Providing Additional Support to Internet-Based Learning by Applying Supplemental Instruction Techniques

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Abstract

Supplemental Instruction (SI) has proven to be an effective tool used to increase student performance in academic courses that have traditionally been labeled difficult. Typically, these courses are characterized by low student success rates and course content that is very analytical in nature, such as the material presented in many engineering courses. During the SI sessions, an SI leader fields questions from students regarding problem areas in their current coursework, prepares sample test questions, and helps the students develop more effective study habits. It is a requirement that the SI leaders have previously demonstrated competence in the applicable course material. All SI leaders are required to attend both preparatory training sessions prior to becoming an active leader and ongoing training sessions throughout the semester after assuming their roles as instructors. These training sessions outline effective means of material presentation, problem solving techniques, test preparation techniques, and note taking strategies. Historical data, gathered primarily from traditional classroom settings, suggests that students can successfully manage difficult courses by attending SI sessions on a regular basis.[1]

With the increasing popularity of non-traditional forms of education, such as Internet based distance learning, SI faces new challenges. Those same courses labeled as difficult for the traditional on-campus student must now be presented effectively to the distant education student entirely through the Internet medium. Success in these difficult courses hinges on providing additional support to the distance education student in a manner that is well suited for their non-traditional schedules. Electronic SI (eSI) sessions may provide this additional support. Therefore, the demands of distance education have initiated the progression of supplemental instruction from the campus classroom to the Internet medium. This paper will examine the challenges, successes, and shortcomings of an actual engineering distance education course using Internet based supplemental instruction sessions.

Introduction

College courses that have been labeled as difficult typically contain highly analytical content and can often be characterized by low student success rates. Historical data suggests that the implementation of a Supplemental Instruction (SI) program targeting those difficult courses can help students to successfully manage those courses.[1, 3] The SI program was developed at the University of Missouri in 1973 by Dr. Deanna Martin and has been implemented in over 600 U.S. and international institutions.[1] However, the SI program was designed for the traditional campus environment and, as a result; the historical data on student performance tends to reflect

the achievements of traditional, on-campus students. For the non-traditional, distance education student these difficult courses present further challenges. Evidence seems to suggest that lack of student discipline and limited communication has increased the dropout rate for distance education students in comparison to the traditional on-campus students.[2, 6] Implementation of an SI program designed for the distance education student may provide a tool to increase student success rates by monitoring student discipline and by increasing communication pathways. The primary focus of this study was to determine whether an SI program designed for, and implemented in, the distance education environment could achieve the same results. In addition, this study will examine and discuss the changes that were made in the traditional SI program design to make the instructional methods more effective and easily accessible to the distance education student.

Traditional, on-campus SI leaders receive required training prior to obtaining a leadership role and at regular intervals during the semester after assuming their roles as SI leaders. This requirement does not change for the eSI leader, since the eSI leader must attend and participate in all training sessions. During these training sessions, the SI leaders and SI supervisor discuss methods of session organization, problem-solving techniques, test- and note-taking strategies, and student study habits. The leaders often share their successes and failures with others involved in the sessions and are able to gain insight into improving their own instructional techniques. Effective instructional techniques are crucial to the success of a distance education course.[4]

As mentioned before, eSI sessions can provide this additional support but changes must be taken into account and steps must be taken to make the actual sessions effective. Success in these difficult courses hinges on providing additional support to the distance education student in a manner that is well suited for their non-traditional schedules. For the traditional student, the on-campus SI sessions are typically conducted two to four times weekly and are held within classrooms to maintain the learning atmosphere associated with the classroom setting. Electronic SI (eSI) sessions can still be held a number of times weekly for the non-traditional student; however, in order to be more effective, the sessions must be offered at times suitable for the working individual. Therefore, the availability schedules of the participants can be a limiting factor when implementing an SI program for internet-based distance education courses. Also, the effectiveness of any SI program can be directly correlated to the overall accessibility of the students to the sessions.[1] This poses a complicated problem with regard to the distance education setting. The typical distance education student is actively employed full-time and, as a result, cannot always attend the sessions at the same time each week. Therefore, the key in increasing the effectiveness of the program is to offer multiple sessions each week with each session occurring within a different time frame (i.e., morning, afternoon, and evening). When the sessions are offered in this manner, the distance education student is given the advantage of increased accessibility. Increasing the accessibility of the SI sessions is, however, just one parameter to consider when designing a program to provide the distance education student an efficient and effective means of acquiring additional support in their coursework.

