INSTRUCTIONAL TECHNOLOGIES, LEARNING STYLES AND PERSONALITY TYPES: WHAT WORKS?

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Abstract

The overall goal of this project, funded by a grant from the General Electric Fund, is to determine how to use new educational technologies to optimize the learning process for students with different learning styles and personality types. We are currently in the revision and planning portion of the third year of this three-year project. This paper reports on results from the first two years of this project. Specifically, we will look at student reactions to the different technologies used to deliver course material. Students' reactions were both attitudinal (i.e., satisfaction and preference) and performance (i.e., course grade) in nature.

In order to achieve the project's goal, student's personality type and learning style were measured using the Learning Style Inventory (LSI) and the Myers-Briggs Type Indicator (MBTI). We compared these differing learning styles and personality types to student performance in two different classes, Mechanics I (freshman level) and Basic Strength of Materials (sophomore level), taught using three different educational technologies: interactive video class (distance learning), a web-assisted class, and a streaming video class. A standard lecture class was used as the control class for this project. The Mechanics I course was studied in years one and two of this study. The Basic Strength of Materials course was studied in year two of this project. For year three, we plan to focus solely on the Basic Strength of Materials course for a second year. Consequently, at this time, we have two years of data from the Mechanics I course and one year of data from the Basic Strength of Materials course.

For the first two years (1999-2001), this study included over 400 students who enrolled in either the Mechanics I classes or the Basic Strength of Materials classes. From these students, we collected LSI information and MBTI information. Several variables were found to have an influential role in student performance. The overall findings, from the first two years, include:

1. Educational technology format had an impact on student performance. Students in web-assisted classrooms performed better than students in traditional lecture classrooms.
2. Students' personality types had an impact on their performance. Realistic decision makers performed better than adaptable realistic or innovative thinking types. While the differences were not statistically significant, students with mental functioning styles of practical thinking performed better than insightful thinking styles.
3. Overall, students with converging learning styles received higher grades than students with diverging and assimilating learning styles. Additionally, students with accommodating learning styles performed equivalently irrespective of the educational instructional format used in the courses they took. This is also true of the students with assimilating and diverging learning styles. Students with converging learning styles performed better in the web-assisted course versus the traditional lecture course. Students rated the web-assisted course higher than the other instructional formats for overall satisfaction and increased students' belief that they could learn the course material. Level of overall student satisfaction was positively correlated with final course grade. Additionally, students had increased contact time with course materials and concepts when they took the web-assisted and high quality streaming video classes. The increased interaction with the materials may be correlated with increased grades and overall student satisfaction.
4. Finally, any form of educational technology helps students perform better versus the standard lecture classes.

The Ohio Learning Network 2002 conference session associated with this paper will more thoroughly review the first two years' results of this project. Results are both performance (course grade) and attitudinal (satisfaction and preference) in nature. The presenters will include participants in results interpretation and brainstorming the applicability, and application, to other courses and institutions.

Introduction

New educational technologies, such as streaming video, the web or internet and interactive video, to deliver instructional material to students are being utilized by many universities. These technologies may show the future direction for innovative higher education. There is research related to technology use [1] or learning styles [2, 3] in science and engineering courses. Another study explored the relationship between presentation mode and learning styles in the field of computer science [4]. There is an under-representation in research studies that explored the relationship between the use of different educational technologies (web-assisted, streaming video, and interactive video) and student's learning style and personality types. This study attempts to fill this void in the research.

This project statistically evaluates how well students learn utilizing these new technologies based on their learning style and personality type. The goal of this project is to determine how to use these new educational technologies to optimize the learning process for students with different learning styles and personality types. This paper reports the results from the first two years of a three-year program.

In order to achieve the project's goal, student learning styles and personality types were measured using the Learning Style Inventory (LSI) [5] and the Myers-Briggs Type Indicator (MBTI) [6]. We were exploring whether or not there was a correlation between these differing learning styles and personality types to student performance in the same class, Mechanics I (freshman level), taught using three different educational technologies: interactive video class (distance learning), web-assisted class and a streaming video class. A standard lecture class was used as the control class for this project.

All classes received in-person instruction which varied depending on the specific educational technology used in that class. The traditional classes were standard lectures. The interactive video classes were lectures augmented by the use of a projection unit that broadcasted the instructors voice, image, and writing to both sites. Students in the web-assisted class and the streaming video class were required to preview the Mechanics I or Basic Strength of Materials course material prior to the required class meetings. The instructors' role changed from the traditional lecturer to that of mentor; they reviewed difficult concepts, answered questions, worked problems, and gave examples of how the materials could be used in engineering work.

A statistical analysis was used to assess student learning based on Myers-Briggs types and student learning styles in the control class and each of the three technology classes. The research questions examined were as follows:

1. How do various personality types and learning styles perform within a specific class?
2. How do various personality types and learning styles perform across all four instructional formats?
3. How does student satisfaction of the class, or educational technology, affect his or her course grade?

