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Utilizing New Instructional Technologies to Optimize the Learning Process

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Abstract

The goal of this project, funded by a grant from the General Electric Fund, is to determine whether using new instructional technologies to optimize the learning process for students with different learning styles and personality types. This paper presents the progress made toward this goal in the first year of a three-year project.

The student learning styles and personality types were measured and compared to student performance in four sections of a single class (Mechanics I) taught using three different instructional technologies: two interactive video classes, (a local and a remote site), a web-based class and a streaming video class. A standard lecture class was used as the control class.

All classes received in-person instruction which varied depending on the specific instructional technology used in that class. The traditional class and the interactive video classes were standard lectures. Students in the web-based class and the streaming video class were required to preview the Mechanics I course material prior to the class. The instructor's role changed from the traditional lecturer to that of mentor; he reviewed difficult concepts, answered questions, worked problems and gave practical examples.

Two widely accepted instruments were chosen to provide information on how students learn: The Myers-Briggs Type Indicator (MBTI) and the Learning Style Inventory (LSI). A statistical analysis was used to assess student learning based on MBTI types and LSI in the control class and each of the three technology classes. We examined how various personality types and learning styles perform within a specific class, how various personality types and learning styles perform across all four instructional formats; and how student interest in the class or instructional technology affects his/her grades.

There were 200 students enrolled in the five classes, a relatively small sample for statistical analysis. Data acquired during the next two years will significantly increase confidence in the results. Significant differences were found between the web-based and streaming video classes as well as the web-based and traditional classes. Analysis revealed that different thinking types

(MBTI types) played an important role in grade performance, while instructional technology did not have a significant influence on the grades. The small sample size resulted in an inability to detect the role that LSI learning styles may have on student performance in a specific technology class.

I. Introduction

Many colleges and universities are using the new instructional technologies, such as streaming video, the internet (web) and interactive video, to deliver educational material to students. These new technologies are very impressive and portend the future direction of higher education. Although the technologies are becoming widely used, no one has measured their effect on student learning. No one has measured how different learning styles and personality types affect how students respond to the new technologies. 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 instructional technologies to optimize the learning process for students with different learning styles and personality types. This paper reports on the first year of a three-year program.

II. Description of the Program

To achieve the goal of this project, we evaluated student learning styles and personality types and compared them to student performance in each of the instructional technologies. We will attempt to answer such questions as: does a particular learning style perform best in a web-based course? What type of personality performs best in a web-based course? This project will address these questions (and many more) for each of the instructional technologies and a standard lecture course.

To answer these questions, we measured student learning styles using the "Learning Style Inventory (LSI)" and the personality types using "Myers-Briggs Type Indicator (MBTI)" instruments.

Three instructional technology based courses are being evaluated:

- interactive video: distance learning – in partnership with Wright State University, (WSU)
- web-based course
- streaming video course

The actual instructional technology evaluation took place during the spring quarter, 2000.

The control class is the standard "chalk and talk" class. The student learning in this class was measured and used as a "control" class. The interactive video class was held both at UC and WSU. Students in the interactive video class were able to interact with the instructor during the class sessions. In both the web-based course and the streaming video course, the students were directed to view the next day'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. Based on this educational plan for the web-based course and the streaming video course, both classes were produced during the winter quarter, 2000.

The faculty participants were carefully selected, based on excellent teaching records and experience in teaching Mechanics I. The faculty received extensive video training for the project by the College Conservatory of Music, Electronic Media Division faculty. A series of workshops, including pilot video productions, was held to prepare the faculty for video-based class work. The workshops covered such topics as:

Understanding the audience
Vocabulary
Dress for success on video
Effective movement in front of cameras
Aspect ratios
Illusion of depth
Audio considerations
Video communications
Message design
Watching for feedback
Preproduction planning
Acquisition of visual images
Talking to the camera/audience
Considerations in the video production
Planning a lecture for streaming video
Delivering a lecture using streaming video
Post production of streaming video

Detailed course planning was conducted by the Mechanics Coordinating Committee. This planning was done in the autumn quarter in order to produce the streaming video class and the web-based class in the winter quarter, 2000. In the spring quarter, all five classes were synchronized to be taught at the same time, used the same text, followed a detailed day-by-day curriculum and took the same quizzes and the same final examination. Both the MBTI and the LSI were administered to all Mechanics I students in the first class session.

Quiz solutions were provided for the Teaching Assistants by the faculty. In each quiz, to avoid grading bias, each problem was graded by an individual Teaching Assistant (TA). For example, one TA graded the first problem on all 200 quiz papers, another TA graded the second problem on all 200 quiz papers, etc. This was to insure consistent partial credit for all students. The instructors met every week during the spring quarter to insure the detailed coordination of all five Mechanics I classes.

Student "satisfaction surveys" were conducted every two weeks in all five Mechanics I classes during the spring quarter. The surveys were designed to help quantify student satisfaction and acceptance of the various technologies and to determine if these instructional technologies resonated with a particular student learning style or personality type.

The project and the Mechanics I classes were tightly controlled in order to achieve the best possible results for this project.

III. Project Goals

The goal of this educational research project is to improve engineering education and optimize student learning by matching student learning styles and personality types with the new instructional technologies. An extensive literature review leads us to believe that this type of research has not been done before. Thus, for the results of this project, we plan to answer such questions as:

- What type of learning style (and/or personality type) is most effective in each of the four different instructional formats?
- What type of learning style (and/or personality type) is least effective in the four different instructional formats?
- How do various personality types and learning styles perform within a specific technology class?
- How do various personality types and learning styles perform across all four instructional formats?
- How can the instructional technologies be utilized to improve and optimize student learning?

