

WEB BASED DISCUSSION ACTIVITIES THAT ENHANCE UPPER-DIVISION ENGINEERING STUDENT LEARNING

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Abstract

Transportation (CE 376) is a required upper division civil engineering survey course at Southern Illinois University Edwardsville. Student participation is vital, though in-class discussions are troublesome and time consuming. A WebCT based discussion component was added to address the content overload, provide equal student access to class discussions, and allow deeper student learning through topics in addition to or parallel to those being taught in class.

The WebCT discussions were required, graded and accounted for ten-percent of the student's final grade. Discussion grades were assigned using a rubric that ranged from rewarding well thought out responses to penalizing disrespectful responses.

Each discussion period was one to two weeks. The students were required to make two discussion page postings; one based on their own personal thoughts on the discussion piece, and another with regard to the comments of other students. This method resulted in the discussion growing in both depth and breadth.

Student reaction to the electronic discussion forum was favorable, once technical issues were addressed. In-class discussion follow-up showed that many of the students had used the opportunity to think through the topics, becoming well versed in them. The depth of thought displayed in the discussion responses was outstanding, well beyond the expectations of the professor.

The use of this WebCT discussion technique provided benefits for this class.

- Allowed student participation at an individual pace;
- Included topics beyond the normal course scope;
- Required the students to participate in a class activity while not physically in-class;
- Challenged students to a high degree of thought (content and format) to receive high marks; and
- Allowed assessment of individual student thoughts and writing without using in-class time.

A WebCT or other electronic based discussion could be successfully added to all upper-division engineering courses with equally successful results.

I. The Course

Transportation (CE 376) is a required upper division course taught for civil engineering students at Southern Illinois University Edwardsville. During the spring semester, 2002, there were 24 junior and senior civil engineering students in this class. This survey course is tasked with introducing the students to all phases of transportation. Following the recommendation of previous mentors and that found in engineering education literature¹, this course focused in-class activities, lectures and assignments on a limited number of core transportation topics.

The course met for three 50-minute periods each week. These class periods were used to introduce topics, cover material through lecture, activities, discussions and homework review. The classroom portion of the class was operated to provide the students with an active/participatory learning environment.

The course was loosely structured for 1,000-points possible: 371-points for homework and quizzes, 100-points each for the WebCT discussions, in-class discussions and final exam, 350-points for a semester long research project, 50-point team member self evaluation, and opportunities for small amounts of extra credit. Course grades were based on a 90%-A, 80%-B, 70%-C, 60%-D, <60%-F scale, allowing the WebCT discussion points to represent a one-letter grade value.

Active classroom strategies were used to keep the classroom lively and the students engaged. Students who were actively engaged in class discussions, asked especially deep, well thought out questions or participated to a clearly higher degree than their classmates were awarded a small index card. The students placed their name on the card and turned it in at the end of class. These cards were part of their participation grade in the course with each card being worth a minimal 0.5 points. This gave the students a tangible reason for staying active in-class, and the instructor a way to monitor in-class participation.

The course format remained with two instructional shortcomings as initially designed: addressing other transportation topics and possible student inactivity. The core transportation topics included transit design and operations, freight and passenger rail transportation, airport design, and contextual highway design. Each topic was introduced to the students using active classroom techniques^{2, 3} to assist students in processing the large quantity of information presented in the course as well as to maintain high levels of student interest⁴.

Class participation is important for student learning, though in-class discussions are wrought with issues stemming from dominant students and time limitations³. Previous experience had shown that only a small number of students would wholly participate in the in-class activities, no matter how they are structured. There are other students who are scared by active classroom activities and shy away from showing their true abilities. Active classrooms are the key to student learning⁴, thereby making student involvement and their learning assessment the primary instructional task.

Many educators, me included, strive to create a holistic learning environment utilizing many different learning approaches to reach every student. Bernold found that use of a holistic learning-oriented environment assisted those who were traditionally less successful⁵. It was theorized that an Internet based discussion course component could address the learning needs of those students who were timid in the classroom and/or needed additional time to process the information.

