions centred on *what* the SWALT could adapt to (measure and respond to) and *how* the SWALT could adapt (change the standard delivery to deliver the material in a more appropriate way)

The delegates agreed that the way to develop a learning technology is to ensure separation of the system into modules, which have the smallest interactions possible. The modules give us an abstraction from the actual underlying models and technology used. One module can satisfy the needs of many models and there can be standing rules about which model to use in which circumstance. Here we analyse each module's functionality and links with other modules so that subsequent developers can create the modules.

2. The SWALT

Cognitive abilities can be measured by getting students to perform a task that involves information processing. The Cognitive Trait Model or CTM [1] would have us measure characteristics of the student that are persistent (and useful for changing the tutoring style). When fed to the tutoring model, the interface module would adapt to the profile of the student, and deliver a customised experience that could otherwise only be achieved through good one-to-one tutoring.

The delegates tried to draw an analogy between the way the students think and the way computers work, but this analogy was unhelpful. The group of delegates felt that they could attack the problem by tackling the "easiest" characteristic to measure, viz. the student's Working Memory Capacity (WMC) as operationalised through some measure of the speed of performing some specific, standardised task. What the delegates did not spot was that an adequate definition [2] of WMC exists:

> "In our research, we used:
> - Randall Engle's definition of working memory capacity
> - the ability to keep our attention focused in the face of distraction or interference."

The work of designing the components of SWALT was divided into four parts, and each part was delegated to one of four groups. Simply put, the task was to describe to a programmer what the SWALT was to do. Retrospectively, we have had to add models: the *didactic, tutoring and student models*, which encapsulate the particular teaching approach to be taken here to adult students. Figure 1 gives a retrospective view of a Simple Web-based Adaptive Learning Technology, with the four modules in light grey. The modules investigated by the four groups of delegates in the summer school were:

1. The Knowledge base **module** is a repository for the content to be mastered, with optional instructional tags.
2. The Tutoring **module**:The delegates aimed to keep it as simple as possible.

3. The User Interface **module**: e.g. Web-based multimedia delivery.
4. The Student **module**: A store of the current state of student outcomes.

