AC 2008-612: MEASURING STUDENT PERCEPTIONS OF CASE-BASED INSTRUCTION IN AN ENGINEERING COURSE

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Measuring Student Perceptions of Case-based Instruction in an Engineering Course

Abstract

One method that has been used as an alternative to the lecture based method of instruction and has produced positive results in the classroom is case-based instruction. Case-based instruction is an instructional technique that has been hypothesized to teach students to learn skills necessary for success as an engineer in the field.[1] The current study focuses on comparing the case-based method of instruction and the lecture based method of instruction in a more uniform way that will allow future researchers to understand the impact of case-based instruction on student learning.

Introduction

In today's typical science undergraduate courses, professors use a lecture style of teaching that concentrates on memorization and recall of material. This approach emphasizes declarative knowledge rather than procedural knowledge.[1] A lecture style format also frequently leads to reductions in student attention and engagement, which results in lower attendance (between 50 to 65 percent) and information retention (typically about 10%).[2] This means that students are not motivated to come to class nor are they retaining information from classrooms that emphasize declarative learning, memorization and recall.[2, 3.] When there is an emphasis on memorization and not application or content understanding, retention of students within the math and science based majors becomes problematic.[4]

Recently, the engineering field has begun to incorporate learner-context teaching such as case-based instruction and other problem based learning methods in the classroom**.** Since World War II, many educational reforms have been made in the field of engineering based on the idea that understanding concepts in a meaningful context and understanding the science behind the techniques learned in laboratories was an essential part of student learning. More recently, various reports (e.g., *Engineering Education for a Changing World; Engineering Education: Designing an Adaptive System; Restructuring Engineering Education: A focus on Change; Shaping the Future; Transforming Undergraduate Education in Science, Math, Engineering, and Technology; Reinventing Undergraduate Education*) have called for a curriculum that is student centered and teaches problem solving, leadership, ethics, communication, and cooperation in teams.[8] One way to incorporate learner-centered methodologies is through the use of case studies to help students develop better conceptual understanding and critical thinking skills.

Case-based instruction is an instructional technique that has been hypothesized to increase students' critical thinking skills by allowing faculty to provide opportunities for students to engage in active learning. Case-based instruction has the potential to help students better succeed in the "real world" of practice by embedding the engineering problems in authentic and realistic context. Case-based instruction has only recently been implemented in the engineering disciplines, but has a long and effective history in the business, law, and medical fields. [2, 6] The implementation of case learning allows for the integration of multiple sources to create an

authentic learning environment where students grapple with the ethical and societal problems within their fields.[4] Cases also allow students to engage in discussions, develop team work skills, problem solving skills, reflective thinking skills, and also gives them a meaningful and conceptual understanding of the topic.[1,4,6,7] Thus, case-based instruction gives students a better understanding of the material presented and allows them to have a smoother transition to the work force by allowing students to learn to apply material rather than memorize it.[5,7]

Overall, case-based instruction has been used in numerous ways in the engineering field with encouraging results.[9] However, using case-based instruction is a technique that requires more effort and more research in the engineering field. Specifically, the implementation of cases and the perceptions of students about this approach is an area where more research should focus. The current research attempted to look at student perspectives on case-based instruction and lecture based instruction. Specifically, this study addressed the following research questions: 1) Do students feel that case studies or lecture helps them to make more gains in terms of conceptual understanding, confidence, realism and connection to other topics, and appreciation and enthusiasm for the subject; and 2) Do students prefer one approach over the other?

Method

Participants

Participants included 60 undergraduates enrolled in a large Midwestern University enrolled in a mechanical engineering course. Participants' age ranged from 20 to 22 years old with six juniors and 54 seniors. Participants included 12 females and 43 males (five participants chose not to respond to the gender demographic question). The course was required for 58 of the participants.

Materials and Procedures

The survey was adapted from the Student Assessment of Learning Gains (SALG) survey (available free via Wisconsin Center for Education Research at http://www.wcer.wisc.edu/salgains/student/default.asp). The survey asked students whether the lesson helped them to make gains in conceptual understanding (e.g., "I made gains in understanding the main concepts"), appreciation and enthusiasm for the subject (e.g., "I made gains in enthusiasm for the subject"), relevance to the real world (e.g., "I made gains in understanding the relevance of this field to real world issues"), and problem solving abilities (e.g., "I made gains in the ability to think through a problem or argument"). Students responded using a Likert-type point scale ("not at all," "a little," "somewhat," "a lot," or "a great deal").

Four different topics were taught using either the lecture or case studies. Two topics (e.g., bode plots and thermal systems) were exclusively taught using the lecture method, while the remaining two topics (e.g., hydraulics and electro-mechanical) were exclusively taught using case studies. After each topic was covered using either the lecture method or the case study method, students anonymously completed the survey.

Results

Survey results suggested that students felt the case study approach helped them to make greater gains in understanding how ideas in the class related to those in other engineering classes, 47.66% of people reported that they made a lot or a great deal of gains when using cases studies and 30.69% of people reported that they made a lot or a great deal of gains when using the lecture style. Similarly, students felt they made greater gains in understanding the relevance of the field to real world issues when using case studies (63.55%) as opposed to lecture (33.66%). Students also felt they made greater gains in appreciating the field while using cases (52.83%) as opposed to lecture (29.70%). Students also felt they made greater gains in enthusiasm for the subject when using case studies (34.91%) as opposed to lecture (22.77%).

However, students preferred lecture when it came to making gains in the ability to think through a problem or argument (39.6%) as opposed to case studies (33.64%). Also, students felt lecture was more successful in helping them feel more comfortable with complex ideas (33.66%) as opposed to case studies (24.53%). Students felt that there was no real difference between the two approaches on their confidence in their ability to do in engineering field (case=27.1%; lecture=28.71%), understanding the main concepts (case=47.67%; lecture=46.53%) and understanding the relationship between concepts (case=44.86%; lecture=42.57%).

Discussion

The findings suggest that students had mixed feelings about case-based instruction when implemented in a course that is primarily lecture based. Students preferred case studies because they increased understanding of engineering and multidisciplinary concepts, while also helping to add realism to the class. Students also felt case studies helped to prepare them for their future careers, which is similar to the findings of other relevant research.[1,4,6,7] This was expected because the purpose of case-based instruction is to allow students to engage in discussions and develop team work skills, problem solving skills, reflective thinking skills, and a meaningful and conceptual understanding of the topic.[1,4, 6, 7] Similarly, cases have been assumed to allow students to have a smoother transition to the work force from college by allowing students to learn to apply material rather than memorize it.[5, 7] On the other hand, students preferred the lecture method in order to help them understand course concepts and complex topics. This may be due to the fact that lecture specifically states what material needs to be learned, while case studies are more subtle and students often feel that there is no “right” answer.[9, 10] The majority of the students had not experienced case studies before; hence, their unfamiliarity with the case teaching method could be hypothesized for their mixed feelings towards this approach.

The results reported in this paper are limited in that student perceptions of the teaching methodology were reported, and no measures were used to assess actual learning gains. While these results say that students prefer case-based instruction to gain certain skills, there is not insight into why this may be the case. Furthermore, this was a survey used in one mechanical engineering course, which means the results may be hard to generalize to other engineering courses. Further research needs to be done to truly understand case-based instruction and to

understand the relationship between case-based instruction and lecture based instruction. Specifically, more research needs to be conducted to examine the influence of case-based instruction on students' learning and conceptual understanding by using actual measures of learning. Furthermore, research needs to also examine how students' preference for a particular teaching method coincides with their actual learning from that teaching method.

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