II. Web Based Discussions

An Internet based discussion component was added to this course through WebCT to augment course content, allow equal student access to class discussions, and allow for deeper student thought about the topics. Catalano discusses the needs associated with creating a student-centered learning environment. Developing questions that facilitate exploration and growth is among the seven teacher roles in assisting students to take an active role in their own learning⁴. These questions must be combined with adequate time for the student to respond to their own highest potential. “When speed is an important factor, it interferes with measurement of knowledge and understanding of slow students.”¹ The web based discussions allowed students to participate at their own pace and to their own potential while allowing the professor to monitor their progress.

The WebCT discussions were a required part of the class, were graded and the combined semester discussion grade counted for approximately ten-percent of the student’s final grade. Grades were assigned using a rubric that rewarded well thought out responses with five points, gave three points for adequate responses, one-point for any response, but penalized disrespectful responses with a minus one-point score. Both these examples received the maximum score of 5-points and represent the diversity of the postings that occurred as the discussion proceeded.

“Competition would be great to decrease prices and cause RR companies to come up with innovative technology. However, if each subsidiary is only going to operate in its own assigned corridor, then competition is not created. You still only have one choice of passenger rail service for a particular area. How is this going to help?”

“I feel that this would be very bad time to introduce competition. We are dealing with a company who cannot even survive on its own without having to lower their fares due to competition (besides other forms e.g. Greyhound). Sure competition would be great for us, we ride cheaper. But the current conditions cannot allow lower fares. Lastly, does this situation look appetizing to a possible competitor who is interested in making big profits?”

Other responses represented minimal student thought and in some cases incorrect perceptions.

“I agree, Amtrak symbolizes the American expansion to the west. Without passenger rail we will lose part of our history.”

The nature of the WebCT discussion created a need for the course instructor to be active in the discussions, reviewing postings daily and commenting as the need arose. “As learning manager, the instructor may nudge the discussion toward certain issues provide mini-lectures on especially

salient points, and design an experience, which uses support collateral or outside resources. As discussion moderator, the instructor must know each participant and provide assistance where needed to enlist more timid students or control more vociferous ones... He must record privately his impressions of the contributions of each student.”⁶

WebCT is an Internet software package available to instructors at SIUE. This software has many features that went beyond the needs of this class, however does include two features that allow for the posting of the discussion subjects and allow for student discussion postings. The instructor uploaded the discussion subject pages to the class WebCT site prior to the start of the semester. Each student was able to access the class WebCT site via special access granted when they registered for the class. Students were instructed in-class and via the WebCT calendar when the seven discussions started and ended.

Student postings were distributed electronically to all other class members through WebCT allowing the entire class to read and respond to each. There was also a “reply privately” option that allowed the instructor to direct specific comments to an individual student if an act of disrespect had occurred.

Each WebCT discussion topic was available for comment from one to two weeks. The students were required to make two postings to the WebCT discussion page; one based on their own personal thoughts on the discussion piece, and a second to share their thoughts with regard to the discussion piece as commented on by other students. This method resulted in the discussion growing in both depth and breadth.

III. Discussion Summaries

“While there are many ways to use cases, the most appropriate approach depends upon specific learning objectives, the maturity of the class, and the level of skill reached by the instructor.”⁵ The first discussion topic was an editorial and was used as a rather whimsical way to introduce the discussion process, allowing the students to work out technical bugs and providing them with discussion grading feedback. This allowed the students to learn the discussion process and the instructor to address minor difficulties that arose.

III.A. Car Potato

This discussion topic was a short op-ed piece that was written in 2001 to explain how we as a culture have become car potatoes in a similar manner that we as a society have previously been identified as couch potatoes.

“Are You a Car-Potato?

You are if your favorite CDs reside in your vehicle CD changer.

You are if you know the drive thru menu at your favorite fast food restaurant by heart.

You are if you have two or more gas company credit cards.

You are if you upgraded to a leather interior when you purchased your last car.

