Evaluation of Learning Styles and Instructional Technologies

Eugene Rutz, Virginia Elkins, Catherine Rafter, Ali Houshmand, Roy Eckart
University of Cincinnati

Abstract

The paper describes the initial efforts of a project to evaluate the impact of various instructional technologies on student learning, and to determine if there is a correlation between learning styles of individual students and the efficacy of specific instructional technologies. The project will use basic engineering science courses (Engineering Mechanics and Basic Strength of Materials) as a platform for evaluating the technologies and their impact on learning. Both courses include multiple sections with rather large student populations. The project is being conducted in the College of Engineering at the University of Cincinnati, in cooperation with Wright State University, with support from the GE Fund.

I. Introduction

Basic engineering science courses are the foundation of an engineering education in that students begin to learn how to apply basic science concepts to engineering problems. The knowledge and problem solving skills the students gain is a crucial step in their engineering education and ultimately their professional expertise. As critical as these courses are, they are rarely taught by the most accomplished teaching faculty, and at some colleges are regularly assigned to graduate teaching assistants. This project will re-engage instructors recognized for their teaching skills in the preparation and presentation of basic curriculum material and in its delivery, using technologies that hold the promise of enhancing student learning.

There is a prevalent assumption that computer-aided instruction can improve student learning by accommodating students' learning styles. However, little practical research has been reported on the learning styles of engineering students or the evaluation of instructional technology that is effective for a particular learning style. This project seeks to fill the gap by providing an assessment of learning styles of engineering students and the impact of various instructional technologies on student learning. By the end of the study, we will be able to determine whether or not there is a correlation between a student's learning style and his/her response to a particular instructional technology.

II. Project Description

The GE Fund will support a three-year project that seeks to improve student learning in basic engineering science courses. The goal of the project is to optimize student learning through use of educational technologies that are commonly used. The basic steps in the project are:

- Train faculty in educational technologies and project goals
- Assess student learning styles

- Evaluate effectiveness of individual educational technologies with respect to learning styles and mastery of course content
- Optimize use of educational technologies based on evaluation of individual technologies
- Test optimized design on second set of courses
- Evaluate project and document results

Student learning styles will be measured by using two instruments: the Myers-Briggs Type Indicator, and the Learning Style Inventory developed by Kolb. Learning styles of the participating students will be assessed during the first week of classes.

Educational technologies being evaluated in the first project year are interactive video, streaming video, and web-based instruction. A traditional classroom lecture section will be included as the control section. During the first year, Engineering Mechanics I will be used to perform the study. A common curriculum and a common set of presentation materials will be used in each of the four sections. Faculty participating in the project will be trained in the effective use of the particular technology.

Analysis of the results from year one will be performed to determine which technologies are effective. During the second project year, additional sections of Engineering Mechanics I classes will be taught using a combination of educational technologies. One section, the control group, will use a traditional classroom lecture format. Learning styles will be evaluated and the impact of the combined-technology course on student performance will be tested.

Also during the second project year, the same procedure will be applied to a second engineering science course – Basic Strength of Materials. This will determine the repeatability of the first year findings. Lessons learned from the Engineering Mechanics I course will be applied in the implementation of the study to the course on Strength of Materials.

During the third project year, the process of presenting the course using a combination of technologies will be applied to two sections of Basic Strength of Materials, with a third section, presented as a traditional class, acting as a control group. At the completion of the third year, a comprehensive report will be prepared documenting the findings, including lessons learned and recommendations for improving student learning.

III. Learning Style Assessment

A number of studies have indicated that personality, experience, and preference for how information is received contribute to differences in how individuals learn. These differences in learning styles challenge an educational system that assumes everyone learns equally well in a classroom lecture setting.

To determine the preferential learning styles of students participating in this project, two instruments are being used, the Myers-Briggs Type Indicator [1] (MBTI) and the Learning Style Inventory [2] (LSI) developed by David Kolb. These two instruments were selected for several reasons. First, the two instruments have been used widely and there is a readily available database of previous research. Past reports, however, have not been conclusive in matching learning styles with delivery methods. This study will add to the body of knowledge and provide recommendations from correlations that may emerge. Second, these are very different instruments: the MBTI is a personality indicator and the Kolb Learning Style Indicator is based on a cycle of learning. Kolb's method describes four different learning modes: concrete experience, reflective observation, abstract conceptualization, and active experimentation. These are illustrated in Figure 1.

