Synchronous chat and electronic ink for distance support in mathematics

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Keywords: electronic ink, synchronous chat, distance education

Abstract

This paper investigates the feasibility of employing a freely available chat client for the teaching of mathematics to distance students. The innovation in our approach is the incorporation of a handwriting tool delivered with the client. The handwriting facility within the chat client allows students and instructors to directly post and edit mathematical formulae and diagrams. We report on outcomes of a pilot study conducted in two first year undergraduate mathematics-based courses, both offered in distance mode only, with a group of volunteering students.

Introduction

While it has been recognized that distance learning web-environments do not generally provide effective tools for discussion and problem solving in mathematically based disciplines [1,2,3], proposed solutions usually require students to have access to proprietary software that may pose an extra financial burden and require prior knowledge of the use of such software e.g. WebEq [3] and Mathchat [1].

Alternate tools such as stand alone chat rooms have been trialed successfully by educators to engage distance students in discussions and peer-assisted learning [1,4,5]. However, most previous studies involving mathematics were restricted to typed communication, where mathematical symbols needed to be displayed in awkward latex-style formalisms or image files created using MathType or MS Equation Editor within Word. Students usually could not respond in kind [3].

This pilot study, conducted with two small groups of students enrolled in two courses in distance mode, investigates the mechanics of employing a freely available chat client for the teaching of mathematics to distance students. This client incorporates an electronic ink facility, which allows students and instructors to directly post and edit mathematical formulae and diagrams while communicating synchronously.

Ease of use and difficulties encountered by both instructors and students are explored. A follow-up study into chat and electronic ink will be conducted on a larger scale in a first year mathematics service course to evaluate the educational benefits of this technology.

Background

Online chats for teaching university students have been used in a range of learning environments, from giving an added dimension to the learning experience of oncampus students [5] to providing a supportive learning environment to fully distance students [2]. Constructivist models of learning suggest that learners construct their knowledge by reflecting on and making sense of their own experience, and that this requires online instructors to be aware of the strengths of the online chat medium by ‘being proactive in enabling rather than directing learning’ [4]. A high

level of interaction is required for any effective distance education course [6,7]. Myers et al. [2] comment that 'the needs of distance students will not be met without resorting to appropriate technology' and notes that possible solutions for 'highly visual disciplines such as mathematics' are too expensive or limited to one on one interactions. Smith and Ferguson [8] comment that 'the current e-learning model which is asynchronous and relies heavily on threaded discussions does not work well for math'.

Compared with other disciplines, teaching mathematics to distance students can be a frustrating experience, since the lack of suitable facilities for discussion of mathematical problem solving, vital for student understanding, poses a hurdle for a two-way exchange of information between student and instructor. Online instructors and students need to be able to view, edit and post diagrams and formulae directly in online postings, without going through laborious intermediary stages [9]. Email and type-only discussion groups are insufficient for this purpose.

Smith and Ferguson [3] recognize the need for a new approach to teaching college mathematics at a distance, as standard distance web-learning environments do not provide the most basic communication tools required. They discuss the educational value of diagrams, compare WebEQ's formula editor, based on the MATHML extension to HTML, as well as NetTutor's Whiteboard in web-based mathematics courses. While NetTutor proves to be not robust, WebEQ does not allow drawing of diagrams. Smith and Ferguson give a list of criteria for an ideal mathematics e-learning environment, and neither of these two packages receives all ticks.

We propose a different approach to enable two-way synchronous communication between students and instructors, which combines the advantages of online chats and electronic ink in a free professional software tool.

Implementation

Chat client and preparation

After unsuccessful attempts at communicating with distance students via WebCT's Whiteboard facility, during which technical problems occurred for instructors, students and observers, it was decided to experiment with software outside WebCT.