You are if your car is an SUV that's never been operated in 4-wheel drive.
You are if your car windows are cleaner than the windows in your house.
You are if you wash your car more often than you mow your lawn... (Greg Luttrell, 2001)"

Student responses ranged from defensive, to creative, to those that understood the concept of a car-potato and expanded on the topic.

"I'm guilty of the first three points, not because I'm a car-potato, but because I spend a lot of time in my car, I drive 30 miles to school every day. If you are guilty of the last four points I can see you being a car potato."

"You could probably add to the list you're a car-potato if half of your wardrobe and at least one pair of shoes/boots can be found in your trunk (I'm guilty of that)."

Another student followed-up on the second comment above by stating,

"You are right. I live in two different places so my entire wardrobe is in the car. Clean clothes in the back seat, dirty clothes in the trunk."

This shows how one student can spawn an idea that another will pick up on, growing the discussion or taking it in another direction.

III.B Amtrak Passenger Trains

This discussion topic included four newspaper articles that chronicled the decisions being made in Washington D.C. with regard to keeping, saving or altering Amtrak. This discussion topic was opened as the class began the freight railroad unit and ended as it covered passenger rail.

The student discussion postings were more focused than for the previous discussion topic. A few students were able to bring personal experiences to the discussion, but most had to rely on readings from the class text, what they understood from the discussion topic newspaper articles, or as in a number of cases, what additional information could be gathered from Internet sources.

"The article "Amtrak might lose two routes" leads one to believe that the company only profited from 2 of its many routes last year. However, after researching this topic at www.amtrak.com, a press release stated..."

This student went on to summarize what had been found from the Internet source, providing additional facts for the discussion. This discussion posting scored a five for providing well through out ideas on the discussion topic, and received a two point bonus for going above and beyond the discussion requirements by providing additional researched facts.

The inclusion of this discussion topic allowed two specific classroom benefits. The first was that the students were thinking and discussing rail issues during their out of class time. This led many students to have a better awareness of the issues, language and topic the first day we discussed passenger rail transportation in-class. The Amtrak WebCT discussion also brought out many of the important passenger rail issues, thereby not requiring valuable class time for presentation of these items. However, since they were brought up during the WebCT discussions, and these discussions were considered part of the course content, the discussion facts/issues remained valid quiz/exam items.

III.C Maglev Trains

As the class left rail transportation and began discussing transit, the WebCT discussion shifted to a topic that was not being directly covered in-class: magnetic levitation (Maglev) trains. This discussion topic was a two page article from the January 2002 issue of Prism magazine titled, “Fast Track for trains”⁷ which discusses the technology involved, design issues, and possible Maglev projects. Maglev trains are high dollar transportation systems that may serve large portions of the population, making the topic one that needed inclusion in this transportation survey course. By including it as a WebCT discussion, the information was given to the students in a short concise manner, and they were able to digest it over a two-week period, commenting on it, and thinking about the implementation issues of such a system.

As no students had personal experience with Maglev trains, this discussion forced them to try and put it into their own context. This is very similar to the process used by students when forced to understand an unfamiliar case study. “When the case method is used, issues are introduced via concrete experiences as generated by the case scenario. This forces most students to employ what Kolb calls reflective observation from many viewpoints in order to develop conclusions and develop conjectural models of the new concept.”⁶ In the first batch of discussion postings these students very quickly identified the main issues of system safety, cost, and connectivity. As the students were able to process the concept and read others postings, comments began to emerge about the visual impact of a raised track infrastructure, safety issues surrounding magnetic and electric impulses, environmental benefits of Maglev and connections of a Maglev system with other transportation systems.

This was only the third discussion of the semester and the students were already demonstrating a strong ability to grasp the impacts, interconnectivity and issues surrounding the discussion topic as it related to transportation as a whole, despite the topic not having been formally covered in-class.