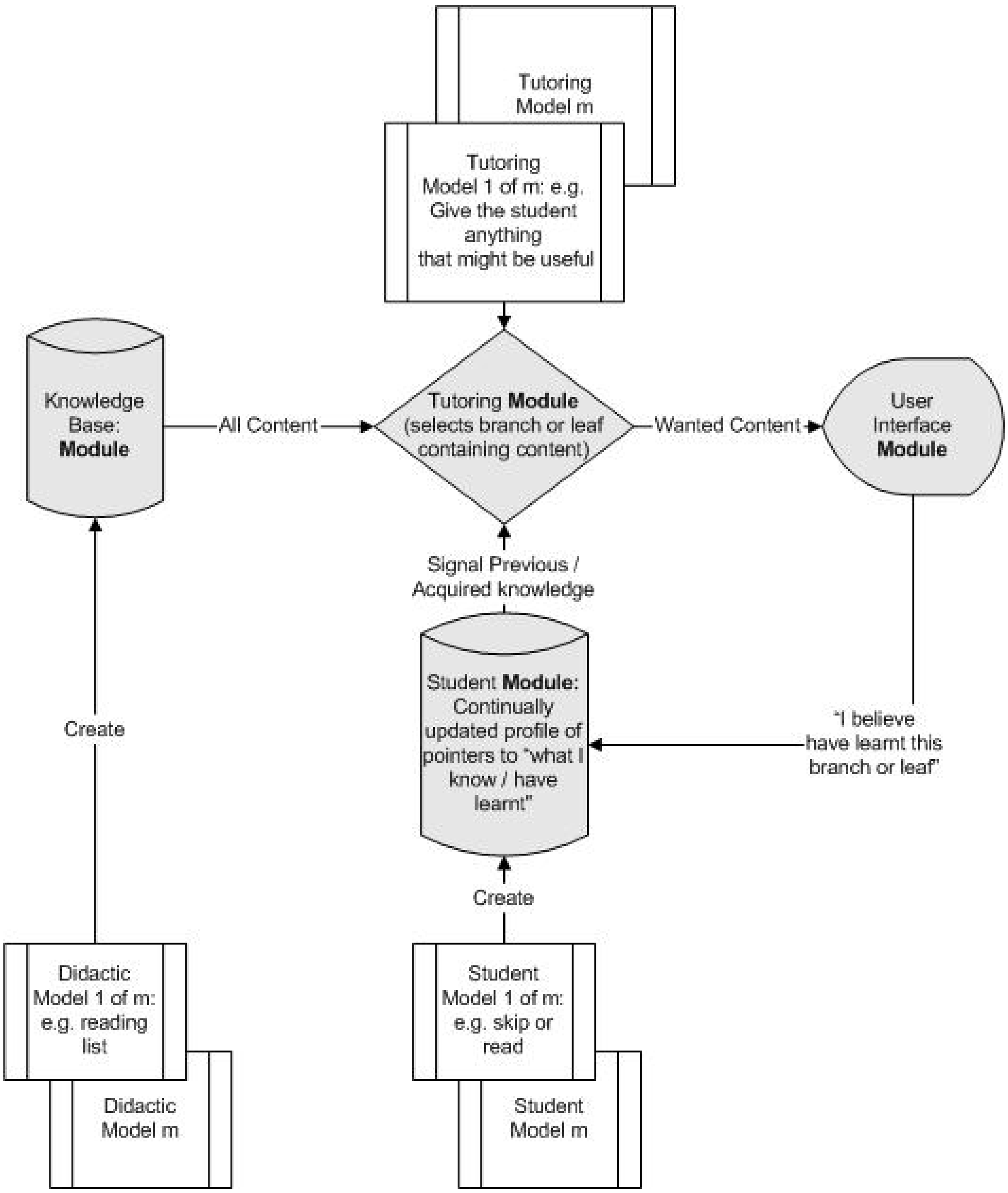

Figure 1. Simple Web-based Adaptive Learning Technology

Subsequent to the summer school, it was found useful to introduce three models: The Didactic, Tutoring and the Student model. The work that the *modules* must perform is based on some **model** that is chosen beforehand and subsequently used. The three pre-selected models are:

A. The Didactic model: based on experience of what works with the target audience. We assume that the educator has some practical experience in what works, and maybe even knows about some good research results in the field.
B. The Tutoring model: e.g. Only give the student that which the student might find useful
C. The Student model: based on self-recognition of own competency.

For example, because the delegates adopted a Webpaedia as the sample Knowledge Base, they were forced to use its tree structure as their particular model for content and knowledge values. There is also an impact of adopting this structure on the student interface: The student interface must then allow the students to navigate

and search through the tree. In a similar fashion, the model of the student will drive what needs to be programmed in the student module. This shows how an early decision is propagated through the whole design.

The backward arrow is the *feedback* path, essential for control in the *adaptive* learning System. For the learning system to be classed as being adaptive, changes must be made to the tutoring while *on-line.* Real-life examples of this occur when educators change their teaching because of feedback. The adaptive system must adapt to differences between individual students as well as to individual students changing.

3. The knowledge base module

The *knowledge base* was the corpus of knowledge that the SWALT was required to transmit to the students. To make the work of the delegates concrete, one delegate supplied a *sample* corpus, the Webpaedia of Research Methods, consisting of critically reviewed links into carefully selected readings in the World Wide Web. The corpus was already categorised into topics and placed into folders that were sorted into a suggested order of reading. The knowledge base was most easily modelled as a tree. The folders constituted branches of the tree, and the content pages constituted the leaves of the tree.

The knowledge base group had difficulty in absorbing the enormity of the knowledge base, and usefully suggested that it required a contents page. There were 20 folders, and a miscellaneous folder. The topics ranged from "The Scientific Method" to "Writing for Research”. The group realized that it was necessary to find some method to determine the students’ knowledge or competence of each concept. To make this work concrete, the delegaes subsequently assumed that the SWALT simply gets each (adult) student to assess the student's own knowledge.

The delegates felt retrospectively that they needed to characterise the knowledge base that had been provided as some "model-of-teaching". The first that came out was to characterize it as a reading-list. A *reading list* is a list of references for material that the educator believes the student must obtain and study. The student should go through all the material, trying to make internal sense of it. Subsequently, it was convenient to characterise the knowledge base didactically as a "tree-of-knowledge" with leaves and branches that could be left out by an "advanced" or "knowledgeable" student.

The knowledge base group astutely spotted that a hidden agenda was for the student to make mental connections between the presented concepts. The content pages were not "atomic" and completely self-standing (the idealistic "learning object"). There would be overlaps of knowledge, contradictions, and gaps resulting from the global authorship of the content.

The knowledge database selected by the delegates can thus conveniently be regarded as the tree of knowledge, from which leaves or branches could be pruned by the SWALT to suit our particular student. A structure which the knowledge base group usefully called a *knowledge value* contains a parallel tree (i.e. overlay) of decimals, each of which indicates the student's competency (or grade) in the understanding of this content on a scale from 0 .0 to 1.0. *Learning* can be defined as the difference between the prior knowledge value and the current knowledge value.

3.1 The didactic model

The *didactic model* encapsulates the particular teaching approach to be taken, here to adult learners. In the case selected by the delegates, the only model is a "reading-list". As Post Graduate students were intended to be the users of the knowledge base, the simplest model would be that it was a reading list. Other models can be incorporated as they are identified, analysed and programmed. Another example of an existing didactic model is a "Learn and reproduce this material at examination time" model. In these models, the delegates are stereotyping one’s way of teaching.

4. The tutoring module

The *tutoring module* is the heart of the SWALT. It encapsulates the way that the SWALT conveys the knowledge base to the student. The delegates decided to keep the tutoring model as simple as possible. They decided to adapt the amount of content or type of media according to the student’s characteristics. A reading list

is a (paper-based example) of *adaptive* teaching, in that fast or knowledgeable students need not read those aspects they are already familiar or conversant with. It adapts to the different needs of different students, and adapts the changing needs of a single student.

4.1. The tutoring model

The tutoring model can be chosen at will beforehand. The following things could adapt:
- the amount of content to be presented to the student
- the navigation through the content.
- the amount of each ancillary media type which is included to explain the content.