The most apparent difference between the traditional SI session and the eSI session is the method employed by the leader to instruct the students. The traditional SI leader typically employs the chalkboard, dry-erase board, or overhead projector to simulate, discuss, and provide the tools

necessary to solve most engineering problems. The methods used are not very different from those employed by the typical on-campus professor; therefore, the majority of traditional students feel comfortable with this setting. The atmosphere of the traditional SI classroom is kept very low-key by conducting the sessions in classrooms instead of learning centers.[1] In contrast; both the eSI leader and distance education student face a completely different set of challenges. Before examining these challenges, a brief description of the Internet and software resources used during this study will be provided. The eSI program observed for this report utilized two primary web sites. It should be noted that the professor for this course included a plethora of Internet links in the main course web site to provide the students information on pertinent course topics such as PSPICE help, technical writing resources, and general technical resources. The main course web site was powered by WebCT software and contained pertinent course information including lecture notes, the syllabus, course schedule, and assignments that were offered in asynchronous mode. This web site provided secondary eSI support by allowing the students, professor, and eSI leader to communicate via its e-mail and discussion board features. Using these features, students could post questions and directly submit homework solutions and electronic simulations using PSPICE or other circuit analysis software for the professor or eSI leader to review. The secondary web site utilized in this course was powered by CentraOne software. The CentraOne web site functioned as the principal eSI tool in synchronous mode and provided the ability to archive sessions for later viewing in asynchronous mode. The features of this software that were utilized primarily included whiteboard, application sharing, agenda creation, and communication via microphone (headset). Video capabilities were provided but were not utilized during the eSI sessions. Using these two web sites, and exploiting the strengths of each, an effective support tool was created where the course professor, eSI leader, and distance education student were all given the ability to more effectively and efficiently communicate during the semester. Furthermore, since communication could occur both synchronously and asynchronously, the student could acquire the additional information that they were seeking in a manner that better fit their own schedule. Offering interactive communication also lessened the isolation that distance education students sometimes encounter and thereby, helped maintain an efficient learning environment.[2]

Method

Participants

The eSI course observed for the purposes of this study was implemented for Active Networks I (ETEE-3211) offered by the Department of Engineering Technology at UNC Charlotte during the Fall 2002 semester. Seventy-three percent of the senior-level engineering technology students completed this particular distance education course. Participation in the eSI sessions was completely voluntary in keeping with the program's on-campus structure; however, efforts were made to encourage participation using the same methods employed by on-campus SI leaders (i.e., postings, e-mails, and verbal invitations).

Materials

As mentioned earlier, this course utilized two main web sites with links to many other supportive

Internet sites and archived information. The main course web site was powered by WebCT software and contained pertinent course information including lecture notes, the syllabus, the course schedule, and assignments, while providing secondary eSI support by allowing the students, professor, and eSI leader to communicate via its e-mail and discussion board features. Students were required to access this web site on a consistent basis to obtain new lecture material, homework assignments, and quizzes, as well as to obtain solutions and grades for previous homework assignments, quiz and tests. WebCT was the central hub for all asynchronous communications during the semester. The second web site utilized the CentraOne software and it functioned as the primary eSI tool through the use of the whiteboard, application sharing, agenda creation, and communication via microphone (headset) and video elements. CentraOne also had a recording feature that allowed each session to be recorded and then archived so the students could recall the session at a more convenient time and as many times as desired. These two primary web sites were used together to strengthen and support the principles and theories presented by the text used for this course.