III.D. Floating Cities

The course did not include any in-class discussion of water modes except a brief mention relative to transportation safety. This was due to class time limitations and the importance the instructor placed on other transportation topics. However, it was important that the students were at least exposed to water transportation in some way. To bring this topic into the course, a discussion topic was included based on a 2001 article about large floating islands. These floating islands would be capable of carrying 115,000 residents, traveling around the world at 10 knots, would include on-site transportation of all kinds, and be accessible by water or air.⁸ The article presents the history of these large vessels including military and oil exploration concepts.

This discussion proved interesting in two ways. First, due to the make-up of the students in the class and information contained in the discussion article, those who responded first, focused on the absurdity of a military use for these large floating cities. Indeed, the students were right in their assessment, however, this was not the reason for using this particular discussion piece. Therefore, the instructor interjected with a few of his own discussion postings, agreeing with the students on their military use assessment and pointing the discussion in the intended direction.

The little side trip down the military route highlights the need for the instructor to stay abreast of the discussion postings so that mid-course corrections can be made if needed.

The second issue raised through this particular discussion topic was one of getting students to be willing to be receptive to ideas that are outside of their circle of experience and understanding. Many could not understand why someone would want to spend \$8 million for a 5,000 square foot unit or spend years living on one of these ships.

“These monster ships don’t seem like to great of an idea. I personally can’t see the appeal of living on a ship the rest of my life. No more driving, nature, eventually you would see everything on the ship and there would be nothing you can do about it.”

“The idea of a floating city is very interesting, but I don’t believe that the idea is practical. No one would want to live on a huge barge that takes two years to go around the world. The only people that would be able to spend extended periods of time away from society would be retired people, and maybe someone who is very wealthy. For this reason the boat would be less like a luxury cruiser and more like a floating retirement home.”

“I believe that what Chris is saying is true. Not many people would be able to afford this “luxury”, if you dare to call it that. Also, not many people would be able to spend that much time away from work, unless you could do everything from work via the Internet.”

Through the discussions, these students were able to discover the user needs of an idea like the Freedom Ship and begin to understand that there is interconnectivity in transportation (i.e.: telecommuting) that could make it a reality.

To assist the students in grasping the bigger picture involved, this WebCT discussion topic was also included in an in-class discussion. It was interesting to see that during the in-class discussion, less than one-quarter of the students participated, despite their all being familiar with the topic through their two WebCT postings. This reinforces the concept that no matter how a class is structured and who the students are; there may always be those who are reluctant to participate in in-class activities.

III.E. Sport Utility Vehicle Safety

This discussion topic served to introduce the concept of the vehicle in the safety equation and the overall topic of transportation safety. A 2002 article titled, “Are SUVs Getting Safer?” was used for this discussion topic.⁹ This article chronicles the many safety issues surrounding sport utility vehicles.

The purpose of this discussion piece was to get the students thinking about all aspects of highway safety. The discussion article discussed issues such as driver speed, vehicle center of gravity, bumper height design, road conditions and driver knowledge. The student discussion postings mirrored public comments on the seat belt debate as exemplified by these three student discussion postings made in successive order.

““Who Cares”, SUV consumers are well aware of the fact that SUVs have a higher rollover rate. If they want to buy one and take the risk, let them, no one is holding a gun

to there head. This goes along with seat belts, why can the government force us to wear one, I know the risk, if I don't want to wear my seat belt I shouldn't have to. What does it matter to them if I die in a crash, I'm not hurting anyone else involved. And why is the government so concerned about our safety, they regulate everything from seat belts to cigs, what are they trying to over-populate the world. Let people smoke and not wear their seat belts, it's just "population control". I know I probably won't get any points for this but, "Who Cares", this is a discussion and I'm discussing my opinion!" Joe.

The first student (Joe) did not receive a score of zero but did indeed receive the maximum score of five points for his posting as it moved the discussion forward through bringing out the concept of government safety controls.

"Joe's argument is hilarious but lets conceive that if you crash you have a good chance of injuring someone else. I agree that lowering the safety protocols is an excellent way of controlling the population, but this kind of natural selection process is not considered to be the norm of the North American population. The "People" pleaded for safer highways and the government responded with agencies that handle safety issues. This is, of course, getting rid of a proficient means of controlling the driving privileged but it is the general consensus of a majority of Americans that safety is far more important than controlling the herd size."

