IMPROVING LEARNING OUTCOMES THROUGH THE UTILIZATION OF NEXT GENERATION E-LEARNING TECHNOLOGIES

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ABSTRACT
Educational practice has in recent times been experiencing significant transitions. The 'sage on a stage' models of learning are slowly shifting to those of learning facilitation; that is the 'guide on the side' paradigm. The traditional model required students to record notes and then undertake exercises to demonstrate their understanding. More recently with the advent of new e-learning technologies the paradigm hasn't changed. The present state of the art has all the disadvantages of the new technology with very few of the advantages: The 'Sage' has been replaced with some form of online material; Exercises are still undertaken and sent in for assessment; Pin boards for messages have been replaced with discussion boards; and Students frequently resort to using emails to ask questions that could have been answered class-wide within lectures. This leads to the thought that online learning is a secondary and inferior method of learning. It need not be. This paper addresses some of the advantages that are possible with computer-based learning in order to improve real outcomes for students. It reports on a research project that involved the development and deployment of a next-generation intelligent tutor support system. This system, (Tutor Connect), takes the age-old concept of a bulletin board and leverages available technologies in order to aid students. The Tutor Connect system incorporates the concepts of trust, relevance searching (a'la Google) for answers, ontological intelligence when dealing with student queries, and automatic FAQ generation. The Tutor Connect system makes use of technologies to move away from the sage on the stage to a more student-driven system of study. The queries that are proposed to the Tutor Connect system are filtered and attempts are made to understand them and provide immediate answers. References to existing and external material are suggested. This paper will also report on the testing and evaluation strategy for the system developed by the authors.

KEYWORDS
Web-based learning, e-learning, intelligent tutor

INTRODUCTION

Computer and Information Technology has been used in the educational process since the early sixties with early applications generally improving in their ease of use and the provision of greater flexibility for the student and interactivity between learner and tutor as well as learner and machine. The World Wide Web (WWW) has been introduced progressively into educational environments to support teaching and provides a vehicle for the development of the Learning Environment (LE). The notion of a Learning Environment, as Wilson (1995) notes, suggests that we are considering the learner being positioned in, and engaging with, some setting where he or she can interact via devices and tools, collecting and interpreting information, interacting perhaps with others in principally a self directed manner. The subsequent focus in this LE is on the learner with learning being facilitated and supported. LE's are not pre-packaged and prescribed, and a "level of uncertainty and uncontrolledness comes into play" (Wilson 1995, p. 37). It is the role of the teacher therefore, to create or identify instructional artefacts and maintain the environment so that successful learning can take place. This new approach of e-learning or networked learning (Rosenberg 2001; Steeples & Jones 2002) provides learners with an educational experience putting them in centre stage of their learning experience thus shifting the role of

the teacher to that of a moderator and facilitator in the learning process (Koschmann *et al*. 1996; McConnell 2000).

A number of universities are using AI techniques to pursue the development of managed, personalised learning environments for students; however, while proving useful, adaptive and interactive teaching on the WWW has not yet been able to achieve the full functionality of traditional Intelligent Tutoring Systems (ITS). Most solutions are highly specific and context dependent. They can, for example, provide feedback on Java programming syntax (Venebals and Haywood 2003) or SQL queries (Coleman Prior 2003) for Computer Scientists (CS) but offer no help for other disciplines. Many projects reported were based on doctoral research and other pilot studies with little guidance on their efficacy in large-scale implementations. Many have not provided useful solution to pressing teaching and learning requirements. There is little evidence that such solutions exist within common commercial off-the-shelf e-learning packages or applications. Little generic functionality could be drawn for embedding these within large-scale university wide online learning environments. When reviewing the capabilities of WebCT and Blackboard, for examples, one finds that these environments have similar course building and management capabilities to those built into many universities' proprietary systems. Communication functions between tutor and learner extend to email, asynchronous discussion boards and synchronous chat groups. There does not appear to be a capability to manage communication data in a way that assists learners in a pedagogical context or the tutor in organizing and responding to communication in a timely and effective manner that will assist student learning. No automated function exists for analyzing student queries into communication tools and generating an appropriate automatic response. The research presented in this paper attempts to remedy some of these deficiencies and proposes that automation is indeed possible.

CURRENT APPROACHES TO E-LEARNING

A plethora of research projects have been undertaken in providing adaptive teaching and feedback within online e-learning environment. Many of the concepts for these have been borrowed from the advances in ITS and particularly Anderson's rule based cognitive modelling (Anderson 1983). Others have used Adaptive Navigation Support to provide adaptive navigation through hypertext pages and thus developed adaptive textbooks for the tutoring, particularly, of software applications (Brusilovsky 1995).

