Proceedings of 2nd International Conference on Information Technology Based Higher Education and Training, Kumamoto, Japan
July 4-6, 2001

An Approach to Encouraging Online Discussion among Students in Technical Courses

A. Dean Fontenot
Texas Tech University, dean.fontenot@coe.ttu.edu
Marion O. Hagler
Mississippi State University, hagler@ece.msstate.edu
John R. Chandler
Texas Tech University, john.chandler@coe.ttu.edu

Abstract

Online discussions, both synchronous and asynchronous, have been used successfully for some time in teaching non-technical courses [1,2]; however, such discussions seem less commonly applied to technical material in engineering courses. Perhaps, one reason is that the perception that technical discussions are too complex or intimidating to be addressed in textual synchronous discussion environments. In an introductory course for first year electrical and computer engineering students, students were introduced to online discussions with the goal of encouraging them, outside the classroom, to think critically about, and thus understand more fully, readings that deal with aspects of professionalism [3,4]. The by-product of these online meetings was that once the teams had formed relationships with each other and with their assigned mentor through discussing non-technical questions we assigned, a few teams began to discuss hardware and software assignments for the course. In addition, during the subsequent offering of the course, we formally broadened the charge to the class's peer mentors to include helping students learn to carry out their work, technical and non-technical, for the course. An end-of-course survey showed that about half of the students consulted other members of their team about technical questions regarding homework during the course, but only about one-third of the students ever contacted their peer mentor about homework. Although, the interaction about homework developed from an entirely informal and unstructured situation, it seems that by adding homework discussion to discussions about professionalism, that online discussion of technical readings can serve as a convenient means of forming online teams whose scope can expand to deal with the technical aspects of the course. Online discussions can therefore be one of the elements in designing courses so that students learn effectively outside the classroom by engaging in discussions about technical and professional aspects of engineering [5].

1. Introduction

The Introduction to Electrical and Computer Engineering at Texas Tech University is designed to introduce students to the concepts of hardware, software, and issues of professional practice [3, 4].

Students engage in online discussions about professional practice by responding to prompts that are posted on the class website. The class reads Tracy Kidder's *Soul of the New Machine* [6] and Samuel Florman's *The Civilized Engineer* [7] and spends an hour in a MOO (Multi-user Object Oriented) with their 4-5 team members addressing issues like women in engineering, ethics, managerial strategies, teamwork, and what Florman calls "existential pleasures of engineering" [7,8]. In addition, students learn about object oriented, event driven programming by using Visual Basic 6. Students have access *to Sams Teach Yourself Visual Basic 6 Online in Web Time* where they conduct a self-study program [9]. Project assignments include a word processor that can open multiple documents and perform a word or phrase search through all of them, a quadratic algebraic equation solver, a comparison of convergence rates for calculations of Pi by different algorithms, a calculator with keypad and paper tape that permits calculation of the statistical mean of a series of numbers entered by a user, and a digital signal processor with VB 6 that implements a variable order smoothing (low pass) filter as a means of discriminating against noise in a signal [3,4]. In addition, students learn electronics by assembling and testing simple analog and digital circuits. They build and test a simple two-loop circuit and make measurements to verify Kirchhoff's Voltage Law, a simple bipolar junction transistor amplifier, and an RS flip-flop. Students submit their circuits, built on a small breadboard [3, 4].

In addition to the regular Introduction to Electrical and Computer Engineering Course, Texas Tech University has an Honors College in which students with 1300 SAT or 29 ACT scores can apply and be accepted.

In the fall of 1999, the 17 Introductory to Electrical and Computer Engineering students who were taking the introductory class and who were also enrolled in the honors section of the class, received their grade by participating in an online discussion over Michael Hitlzik's book, *Dealers of Lightning: Xerox PARC and the Dawn of the Computer Age* [10]. This honors section was a pilot to study how to facilitate online discussions that might lead to including off-campus students in the future. The honors students were put into groups for online discussions in DaMOO, an educational MOO at California State University at Northridge [11]. MOOs are much like chat rooms because they allow for synchronous online interaction, but in MOOs the conversations can be logged and archived—a significant attribute for educational discussions—and the object-oriented environment can be changed by developing rooms and characters that can be seen by anyone entering the room. Person engaging in dialogue in MOOs can whisper to other members without disturbing the discussion, page people in other rooms, or hold up big signs which can be like shouting or speaking into microphone, it gets attention. Students meeting in MOOs can describe themselves and, in most MOOs, can build simple "bots" or objects that will do something, like a bird that flies around the room. It is this non-threatening, social-like environment that lends itself to an environment for team building.