Design, Procedure, and Results

As mentioned previously, the success of eSI directly correlates to the accessibility of the sessions.[1] In order to make support for this course more accessible, two eSI sessions were created and one lecture/problem session was created. One eSI session was scheduled for the lunch time frame between 11:00 A.M. and 1:00 P.M., and the other eSI session was scheduled for the afternoon time frame, between 2:00 P.M. and 5:00 P.M. The first author of this work led these sessions. The lecture/problem session was led by the professor and was held in the evening after 5:00 P.M. In addition to offering these sessions, students were encouraged to send e-mails or post discussion threads in WebCT in order to get quick support on encountered problems. Both the course professor and the eSI leader regularly monitored the discussion board and responded to e-mails and discussion postings. The e-mail feature within WebCT proved to be quite useful and became the venue of choice by the students for communication between the students and the professor or the eSI leader. For this feature to be efficient, the professor and eSI leader had to be diligent in checking incoming e-mail and responding to questions in a timely manner. In this course, in common with some other distance education courses, the homework assignments were posted well in advance of their due date and homework submissions were due by a given day and time. The students were strongly encouraged to submit their homework solutions for this course online in the student's own personal folder space within WebCT. WebCT time-dated each submission and late entries were accepted only for special circumstances. Due to the imposed time limitations on homework and the complexity of the subject matter, it was very important for the eSI leader to respond to e-mail or discussion threads in a timely manner. The author found that diligence spent on responding to e-mail and discussion postings inspired trust in the students and consequently, the students were more open and less hesitant in asking for assistance or posing a technical question and as a result, more amenable to attending eSI sessions.

For the remainder of this examination, the semester during which this distance education class was offered will be broken down into three sections. There were three tests administered during the semester and therefore, it seems logical to discuss the performance of the distance education students in the intervals leading up to these three tests. In this manner, the general trend of the

students can be more easily discerned. Since the purpose of an SI program is to help students manage difficult courses through the development of more effective study habits, it seemed reasonable to examine the test score trends during this semester. These trends were then correlated with techniques implemented in the eSI program and student feedback. There are many factors that can play a role in student success; however, this study focuses on the implementation of an eSI program. Furthermore, there is historical evidence indicating the successfulness of properly implemented SI programs.[3, 5] This evidence is based upon several factors including comparison of the grades of students who attended SI sessions versus those that did not attend, decreasing dropout rates in "high risk" courses, and removing the "high risk" label from those classes that exhibited significant improvement in pass/fail rates. The intervals will be labeled by their associated test (i.e., Test 1 interval, Test 2 interval, and Test 3 interval).

Test 1 Interval

During the Test 1 interval, the eSI leader and distance education students were engaged heavily in learning the new software used for this course. The initial plans for the eSI instructor were to lead the sessions, answer e-communications, and assist the professor as needed. This plan worked well during the learning period because the complexity of the course subject matter was low and consequently, the attendance was low during the eSI sessions. It should be noted here that the ETEE-3211 course at UNC Charlotte is the first of a two-part course dealing with electronic devices. Material for ETEE-3211 includes basic semiconductor physics and chemistry, and an introduction to devices such as diodes, bipolar junction transistors (BJTs), and operational amplifiers (op-amps), as well as the analysis and design of systems utilizing these devices. Common to many engineering courses, the course material builds as the semester progresses and therefore, the subject matter at the beginning of the semester is typically not as complicated as the subject matter at the close of the semester. During this interval, if no students participated in the eSI session, no recording was posted for that particular session. Recall that CentraOne has a recording feature that allows the eSI or lecture/problem session to be recorded for later playback. The e-mail input during this interval was also somewhat lower than expected. As the first test approached, the communication (in the form of e-mail and discussion postings) between the students and the eSI leader increased. The overall average grade for the distance education class for the first test was 86.9 with a standard deviation of 15.2 and a median grade was 87. It should be noted here that the professor included one extra credit problem on every test and that allowed the test scores to be higher than 100. From the numerical data, it can be inferred that the grade point distribution was very symmetrical about the median.