An intelligent tutoring system is traditionally formed of two parts: an 'expert system' and a 'communication module'. Within the expert system, there are three modules, the 'learner' module, the 'pedagogical' module and the 'knowledge domain' module. The learner module gives the learner history; the pedagogical model provides information about the teaching process and the domain knowledge module provides the material that is being taught. ITS have been shown to enhance student motivation and learning (Anderson 1983). There are systems that include a semantic network of concepts to represent the domain knowledge (domain model); whereas other systems (Brusilovsky 2000) use frame-like representations with sets of attributes to provide a finer resolution of a concept.
Some of the most desirable characteristics of emerging e-learning environments as suggested by Maurer (2002) include:

- Re-usable content modules accompanied with searchable meta-data. That is content that can be re-tasked for different contexts containing information that a search engine either external or internal can use.
- Facilities that allow use of the system for various learning paradigms and different levels of learners. That is abstraction of the storage mechanism from the mechanism of teaching in addition to stratifying the content so that it can be served up to different levels of learners.
- A range of tools to create, combine and modify such modules into new ones. Abstract level mechanism for re-tasking content into new contexts of use.
- Tools that allow the administration of the modules mentioned with statistical data gathered for authors, teachers, tutors and students as the system is used. This allows for tailoring of teaching

(content and methodology) on an ongoing basis. Sadly such information is rarely used for this purpose. It also allows collection of statistical data for measurement of teaching effectiveness.
- A set of features for communication and collaboration including chats and discussion fora. Currently these features are limited to textual (and in some rare cases video) intercourses between student and staff member. Unfortunately, these mechanisms prove to be a poor substitute to real life interaction.
- Provision of a high degree of interactivity with powerful tools for (self) testing and feedback. Currently that is limited to online testing and some forms of automated marking.

A learning environment is then a domain populated with instructional items, presented as either multimedia or hypermedia objects with some addressing mechanism and supported by a group of tools. The address might be a URL, or a directory path to a locally stored object. The term object is used here to conform to the IEEE Learning Technology Standards Committee specification for learning objects and there is general agreement with (Wiley 2002) interpretation as 'any digital resource that can be reused to support learning'.

Email and chat messages have recently become the most significant channels for interaction between teachers and learners. The ease at which computer mediated communication can take place has resulted in a dramatic increase in the use of this medium. Although such frequent interaction between teacher and learner are desirable, it is becoming increasingly difficult for academic staff to provide timely and personalized responses to students. Furthermore, many of the questions students ask are routine and repetitive, yet they need to be answered individually by the tutor. It is thought that the ease by which email can be sent encourages its use without the pre-requisite consideration of the problem at hand. By making the learning environment at least as easy to use as email and providing a faster satisfactory resolution to the learner's inquiry, thereby discouraging the use of email and encouraging the use of the learning environment, we support the four conditions of feedback present below.

In any teaching and learning transaction, one of the most important aspects of the mutual influence between learners and their instructional resources involves feedback. Kulhavy (1977) has described four conditions of feedback:
1. Feedback is most potent when it corrects errors;
2. The error-correcting action of feedback is more effective when it follows a response about which the student felt relatively certain;
3. The effectiveness of feedback is enhanced if it is delivered after the learner has made a response; and
4. Feedback is more effective when its availability in advance of learner response is controlled.

Part of the communication and interaction between teacher and learner takes place as questions are answered and student feedback and guidance provided within the learning transaction (Oliver, Herrington and Omari 1996). The provision of timely and effective feedback not only enhances learning but also improves teaching, for thorough understanding the type and content of questions students ask the tutor is better able to structure content and utilize teaching strategies that better facilitate learning. Furthermore, greater interaction and personalization of the learning transaction builds a better relationship with the student that in turn makes future learning easier.

Online Learning Communities

The advent of Web technologies has enabled learners in different geographic locations to meet communicate, collaborate and learn in a 'virtual' way thus giving rise to what is now known as 'online communities'. Much research has pointed to the value of online communities in the learning process. Members of online communities can learn through interaction with their peers and can contribute, discuss, and learn from the community's knowledge and from each other (Laister and Koubek 2001). The communication tools for synchronous and asynchronous interactions include email, newsgroups, discussion fora, chat rooms, whiteboards, real-time videoconferencing, blogs, etc.

Email

The power of email has now gained universal understanding and acceptance as a very powerful tool for online communication. Although email has been embraced in the educational context as a replacement to the telephone and post, its value as an educational tool is limited, particularly due to its asynchronicity and the increasing delay between the exchange of information. This is not a technological problem but rather the overload of email messages that the tutor receives.