The delegates ignored the last possibility, as the sample knowledge base had no media other than text. They decided to give the student anything that might be useful, excluding those leaves or branches of content that the student claims to have mastered.

5. The interface module

The *interface module* sketches the form of the Human-Computer Interface needed to deliver the knowledge base to the student, following the didactics in the specified tutoring model, and assuming that the student complies with the specified student model.

The interface module of the SWALT has to display a view of material from the knowledge base [3]. Two broad approaches which may used to design the interface module are:
- Hyperspace (navigational) structuring
- Stylistic and media changes to the view or look and feel of the interface [4]

Here the delegates only had time to consider the first approach, and adapt the list of topics to be navigated by inquiring from students their knowledge of each branch and leaf. If the students do not comply, e.g., by lying about their prior knowledge, the Learning System will obviously fail to teach. The delegates decided to make the interface adaptable in a way that would let students navigate efficiently through the content.

The design of the Interface module is
- driven by the structure of the knowledge space to form a structured hyperspace
- didactically appropriate through the use of annotations, link hiding, and dynamic exclusions
- responsible for all interactions with the student and
- responsible to relay the feedback information to the tutoring module so that it can make adaptations over time.

6. The student module

The delegates subsequently realised that they have to keep very clearly in their minds the difference between the student *model* and the student *module*. In general, the *module* will be programmed to respond appropriately to many *models* that might be invoked.

For each student, the *student module* keeps track of those leaves and branches that the student claims were previously mastered, or were visited. In general, for each student, the student module dynamically updates what it believes is the current profile of the student. The profile will contain a field which is the category of student (e.g., adult_learner); what the student's options are (e.g., prefers_biggest_font); and which leaves and branches the student has traversed and hopefully internalised.

6.1. The student model

In the educational field, the model of the user is called the *student model*. The *student model* attempts to capture an explanation of how the student goes about the task of studying the material. It is dynamically updated, e.g based on manifests of cognitive traits. The student is initially modelled as possessing some prior knowledge, which is a subset of the knowledge base.

The student model selected by the delegates could be termed an "honesty model", where the adult students assess their need for material. Being adults, the students would be expected to retrieve the educational material themselves, read those passages that were referred to, ignoring others. They would be expected to highlight important text and figures, making their own marginal notes as they went along. Each student would be expected to discover the "shape of the field", and "make connections", linking together the diverse and possibly contrary viewpoints of the disparate authors, and making an integrated and integral whole of the material.

7. Discussion

There are many ways of measuring Working Memory Capacity (WMC). However, no measurement of WMC can be made reliably and repeatedly, because all measurements e.g., if the student's short term memory capacity would have to go through the student's vision and voice or other "input/output devices". Other possible characteristics were even less easily measured and in the time available, the delegates were not able to operationalize a measure that a programmer could use, less still validate its worth. The complexity of the student frustrates the research progress. Sadly, thus far, almost no [5] adaptive learning system can measure and adapt using cognitive traits derived from observing the student. The system described here uses one aspect of cognition, namely knowledge.

In retrospect, perhaps a practical way of customising the experience (adapting) for every student is simply to ask before each topic "Are you sure that you know what the scientific method is?" ... "Are you confident that you know enough about writing for research?", and then recommend that the student skips the topic or study the topic. In practice, this process can be made more subtle by phrasing the title as a question: "What is the Scientific Method?" ... "How does one write for Research?" and linking to a list of sub-questions (branches), which are then linked to the final text (leaves).

8. Recommendations for further work

The following manifests or measures of working memory capacity should be researched for their *measurability* and *usefulness*:

- Speed of execution: This might be the time that the student takes to give an answer or to complete a task.
- Navigational pattern followed: holistic (short-term) or serial (long-term). The adaptive learning system could keep track of the paths that the students follow during their navigation through the didactic content.
- Ability to process tasks simultaneously. The degree of non-linearity of the path followed, and whether more than one browser window is open at a time.
- Ability to memorize and retain. If the adaptive learning system provided some assessment tests then the measure might be the assessment marks given for the test itself. Otherwise, the adaptive learning system might measure how many times during the session the students return to previous topics. This could be a measure of the students' inability to retain the information.

9. Conclusion

This activity report has presented the architecture for a simple, web-based, adaptive learning technology. The authors trust that this will be a useful start for those researchers wishing to create more complex systems that will truly imitate the best human tutors, in measuring and tracking the real needs of students, and providing an appropriate learning experience.

Notes

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Ian G. Kennedy
i.kennedy@ee.wits.ac.za

Sanaz Fallahkhair
S.Fallahkhair@brighton.ac.uk

Veronica Rossano
rossano@di.uniba.it

Anna Trifonova
trifonova@science.unitn.it

Antonella Grasso
grasso@di.uniba.it

Sabine Graf
graf@wit.tuwien.ac.at

Jean-Claude Ziswiler
Jean-Claude.Ziswiler@cui.unige.ch

Ricardo Fraser
rickysoft@tstt.net.tt

What Interest Rate Are You Getting?

