AC 2007-2888: WEB-BASED FORUMS FOR STUDENT LEARNING THROUGH TEACHING

Stephen Crown, University of Texas-Pan American
Arturo Fuentes, University of Texas-Pan American
Web-Based Forums for Student Learning Through Teaching Using Course Projects and Homework

Abstract

Providing opportunities for students to learn through teaching is becoming practical due to new educational applications of commercial technology and may not only be advantageous to a student's own process of learning, but beneficial to other students. The media age has introduced positive advances to education and several challenges. The prevalence of quality media rich content related to course material has produced an increasing expectation among students that learning should be easy and is primarily the responsibility of the instructor. Additionally, access to report writing services and vendors who will sell homework solutions manuals presents many challenges to students. Addressing these issues can be frustrating and time consuming for faculty. This paper presents the experiments conducted in four mechanical engineering courses spanning from freshman to graduate level courses that lead the authors to discover that many students enjoy partnering with the faculty in addressing these issues, the benefits to students through involvement in the process, and the practical issues in terms of implementation. In each course students were given projects and or homework assignments that might typically be viewed as work to be accomplished by the instructor. Such activities include the creation of relevant homework problems and solutions, the creation of media-rich instructional materials such as tutorial movies for course related software, and the development of web-based instructional materials related to the course. The impact of the “student learning through teaching activities” on student learning has been positive as evidenced by the improved performance in exams and the positive feedback on surveys. Students are motivated by the fact that their work is being evaluated by their peers and that it has some useful purpose that will continue to serve students for semesters to come. Finally, this paper discusses the use of different web-based forums that are managed by students to facilitate the implementation of the proposed activities.

Introduction

The recent growth in blogs and public forums is startling. The number of sites, volume of content, and number of users that post and access content is so large that it is difficult to categorize who is accessing and posting this information and what is the value of the content. It does not, however, take much time to explore a random sample of these sites to determine that in the mix there is a wealth of helpful and accurate information being posted and accessed by users. The growth and popularity of this medium that promotes communication, debate, problem solving, etc. and then documents and provides access to that information certainly has some bearing on higher education. There is no question that some students and faculty currently use this medium to answer questions or discuss educational issues (1,2), however the full potential of this technology and its potential positive impact has not been fully exploited.

The objective of higher education is to produce graduates who have grown significantly in their knowledge and who are prepared to continue on a path of acquiring knowledge and applying it in their field. Although this objective has not changed throughout the long history of higher education the culture, institutions, and technology have. Some of these changes necessitate
and/or allow for changes in pedagogy that help to meet the objective of promoting a higher level of learning with reasonable and sustainable effort and resources. One promising strategy that has not been widely used because of some of the roadblocks to implementation is the use of students in the development and delivery of course content. Student learning through teaching can be a great benefit to the student teacher, the class, and in some aspects reduces the load on the instructor. The challenges faced, however, include managing the collection and delivery of developed content to students, assessing the quality of developed and delivered content, and mentoring students ahead of when the class needs the content. Many of these challenges have limited the implementation of this useful educational tool.

The benefits of student learning through teaching has been discussed in the literature (3,4). The marriage of public forums and student learning through teaching (SLTT) directly addresses many of the challenges faced in implementation of SLTT activities and opens the door for greater learning. The fact that the content of public forums is largely generated, assessed, and in many ways managed by users explains their growth and sustainability. These positive qualities are the very same challenges associated with implementing SLTT activities. To study the impact of marrying public forums and SLTT on student learning and required faculty effort, a public forum was created and used to assist with the implementation of SLTT activities in four mechanical engineering courses. The courses span the curriculum from a freshman engineering graphics course to a graduate course in mechanical vibrations.

**Student Learning through Teaching**

The objective of student learning through teaching is to improve learning of both the student teacher and the students being taught without incurring unreasonable cost to the instructor. Our basis for the development of SLTT as an effective means of improving student learning was the byproduct of a previous experiment in the engineering graphics course. The instructional method in the engineering graphics lab course was restructured to accommodate the growth in the total number of students taking the course (as many as five sections taught by one instructor) and the number of students in each lab section (as many as 30 students) [5-7]. Computer screen capture tutorials were used to walk the students through homework assignments in the use of engineering computer aided design software. Each week students were provided with approximately one hour of tutorial movies created by the instructor. Hundreds of instructor hours were used to develop the materials that were well received and very effective in teaching students how to use the software. After several years the entire set of instructional movies had to be redone by the instructor to accommodate a change in the CAD software used in the course. Finally, new releases of the software every 18 months required constant revision of the movies. What had proved to be a tremendous asset to student learning was in jeopardy of being dropped because the required investment by the instructor was not sustainable.