Newsgroups

The participants in a newsgroup form a virtual community where they have similar interests or needs in some particular subject. Users subscribe to a newsgroup(s) and thus become its members. Within a newsgroup, users are then recipients of information pushed by the facilitators of the newsgroup. Like every community, newsgroup communities evolve, grow and often perish.

Discussion Fora

Discussion fora are similar online communities but create an environment where members are able to interact freely and exchange information and knowledge. Users post text messages or read the contributions from others. Some users are authorized to create or delete a message or create discussion threads.

In the educational context discussion fora are usually moderated by the tutor. A number of problems related to the threaded nature of discussion fora have been identified (Guzdial and Turns 2000; Hammond 2000; Looi 2002; Rainsbury and Malcolm 2003), such as:

- The discourse discourages convergent discourse operations.
- The content gradually becomes more diffuse.
- The discourse is susceptible to conversational drift.
- Threads introduce a tendency toward sub-optimal intellectual effort.
- The discourse fragments communities over time.
- Users who join a discussion forum halfway may need to read all or most of the discussion in order to contribute to the discussion.
- Students perceived that they can also suffer from information overload and ignore or review postings superficially.
- Students could misinterpret postings or have off-topic discussions.

Despite some disadvantages mentioned above, discussion fora represent a key element of online learning.

Chat Rooms

Chat rooms are 'virtual rooms' in which real-time (synchronous) text discussion between two or more users takes place. It allows learners to receive immediate responses to their questions comparable to face-to-face communication or classroom discussion. The value of these diminishes however as the number of participants engaging in the 'chat' reaches a practical limit.

Blogs

Blog, short for Web log, is a Web page that serves as a publicly accessible personal journal for an individual, often reflecting the personality of the author, and frequently updated. It is a technologically simple development, which enables any information to be entered into a blog and instantly to be published to a Website.

One key element of successful learning communities is the ability to provide feedback to students (Laister and Koubek 2001). However, the problem of lack of feedback was perceived by members in online learning communities (Rainsbury and Malcolm 2003; Singh *et al.* 2004; Wasson and Mørch 2000). Collis et al. (2001, p. 313) contend that "thus there are new forms of feedback, beyond the labour-intensive approach of the instructor giving an unstructured and elaborate comment to each individual student, which can not only help the time and management aspects associated with feedback, but also integrate the feedback process with an enriched learning process for the students." Therefore, in

dealing with this situation, an effective solution would be to get students involved in giving feedback, and a system with better efficiency and management features for doing this task.

TUTOR CONNECT

Tutor Connect integrates online technologies such as discussion boards, email and chat to enhance the level of interactivity, and the efficiency of the learning transactions. By leveraging the collective knowledge of the discussion, it allows the teacher to guide and facilitate learning.
The Tutor Connect was designed with the following objectives:

1. Improved response time to answering students' questions by partially automating the process of answering student queries (via ontological search). Students perceive faster response times and have reduced downtime waiting for responses, resulting in higher student satisfaction and success rates.
2. Increased relevance of search responses to a question. Rather than using a basic search engine to search for answers to their queries, the ontological engine will find results that match their context of use. For example if a student searches for 'speed requirements for buses,' a student within a computer science course would be interested in computer hardware buses but a student from civil engineering would want to find answers that are relevant to mass transit vehicles travelling along roads. By teaching the system the difference in meanings we retrieve results that are more likely to be relevant rather than spurious false-positives.
3. Reduced academic time in answering repetitive questions. Channelling questions into the Tutor Connect system, rather than email, prevents repetitive questions. The answers to questions which have already been resolved are presented to the student immediately, without any intervention by the academic. And only questions that are novel are required to be examined by the tutor.
4. Provide dynamic Frequently-Asked Question (FAQ) generation. Common questions that are either read or repeatedly asked are automatically compiled into a FAQ. These FAQs also serve as a resource for the educator to identify potential weaknesses in the course syllabus or in the teaching techniques employed.
5. Tight integration with student learning environment. The system ties into the learning system by cross indexing teaching materials from other online systems. In this way the search engine not only returns results from the previous questions but also from the teaching content.
6. Create a virtual study group culture, students helping students. By letting students answer other students in the system we encourage a culture of virtual study groups where students are discussing each others questions. Moderation by tutors ensures the integrity and correctness of the information being exchanged.
7. Make every student a tutor. If a student feels they know the answer to the question the nature of the system allows them to answer the question.