The students met as a team on a regular basis to respond to prompts, posted on the web, regarding the book. At first students stumbled through the technology of using online synchronous environments, and grappled with the responsibilities of using technology in a new way—to work in teams and to engage in discussion much like classroom discussion. They quickly learned the technology and started functioning as an online team.

A significant part of assigning them to teams in which they were to discuss *Dealers* was to encourage the development of teamwork and team learning, but more specifically to develop skills for **online** teamwork/team learning. What evolved from this initial course was awareness that the students did develop a community of online learners because they shared more than just the arbitrary discussion over the book.

It was only when we scaled the online discussion part of the course up to include the entire Introduction to Electrical and Computer Engineering class and that we engaged the students from the previous semester's honors section as mentors that it became evident that team-learning was taking place within the online community. The syllabus of the course told students that "You are encouraged to develop and share ideas for solutions of homework assignments with others in the class but the files you submit cannot closely duplicate those submitted by another student. The files you submit must demonstrate clearly to the grader your personal, individual effort."

We were delighted when it became very evident through anecdotal information that some students were sharing problems and solutions to homework through email and when they met socially in the MOO.

2. Building Online Relationships

A primary difference between high school and college learning is the proportion of learning that is done outside of the class at the college level. For the most part, high school students spend time in class learning under the tutelage of the teacher. On the other hand, college students "spend 2 hours outside of class studying and learning the course material for each hour spent in class" [5]. Online learning and teamwork can augment the out-of-class learning time because students have the opportunity to share knowledge and information out of the constraints of place and time. Frequently, college students get together –in study groups at odd hours of night and early morning. Online groups have very few problems with meeting with their groups, once students become familiar and comfortable with the online environment.

Study groups proliferate in all disciplines—from writing to science—and within study groups, communities traditionally are formed. The same is true of online study groups. The main difference is that communication is written instead of verbal. It is the written communication and the feeling of anonymity that often strengthens a student's participation in discussions. Even when students sign on with their own name and use email with their given name, the sense that there is safety behind the screen allows students who might not otherwise do so to voice opinions. This strengthens the contributions that students make to discussing the problem [12].

Educational MOOs have been around for quite sometime and have been used in humanities courses as a means for interaction over texts in writing and literature courses. For almost fifteen years, MediaMOO at MIT has been an online meeting place for teachers of composition and literature, where they meet every Tuesday night to discuss issues relating to pedagogy. Although the content of most educational MOOs focuses on objective issues, technical issues related to hardware or software homework problems are easily addressed in textual environments like MOOs or email.

Online discussions can have the same desired outcome as classroom discussions, to get students to think critically about a given topic. Students in the Introduction to Electrical and Computer Engineering are using writing to improve their critical thinking skills within group discussion by having to engage in the writing process.

They engage in very casual writing in the MOO and through emails, but proceed to more formal writing when they post summaries of their MOO discussions over the books' chapters on the *EE1305* threaded discussion list. One student writes the summary, a different student for each discussion, which allows each student to engage in writing a very short formal summary by the end of the semester [8].

The process of writing enhances collaborative learning whether the student is using email or MOOs. Collaboration means that students must think for themselves in situations where they must also listen and learn from others, and construct knew knowledge that they can use and share. Writing is learning. Writing online especially in MOOs allows students a chance to express their thoughts without waiting for someone else to quit talking before they can speak, and with the feeling of autonomy behind the video screen, students are free to express their ideas and opinions "without exposing themselves to social complications of face-to-face utterances or the sometimes frightening prospect of speaking extemporaneously before the class" [13].

Unlike objective discussions over literature or professional issues, technical issues traditionally have not been discussed online. One reason might be the perception that discussion of technical topics adds an additional layer of intimidation on top of the intimidation that many feel when they begin online discussion about any topic. However, once students become comfortable with online discussion, they become less intimidated by the online environment and more comfortable discussing technical issues. It seems that those students who are most comfortable with online discussions are those students who are comfortable bringing up social issues during the discussion. In fact, during the historical Gore-Bush election in November, students interjected their discussion about the text with updates on the election:

Jim Vaughn says, "because GORE 192 BUSH 153" Brian Crowell says, "holy cow"
Matthew Harrison says, "we started a little late"
Jim Vaughn says, "must cry now..."
Matthew Johnson says, "i know jim.....i saw...."
Mark Smotherman says, "this hurts"
Matthew Johnson says, "bush has to win the west....." [8]

The community socialization plays a significant part in building up trust in a peer, especially a peer from whom a student may be depending on help with homework that will be graded. What may look like digression or play on the surface actually helps to build community trust.

