Application of Interactive Learning Tools in Construction Engineering Course

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In a Construction Engineering program at Texas A&M University – Commerce, the Engineering Mechanics course, which includes traditional Statics and Dynamics subjects, is a gateway course for engineering students. The students are required to take this course in their first semester of sophomore year and it is often found to be the most challenging course because students find its concepts difficult to grasp. This results in a low retention rate from sophomore year to junior year. The main objective of this research is to develop interactive learning tools to promote students' active learning of key concepts taught in an Engineering Mechanics class. The authors expect the developed tools will encourage students' participation in application of the concepts in given examples and to improve retention rates of students from sophomore to junior year. Initially, three interactive tools were developed for three example problems: (1) a statically determinate truss problem, (2) a statically determinate beam problem, and (3) a Dynamics problem involving pulleys. Each example problem is modeled in SolidWorks including a parametric design capability. Unfortunately, unanticipated issues were found at the last minute with the pulley model. Therefore, only the first two interactive tools were used in this research.

To evaluate the effectiveness of the interactive learning tools, participants were provided with the SolidWorks models, written instructions of what parameters the participants could modify, and how they could accomplish modifications they desired. A session for one example typically lasted 10 to 15 minutes. At the beginning of the session, the participants answered pre-experiment survey questions. The pre-experiment survey questions were designed for the authors to gather background information about the participants including questions that would indicate the students' learning types, previous experience and familiarity with calculus and physics, how long it has been since he/she took a calculus-based Physics class, how many hours he/she works outside the school, and other questions aimed at understanding the motivations students had for enrolling in an engineering program. At the end of the session, the participants answered another set of survey questions for the authors to obtain their feedback and comments on easiness of the learning tool to use, modify, and understand, the effectiveness of the learning tool in assisting the students to understand key concepts related to the given problem, and suggestions for improvements that can be made to the tools.

The results show 93% of students found the learning supplement easy to follow and made similar remarks on the usefulness of the step-by-step format used in the written instructions for the tools. On a scale from 1 to 7 (1 being "Completely Disagree" and 7 being "Completely Agree"), the evaluation result was 6.27 out of 7 for a statement of "It was helpful to visually see the deformations in the structures in order to understand how forces affect members." For a statement of "I feel like I have a greater understanding of how these structures react to applied forces," the results was 5.7 out of 7. For a question with a statement "I feel more confident in my ability to answer questions concerning these structures," the result was 5.07 and for the statement " I am more confident in my understanding of the core concepts this learning supplement covered," the result was 5.5 out of 7. Suggestions for improvements that the students provided include the followings: (a) more exposure the program used (SolidWorks) is desirable prior to the use of the learning tools, (b) more "things to do" while interacting with the simulation are necessary, (c) additional examples and/or animations throughout a semester would be helpful to be successful in the engineering mechanics class, and (d) video or teacher lead examples would be preferred rather than written instructions to use the learning tools more efficiently. Based on the survey results and students' comments, it could be concluded that the developed learning supplements were effective in assisting students' learning and motivating their confidence in the concepts.

Keywords: Interactive Learning Tools, Engineering Mechanics, Retention Rates