Motivation for Tutor Connect

The learning environment manages messages posted by students either via email or chat on the courses discussion board. The system manages messages related to a course and assists online tutors to provide effective, efficient and timely feedback to students. The system is based on a knowledge base and, through a user-friendly intuitive interface, it is able to help review and deliver answers to specific questions as well as provide intelligent searching capabilities for information such as learning resources (lecture notes, reading notes etc) and discussion room messages which relate directly to the question asked by the learner. It will also notify the tutor when the answer provided does not satisfy the student so that the tutor can follow-up the question.

A core activity in teaching is providing student feedback and guidance on the learning transaction. The provision of timely and effective feedback not only enhances learning but also improves teaching. By understanding the type and content of questions students ask, the tutor is better able to structure content and utilize teaching strategies that facilitate learning. Furthermore, greater interaction and personalization of the learning transaction enhances the relationship with the student this, in turn, makes future learning easier.

Email and chat messages have recently become the most significant channels for interaction between teachers and learners. The ease at which computer mediated communication can take place has resulted in a dramatic increase in the use of this medium. Although such frequent interaction between teacher and learner are desirable, it is becoming increasingly difficult for academic staff to provide timely and personalized responses to students. Furthermore, many of the questions students ask are routine and repetitive, yet they need to be answered individually by the tutor.

Existing online teaching channels are *pull* technologies, through which the student seeks out information by initiating communication with the tutor. While embraced by many students, some may feel intimidated and choose an uncommunicative role. In addition to allowing students to interact pseudo-anonymously, the tutor connect system incorporates a *push* option. The tutor, during the course of providing answers to specific questions, who feels that such feedback may be necessary for the entire cohort of learners, can then flag such responses to be placed in a 'must review' container made available for all students to access. The system automatically identifies which students have not accessed the corresponding feedback items within a pre-defined time and can push those items via email, SMS, or some other instant delivery method. This can be extremely beneficial to clarify some details prior to the due date of an assessment piece.

The Tutor Connect Model

The Tutor Connect system has the following features:

- Ability to receive student messages and questions. This may be either from direct submission via a web form or via an email message sent to the board directly.
- Provide automated replies to acknowledge queries. To encourage the student to interact on the board a message is sent back containing a link to the location of the query they are attempting to answer.
- Classify the messages and store them in database/xml form base of questions and their corresponding responses. This means that the system can be cross-indexed and be used as a knowledge base by search engines.
- Provide possible answers to the student queries for the online tutor to choose and transmit appropriate feedback. The tutor can use canned responses, a free form response or combination of both.
- Search the online course content base for related information to the student query. This may be specific answers, portions of lecture notes, reading materials, multimedia resources, discussion room messages, as well as activities and exercises to activate student learning around the original question asked by the student.
- Provides a push facility for tutor flags responses to be sent to and read by all students in a course.
- Have the ability to monitor response times to student questions. This would provide the course coordinator and the organization with valuable data which assists in developing strategies to increase student responsiveness. The system can also email subscribed individuals to alert them if a question has gone unanswered for an unacceptable (to be determined by the course coordinator or other instructor) amount of time. This prevents questions from 'slipping through the cracks'.
- Permit students to conceal their identity from other students. This increases participation by students who would otherwise shy away from asking questions in a public or peer forum. The identity of the person posting the question or answer is stored in the database and available to administrators.
- Post management – Posters can delete and edit their own posts, as can instructors and administrators. Key words automatically parsed from a post can be edited to reduce the number of noise words, as can ontological substitutions.
- Increased accuracy with increased use. Rather then slowing the system down, increased use helps the Tutor Connect 'learn' about relationships and associations between posts and other online resources. As potential answers to questions are presented, students have the option to mark them as being closely or weakly related, or even completely irrelevant. Future queries which the system identifies as related to another will automatically link to the posts strongly related to that other,

even though they may not have been discovered originally. Conversely, even posts which may indicate a match would be rejected if sufficient users have marked them as irrelevant to that topic.

Tutor Connect Architecture

As illustrated in Figure 1 below, Tutor Connect employs a multi-tiered architecture. The front-end is a dynamically-generated web page which displays contextually relevant information to the user. The appearance varies depending on the user's permissions, enrolment or membership in various classes or groups, and on the status (read/unread, etc.) of the information presented.

The back-end is a normalized database which holds the data, most significantly the questions and answers posted, and the metadata, including the keywords, rankings, FAQ ratings, etc. This is a normalized database which could be managed by any relation database management software.