Summary of the Study

The goal of this project is to determine how to use new educational technologies to optimize the learning process for students with different learning styles and personality types. In order to achieve this goal, we evaluated students in Mechanics I courses taught during the spring quarter 2000 and spring quarter 2001 and students in Basic Strength of Materials courses taught in spring quarter 2001. We measured student learning styles using the "Learning Style Inventory (LSI)" [5] and the personality types using the "Myers-Briggs Type Indicator (MBTI)" [6] instruments. Three educational technology based courses were being evaluated: 1) Interactive video, distance learning, in partnership with Wright State University or with two classes at University of Cincinnati; 2) web-assisted course; and 3) streaming video course. The control class was the typical lecture class. Students were randomly assigned to one of five classes per course (interactive video-originating site, interactive video-receiving site, web-assisted, streaming video, or traditional lecture). An analysis of students' prior calculus and physics grades indicate that these students' academic ability was equivalent across all classes and any difference in grades would not be due to one class' inherent higher achievement level, as indicated by prerequisite course grades.

Student learning was evaluated in all classes. The standard lecture class was used as a "control" class. The interactive video class was held at both University of Cincinnati and Wright State University during the first year and solely at University of Cincinnati during the second year. There was an instructor at all sites. Students in the interactive video class were able to interact with the instructor during the class sessions. In both the web-assisted and the streaming video course, the students were directed to view the next session's lecture material prior to the actual class session. During the scheduled class session, the students met with the instructor and were able to ask questions, clarify theory and discuss problems. The instructors were told to use class time to enhance the learning material.

All faculty participants were carefully selected, based on excellent teaching records and experience in teaching either Mechanics I or Basic Strength of Materials. The faculty teaching the streaming video courses received video training for the project from the College Conservatory of Music, Electronic Media Division faculty. The faculty-teams conducted detailed course planning during the fall quarter of 1999 and 2000. In the spring quarter, all classes, within a subject, were synchronized so that they were taught at the same time, used the same text, followed a detailed day-by-day curriculum and took the same quizzes and final examination. To avoid grading bias, one teaching assistant graded all students' problem one of a quiz or final, while another teaching assistant graded all students' problem two, etc. Both the MBTI and LSI were administered to all students during the first class session. Student satisfaction surveys were conducted toward the end of the quarter. The surveys were designed to help quantify student satisfaction and acceptance of the various educational technologies used. The students were asked to respond to a variety of questions using a modified Likert scale of 1-5, with 1 being "strongly disagree" and 5 being "strongly agree".

Discussion of the Findings

The project team met all proposed project goals for the first two years. We are building a database of students' LSI and MBTI data [5, 6]. The student learning styles obtained were relatively consistent with known averages. The MBTI data are also consistent with national trends for engineers. It appears that University of Cincinnati students may be more perceiving than other databases, but how this impacts student performance and retention is not known at this time. Overall, the body of students involved in this study appears to be representative of engineering students around the country. We are currently in the middle of a three-year project. Therefore, no definite conclusions can be drawn, but we were able to observe some trends.

For the first two years (1999-2001), this study included 501 students who enrolled in either the Mechanics I classes or the Basic Strength of Materials classes involved in this study. From these students, we collected LSI information from 408 students and MBTI information from 437 students. As indicated by final grade received, four hundred thirty-eight students completed these classes.

Several variables were found to have an influential role in student performance. First, educational technology format had an impact on student performance. Students in web-assisted classrooms performed significantly better than students in traditional lecture classrooms (average final course grade of 77.49 vs. 69.68, respectively; $F_{(4, 433)}=3.46$; $p=0.01$). Students' personality types (MBTI) had an impact on their performance. Realistic decision makers (MBTI - SJ) performed significantly better than adaptable realistic (MBTI – SP) or innovative thinking (MBTI - NP) types (average final course grade of 78.77 vs. 72.93 or 72.75, respectively; $F_{(3,404)}=3.92$; $p=0.01$). While differences were not significant, students with mental functioning styles of practical thinking (MBTI- ST) performed better than insightful thinking styles (MBTI - NF). Overall, students with converging (LSI - CNV) learning styles received significantly higher grades than students with diverging (LSI - DIV) and assimilating (LSI-ASM) learning styles (average final course grades of 76.96 vs. 67.71 and 72.38, respectively; $F_{(3,377)}=4.39$; $p=0.01$). Additionally, students with accommodating (LSI - ACC) learning styles performed equivalently irrespective of the educational instructional format used in the courses they took. This is also true of the students with assimilating and diverging (LSI) learning styles. Students with converging learning styles performed significantly better in the web-assisted course versus the traditional lecture course (average final course grade of 82.79 vs. 70.74, respectively; $F_{(4,148)}=3.80$; $p=0.01$). Additionally, students rated the web-assisted course significantly higher than the other instructional formats for overall satisfaction ($F_{(3, 212)}=15.92$; $p=0.00$). This led to students' increased belief that they could learn the course material. Level of overall student satisfaction was positively correlated with final course grade (Pearson correlation=0.14; $p<0.05$). Finally, students received higher final grades in the classes utilizing any form of educational technology relative to the traditional lecture classes (75.27 vs. 69.68). This difference is significant ($F_{(1, 436)}=9.89$; $p<0.00$).