In the spring of 2004 an experiment was conducted in engineering graphics to use students to create the tutorial movies that would be used by students in the following semester. The group assignment was given as a semester project that would be presented to the class. With instruction (in the form of tutorial movies) student groups successfully created significant and helpful tutorial movies on the use of the CAD software. The activity has successfully continued for the past six semesters and has evolved to the point where in the fall of 2006 all of the CAD
instruction delivered in the course was developed by previous students. One aspect of the project that has led to its success is that with each new release of the software students simply recreate the previous instructional movie but using the new software. The regular revision of instructional content has led to the production of high quality learning content. Additionally, student learning has improved as students are motivated to work toward a higher standard knowing that their content will be used and evaluated by their peers. The use of a screen capture program and advances of the internet have helped make this SLTT activity a useful and indispensable part of the course.

The positive experience with SLTT in engineering graphics promoted the exploration of SLTT activities in other courses and with the involvement of other faculty. Various SLTT activities were implemented in the fall of 2006 by the authors in four mechanical engineering courses namely: engineering graphics, measurements and instrumentation, mechanical vibrations, and a graduate level vibrations course. Observations were made about the practical mechanics of implementing the SLTT activity, the required investment of the instructor, the required investment by students, the level of participation, the response of students, and most importantly the impact on student learning. A variety of SLTT activities were implemented over the course of the semester where observations of previous SLTT activities were used to guide the development of new activities. When possible, the activities were implemented in several courses by both faculty members so that general conclusions about the effectiveness of the activity could be made.

Early in the semester SLTT activities involved greater faculty involvement in collecting, evaluating, and disseminating student developed teaching materials. One of the first coordinated SLTT experiments conducted was the development of chapter end homework problems. Students were assigned to create their own homework problems and solutions that supported the content covered in lecture and in their text. Students were encouraged to create problems that other students would find interesting and useful in understanding course content. The best problems were selected by the instructor and redistributed to students. Students were responsible on the exams for understanding the selected problems and their solution. Although most students found the exercise more profitable in terms of learning than using problems from the text, many expressed that the exercise was time consuming and the work required by the instructor to evaluate over 100 unique homework problems was prohibitive.

Through observation of the first SLTT experiment several useful conclusions were drawn about SLTT activities. As students participate in all aspects of the learning process, they gain a deep understanding of the content and are more comfortable with that knowledge. The creation of helpful chapter end homework problems requires a good understanding of the text, how the information can be practically applied, and what aspects of the content are difficult to understand and need reinforcement. Involving the student in this process gets them to reflect on the lecture, read the text, think about application in an area that is of interest to them, and consider what content was problematic for them. It is clear why students that met the challenge saw the benefit to the learning process and why the assignment was time consuming. Changes that need to be implemented to address some of the problems encountered include giving more credit and time for the assignment, both good and bad examples for the students to view to raise the standard,
and a method for collection, evaluation, and dissemination that is not as time intensive for the instructor.

During the course of the semester several other SLTT activities were tested and evaluated. Based on the experience of SLTT activities and the positive results from the first SLTT experiment the assignment of having students generate homework problems was repeated. This time, however, several changes were made to make the assignment more manageable for both faculty and students. Students were given the task of generating review problems for the final exam that covered content for the entire course. The task was evenly distributed among students formally as assigned by the instructor in two of the courses and informally on a first come first serve basis in the other course. The assignment was not given to the freshman graphics course. The length of the assignment was reduced to the generation of one problem and solution covering a unique section of course content. The classes were large enough that the collection of problems would provide a good overview of the entire course.