MSN Messenger (subsequently referred to as Messenger) is a free chat client for Windows XP or Windows 2000 operating systems. This client offers an electronic ink facility once Windows Journal Viewer is installed. A button allows switching between type and ink modes. Messenger is often already available on student computers, and may even be the chat client of choice for most students to keep up with friends and family.

Similar to other chat clients, the user composes a complete message before posting it in Messenger. A posted message is added to the 'history', which can then be saved to keep a record of the conversation. Participants can refer back to previous messages by scrolling up. This approach is different from a whiteboard, on which only the most recent image is kept unless recording facilities are integrated. Held against the criteria for an ideal college mathematics learning environment [3], Messenger receives one more tick than NetTutor, since the system is robust.

Observations

Two mathematics-based first year courses were selected for this study; both offered to distance students only:

- Data Analysis covers introductory statistics, taken by a diverse group of students often with a weak mathematical background.
- Discrete Mathematics is a mathematics course, mainly taken by IT students.

Student participants were recruited from volunteers at the beginning of the semester to join an 'online chat tutorial'. Volunteers were asked a number of questions about their previous enrollment in the course, computer and online chat literacy as well as their ability or permission to install software on the computer they were using. 10 Data Analysis and 7 Discrete Mathematics students were recruited.

Each tutorial was run by an instructor who was not part of the official teaching team in the course, and there was no assessment of tutorial participation. During the first tutorial, students were asked to experiment with the electronic ink facility. Some students could not see any drawing, others could see it but not draw themselves, and a few were able to draw immediately. The former two groups were asked to install Windows Journal Viewer, as instructed in the help document of Messenger. Only one student reported technical problems.

The online tutorials were conducted in a very friendly and supportive atmosphere, where students could ask any questions, and other students were encouraged to answer before the instructor intervened. Students who remained silent for some time were encouraged directly by the instructor to participate. Occasionally it was necessary for the instructor to take the initiative and shut down students, because an important topic needed to be explained to all before students asked further questions. In these cases, students just listened patiently and acknowledged their understanding when prompted. The tutorials were initially offered for one hour a week at night, as most students worked full time. However, later in the semester these sessions tended to continue for up to two hours.

Comparison of the frequency and initiation of electronic ink for instructor and students showed that it was mainly the instructor who started an explanation with electronic ink. Students followed when prompted, or when they decided it was easier to draw rather than to type. Type dominated every chat session, and ink was used to explain concepts further, to use symbols and graphs and to show how to set out solutions to a problem.

Oviatt et al. [6] observed that 'during multimodal pen-voice interaction, users tend to prefer entering descriptive information via speech, although their preference for pen input increases for digits, symbols and graphic content.' We found a similar attitude in both instructors and students, where the typing replaced the speech for entering descriptive information, and symbols and graphics content were drawn with electronic ink (see Figure 1). Since a single message could not include both electronic ink and type, a conscious decision had to be made whether to use type or ink. Typing proved to be faster than writing, where text was the major component of the message.

No major technical problems occurred during the use of Messenger for the online tutorial; the software was very robust. However, it was sometimes difficult to invite a student who had lost internet connection back into the same chat room. Opening a new chat room resolved this issue.

The summer semester is usually the most difficult semester for students, as the study schedule does not allow for a break around Christmas time, and the semester is more compressed than other semesters. Not all students remained in the chat tutorial for the whole semester – 3 students for Discrete Maths and 6 students for Data Analysis participated for the whole semester.

Discussion and Implications

Students were not notified that the focus of this study was the electronic ink feature of the chat client. The authors used a graphics tablet and a tablet PC to draw and write on the computer. Students were not told that the instructor was using a device more sophisticated than the mouse. They acknowledged that the instructor was more competent using electronic ink, but this did not seem to influence their attitude towards the tutorial.