In between the front and back-ends, the application layer has three major components:

1. The security layer,
2. The question-processing layer, and
3. The data management and administration layer.

The security layer maintains the integrity of the system by authenticating users and allowing only options available to them, based on their permissions, to be presented in the interface. Disabled buttons and menu items are not displayed at all. This not only increases the security of the system by not exposing unnecessary information, but reduces the clutter of the interface, making it more user-friendly. Permissions are on a course-by-course basis, so an individual may have learner permissions in one course while enjoying greater power (and responsibility) as a tutor in another.

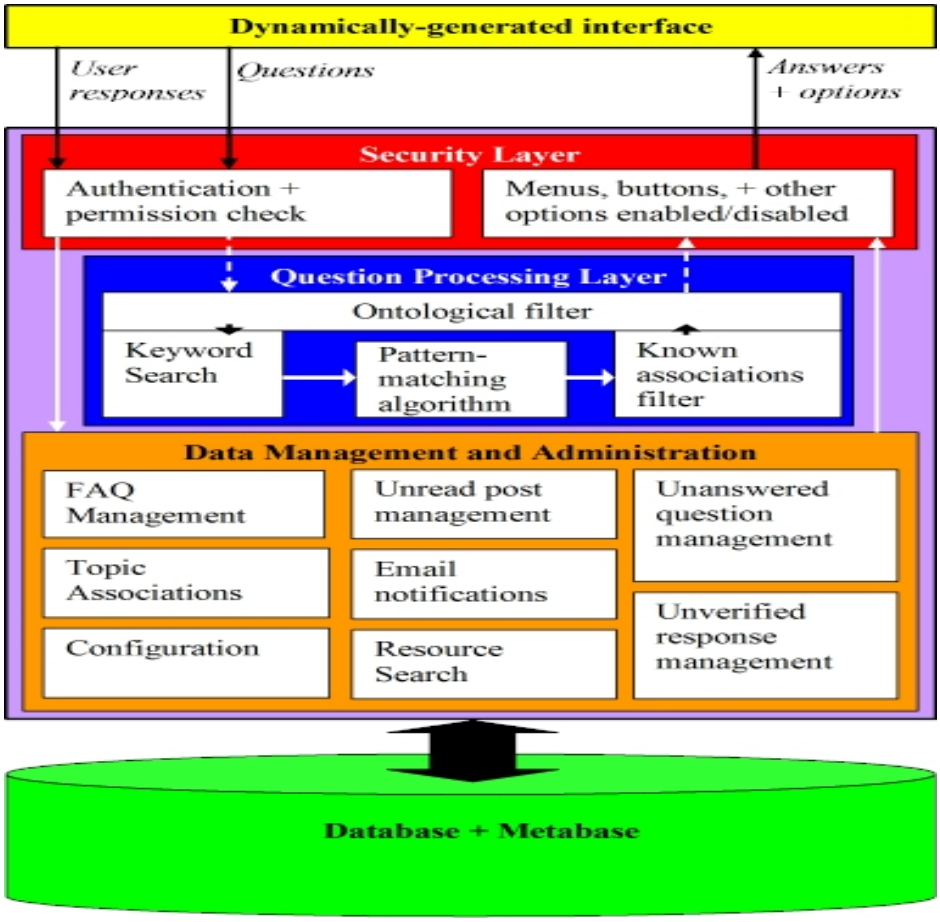

Figure 1. System Architecture

The question-processing layer is arguably the heart of the system. It parses keywords from incoming messages in order to index the post for pattern-matching. Certain domain-specific words are understood in context and substituted with unique terms by the ontological filter. If the post is a question, previous questions, answers, and other identified online resources with matching or similar word patterns are identified. Of those potential results, ones marked as spurious based on previous interaction are removed from the list, while other marked as related to the topic are added. The ontological filter replaces the unique terms with the domain-specific vernacular, and the results are presented to the user in a context-sensitive interface, again, based on the user's permissions.

The data management and administration layer manages the metadata, notifies subscribed individuals of new or aging posts, and provides tools for users to administer their profiles, manage class settings, and other settings. The options presented to the user are, again, filtered by the security layer, so that only functions available to the current user are presented.

Prototype

The prototype Tutor Connect system has four classes of user:

1. Administrator. This user is responsible for maintaining the system.
2. Teacher. The user that controls the content and assigns tutors. Answers from these users are considered automatically valid. Can validate student's replies. Can manage class settings (e.g. anonymous posting allowed). Can manage all metadata.
3. Tutor. Can answer questions and the answers are automatically considered valid. Can validate student replies. Can manage some metadata.
4. Student. Can answer questions however, these answers are flagged as 'Not Validated' (with both colour and text) until a tutor or teacher tags them as correct.