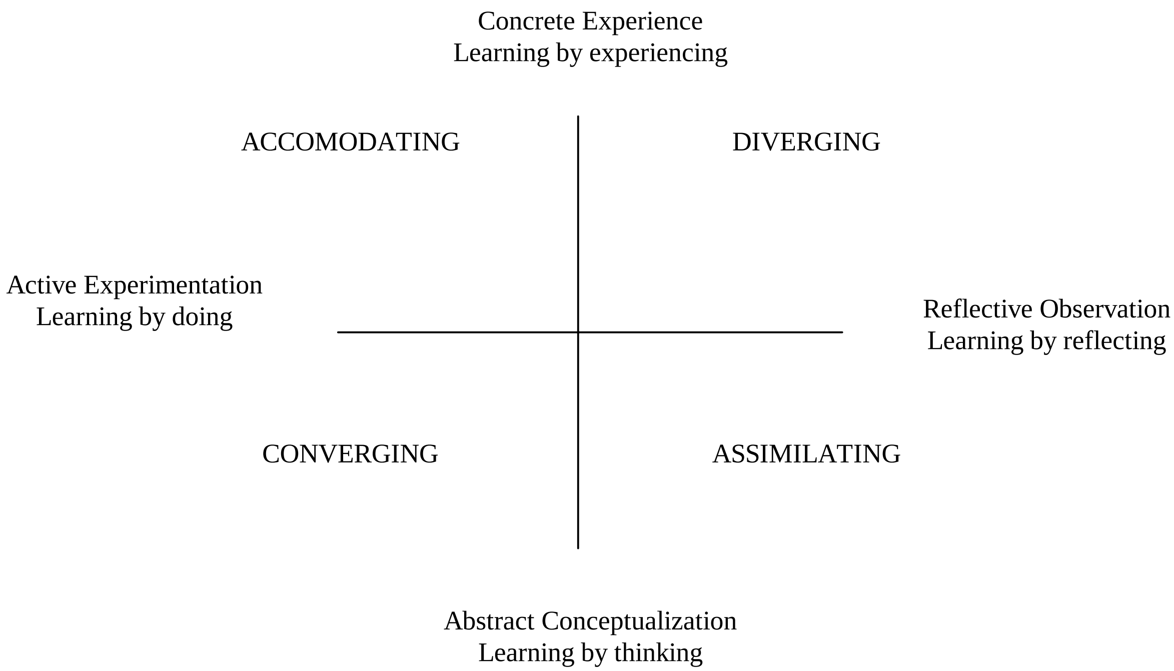

Figure 1 Kolb's Model of Learning Styles

In addition to the learning modes, Kolb describes four learning style types:

1. Diverging – combines learning modes of Reflective Observation and Concrete Experience
2. Assimilating – combines learning modes of Abstract Conceptualization and Reflective Observation
3. Converging – combines learning modes of Active Experimentation and Abstract Conceptualization
4. Accommodating – combines learning modes of Concrete Experience and Active Experimentation

The MBTI contains four different indices that describe the preferences individuals demonstrate for perceiving and judging. These indices are:

- Extraversion or Introversion (EI)

- Sensing or Intuition (SN)
- Thinking or Feeling (TF)
- Judgment or Perception (JP)

Individuals prefer one aspect of each index to the other, resulting in sixteen distinct MBTI types. Based on the type, individuals typically develop greater skills in the processes they prefer and with the attitudes they prefer to use these processes. One manifestation of these different MBTI types is in motivation to learn and acceptance of specific teaching styles.

The project uses the MBTI and the LSI to categorize students' preferences for learning. Analysis of the project results will include an assessment of the correlation between the various educational technologies and the performance of the students with various learning styles.

IV. Initial Evaluation of Student Learning Styles

To gain experience with the evaluation instruments and to accumulate a base of knowledge on learning styles of engineering students, the MBTI and LSI were administered to students in Mechanics I classes in the Fall and Winter quarters of the '99 – '00 school year. A total of 190 students from the University of Cincinnati and Wright State University are included in this group.

The results of the MBTI assessment are listed in Table 1. The percentage of students with each specific type is listed. Also listed (in parentheses) is the percentage of the US population that indicates the preference for the MBTI type.

Table 1 Results of Preliminary MBTI Assessment

ISTJ 15.3 % (11.6%)	ISFJ 5.3% (13.8%)	INFJ 3.2% (1.5%)	INTJ 5.8% (2.1%)
ISTP 6.3% (5.4%)	ISFP 4.2% (8.8%)	INFP 6.3% (4.4%)	INTP 12.6% (3.3%)
ESTP 3.7% (4.5%)	ESFP 1.6% (8.5%)	ENFP 13.7% (8.1%)	ENTP 4.2% (3.2%)
ESTJ 3.7% (8.7%)	ESFJ 3.2% (12.3%)	ENFJ 4.7% (2.5%)	ENTJ 6.3% (1.8%)

The preliminary results listed in Table 1 provide an indication that a variety of MBTI types are attracted to engineering. The ISTJ, ENFP, and INTP accounted for the largest groupings of this initial sample. These results are fairly consistent with a study reported in Myers and McCaulley[3] that indicates the –N-J, I-J, and IN-P styles have the highest preference for engineering.

The initial results of the LSI from the testing in the Mechanics I classes are outlined in Figure 2.