All participating students were asked a number of survey questions before the final exam. Asked if they could imagine doing the tutorial without handwriting, they said it would have been difficult. While the tech-savvy Discrete Mathematics students used the handwriting feature nearly as much as the instructor, the Data Analysis students did not and commented it was difficult to use. One Data Analysis student commented that it was difficult to use the handwriting tool with a mouse because she was left-handed, however she was the student who used it the most. All students agreed that while they may not have been comfortable writing themselves, they were comfortable reading what was written in electronic ink, and appreciated that it was most useful for graphs and diagrams and to replace a verbal explanation which would have involved terminology that students were still struggling to retain.

Students reported that they used the chat outside the tutorial hour to discuss further problems and help each other. One student remarked that the online tutorial helped the most as it was the only real direct contact with the university. All students said that it had been worth the time involved, and that they would attend this type of tutorial if it was offered for other courses.

Cox et al. [5] remark that ’online chats should be integrated into the course design otherwise students will not see the need to participate’. We have experienced this differently, where distance students were grateful for tutorial support and did not even suggest the tutorials be assessed. Engaging students was not an issue.

Conclusion

We propose the use of a chat client with electronic ink facility for teaching mathematics at a distance. Advantages that this chat client offers are that it is free, tends to be already available on students’ home computers and that many students are experienced with the chat function through chatting with friends and family. It is simple to install the additional handwriting functionality, and its use is straightforward, even with a mouse.

Our study was conducted in two first year undergraduate mathematics-based courses, both offered over the Australian summer semester (November-February) in distance mode only. Student volunteers were selected to form a small tutorial group for each course, with synchronous online tutorials offered at a fixed time once a week. Student feedback was very positive.

Smith and Ferguson [3] state that ‘most online mathematics instructors still wait for a simple and convenient way to communicate two-way with their students in the very language of mathematics’. We believe that we may have come a step closer to this goal by using synchronous chat and electronic ink with Messenger.

Acknowledgements

The authors would like to thank Jamie Shield for finding and pointing out the electronic ink feature of MSN Messenger.

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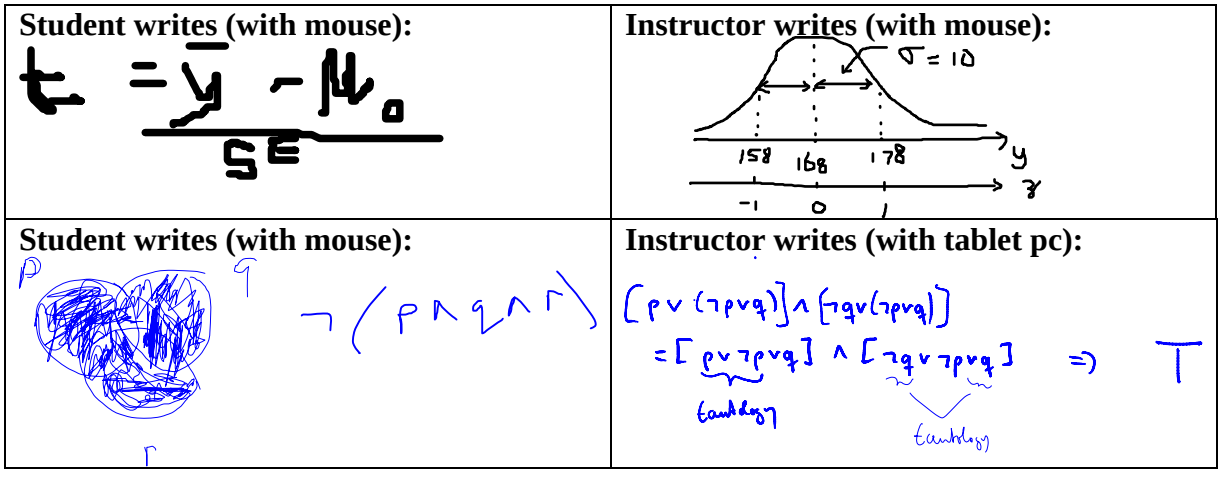

Figure 1: Examples of electronic ink use by students and instructors