All users can post messages to the system; however, student answers are flagged in a different colour so that other students know that the answers are peer suggestions. A teacher/tutor may flag a posting as being valid. A valid response is considered one that adds to the discussion and contains no factual errors. Figure 2 below gives an example of a teacher logged into a discussion board with an unvalidated response. The staff member can click on the 'Validate' button to change its status.

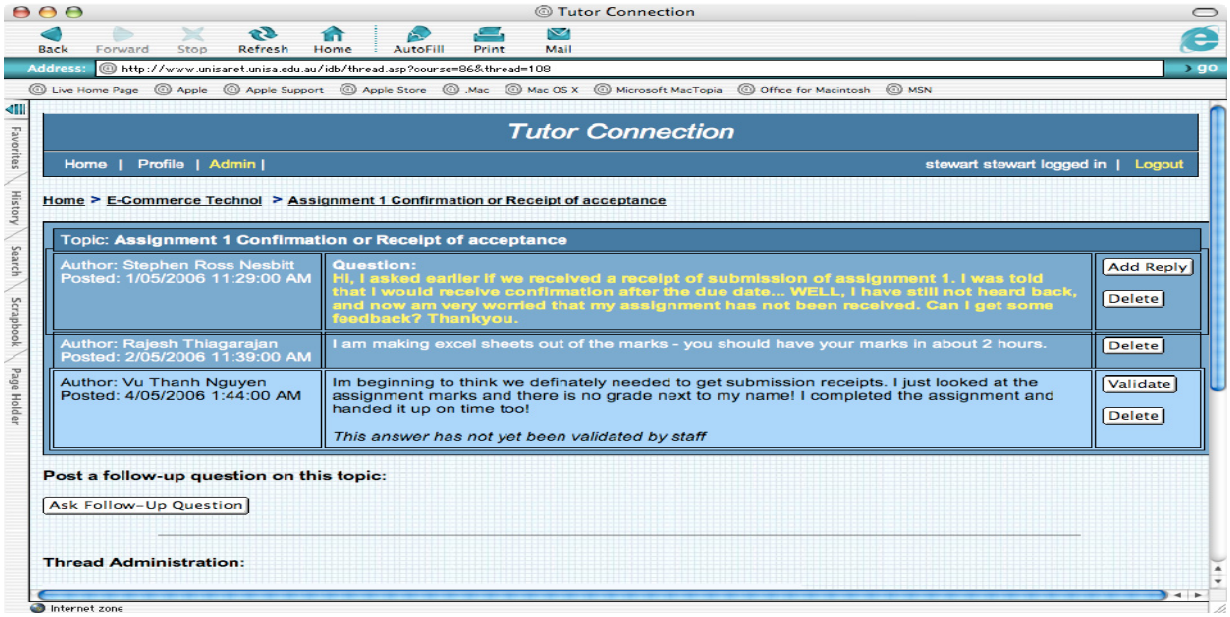

Figure 2. Example Unvalidated Reply

The third message is highlighted in light blue, indicating that it was a student's response and may or may not be accurate. Once validated by a tutor or teacher, it will revert to the same blue as all other

posts – until then students should not rely on the post without verifying its accuracy for themselves. In addition to being highlighted in a different colour, the text 'This answer has not yet been validated by staff' is added so that, in the interests of accessibility, no information is conveyed by colour alone.
Note that this staff member's permissions allow him or her to delete any messages, validate the third post, see the names of the students who posted the messages, and access the 'Admin' menu. Someone with only 'Tutor' permissions in this course would not see the 'Admin' menu, but would see the other items mentioned above. A 'Student' would not have a 'Validate' button or the 'Admin' menu. The 'Delete' button would appear only in regard to messages posted by that user, and, if the course is set to allow anonymous posting, would not see the names of the other students. They would be identified simply as 'Student' so that the user can judge the veracity of the posts accordingly.

When a student or staff member logs into the system they can see quickly the status of the course in order to navigate easily to areas which require attention. In figure 3, one can see that there are two threads (light blue with tag 'Needs Review") which contain messages that need to be reviewed.