IV. Results of the LSI and MBTI Inventories

Both inventories were given in the first class session for the Mechanics I classes. Table I shows results of the LSI evaluation. The learning styles of the UC students are consistent with national norms. The MBTI showed similar results.

Table 1
Comparison of UC Students Learning Styles
with National Averages

	CE	AC	AC-CE	RO	AE	AE-RO
UC	22.3	34.4	12.1	28.9	34.1	5.2
National	23.2	32.4	9.2	29.0	35.6	5.5

V. Results of the Student Satisfaction Surveys

Students were asked to respond to a variety of questions using a modified Likert scale of 1-5, with 1 being *"strongly disagree"* to 5 being *"strongly agree."*

The results of this survey showed that the use of instructional technology helps the students to stay engaged in the Mechanics I classes. The web-based class proved to be very engaging (3.5 on Likert scale) compared to the traditional class (1.7 on Likert scale.) When asked about the effectiveness of the instructional technologies in learning Mechanics I the web-based course scored a 4.4 on the Likert scale compared to the traditional class score of 3.4.

The results of the student satisfaction surveys illustrate the strong preference students demonstrated for the web-based instructional technology. Survey results indicate that the web-based course, coupled with a dynamic in-class presentation, is an effective, engaging technology. Results of this survey suggest that a web-based course, enhanced with an in-person lecture, is a significant enhancement over the traditional setting. The other instructional technologies were not viewed as being more effective than a traditional class by the students. Some additional results of the student surveys:

- Results of the various evaluations indicate the students' acceptance of the web-based technology as an enhancement to regular classroom instruction. The surveys reflect the student view that this is an appropriate method for teaching Mechanics I and is more engaging than traditional teaching and more effective than traditional teaching alone.

- Students were neutral on the effectiveness of streaming video for Mechanics I. In general they felt a traditional setting would be more effective. Students did appreciate having the materials available at their convenience – anytime and anywhere.

- Interactive Video - Results of the evaluations indicate that the students are fairly neutral on the effectiveness of interactive video compared with the traditional classroom setting.

- Overall, students had a slight preference for a traditional setting compared with the interactive video format.

- Interaction between the local and remote classroom sites was not a significant issue. In general, students felt that the interaction with the instructor at the remote site was slightly better than neutral while interaction with remote students was neutral to slightly less than neutral.

- Using interactive video did not lessen the clarity of the presentation for these students. Problem sessions were effective using the interactive video format.

VI. Statistical Analysis of Student Performance

The statistical analysis of the data examined the role of instructional format, LSI learning styles and MBTI personality types on student performance. Analyses were also conducted on the student satisfaction surveys that addressed the quality and effectiveness of their Mechanics I classroom experiences.

In general, the statistical analysis consisted of the use of three basic statistical methods: analysis of variance, Dunnett C and a two-way analysis of variance. The specific analysis examined:

- effect of instructional technology in student performance
- role of personality type on student performance
- role of learning styles in student performance
- predictions of student performance
- student performance within each instructional format
- course evaluations and student performance

Although there were almost 200 students who were initially enrolled in the five Mechanics I classes, the usable set of data consisted of approximately 170 students. This is not really sufficient data to draw firm conclusions and articulate results. The two additional years of the program will hopefully yield sufficient data to produce meaningful results.

VII. First Year Observations Based on the Statistical Analysis

The following observations are the result of the statistical analysis of the first year's data.

Although there were almost 200 students (with 170 usable data sets) in the Mechanics I courses in the spring quarter, this is a relatively small sample for a statistical analysis. Data that will be acquired during the next two years will significantly increase confidence in the results, as well as reveal relationships that may currently be undetectable.

The performance of students was examined with respect to the personality types that reflect different thinking styles (ST, SF, NF and NT). Analyses revealed that different thinking types played an important role in grade performance. Significant differences were also found between the matter-of-fact thinking types (ST) and the enthusiastic and insightful types (NF), with the ST's obtaining significantly higher scores than the NF students. The type of instructional session they attended did not appear to influence the performance of students with different personalities.

Data analysis of students with different perception and orientation styles (SJ, SP, NP, NJ) revealed that these personality types played an important role in grade performance. Additional analysis indicated significant performance differences between the realistic decision makers (SJ) and both the adaptable realists (SP) and the adaptable innovator (NP). The SJs obtained significantly higher total grades than the NP or SP students.

The small sample size resulted in an inability to detect the role that LSI learning styles may have on student performance in a specific technology class. The analysis revealed that the type of LSI learning style of students did not play an important role in the total grade performance of the students.

Analyses of student performance within each instructional section revealed no differences in the performance with different personality styles. However, analyses revealed differences between the performance of students with different learning styles in the streaming media section. Students with converging learning styles (CNV) performed better than students with accommodating learning styles (ACC) in this classroom.

An examination of course evaluations and student performance revealed that students who rated the material as interesting and engaging performed better than students who did not. Similarly, students who felt that the material was effectively presented and that the classroom provided an effective learning environment performed better than students who did not. Finally, students who felt that, in general, the course was a success performed better than students who felt the course was not a success.

What did we learn?

The student learning styles were relatively consistent with known averages. The MBTI data are also fairly consistent with national trends for engineers. Thus, the student body appears to be representative of engineering students around the country. The data base is small for the statistical analysis. No definite conclusions can be drawn for the first year's research, but we were able to make some observations.

We did not observe a significant difference in student performance based on learning styles and different instructional technology classes. The technology driven classes improved student engagement in the lecture material. The streaming video class required special technical expertise and instructional skill.

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