3. Students Initiate Homework Discussion

Through the social interaction, students brought up issues about homework in the online MOO discussions:

Jason Pharis says, "if it makes you feel any better i got a diff eq test tomorrow i should be studing for"
James Tucker asks, "Ok, back to the question at hand...What did we decide?"
Hai Zhang says, "yes...homework..too much..."
Keith Uplinger asks, "what class is that???"
James Tucker says, "Differential Equations"
Keith Uplinger says, "cause i just took a test in Calc 3.."
Jason Pharis says, "Differential Equations"
Hai Zhang asks, "calc 3?"
Jason Pharis says, "MA 3350"
Hai Zhang says, "easy"
Adam Newell says, "i have cal1 test thurs"
Hai Zhang says, "j/k :P"
James Tucker says, "Calc 4, if you had to tell it that"
Keith Uplinger says, "ahh i'm taking Ma 3350 next semester..."
Hai Zhang says, "...me too" [8]

Although this discussion went no further because they were focused on responding the prompts, it seems that by designing prompts that students could respond to about technical aspects of the electronics or VB6, students could engage in developing analysis of the technical issues of the course. There were many of these conversations that students said led them to ask, after the MOO discussion was over, for help from their peers because they realized, just as in a non-online class, that there were students in the class who had either taken the course before or were in a similar course. In an end of the semester evaluation form, students were asked if they consulted each other or peer mentors for help with homework problems. This evaluation dealt strictly with teamwork but related to how they worked together as a team online. One of the questions, "Team member was willing to help other members who might be stuggling with some aspect of the assigned reading or the assigned homework in the course—acted as a peer tutor" gathered a positive response. Most of the students rated their peers very high, "satisfactory" or better; although, a few students rated very low, "unsatisfactory" to "very poor." The students who rated low were also the students who did not participate in the online discussions on a regular bases and who did not engage in social interaction in the MOO.

Students evaluated their peers on their performance in the MOO and how well they were prepared before they came to the MOO discussion. Through anecdotal information from the students, it appears that students who were prepared and participated in the discussion were sought out to help with homework problems. For instance, students in the following team said that they

often got together or emailed each other a lot about specific homework questions. From their discussions and conversation, they seem to have a healthy community and share in social interaction:

Matthew asks, "#1 or #2 next?"
Bobby says, "#2"
Joshua says, "1"
Jacob . o O (whatever)
Matthew says, "raise your hand if you want #1"
Colleen says, "#3 - i know the answer to that one"
Bobby says, "we just did #3"
Colleen . o O (bobby's a little slow tonight)
Bobby says, "FLIP A COIN. I CALL HEADS"
Colleen says, "#2"
Jacob says, "tails you lose"
Jacob says, "Sorry "
Bobby says, "I WANT A REFLIP"
Colleen laughs
Jacob says, "guess we are doing 2"
Colleen says, "lets go ...."
Matthew says, "I kind of like #2 I think"
Colleen says, "i'm the girl so i have final say - #2" [8]

4. Mentors as Tutors

The initial purpose for using online mentors was to facilitate the off-campus students who were high school students enrolled in the introductory course. At Texas Tech, high school students with 1180 SAT or 27 ACT can apply for admissions, and if accepted, register for courses on campus. In order to provide the same opportunity to students in the far-reaching communities of West Texas the same opportunity as students in Lubbock, Texas, the Early Admissions Program was developed. In the EAP, high school math or science teachers act as on-site facilitators to the students taking an EAP online [3]. By fall 2000, the online mentors had taken on roles that were not earlier foreseen. They not only acted as online support, they managed the teams, converted the text files from the MOO to html for posting on the website, and became tutors for homework problems that the students were having.

