Abstract

From:

<https://engineering.purdue.edu/ENE/Research/Seminars/Open-EndedProblemSolvinginEngineering>

Open-ended problem solving is a skill that is central to engineering practice. As a consequence, developing skills in solving such problems is imperative for engineering graduates. Open-ended problems are often ill-defined and can have more than one viable solution, which can create additional challenges for students and teachers. For example, solving open-ended problems can require consideration of a complex array of constraints, and the paths to a solution are many. This presentation presents results from a mixed methods project to understand open-ended problem solving of engineering undergraduate students. The overall goal of this project is to describe and understand the contributions of reflective judgment (i.e., students’ views of knowledge) and their cognitive ability (i.e., working memory capacity), when solving open-ended problems. We are particularly interested in specific problem-solving strategies undergraduate engineering students use when dealing with the ambiguity of open-ended problems.

Data were collected using a multi-stage process. Students were first given a set of quantitative instruments that measured their engineering content knowledge, epistemic views on knowledge, and working memory capacity. In the second stage students were asked to solve four problems that differed in their open-endedness and complexity; students were provided a text to use as a resource while solving the problems. Some of these students solved the problems using a think aloud protocol in which they were videotaped while speaking aloud about the strategies they were using. These students were subsequently interviewed to gain further information on their problem-solving processes. A number of insights regarding problem-solving by students have been obtained. For example, there was a significant negative correlation between time spent on the text and score on the problems. From the qualitative data three primary problem-solving strategies were identified: extreme fixation/distraction; fixated and uncertain; systematic and linear. Overall, the results indicate the importance of educating students in how to solve engineering problems that are complex and open-ended.

Bio

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Dr. Elliot P. Douglas is Associate Chair, Associate Professor, and Distinguished Teaching Scholar in the Department of Materials Science and Engineering at the University of Florida. His research activities are in the areas of active learning, problem solving, critical thinking, and use of qualitative methodologies in engineering education. Specifically, he has published and presented work on the use of guided inquiry as an active learning technique for engineering; how critical thinking is used in practice by students; and how different epistemological stances are enacted in engineering education research. He has been involved in faculty development activities since 1998, through the ExCEEd Teaching Workshops of the American Society of Civil Engineers, the Essential Teaching Seminars of the American Society of Mechanical Engineers, and the US National Science Foundation-sponsored SUCCEED Coalition. He has received several awards for his work, including the Presidential Early Career Award for Scientists and Engineers, the Ralph Teetor Education Award from the Society of Automotive Engineers, and being named the University of Florida Teacher of the Year for 2003-04. He is a member of the American Society for Engineering Education and the American Educational Research Association and is currently Editor-in-Chief of Polymer Reviews.

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