Abstract

In an era when universities and colleges are increasingly being held accountable according to commercial business practices, it seems appropriate to use as a title a phrase drawn from the world of finance. The interest rate proposed here, however, is unrelated to home mortgages or personal loans. Rather, it refers to the level of interest in the subject that the instructor (lecturer, teacher, facilitator) is able to convey to the online learner (student, pupil, undergraduate). This short paper puts forward the controversial view that it is this, rather then the level of interaction, the means of communication, the type of assessment, or even the content, that is the most important, and often decisive, factor in achieving a successful learning outcome.

Introduction

Many different theories of learning have been proposed, and vie for general acceptance. No less than fifty such theories are listed at Greg Kearsley's Theory Into Practice site (Kearsley 2004). Many, such as Bruner's Constructivist Theory, Piaget's Genetic Epistemology, Garner's Multiple Intelligences, Lave's Situated Learning, Skinner's Operant Conditioning, and Vygotsky's Social Development, are regarded by many educators as critically important milestones in the theory of learning.

Few similarities exist between many of the theories. Some stress the physical environment of the learner, while others emphasize the cultural setting in which the learning takes place. Many stress the importance of interaction, while disagreeing about how such interaction can be meaningfully measured. Some are focused on ensuring effective communication between the instructor and the learner, while others focus on the communication between the learners themselves. And so on.

Kearsley (2004) points out that motivation is a pivotal concept in most theories of learning, but that in most cases,

> …it is closely related to arousal, attention, anxiety, and feedback / reinforcement. For example, a person needs to be motivated enough to pay attention while learning; anxiety can decrease our motivation to learn. Receiving a reward or feedback for an action usually increases the likelihood that the action will be repeated.

This paper proposes that the *interest* that the student has in the subject is the most important factor in true learning. The term *interest* as used here is closely related to Kearsley's *motivation,* but also includes *enthusiasm*, which the American Heritage Dictionary defines as

> "Great excitement for or interest in a subject or cause"

and cites in reference to the etymology of the word that

> "Enthusiasm first appeared … with the meaning "possession by a god." …Over time the meaning of enthusiasm became extended to "rapturous inspiration like that caused by a god" … and eventually to the familiar sense "craze, excitement, strong liking for something." Now one can have an enthusiasm for almost anything, from water skiing to fast food, without religion entering into it at all "

Quite so. Back in the early eighties John Keller presented a model of instructional design that encompassed four aspects:

- arousing interest,
- creating relevance,
- developing an expectancy of success, and
- producing satisfaction through intrinsic/extrinsic rewards (Keller, 1983).

This later came to be known as the ARCS (attention, relevance, confidence, and satisfaction) model. It is interesting to note that all of these are particularly amenable to the appropriate use of online technologies.

How do we arouse interest? By showing real achievable outcomes, benefits, and results at the beginning of courses, not at the end. For example, for a programming course, having completed working demonstration programs accessible from the start, so that students can see what can be achieved. For a multimedia course, having plenty of working animations, films, videos, etc. to use as examples. For a criminal law course, showing how the methods and techniques covered in the course are used in real cases to bring the guilty to justice, or protect the innocent. For an accounting course, showing how simple methodologies could have saved a company from bankruptcy, or empowered management to make alternate decisions. And so on.

How do we create relevance? By linking theoretical material to real-world applications. Every time a new concept is introduced, it can be accompanied by links to illustrative sites in the outside world. This is far easier to achieve in a web-based environment than in a traditional lecture theatre, where the closest one can get to the real world may be a few outdated overhead transparencies.

How do we develop an expectancy of success? By having online self-test exercises, which students can use to measure their progress from day one. Here it is important that the exercises be easily available, and be regularly and frequently-spaced throughout the course. A small weighting in terms of grade is usually sufficient to ensure maximum student participation. A figure of between 10% and 15% would seem to be ideal in terms of encouragement, and yet small enough that any plagiarism and cheating is not a major concern. Such exercises can be automatically monitored, and, if resources permit, special attention paid to topics that seem to have caused difficulty, or students who seem to be struggling.

How do we produce satisfaction by intrinsic and extrinsic rewards? This will vary according to the context. Children may easily be rewarded as they progress via an automatically-generated complimentary comment or two, or the playing of a free game when a certain skill level has been successfully achieved. For adults, the mere joy of learning may be enough, especially if the real-world relevance of that learning is clearly demonstrated throughout the course. A more immediate reward will be forthcoming for grade-oriented students via marks attained in the regular tests mentioned in the previous paragraph.

In summary, therefore, the appropriate use of learning technologies allows far more flexibility to both course structure and assessment, by which all four of Keller's motivational aspects may be enhanced: student interest can be maximized, relevance can be created, an expectancy of success can be developed, and satisfaction produced.

By using online technologies not for their own sake, but instead, primarily as an aid to ensure interest and motivation, learning outcomes are likely to be maximized.

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Tim S Roberts
Faculty of Informatics and Communication
Central Queensland University,
Bundaberg, Queensland 4670, Australia
t.roberts@cqu.edu.au

WorkspaceNavigator: Adaptable Technology for Project-Based Learning Environments

WorkspaceNavigator is a system of tools that support knowledge capture and reuse for design teams engaged in a dedicated physical workspace. WorkspaceNavigator was created to address the special needs and considerations associated with project-based learning, needs which are distinct from those of more structured classroom environments. By recording design activity in both the physical and digital domain, WorkspaceNavigator helps instructors monitor the progress of student team projects, promotes student awareness of fellow team member activities, and enables high level reflection through the creation of a lasting record of the design process. This article will describe WorkspaceNavigator and its deployment in project-based learning environments.