The second student draws from the words of the first and then brings the discussion back to an even keel.

"Unfortunately (or fortunately depending on how you look at it) the government regulates things like automobiles and cigarettes to protect ignorant and naive consumers as well as the general public. Tobacco companies would like us to believe that their products are safe. The government steps in to inform the uninformed consumer so he/she does not have to rely solely on the information (or advertisements) provided by the profit hungry tobacco industry. Other regulations set forth by the government protect society from things like second hand smoke. The government plays the same role in the automobile industry. SUV manufactures are not about to educate consumers on the potential dangers of driving an SUV unless the government makes them. Government regulations on automobiles also attempt to prevent Joe's point that people should be free to smoke or drive SUVs if they so desire, but I think the government should attempt to ensure that consumers make an educated decision and try to protect the general public."

Finally, the third student provides a well informed and concise summary of the SUV safety issue with respect to the need for government intervention.

One SUV posting highlights the ability of this type of course activity to identify students who may have problems with written communication skills. The student posting read,

"I'm not a big fan of SUV. Not only its difficulty to drive on smooth road, but also the high gas mileage it consumes especially during the high price of gas these days."

The course instructor was able to identify the quality of English skills of each student through careful observation of their individual discussion postings.

Interestingly, the class as a whole, through the WebCT discussion postings came to the conclusion that driving SUVs is such a specialized task, prone to such high levels of danger that a special driver's license should be required for those driving sport utility vehicles. This may not be

feasible, but the insight shown by the students in understanding the issues, processing the information and formulating this particular solution shows the depth of thought that can be achieved through the student-centered pace allowed by web-based discussions.

III.F. Belleville Crash

This discussion topic examined the issues surrounding a single vehicle crash at a local intersection where safety issues existed with respect to the vehicle, driver and intersection. This topic was discussed in WebCT during the time when the class was working through highway geometric design in-class. Therefore, this discussion topic served to provide another view of geometric design than we were covering through the in-class materials, activities, and homework.

III.G. Ginger

The last part of this course was stressful for the students as they prepared for their final research presentations and the final exam. Therefore, the discussion topic took a look at the first new transportation mode to be introduced in almost one hundred years: the personal transporter, commonly called “Ginger”. The students were directed to the Segway website and provided a newspaper article that previewed Ginger being ridden by the inventor.

The students provided discussion comments that broke into two camps. Many felt that this new vehicle had no place in our auto-dominated society, seeing no need for an alternative to the transportation modes already present. The second, and more thoughtful comments, focused on implementation issues, and interaction with other modes and the existing transportation infrastructure.

“This is quite a feat of engineering! When you’re on the thing you simply think about moving forward, naturally lean slightly forward and the Segway moves forward... it’s like something from the Jetson’s. Amazing as this invention is I think it’s rather impractical for private use. However, I think Segway would be useful for Police and EMT’s on crowded city sidewalks and at special events... Segway has its place, it just has to be marketed to groups that can benefit from the new form of transportation.”

This topic was also discussed in-class, and to reinforce the possible usefulness of the Segway device, the students were asked on the final exam to provide a list of major changes to the transportation system that would have to take place to accommodate it.

IV. Student Responses Rates

One of the purposes of the WebCT discussions was to promote active student participation through this out-of-class activity. Student responses were evaluated two ways to determine the level of participation in the WebCT discussions: by course grade, and by discussion topic.

There were 24 students in the course, all of who participated in the WebCT discussions. Table 1 shows how students were more likely to not provide discussion responses at the lower course grade levels (B, C/D) than those who received a high course grade (A). There were 14 possible

graded discussion postings for the semester. This table provides the average number of responses provided by students in each grade group over the course of the semester.