Test 2 Interval

During the Test 2 interval, the complexity of the subject matter increased. As a result, the number of e-mail questions and discussion postings steadily increased. Strangely, the eSI attendance remained fairly low. The professor and eSI leader decided that the eSI sessions where there was no participation should be used advantageously for the students. An alternate eSI strategy was developed. If no student participated or logged on to the session after the first 15 minutes of the session, then the eSI leader would record and post a tutorial on the subject matter of the moment. It should be noted here that student feedback influenced the topic of each tutorial usually through

e-mail or online synchronous communication[7]. The tutorial was then offered in asynchronous mode to the students following the procedure described below.

Using the functions of the whiteboard, application sharing, agenda creation, and recording utilities of the CentraOne software, tutorials could be created quickly and efficiently. The typical tutorial involved using the whiteboard to draw a circuit from a homework problem, construct a set of steps to solve the problem, and then to perform the arithmetic. For this application, the following steps were performed: draw the circuit and solutions using the whiteboard, save and name each whiteboard image by using the "Save to Agenda" utility, begin the recording when ready to perform the tutorial, and dictate the tutorial thoroughly. Upon completion, the recording was stopped, saved, and archived according to session date and time. An e-mail notification about the tutorial was then sent to all students. This utilization of the recorded eSI sessions proved to be popular primarily because the students could view these archived recordings whenever convenient and as many times as needed.

To further enhance the amount of support available to the students, it was decided that tutorial containing sample test problems be recorded. These tutorials were created approximately two weeks prior to the test so that adequate time was given for the students to review these tutorials during their normal test preparations. It was the responsibility of the professor to determine which type problems should be created as tutorials based upon student feedback. Usually, the professor based the topic upon which material was common to the majority of the students' questions. After receiving this information, the eSI leader chose problems similar to those suggested by the professor. These problems were then solved using the whiteboard application of CentraOne, dictated, saved, and archived. As with the other tutorials, an e-mail notification was sent to all students with information about the sample test questions. This eSI strategy also proved popular with the students and many students commented that they incorporated the tutorials into their normal test preparations.

As the second test approached, once again the communication between student and eSI leader increased. This time the communication involved e-mail, discussion postings, and online commentary during the lecture/problem sessions and active participation in eSI sessions. The overall average grade for the distance education class for the second test was 105.9 with a standard deviation of 11.4 and a median grade of 104. This represented an improvement in the overall average grade of 22 percent as compared to the overall average grade for test 1 (86.9). The greatest improvement in any individual student's grade from Test 1 to Test 2 was 62 percent and the minimum improvement was 12 percent. Whether the improvement seen in the Test 2 scores was directly correlated to the implementation of the tutorial and sample test question methods cannot wholly be ascertained. However, the students provided extremely positive feedback about the availability and content of the sample test problems. The communication between the students and the eSI leader and/or professor increased as the semester progressed and the impact that the additional support from those communications had on the overall test scores cannot be measured accurately with a single semester of experience. However, as mentioned before, communication is crucial to the success of a distance education course.[2]

Test 3 Interval

The tutorials were continued during the Test 3 interval in eSI sessions where there were no participants. Also, sample test problems were given to the students in tutorial format beginning approximately two weeks prior to the third test. Some interesting results were recorded for the third test and a possible explanation for the apparent reversal in the positive trend will be given in the Discussion section of this report. The overall average grade of the class for the third test was 76.4 with a standard deviation of 21.4 with a median grade of 70. There was a regression in the overall average grade of 29 percent as compared to the overall average grade for test 2 (105.9). This was not entirely unexpected since the course material at this point in the semester is significantly more complicated than the material presented earlier in the semester. No improvements in test scores were recorded from Test 2 to Test 3.

A graphical representation of the test scores from Test 1, Test 2, and Test 3 is shown below in *Figure 1*. The grade point distribution for Test1, Test 2, and Test 3, based on a standard ten-point scale, is illustrated below in *Figure 2*.