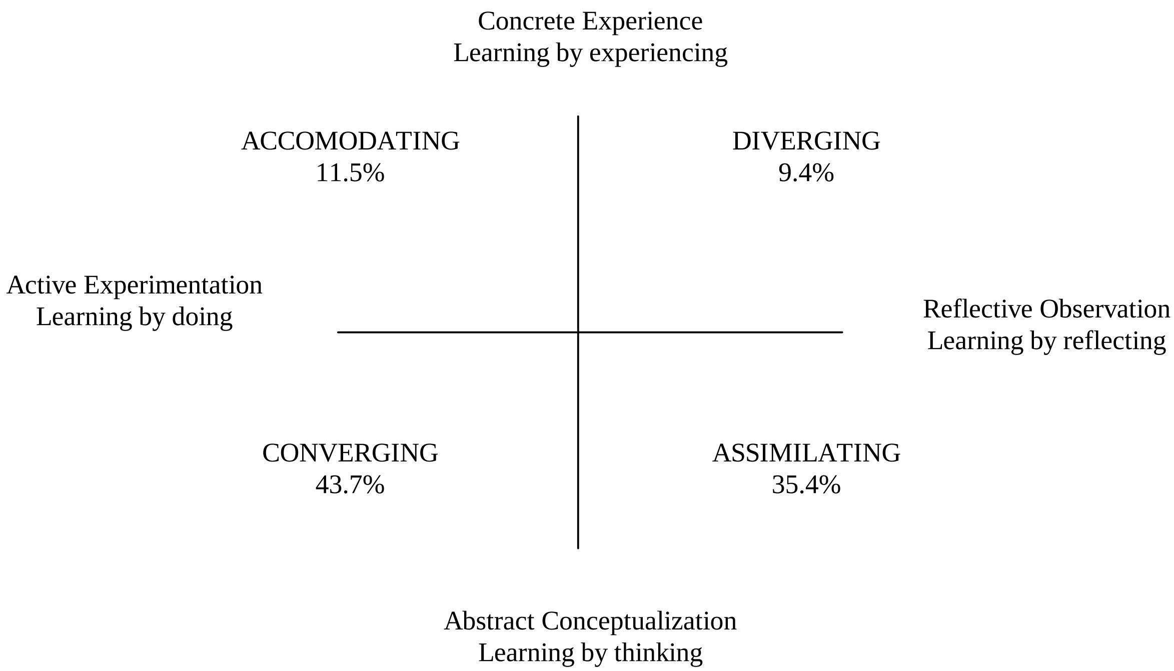

Figure 2 Results of Preliminary LSI Assessment

These first results seem to indicate that these engineering students have preferences for using the converger or assimilator learning styles when faced with traditional lecture models. The spring sections will provide an opportunity to observe how different learning styles function with different delivery methods.

V. Work in Progress

The faculty participating in the project are currently developing a set of common presentation materials to be used in all sections of the Engineering Mechanics I course to be taught during the Spring quarter. While individual faculty will not be limited solely to the common presentation materials, using the same material in all four sections should minimize differences in content presented to students.

Instructors are currently receiving training in effective use of technology for instruction. Members of the Electronic Media faculty who are expert in the various technologies are providing workshops to the participating instructors and their graduate assistants.

Bibliography

1. Myers, I.B. and McCaulley, M.H. *Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator*. Palo Alto, CA: Consulting Psychologists Press, 1986.
2. Kolb, D.A. *Experiential Learning: Experience as the Source of Learning and Development*. Englewoods Cliffs, NJ: Prentice Hall, 1984.
3. Myers, I.B. and McCaulley, M.H. *Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator*. pp. 115-118. Palo Alto, CA: Consulting Psychologists Press, 1986.

EUGENE RUTZ
Eugene Rutz is Director of Engineering Professional Development and Distance Learning in the College of Engineering at the University of Cincinnati. Mr. Rutz is a registered Professional Engineer with experience in mechanical design, testing and analysis, project management and teaching. He received his B.S. in Nuclear Engineering in 1982 and an M.S. in Mechanical Engineering in 1987 from the University of Cincinnati.

VIRGINIA ELKINS
Virginia Elkins is Assistant Dean in the College of Evening and Continuing Education. Her background includes research in learning styles and life span development.

CATHERINE RAFTER
Catherine Rafter is Assistant to the Dean in the College of Engineering. She holds Master's degrees in Art History and in Counseling from the University of Cincinnati.

ALI HOUSHMAND
Ali Houshmand is Associate Professor of Industrial Engineering and Director of Student Assessment. He is also responsible for ABET 2000 in the College of Engineering. He earned his Ph.D. at the University of Michigan, and specializes in Applied Statistics, Quality Control, Design and Management.

ROY ECKART
Roy Eckart is Associate Dean for Academic and Administrative Affairs and Professor of Nuclear Engineering. Dr. Eckart received an M.E. from Stevens Institute of Technology in 1956, an M.S. from the University of Cincinnati in 1964, and his Ph.D. from the University of Cincinnati, 1971.