Needs Analysis

Project-based learning endeavors to balance traditional classroom learning with opportunities to apply knowledge and problem solving skills to open-ended design problems. Project-based learning classes vary widely, but commonly involve teams of students working collaboratively, extended project durations, and a wide variety of work environments. The open-ended projects create a need for instruction staff to keep close tabs on students so that they might anticipate issues, and yet such oversight is difficult because the work is often distributed amongst different individuals, in different locations, and over a long-time frame. Project-based courses also present unique issues for students, who must constantly work to keep other team members apprised on various aspects of the project, track numerous details over the project and manage a wealth of generated knowledge to document their work.

WorkspaceNavigator is designed to capture knowledge generated throughout the design process. It captures information wherever it is created: during a team brainstorm, at a personal computer, or on the workbench where things are being built. It also adapts to the needs of its different user populations. Those in a design oversight role, such as the instructional staff, need an interface that presents high-level information about team activity, whereas those actively engaged in design need far more detail and fine grain information to allow them to access specific documents or activities at different points in the design process.

WorkspaceNavigator Design

The WorkspaceNavigator has a data capture mechanism and a data retrieval mechanism. The data capture mechanism is a modular system with implicit and explicit capture tools that can be combined according to the physical needs of a design space. The implicit capture modules are triggered at regular time intervals by the system to capture data synchronously in packets we call *timeslices*. The explicit capture tools place information into the data stream in response to user actions. A typical team design space outfitted for capture could include implicitly captured whiteboard snapshots of team drawings, overview images of the team space, and desktop computer screenshots showing data sheets, as well as explicitly captured data including user annotations and uploaded digital images of prototypes.

To assist users in browsing months of data, the WorkspaceNavigator relies on capturing only discrete data rather than continuous audio or video streams. We developed two data retrieval mechanisms to support different users. For design team members, the *WSN Browser* presents captured project data for a single team. It provides a unified interface for accessing all of the captured information from a physical design workspace (Figure 1). The focal elements of the interface are a timeline and an overview wide-angle image of the workspace. The timeline contains two rows, one representing implicitly captured discrete data acquired at regular intervals, and the other representing explicitly uploaded digital images. Users can navigate through the captured timeslices and move deeper into the data by clicking on the overview images. The *WSN Viz* is targeted at people overseeing the design process and who want high-level information about workspace activity and patterns to facilitate cross-team comparison. It provides a graphical visualization of activity in several team spaces simultaneously (Figure 2). Each row represents a different physical space, each block represents a time period, and the brightness of each block represents how much activity was occurring at a given point.