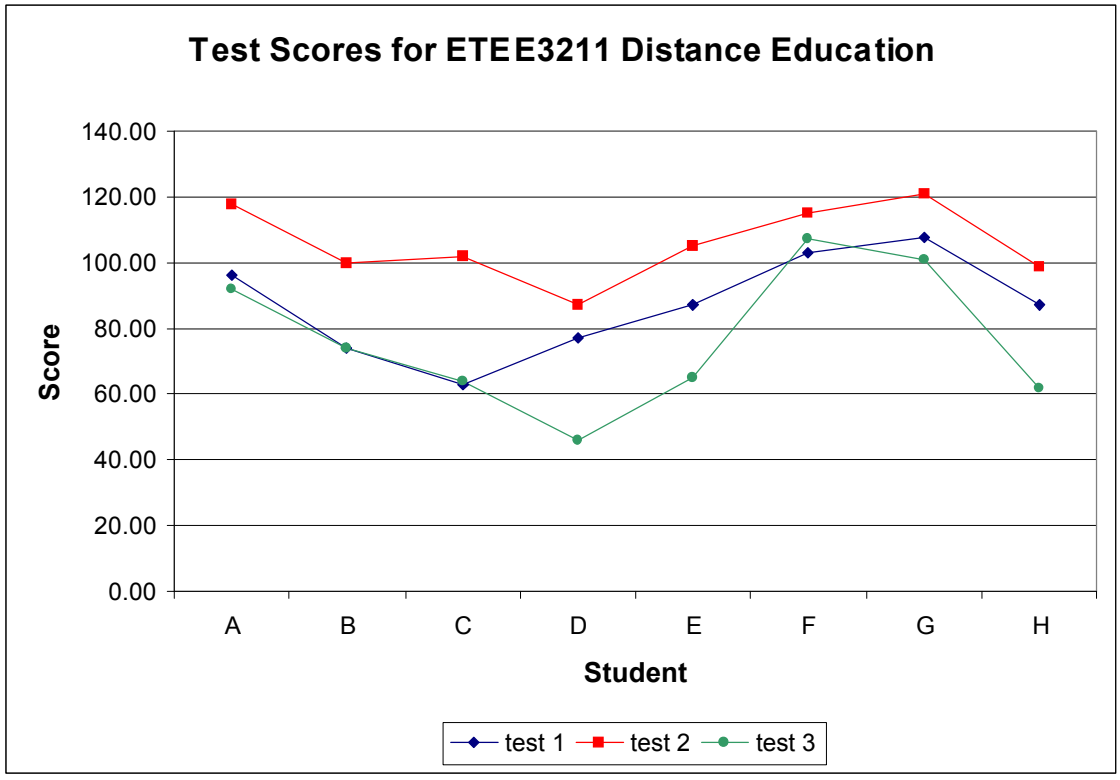

Figure 1: Comparison of Test Scores for Test 1, Test 2, and Test 3

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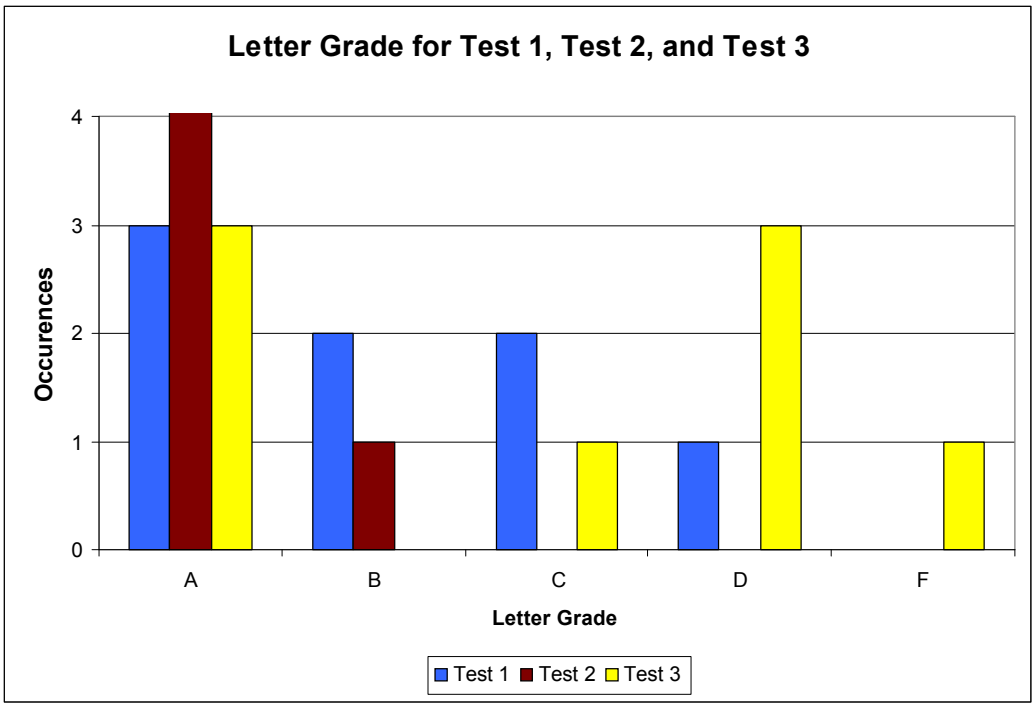

Figure 2: Comparison of Letter Grades for Test 1, Test 2, and Test 3

Summary and Discussion

The data gathered from SI programs across the nation show that students who attend SI will have average grades that are one-half to one full letter grades above those students who do not attend SI.[1, 3, 5] However, the SI program was originally designed for the traditional campus setting and the historical data tends to reflect the achievements of the traditional student. The purpose of this study was to provide an initial step in examining the challenges, successes, and shortcomings of an SI program implemented for a totally Internet-based distance education course. Could the implementation of an electronic SI (eSI) program achieve similar results in the distance education environment? That was the question posed at the outset of this program.

The semester was broken down into three sections for further evaluation. There were three tests administered during the semester and it seemed logical to chart the students' progress during the semester by comparing the recorded scores during the three testing periods. After Test 1, some changes were made to the eSI program including the implementation of tutorials during sessions with no participants and the implementation of sample test problems in tutorial format given prior to the upcoming test. These proved to be popular with the students primarily because the students could view these tutorials repeatedly at their convenience. Students could also communicate with the professor and/or the eSI instructor at anytime by using the e-mail and discussion posting tools of WebCT. As the semester progressed, the number of e-communications increased. This could be attributed to the increasing complexity of the course material and/or that the students had become more acquainted with the software, professor, and eSI leader and were less hesitant to pose questions. After these changes were implemented, a definite improvement in test scores was noted.

All students showed improvement in their test scores from Test 1 to Test 2. The impact that the newly implemented tutorials and sample test problems tutorials had on the outcome of the second test cannot accurately be ascertained with results from a single semester; however, several remarks were made by the students that they had incorporated these tutorials into their study and test preparation routines.[7] One of the attractions of SI for potential students to consider is stated in The Leader's Guide to Supplemental Instruction as, "It's [SI sessions] guaranteed study time".[1] In this study, the tutorials accomplished that task. The tutorials were designed to provide support on the current course topics and if the student put forth the effort to view the tutorial then they were allowing themselves study time each week. The tutorials provided them with approximately 30 to 45 minutes of material per each session or 1 to 1.5 hours of material per week at their convenience.

