Mathematical Discussion System

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ABSTRACT

The Mathematical Discussion System (MDS) enables students and instructors to hold embedded discourse in an online electronic text. These contextualized conversations are recorded and are able to improve the value of the text for students, instructors, authors, and publishers.

Keywords

embedded discourse, hypertext, SER, collaborative learning, discussion moderation

INTRODUCTION

While studying, students may encounter breakdowns in comprehension, and they may need to consult other resources before being able to move forward. In these cases, many people find a friend or a teacher that may be able to help. Another outlet for a struggling student can be the Internet. In both cases, the cause of the breakdown as well as the solution are rarely recorded. The MDS addresses this problem by reducing the distance between the source of the breakdown and a subsequent discussion. The discourse is recorded in the MDS for others so that if they need help on the same topic, there may be a discussion embedded in the relevant portion of the text. In a way, the text becomes a well-known place in which students and instructors can discuss course material without needing to be temporally or spatially collocated.

The MDS naturally supports the Seed-Evolve-Reseed [Fischer, et. al] process. Because the conversations are recorded within the original text, these discussions add value to the material. From the student point of view, using an online text that has conversations about the material may be much more useful than the same text without such embedded conversation. For instructors, the discussion forums can serve as an excellent way to understand what the students are struggling with, so that those topics can receive more attention in class. For book authors or publishers, embedded discourse can serve as embedded reader feedback, suitable for reference in future revisions. The original text serves as a seed; the discussions provide an evolution process for that seed; and the act of reflecting and changing teaching behavior, or the text itself, can be seen as reseeding.

PROTOTYPE DEVELOPMENT

During the summer of 2000, we built a prototype system to be used by an undergraduate differential equations course at the University of Colorado. We wanted to study how well such a prototype would facilitate learning and discussion between classmates and instructors.

In one manner of thinking, the electronic text provides a sort of “virtual place” for students and instructors to discuss course material within the context of course material. The electronic text becomes a location where readers can expect to find topical conversations. The discussion forums are very similar to today’s Internet newsgroups, the MDS prototype provides a number of features (discussed below) to the discussion forums that extend the utility of standard newsgroups.

Due to the inherent attributes of an ASCII newsgroup, many students have found them to be inadequate modes of communication. For example, it is difficult to relate mathematical equations or other symbols not found on a QWERTY-keyboard. The MDS enables people to insert such symbols into their messages—addressing the limitation of ASCII-only newsgroups.

One major limitation of web-based discussion forums stems from the pull nature of web sites. In general, people happen upon discussions that interest them by browsing. It can be difficult to remain engaged in these forums because the user must actively look for new messages, rather than receiving them passively, as is the case with email [dePaula 2001].

People reading an MDS text are presented with colored squares next to each paragraph. These squares represent places where conversations take place regarding the surrounding paragraph. We call these squares hooks, because the conversations are thought to be hanging off the main text. These hooks are color coded to indicate activity. If there are new messages relating to the paragraph, the hook is red. Otherwise, the hook ranges from light blue (indicating a few messages) to dark blue (indicating many messages). When the reader clicks on a hook, a discussion forum interface is presented.

Users may not place their own hooks. In initial designs of the MDS, users were given the ability to create their own hooks based on arbitrary portions of text. Users could select a few words, sentences or even paragraphs, and comment on the selected text. This was problematic because after a number of people had created their own hooks, the page was visually cluttered. The hooks began to distract from the text of the page. We chose to give the page author the responsibility of marking up the page with hooks in order to avoid this problem.

Another problem inherent in online discussion forums is the presence of a large number of poorly thought out or erroneous postings. It is possible that a posting with incorrect content can lead students to believe things that are not true, but it is also possible that these 'bad' postings can be used to understand student's misconceptions and to use them as opportunities to set things straight. We have implemented a moderation system in the MDS which is very similar to the moderation system used by Slashdot [http://slashdot.org]. When a person reads a message and finds it to be particularly good or bad, he or she can give or take away a moderation point. After a number of people have read a message, it may achieve a good or bad moderation score. This score can be used to filter messages so that only messages above a certain threshold are displayed. Each user may set his own moderation threshold, so that all posts may be shown, or only the most highly rated posts are shown. This helps users sort out the potentially good messages from the large numbers of superfluous posts that are common within so many of today's newsgroups.

FUTURE WORK

The current MDS system remains a prototype. To better understand how the MDS can enhance learning, the prototype should be improved to a state that it can be used by a large number of students. Initially, we intended to use the MDS in a differential equations course at the University of Colorado, Boulder. Clearly, the MDS can be used outside of the domain of mathematics. We would like to study how the MDS is used by students in different fields such as engineering, the arts, and literature.

A clear design flaw in the current implementation of the prototype is that the seed text must be marked up by hand so that it can be used by the MDS. First, the text must be converted to HTML, then hooks must be inserted into that. This is a complicated process, and for our implementation to become more widely used, an easier method of marking up documents must be created. We would like to create a web page that serves as a proxy for marking up arbitrary HTML pages on the Internet so they can be used with the MDS. This way, authors can save their documents as HTML and put them on web pages, without having to convert their work for use with the MDS. In fact, authors may not even be aware of the MDS's existence—people could distribute a URL and ask other people to discuss that web page via the MDS proxy service.

The true test of the MDS prototype would be to conduct a full-scale study of the system within a real classroom environment. The primary aspect of the prototype we wish to study is the embedded discourse, but we would also like to study the usefulness of the features of the discussion forum enumerated above.

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