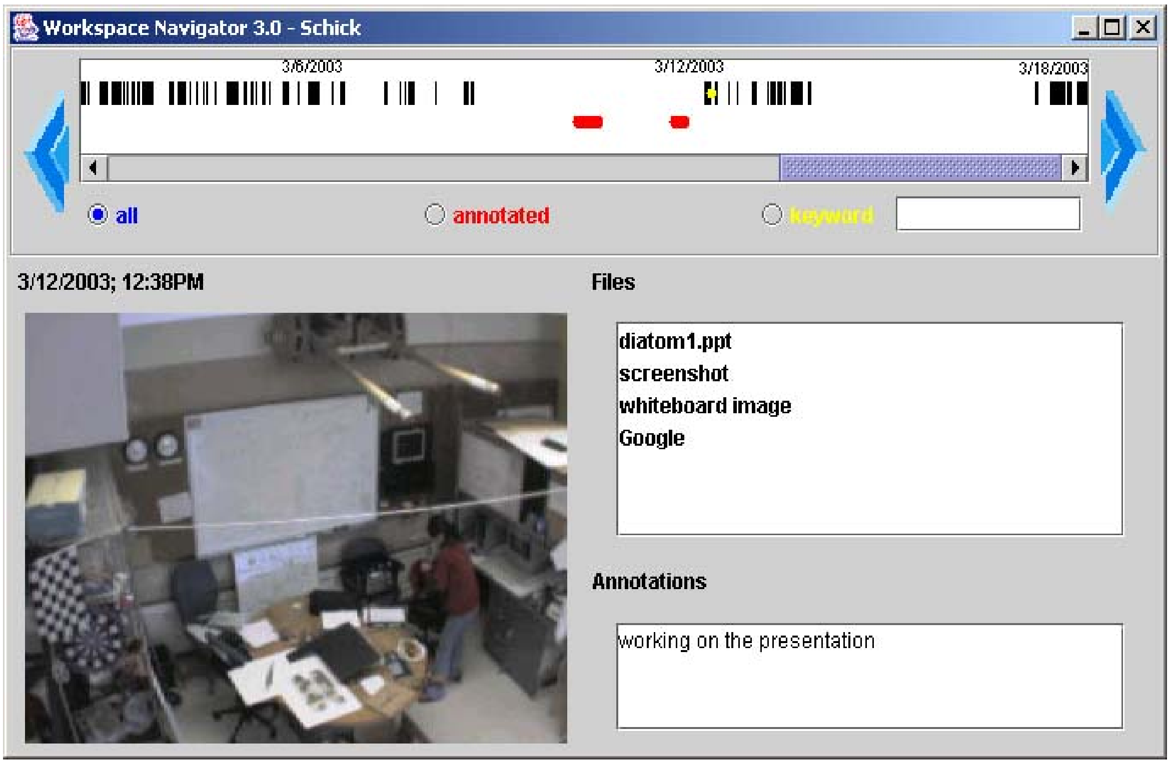

Figure 1. WSN Browser

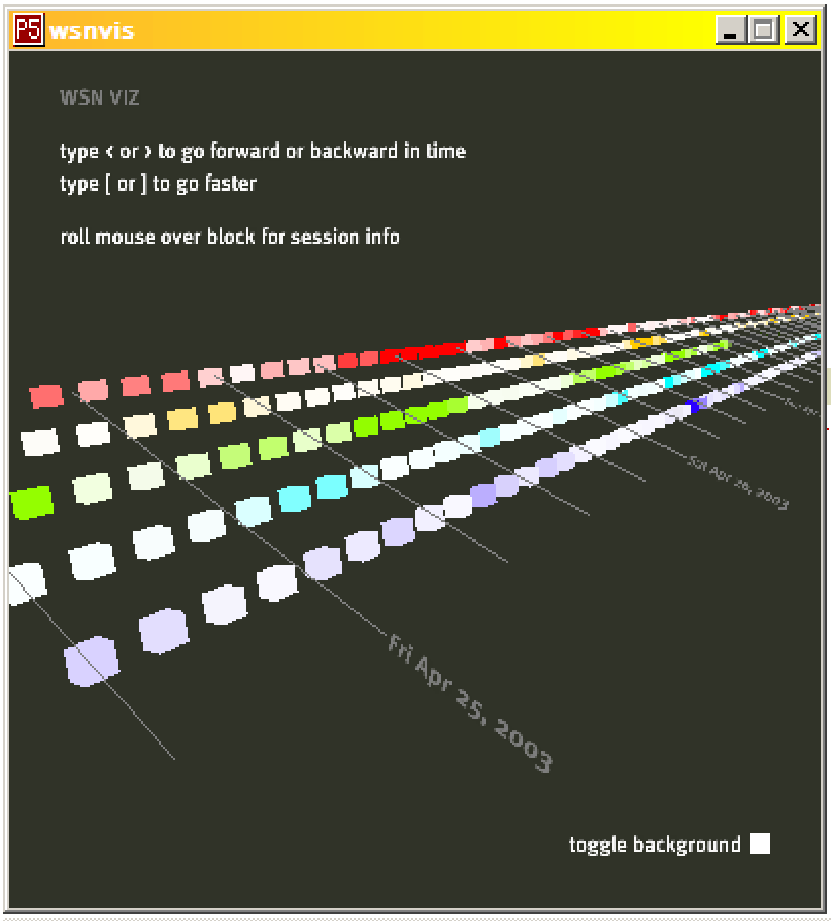

Figure 2. WSN Viz

WorkspaceNavigator Usage

After a number of pilot studies, we deployed WorkspaceNavigator in a variety of pre-existing design workspaces associated with two courses in the Mechanical Engineering department. Both courses involved team-based design projects and had large laboratory spaces with specific areas designated for each team's use. The study and data collection took place over nine months.

Since WorkspaceNavigator is a modular system, we were able to quickly adapt the system to new spaces, and we observed widely differing patterns of use within similar spaces. For example, students actively re-oriented their overview cameras to different places in their workspace to capture the activity they felt was most important at that point in the design process. By incorporating implicit and explicit capture mechanisms, we found that WorkspaceNavigator successfully supported different types of users, from those who were actively engaged in capturing and organizing information to those who were passive and unmindful of documentation. In fact, the most compelling argument for WorkspaceNavigator came from a team that did not think about capturing their notes and activities, but were then “saved” by WorkspaceNavigator’s implicitly captured data when it came to writing their final reports and reflections on their design process.

Conclusion

One of the recurring design themes for WorkspaceNavigator is flexibility. The modularity of the capture mechanisms allows the system to adapt to different learning environments. Having both explicit and implicit capture tools allows both active and passive users to benefit. Adapting data retrieval interfaces to provide varying levels of detail allows different users to access the captured information to best suit their needs. These features make WorkspaceNavigator particularly useful in nontraditional learning environments. In this way, these educational technologies might benefit those with a variety of teaching and learning styles.

Arna Ionescu, Wendy Ju, and Terry Winograd
wendyju@stanford.edu

Real-time Learning Behavior Mining Algorithm

1. Introduction

Over the last years, we have witnessed an explosive growth of e-learning. More and more learning contents have been published and shared over the Internet. Therefore, how to progress an efficient learning process becomes a critical issue. This paper proposes a sequential mining algorithm to analyze learning behaviors for discovering frequently sequential patterns [2]. By these patterns, we can provide suggestions for learners to select their interest learning contents. Different to other sequential mining algorithms, this study provides an incrementally method to analyze learning sequencing. More specifically, the mining algorithm in this paper can provide real-time analysis report to learners for selecting learning contents more easily.