After reviewing the test scores from Test 2, it was decided to implement the tutorials and sample test problem tutorials for the third test section. Some interesting results were recorded for the third test. A possible explanation for this regression could be the occurrence of a natural event in the Charlotte area, which hampered paths of communication. The ice storm that occurred during the first week of December 2002 caused severe damage (downed telephone lines, power outages, and cable outages) to large sections of North Carolina and South Carolina. The storm also happened to coincide with the last week of the Fall 2002 semester at UNC Charlotte and occurred during the week that the third test was scheduled. The inconveniences of this occurrence and the added stresses associated with dealing with the ice storm could have hindered and disrupted the study habits of this student population. Further, if the tutorials were relied upon heavily during their normal test preparation then, hypothetically, if the students did not have access to these archived tutorials due to these outages then this could have affected their normal study routines in negative manner. The impact that the ice storm had on the outcome the third test cannot be measured accurately but it cannot be easily dismissed either. An alternate explanation for the regression in test scores could be the decline in student performance that many professors observe on the third and/or final test of any semester, particularly if the complexity of the course content has increased as the semester has progressed.

Conclusion

The implementation of an eSI program to provide additional support to the ETEE-3211 Internet-based distance education course offered the students many benefits and achieved success in helping these students manage this difficult course. Based upon student commentary, the greatest benefit was the tutorials and the increased interaction with the professor and eSI leader.[7] The course material tutorials and sample test problem tutorials provided the students with numerous examples and helpful hints on solving these problems in a format that was easily comprehensible. The hints and strategies provided to the students by the eSI leader were developed when the leader had previously taken this course in a traditional campus setting. Furthermore, the tutorial material was chosen based upon student feedback. This empowered the students and shifted the control over eSI content into the hands of the students; thereby creating a learning environment more suitable to their needs and skills. This was a major advantage to the distance education students. Another benefit was that the tutorials, if viewed on a regular basis, guaranteed that the

student would have approximately 1 to 1.5 hours of study time per week at their convenience. According to student commentary, incorporating these tutorials into their study routines helped them more efficiently prepare for the tests and understand difficult material.[7]

The two shortcomings that were noted during this study were the student population size and the effects of weather-related phenomenon. The reversal of the positive trend that occurred with the scores from the third test could have been affected by circumstances beyond the control of this study. Although rare in occurrence, the ice storm did coincide with the final week of classes and timing of the third test. This occurrence not only disrupted normal day-to-day routines; but also could have interfered with the time that would have been otherwise allotted for and spent on studying for this test. Also of note, the student population for this study was small (eight students) and data from a larger population and future semesters would be statistically more revealing. Further research is required to provide the data necessary to quantify the value of the eSI program.

In conclusion, this study provided some positive trends worth investigating in future distance education classes. Based upon the commentary from an anonymous end-of-semester course improvement survey, the implementation of eSI strategies influenced the study habits, student discipline, and communication of the students in a very positive manner. The results from this study seem to suggest that eSI can be an effective tool for educators to utilize in order to facilitate an efficient learning atmosphere in the distance education environment.

References

[1] The Curators of the University of Missouri. The Leader's Guide to Supplemental Instruction. (1996)

[2] Cohen, M.S. and Ellis, T.J. "Teaching Technology in an Online, Distance Education Environment," Session T1F, *Proc. 31th ASEE/IEEE Frontiers in Education Conference*, Reno, NV (2001).

[3] Marra, R.S. and Litzinger, T.A. "A Model for Implementing "Supplemental Instruction" in Engineering," available at http://fie/engrng.pitt.edu/fie97/papers/1070.pdf. (1997).

[4] Zywno, M.S. "Attitudes of Engineering Faculty Towards Technology-Assisted Instruction – A Polemic," World *Transaction on Engineering and Technology Education, Vol. 1*, Melbourne, Australia (2001).

[5] Webster, T. and Dee, K.C. "Supplemental Instruction Benefits Students in and Introductory Engineering Course," available at http://fie.engrng.pitt.edu/fie97/papers/1012.pdf. (1997)

[6] Lake, D. "Reducing Isolation for Distance Students: An on-line Initiative," *Open Learning*, 14(3), (1999)

[7] Student commentary for the ETEE3211 Distance Education course during the Fall 2002 Semester was compiled and is available by request through the Engineering Technology Department at UNC Charlotte.

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