In an effort to promote peer review and generate enthusiasm for the activity, students were informed that questions from the assignment would be used on the final exam. Solutions posted by the students were not corrected by the instructor so that students had to take the responsibility for reviewing and commenting on the work of their peers. This allowed for a quick turnaround in the distribution of problems to other students and for continual feedback on the accuracy of submitted solutions. The students were very interested in viewing the problems of other students but were reluctant to post corrections or comments. A sample student problem posted by in the undergraduate mechanical vibrations course is shown in Figure 1.

In two of the classes the assignment was given credit as a homework assignment. In the other class the participation in the activity was voluntary. Although participation in the generation of review problems and solutions was low, participation in viewing of the content was high. In the undergraduate mechanical vibrations course eight students posted a review problem (61.5% participation). In the graduate vibrations course seven students posted a review problem (65% participation). Finally, in the measurements and instrumentation course where participation was voluntary sixteen students posted a review problem (32% participation). Participation in the viewing of content was high as evidenced by the number of views recorded. The average number of views per student for each problem was 2 in measurements and instrumentation, 5.7 in mechanical vibrations, and 5.5 in the graduate vibrations course. Student surveys in mechanical vibrations and graduate vibrations show that the students perceived that the forum impacted their learning significantly. Furthermore, students reported issues related to accessibility and printing of all student homework.

The SLTT activity was viewed as a success in all three classes with the observation that additional changes in the structuring of the assignment could greatly improve the results. As indicated in student surveys the level of learning in students who participated in the SLTT activity was high. The effort required by the instructor to manage the SLTT activity was comparable or lower than the grading of a typical homework assignment. Finally, the number of students who accessed the posted content was high. Most students made repeated visits to view student problems. Changes that may improve participation would include: repetition of the activity as students are often slow to respond to unfamiliar tasks, recognition of students in class
Figure 1: A student generated problem and solution of a mechanical vibrations problem posted as a SLTT activity.
who posted creative problems or replied to and corrected solutions, and demonstration of successful interactions from previous semesters to give students a glimpse of what the process looks like. It should also be noted that student participation, even in submitting typical end of chapter text problems, is often at a low near the end of the semester and that accordingly participation in the first SLTT activity was high.

**Use of Public Forums**

The use of public forums will likely not in and of themselves improve student learning, however, their use does provide a mechanism for the implementation of SLTT activities. The successful implementation of the generation of final exam review problems discussed above would not have been possible without the use of a public forum. The public forum provides many features that support SLTT activities that improve student learning and provides a mechanism for managing the collection, dissemination, and evaluation of student generated instructional content. Additionally, there are many free host sites for public forums and free, easy to use hosting software if an instructor wishes to host their own forum.

The purpose of a public forum is to provide easy access to a community of users who desire to share information, be challenged by different viewpoints, and solve real problems. The success of forums as a problem solving tool depends on people’s desire to help others find answers to problems. The motivating force behind this activity may be that they themselves have been helped by others in the forum, that many find a sense of satisfaction and reward in helping others, that the process of tackling problems refines the skills of the problem solver who is both a helper and a learner. Whatever the motivating force behind the continuous and countless problem solving that occurs on public forums, the number and popularity of public forums has grown dramatically. Taping into the success of public forums as an activity that supports SLTT activities may produce similar success in student learning. Preliminary results show that this is true.

**Structure of Public Forums**

The general structure of a public forum is based on a four tier structure of categories, forums, topics, and posts as shown in Figure 2. Within this structure all of the content is housed in a single database that is managed by the instance of the server program. Categories, the top level of the structure, are general groupings of like discussions. The categories used for the SLTT activities were simply the four course titles included in the experiment namely: Mechanical Vibrations, Intermediate Vibrations, Measurements, and Engineering Graphics. Only the administrator can create categories. Additional categories can be added to accommodate new courses that are added to the site. The decision to use categories to separate the different course rather than separate databases was based on the desire to maintain a single database and provided an avenue for students to explore other categories. The content under each category can be expanded or collapsed as shown in Figure 3 so that students can easily focus on the intended course.

The second tier of structure is the forum which is also under the sole control of the system administrator. The forums are groupings of content related to a subset of the category. In the
case of the exam review question SLTT activity, a forum was created in each category (course) entitled “Final Exam Review Problems and Questions”. The forum structure quickly directed students interested in the exam review questions to the appropriate content. Clicking on the forum will reveal the title of all of the posted review problems. The structure of the forum also assists with search functions. If a search is made on a key word the search may be restricted to a particular forum of interest.