2. Learning pattern mining

The main input to this mining algorithm is a learning sequencing which can be seen as a sequence. Besides, the sequence is an ordered list of one or more learning elements. These learning elements are learning behavior recorded on user log file from WWW (World Wild Web).

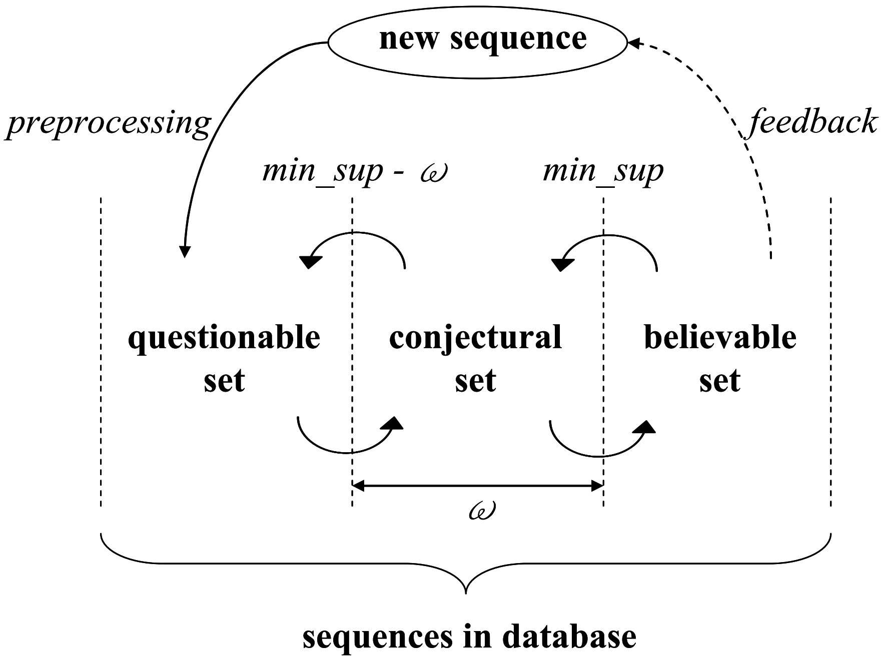

Figure 1. Diagram of sequences state transfer

Figure 1 shows the sequence database composed of questionable, conjectural, and believable sets. Following that, the mining algorithm decomposes the input sequence to several subsequences and records them into the three sets. For each sequence in the sequence database, it has a count of occurrence value which is the support count of the sequence. Generally speaking, sequences in believable set which are satisfying minimum support threshold are useful for discovering learning patterns. Questionable set contains the sequences that do not satisfy the tolerance of minimum support threshold (*min_sup-ω*). Conjectural set begins from the tolerance of minimum support threshold to believable set (*min_sup*), where the constant *ω* is the range of conjectural set. In addition, support counts in conjectural set approximate to the threshold, and they probably transfer their state when next sequence comes into the sequence database. According to the growth of sequence database, minimum support count changes rapidly, one sequence satisfies minimum support currently but perhaps not in next time period and vice versa. Hence, members in conjectural set are not stable and some of them possibly transfer to questionable set or believable set. Similarly, the state transformation could be happened in questionable and believable sets.

Whenever a new sequence comes into the sequence database, the minimum support count adds this record, and it does not cause the sequence database with rapid changes in questionable and believable sets. In conjectural set, the minimum support threshold of each sequence is very close, and we separate this part to be a dynamic checking section. The sequences in conjectural set could transfer into believable set very soon. Therefore, the conjectural set can be seen as a buffer between questionable and believable sets.

3. Definitions

Table 1 summarizes the notations used throughout the paper with a brief description of its semantics. Besides, more details about definitions are showing as follows.

Table 1. Notations

Symbols	Semantics
→	Probability of successive appearance, which contains support and confidence values.
D	A sequence database.
S	A learning sequence.
S_{ab}	A learning sequence combined with S_a and S_b, where S_a, S_b and $S_{ab} \in S$.
Count(S)	An occurrence count value of S in D.
$\|D\|$	A count of all sequences in D.
$\|S\|$	A count of all elements in S.
min_sup	Minimum support threshold
β	A believable set in D.
σ	A conjectural set in D.
ρ	A questionable set in D.
ω	A tolerance of minimum support threshold in σ.