As stated previously, there was a trend toward student performance differences based on learning styles and educational technologies used in a class. The technology driven classes improved student engagement with the course material. The students took advantage of the fact that they could access the lecture material on the web for both the streaming video and web-assisted classes. Both of these instructional formats required the students to spend more time on task versus the lecture and interactive video classes. The increased interaction with the materials may be correlated with increased grades and overall student satisfaction.

Statistical evidence revealed that the students' opinion of the quality and effectiveness of the course was correlated with their performance. Students who rated the course more positively performed better than other students. In the future, it would be interesting to determine what factors are causing this relationship.

All of these educational technologies enhanced the student learning process. Currently, these technologies are used as auxiliary instructional support systems. The instructor is still the primary support for learning. The exact nature of this educational support is changing but an instructor is needed to review concepts, mentor, and guide students in their learning and applying these fundamental engineering concepts.

Technical experience and expertise was very instrumental to the current success of this project. The project team learned a great deal from experiences during the first two years. The web-assisted course was an excellent production. The interactive video course was successful at both University of Cincinnati and Wright State University. We are continuing to improve the electronic equipment to minimize technical difficulties. During the first year, the streaming video class had technical difficulties and was a challenge to produce. These difficulties were addressed as they became apparent. At the beginning, the instructor was responding to student questions by solving problems on the board at the front of the classroom. These actions were not clear when the lecture was viewed via the web. To capture this necessary movement, the College Conservatory of Music purchased new equipment. The current production quality is very good. The instructor's motion and the rapidly changing blackboard material are captured simultaneously.

Overall, the web-assisted course was an outstanding success. This success was due to the combination of very good web site materials and engaging instructors. Each instructor designed their web site and expected his students to review the material before the classroom sessions. When the students and instructors met face-to-face, the instructor did not lecture on the same materials covered in the web-based materials. The instructors interacted with their students via questions and answers that required the students to read the web-based material before the class. During class sessions, the instructor would clarify theory, work problems and give practical examples of how the Mechanics I or Basic Strength of Materials concepts are used by practicing engineers. This combination of web-assisted material and an engaging in-person class session is a significant enhancement versus traditional lectures. The other educational technologies were as effective as traditional lecture classes for student learning and may have other benefits associated with their use in higher education.

Implications for Education

This study identifies both pedagogy and engineering education implications for the use of an interactive video class (distance learning), a web-assisted class and a streaming video class versus a standard lecture class. Considering the dynamic state of educational technology, sustainable results from this study illustrate the following:

- Web-assisted classes were used successfully to teach undergraduate engineering students both Mechanics I and Basic Strength of Materials concepts. This study also shows the promise for broader educational applications.
- Interactive video and web-assisted educational formats were successfully used to teach Mechanics I and Strength of Materials to undergraduate engineering students. Student learning is not negatively affected by the use of technology and some types of students actually prefer the use of educational technology to a lecture only instructional format. This study shows the promise for broader educational applications.
- The production of a streaming video course was challenging. The interactive nature of instructors solving problems during the class presentation presented a unique challenge to the video production team. During year two, these challenges were met by the purchase of new equipment to capture this dynamic nature of the course. Special equipment may be needed to produce high quality course material to be displayed via the web.

- If educational technology enables students to become engaged and interested in the material, their course performance increases. Students enjoyed the freedom streaming video and web-based course materials gave them to view these materials at their convenience. This led to higher levels of student contact time with the course materials.
- The production and delivery of technologically enhanced courses consume a considerable amount of technological, financial and human resources. These resources need to be available for a project to be successful.

Conclusion

In conclusion, this study provides promising evidence that internet and web-assisted technologies can be utilized to enhance the learning process. Since the number of courses and students was small for statistical analysis, no definite conclusions can be drawn from the first two years' research. We did observe a significant difference in student performance based on learning styles and different types of educational technology used in the classes. The web-assisted classes improved overall student satisfaction and increased students' belief that they could learn the course material. The students also performed better in the web-assisted class relative to the standard lecture course. The other educational technologies utilized (streaming video and interactive video) did not impede students' learning and could be used to supplement the standard lecture hall instructional format. Creating high quality streaming video and web-based materials required special technical expertise and instructional skill.

Year Three Activities (September 2001-August 2002)

Using the same research design, we are continuing with a second year of the Basic Strength of Materials classes. The lessons learned during the first two years of educational research will be incorporated into the web-assisted course and the course presentation materials. The web-assisted course is being revised. It will have less word-only pages and new flash presentation of engineering concepts and examples. Some of the presentation materials used by all instructors will be modified to increase students' comprehension. Data collection is occurring during spring quarter 2002.

After this data has been collected, the results from the Mechanics I course and the Basic Strength of Materials course will be analyzed separately. All freshmen engineering students take Mechanics I while a select group of sophomores are required to enroll in the Basic Strength of Materials course. Does this difference in age and college experience effect students' reactions to the educational technologies studied in this project? We will use these data to address this additional research question.

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