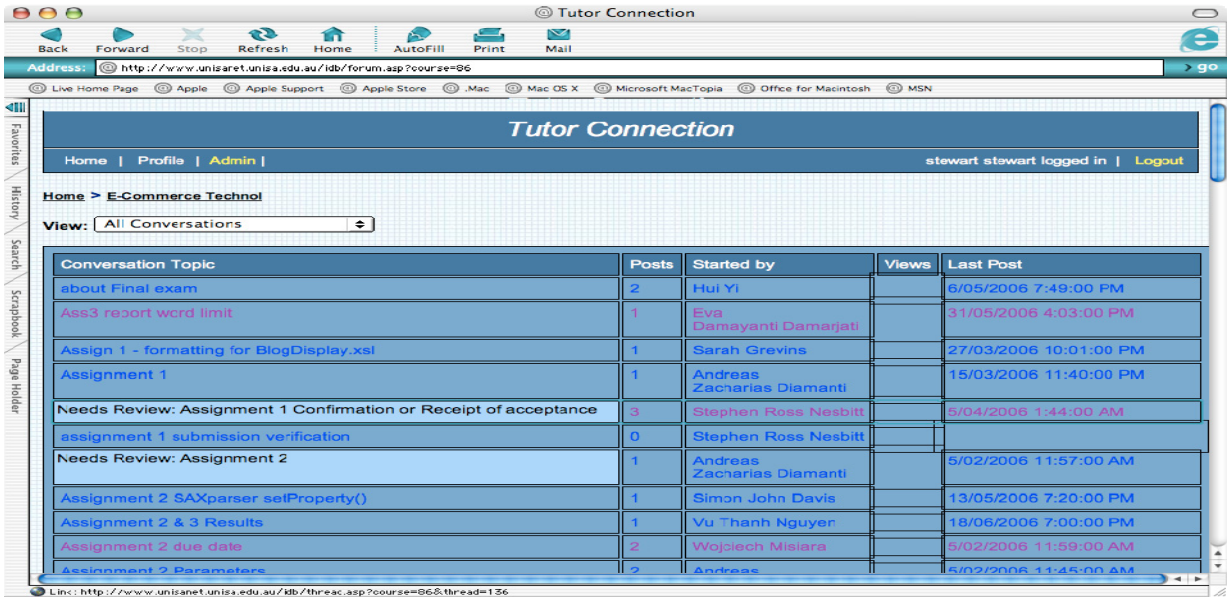

Figure 3. List of Threads in a Course

The screen offers a drop-down list allowing threads to be filtered based on whether they contain:

- Unanswered questions,
- Unvalidated answers,
- Unread posts, or
- FAQs.
-

Some of the drawbacks of discussion fora discussed earlier, such as the need to read all previous posts and the difficulty in locating relevant information in multi-threaded posts, result in many students simply posting their question even though it may have already been asked and answered many times. The Tutor Connect allows students to take this path of least resistance:

1. A typical interaction with the system starts with a question being posted in a particular course:
   a. The system searches for any similar questions, answers, and other online resources as described in the architecture section above.
   b. If found, a possible answer or answers are presented to the user, along with links to resources where more information can be obtained.
   c. The user can decide if his or her question has been satisfactorily answered.

i. If the user is satisfied with the answer, the transaction is complete. The academic staff has been saved the effort of repeating information in another email and, perhaps more importantly, the student received immediate results, allowing him or her to continue with his or her work. The rating of the post which supplied the answer is elevated and, if it passes a dynamic threshold, it may become an FAQ.

ii. If the user in not satisfied with any of the answers, or if none were found, the user can search for more resources and repeat this process, or elect to post the question.

iii. In either case, the user can optionally indicate if each answer and resource presented was related to the question, but simply did not answer the specific query or if they were not relevant and should not have been presented. The system uses these responses for metadata management in order to learn and increase its efficacy in future queries.

2. If the transaction was not completed (in step 1.c.i. above), the question is posted to the discussion board. Any authenticated user may answer it by clicking the 'Answer' button. It appears in yellow on a red background and is labelled 'Unanswered Question' in order to draw immediate attention (see figure 4). Any users who elect (in their profile) to be notified of new questions, get sent an email indicating that a new question has been posted, and a link so they can access it with a single click.

   a. Depending on the permissions of the person posting an answer, it will appear as validated or unvalidated as described above. The question itself will revert to the standard blue background and the label will change to 'Question'.

   b. When it is answered, the person who posted the question will receive an email alert that the question has been answered, with the caveat that it was answered by a fellow student if applicable.

   c. Just like any other user, the original poster may post a follow-up question if the answer did not fully satisfy the original question, or if it raised a new one.

   d. If the question remain unanswered for a given amount of time (set by the administrator), an email is sent to all teachers and tutors related to that course, reminding them that a student is waiting for a response.