Table 1 - Number of Discussion Responses by Student Course Grade

Course Grade	Average Number of Discussion Responses	Number of Students
A	12.8	18
B	8.0	4
C/D	6.5	2

A second analysis of student no responses to the discussion topics was performed. This longitudinal analysis examined the number of student responses by discussion topic. The number of student discussion responses decreased as the semester progressed as shown in Table 2. Discussion topics #1-3 in the first third of the semester were responded too more than topics #6-7 which near the end of the semester.

Table 2 - Number of Discussion Responses by Discussion Topic

Discussion Topic	Number of Discussion Responses	Percent of Possible Responses
#1 - Car potato editorial	41	85.4%
#2 - Amtrak railroad	41	85.4%
#3 - Maglev trains	43	89.6%
#4 - Floating city	38	79.2%
#5 - SUV safety	40	82.3%
#6 - Belleville crash	36	75.0%
#7 - Personal transporter	37	77.1%

Non-discussion items that occur within the typical semester may explain the discussion participation level. As the semester progresses, student workloads increase as projects become larger and deadlines loom. Therefore, time spent early in the semester on a relatively minor assignment such as these discussions postings may be discounted in the rush toward the end of the semester.

There was little difference in the number of responses between the two required postings. The first posting experienced a total of 142 student responses throughout the semester while the second posting experienced 134.

V. In-Class And WebCT Discussions

The structure of the class required that all students participate, and all did in the WebCT

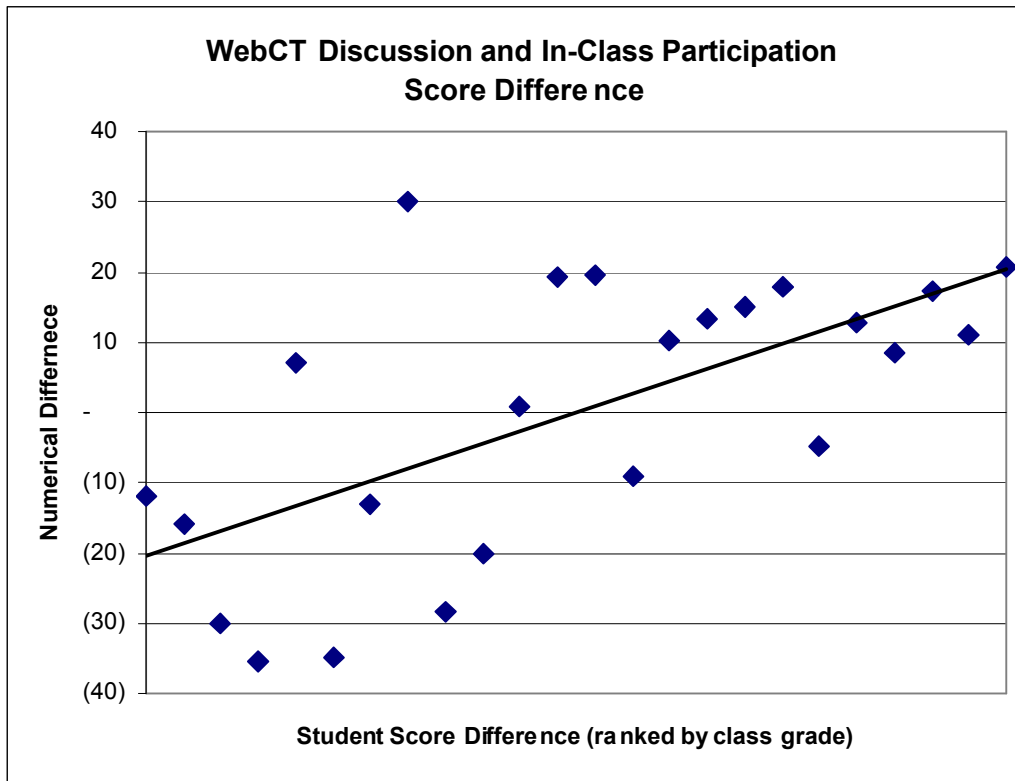
discussions, while not everyone participated all of the time in the in-class activities. In-class participation was rewarded by students receiving 0.5 points for each intuitive question, well thought out comment or above active participation. These points were totaled at the end of the semester and used as part of the in-class participation portion of the course grade. In general, in-class student participation was higher by the better students (defined as receiving an A grade in the course) and lower by the poorer students (defined as receiving a B/C/D in the course).