In one specific case of the peer mentors acting as homework tutors, a non-traditional student who was taking the course for the third time (many of his earlier problems had to do with him not having or being comfortable with computer technology), asked one of the mentors to act as tutor and he would pay the tutor for his help. What started as a one-on-one tutor/student homework relationship addressing problems the student was having with VB6, turned into three mentors helping the student to work through the homework problems. The student finished the course, the mentors learned that tutoring is not as simple as it may be perceived, and the mentors re-learned the material by teaching it to the troubled student.

5. Conclusion

From observing students who build communities online, it seems perfectly feasible to develop prompts that would engage students in analytical discussions about technical issues relating to homework, especially after they have learned to discuss non-technical issues online. If study-groups can get together face-to-face to discuss homework issues, online environments can be used just as effectively, and possibly even more so, since email documents can be saved and revisited, and MOO discussions can be logged and archived and, therefore, revisited. As some students have noted, it is much easier to go back and revisit written documents than to worry about taking copious notes while trying to work through specific problems. For instance, the final homework for the course was Digital Filtering of Signals, using Visual Basic to construct a digital filter and document how it can change the frequency spectrum of a signal [14]. One of the observations made within the assignment was:

Analog filters can produce similar results. Whether filtering should be implemented in analog or digital form is an engineering decision. Analog filters can work on signals with higher frequencies and higher powers than digital filters. That's a plus for analog filters. But changing the pass band of frequencies for an analog filter means changing a physical component while changing the pass band of a digital filter means changing only the software. That's a plus for digital filters. Cost and size are other factors whose importance varies depending on the particular type of application and its environment.

Students could be assigned a discussion on why would one want to change the pass band, how would one go about making this change, or when would cost be an issue in developing the type of application.

For each homework assignment, students could be assigned an assessment assignment to discuss online in teams the process they went through, what problems they had in working the problem, and when they made a specific discovery on how to handle the problem. As the students did in the introductory course, they could schedule specific meeting to discuss specific problems prior to the due date of the homework. Although technical issues are more intimidating for discussion than professional issues, once students become comfortable with the online environment, discussions of any nature will be as easy as face-to-face discussions. In addition, developing skills to discuss technical issues online prepares students for online interaction once they enter industry.

6. References

[1] Fontenot, A. Dean. “Teaching Literature Collaboratively in a Computer-based Classroom,” *Wings*, Fall 1993

[2] Chandler, John R., and Fontenot, A. Dean. “Writing in Cyberspace: Using Networked Computers, the Internet, and the World Wide Web as Writing Spaces in the Classroom and the Workplace," Society for Technical Communication Annual Conference, May 1996

[3] A. Dean Fontenot, Marion O. Hagler, and John R Chandler, "Learning Outside the Classroom – On Campus and Beyond," Proc. International Conference on Information Technology Based Higher Education and Training, July 3-5, 2000, Istanbul, Turkey, pp. 93-98.

[4] A. Dean Fontenot, Marion O. Hagler, and John R. Chandler, "On-campus and Off-campus First-Year Electrical Engineering Students Engage in Interactive Learning Environments, Proc. 2000 Frontiers in Education Conference, Kansas City, October 18-21, http://fie.engrng.pitt.edu/fie2000/papers/1187.pdf).

[5] Marion O. Hagler and William M. Marcy, "Strategies for Designing Engineering Courses," J. Engr. Educ. 88, 11-13, (1999).

[6] Tracy Kidder, *The Soul of the New Machine*, Avon Books, New York, 1982.

[7] Samuel C. Florman, *The Civilized Engineer*, St. Martin's Press, New York, 1987.

[8] http://aln.coe.ttu.edu/ee1305fall/DISCUSSIONS/discussions.htm

[9] Mark Spenik, Andrew J. Indovina, David Jung and Pierre Boutquin, *Sams Teach Yourself Visual Basic 6 Online in Web Time*, Sams Publishing, Indianapolis, IN. 1999.

[10] Micahel A. Hilzik, *Dealers of Lightning: Xerox PARC and the Dawn of the Computer Age*, Harper Collins, New York, 1999.

[11] http://damoo.csun.edu:8888/

[12] Jan Rune Holmevik and Cynthia Haynes. *MOOniversity: A Student’s Guide to Online Learning Environments.* Allyn and Bacon: Boston, 2000.

[13] Bertram Bruce, Joy Kreeft Peyton and Trent Baston. *Network-Based Classroom: Promises and Realities. Cambridge University Press: 1993.*

[14] http://aln.coe.ttu.edu/ee1305fall/index.htm/