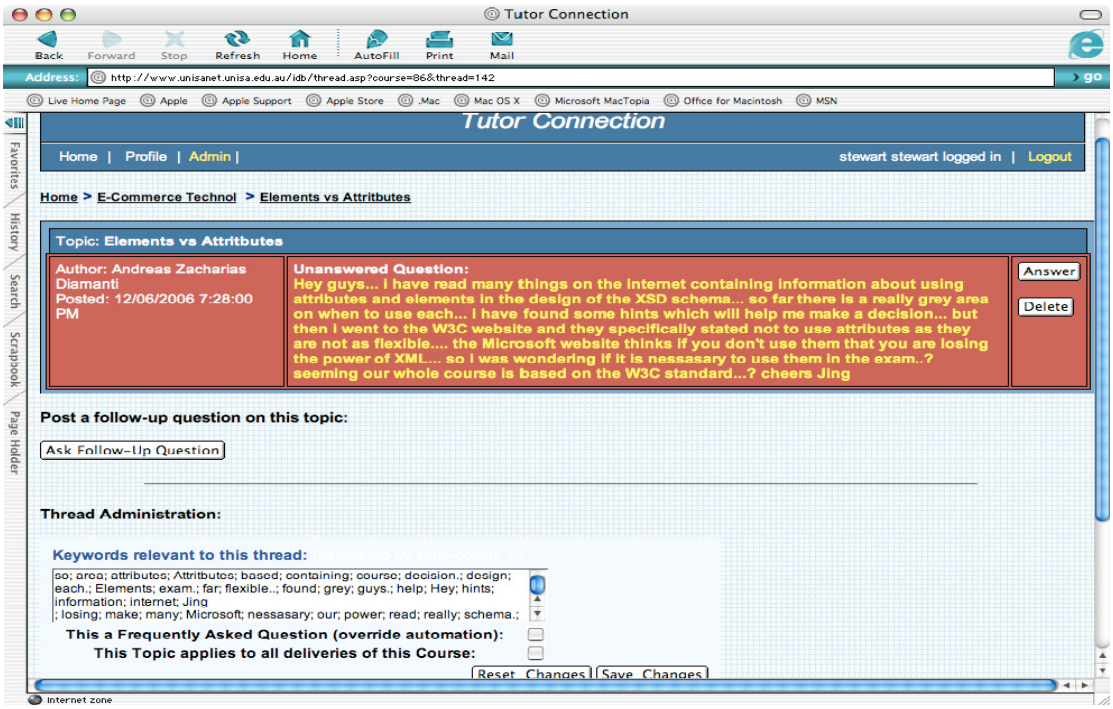

Figure 4. Example Unanswered Question

Testing and Evaluation

The current prototype of the Tutor Connect system has been completed and trialled within a computer science course as the core communication platform for student teacher and student tutor communications. The course had approximately 40 students using it as their only communications medium other than the face-to-face communication of lectures. This was highly successful with the majority of the students using the discussion board for discussion of either administrative questions or content related questions (166 postings), opting to use the system rather than resorting to email. Initial evaluation of the system points to significant improvements in efficiency and speed of feedback received by the learner. Increased participation both by in number of students as well as number of logons during the duration of the course was also recorded. The goal of making the Tutor Connect be the simplest avenue to find answers quickly ('the path of least resistance') has been satisfied.

A survey of the student following the conclusion of the course indicated overwhelming satisfaction with the features. Some feedback suggested minor improvements to the interface. Overall it was judged to be very successful; however, the number of students participating in the survey was not significant and a larger-scale test is required to validate the results.

CONCLUSION AND FUTURE WORK

This research project has increased the level of interactivity and improved the speed and quality of feedback received by the learner in an online learning community such as a Discussion Board. Furthermore, it has the potential for improving the efficiency of the tutor by handling the numerous duplicate queries from the students and should provide students with the opportunity to become central actors in their own learning, but with the support of the 'guide on the side' intervening only where learning support is required.

The Tutor Connect system semi-automates the process of student query and staff reply by understanding the context of questions. This reduces the traffic that the staff deal with, allowing the staff to devote more time to the important and novel questions. The ontological back end of the system allows students to ask a question and get an answer that is relevant to their context. Initial evaluation of the system points to significant improvements in efficiency and speed of feedback received by the learner. Increased participation both by in number of students as well as number of logons during the duration of the course were also recorded. Further development of the Tutor Connect system is currently being undertaken and enhanced mobile technologies will also be integrated in the system.

Note: The full PowerPoint conference presentation of this paper can be viewed at http://www.vonitzstein.com/research/teaching. The authors would like to acknowledge the University of South Australia for supporting this research, and Dr Jing Gao for testing the prototype.

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