Similarly, the student discussion postings were graded and summed at the end of the semester. These scores were mathematically factored so that they represented ten percent of the final course grade. In general, those students who received an “A” in the course scored better on the WebCT discussion postings than those who received lower course grades.

The student scores were compared under the two environments (in-class participation and WebCT discussion). Both sets of scores were based on a maximum of 100-points with the in-class scores averaging 90-points and the WebCT discussion scores averaging 70-points. The WebCT scores were increased by the 20-point average score difference so that individual student comparisons could be performed. For evaluation purposes the student scores were grouped by grades: “A” and less than “A”. The students who received an “A” in the course scored an average of 7-points better on the WebCT discussions than their in-class participation scores. Those receiving a less than “A” course grade scored an average of 20-points less on the WebCT discussions than the participation score. Figure 1 shows the difference in the WebCT score and the in-class participation scores. This figure lists the student score differences from the student receiving the least number of course points on the left to the most on the right.

This evaluation of student scores from the in-class participation and WebCT discussion found that “A” students averaged an in-class participation score of 92.4 and 79.1 for the WebCT discussions. Students who received course grades of less than an “A” averaged an in-class participation score of 84.3 and 44.1 for the WebCT discussions. Therefore, the better students did better in both environments.

Figure 1 - Student Score Difference for WebCT Discussions and In-Class Participation



This numerical evaluation raises a concern that while all students participated in the WebCT discussions, it may have hurt the poorer ones. Intuitively, based on discussions with students and student comments, I don't believe this to be the case. However, this is an issue that must be closely observed when this teaching technique is used in the future.

Finally, the issue of student learning must be addressed. The WebCT format allowed the inclusion of topics not taught in class (i.e.: maglev trains), the introduction of topics prior to their being brought up in class (i.e.: Amtrak), and the continuation of discussions once a topic had been covered in class (i.e.: Sport Utility Vehicle Safety). The most poignant example of the deeper student thought brought out through this instructional method came from the SUV discussion. The students, on their own, got to a place where they had 1) identified the severity of the SUV safety problem, 2) identified that it is a driver skill issue, and then 3) arrived at the solution of requiring a separation license for driving an SUV, similar to commercial licenses. This is certainly a viable alternative as a solution to the SUV safety issue that has not openly been discussed; indicating that the students came to this solution through their own thinking and discussing of the topic.

Individual examples of deep student thought were evident. The SUV discussion comments cited earlier show a student relating SUV safety and government oversight to societal wants and needs.

This particular student was not articulate in his in-class mannerisms; but was able to very clearly and concisely put his thoughts together for the WebCT discussion posting.

VI. Conclusions

The use of the out-of-class WebCT discussion technique provided many important benefits for this class.

- Allowed student participation at a pace set by each student;
- Allowed all students to participate unbridled by in-class pressures;
- Allowed inclusion of topics beyond the normal scope of the course;
- Required the students to participate in a class activity while not physically in-class;
- Challenged students to a high degree of thought (content and format) to receive high marks; and
- Allowed assessment of student thoughts and writing without using in-class time.

The instructor must plan for, be, and remain committed to the discussion process throughout the semester.

- Discussion topics must be integrated with the overall course objectives and augment in-class activities, student learning.
- To maintain student interest in the discussions through the semester, there is a need to continue to focus the discussion topics in the class activities through formal (tests, quizzes, questions) and informal (in-class discussions, activities) methods.
- The instructor needs to oversee the discussion progress close enough to address disrespectful comments, answer questions, and guide the discussion away from unwanted areas.

As with any new instructional change, there is a large initial amount of preparation time, and teacher learning that must occur for the experience to be a success. A WebCT or other electronic based discussion could be successfully added to all upper-division engineering courses with equally successful results.

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