The third tier of the forum is the topic. Topics are created by the user. In the case of the creation of the exam review problems, each student created a topic which was the title of their exam review question, for example “Section 1.2: General Measurement System (A. Perez)”. Finally, under the topic structure are the actual posts. The posts, which represent the fourth and final tier of the structure, contain the actual problems, solutions, and replies to the original post. All of the posts under a topic are displayed as a single scrolling webpage indicating who posted the content and when it was posted. To view an exam review question in vibrations a student simply opens the forum web site, clicks on the category labeled “Mechanical Vibrations”, clicks on the forum for the exam review, and then selects any question listed. This will bring up posted problem and solution as shown in Figure 1. The student may then study and try to solve the problem themselves and then compare their answer with the posted solution. Any differences between the solutions are cause for concern. If the student feels that their solution is correct they may simply post a reply to the original posting. This activity of users reviewing original posts and commenting often leads to several replies on a posted topic especially when the questions are complex or thought provoking. The strength of the public forum is in its ability to encourage and support peer to peer mentoring and to allow others to view that documented learning process and continue the cycle. The involvement of an “expert” may actually weaken the process since users will likely step back and wait for the expert to answer questions. Although students may post inaccurate information, other students often post corrections as they browse the forum. If disagreements arise, the students are encouraged to email the link so that their instructor can

Figure 2: General Forum Structure

- Category 1 (MECE 3320)
  - Forum1 (Chapter 9 Homework Problems)
    - Topic 1 (Thermocouple Temperature Measurement)
      - Post (Student Generated Review Problem)
      - Post (Student Generated Solution)
      - Post (Feedback From Peers)
      - Post (Instructor Feedback)
    - Topic 2
      - Post 1
      - Post 2
  - Forum2 (Chapter 10 Homework Problems)
    - Topic 1
    - Topic 2
- Category 2
provide appropriate feedback. This process is analogous to the use of student study groups where erroneous information may be shared and the instructor generally called on only where disagreements or confusion arise.

Conclusions

The web-based forum provides many features that support student learning through teaching activities that improve student learning and provides a mechanism for managing the collection, dissemination, and evaluation of student generated instructional content. Student learning through teaching is not only advantageous to a student’s own process of learning, but beneficial to other students. The benefits of student learning through teaching have been well documented in the literature for years, however a number of significant challenges have limited widespread application. The marriage of public forums and student learning through teaching directly addresses many of the challenges faced in implementation of student learning through teaching activities and opens the door for higher level of learning.
The authors conducted experiments in four mechanical engineering courses spanning from a freshman to graduate level course that lead them to a number of discoveries such as: students enjoy partnering with the faculty in teaching and developing course content; there are numerous benefits in terms of student learning for both students providing and receiving the teaching and content; and the use of student learning through teaching has become more practical in terms of implementation through the use of public forums. The positive student response to the experiment is due in part to the expressed notion that they are motivated by the fact that their work is being evaluated by their peers and that it has some useful purpose that will continue to serve students for semesters to come. Without the use of public forums this objective would be difficult to achieve. Through the process of teaching, the students organize their thoughts, put them to words and communicate, and become sensitive to the response of students. The public forum has already been proved to be an effective mechanism for this process of interaction outside of academia. Changes that need to be implemented to address some of the problems encountered include giving more credit and time for the assignment, both good and bad examples for the students to view to raise the standard. Preliminary results show that taping into the success of public forums as an activity that supports student learning through teaching activities will prove beneficial.

The full potential of web-based forums and its potential positive impact in higher education remains to be determined and exploited. It is very likely that students themselves will play a key role in leading the journey and ideally under the advice of faculty members. Faculty members may consider the use of forums for teaching activities related to the classroom, such as student learning through teaching activities, as well as for student academic advising, posting of student projects and faculty feedback, faculty mentoring, students mentoring students, and supporting research activities and local professional societies. In some of these cases, student assessment criteria, aligned with the learning process, may help direct the use of this technology. It will always be recommended that faculty align students’ perspectives and expectations about objectives and the learning process when introducing web-based forums that are eventually managed by students with only limited faculty supervision.

References