Definition 1: A learning sequence S = < s_1, s_2,…,s_i > is a logical unit of learning behaviors characterized by a serial of learning elements < s_1, s_2,…,s_i >.
Definition 2: Consider a valid learning sequence S_{xy} = < S_x, S_y > combined with S_x = < x_1, x_2,…, x_i> and S_y = < y_1, y_2,…,y_i>, where S_x, S_y and $S_{xy} \in$ S. Following that, for x_i in S_x, such that $x_i \notin (S_x - x_i) \cup S_y$ and for y_i in S_y, such that $y_i \notin (S_y - y_i) \cup S_x$.
Example 1: Suppose there are two learning sequences S_1 = < A, B, C, D > and S_2 = < A, A, B, C >, where S_1 and $S_2 \in$ S. Besides, S_1 is a valid learning sequence but S_2 is not.
Definition 3: Consider a valid learning sequence S_b = < b_{j+1}, b_{j+2},…, b_{j+k} > is a subsequence of valid learning sequence S_a = < a_1, a_2,…a_i >, where S_b is a continuous part of S_a. If and only if the following conditions hold: 1) i, j and k are integer; 2) $0 \le j \le i - 1$; 3) $j + k \le i$.
Example 2: Consider three valid learning sequences S_1 = < A, B, C, D, E >, S_2 = < A, B, C > and S_3 = < B, C, E >, where S_2 is a subsequence of S_1 but S_3 is not a subsequence of S_2.
Definition 4: Imply (→) means the probability of successive appearance; it contains support and confidence values. Besides, the ranges of the two values are between 0% and 100%.
Example 3: An association rule A→B [support = 20%, confidence = 60%] means least 20% of all sequences, which shows A and B occur continuous and together. Furthermore, it also indicates when A appears then in 60% cases B also appears successively.

4. The proposed algorithm

The incrementally sequential mining can be decomposed to two phases: 1) Add phase and 2) Adjust phase, and each of the detail shows as following sections.

4.1 Add phase:

```
Procedure AddSequence (D, S)
begin
1.   let S := a new valid learning sequence
2.   let S_xy := valid learning sequences
3.   let n := 1
4.   repeat {
5.       S_xy := subsequences of S which is produced by scan S with (n)-gram
6.       for each subsequence S_xy ∈ S do {
7.           if (S_xy ∈ D ) then
8.               Count(S_xy) := Count(S_xy) + 1
9.           else
10.              create S_xy in D
11.              Count(S_xy) := 1
12.              |D| := |D| + 1
13.              call procedure AdjustConjecturalSet ( σ )
14.          endif
15.          if ((Count(S_xy) ≥ (min_sup * |D|)) and (|S_xy| > 1)) then
16.              move S_xy from σ to β
17.              create association rules that S_x→S_y
18.          endif
19.      }
20.      n := n + 1
21.  } until (n > |S|)
end
```

Figure 2. Algorithm for adding new sequence into sequence database

Figure 2 shows pseudo code for ***AddSequence*** algorithm, which provides the solution to add sequences into the sequence database. In the iteration of the repeat loop, which spanning steps 4-21, each S_{xy} is produced by scan S with n-gram [1]. Following that, steps 7-8 shows that S_{xy} existed in *D,* and then add 1 to Count(S_{xy}). Otherwise, step 9-14 creates S_{xy} into *D*, sets Count(S_{xy}) to 1, and calls ***AdjustConjecturalSet*** procedure to adjust sequences which lie in conjectural set (σ). In steps 15-18, it checks two conditions: 1) Count(S_{xy}) satisfies support threshold, and 2) has more than one elements in S_{xy}. If the sequence satisfies these two conditions together, S_{xy} transfers to believable set (β) and creates corresponding association rules.

4.2 Adjust phase:

```
Procedure AdjustConjecturalSet ( σ )
Begin
1.   let S_xy := valid learning sequences
2.   for each S_xy in σ do {
3.       if (Count(S_xy) ≥ (min_sup * |D|)) then
4.           move S_xy from σ to β
5.           create association rules that S_x→S_y
6.       else
7.           if (Count(S_xy) < (min_sup * |D| - ω)) then
8.               move S_xy from σ to ρ
9.           endif
10.      endif
11.  }
end
```

Figure 3. Algorithm for adjusting sequences in conjectural set.

The ***AdjustConjecturalSet*** algorithm is shown in Figure 3, which checks the support counts of sequences and adjusts sequences in conjectural set. Assume that the support count of sequences satisfy minimum support threshold, then transfer the sequences to believable set and create all the relevant association rules. Oppositely,

any support counts of sequences less than the tolerance of minimum support threshold in conjectural set, then transfer these sequences to questionable set (ρ).

$$confidence(S_x \to S_y) = P(S_y \mid S_x) = \frac{\text{Count}(< S_x, S_y >)}{\text{Count}(S_x)} \qquad (1)$$

Once the association rules $S_x \to S_y$ have been found, it is straightforward to generate *strong association rules* from them (where *strong association rules* satisfy both minimum support and minimum confidence). This can be done using the Equation 1 for confidence, where Count(<S_x, S_y>) and Count(S_x) are occurrence count values of sequences satisfying support threshold.

5. Conclusions

In this paper, we have proposed a real-time leaning algorithm to improve traditional sequential mining method. Owing to the rapid growing amount of data, this algorithm uses the incremental data mining technique to enhance the efficiency of mining each learner's behavior log. Besides, we divide the sequence database, used to dynamically generate association rules, into three sets to reduce the computation time. Those association rules provide guidance to learners for making learning decisions.

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Yen-Hung Kuo
Department of Engineering Science,
National Cheng Kung University, Taiwan
keh@www.mmn.es.ncku.edu.tw

Juei-Nan Chen
Department of Engineering Science,
National Cheng Kung University, Taiwan
nan@www.mmn.es.ncku.edu.tw

Yueh-Min Huang
Department of Engineering Science,
National Cheng Kung University, Taiwan
huang@mail.ncku.edu.tw