Work in Progress: Student-Created Multimedia Dynamics Example Problems - A Model-Eliciting Activity

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Abstract

Instructors and publishers alike have begun to explore the benefits of online and multimedia content for enhanced learning in a number of engineering courses. Topics in Dynamics can especially benefit from this medium, where videos and simulations can be used to highlight the time-dependent nature of moving systems. Instead of developing such content ourselves, we decided to create a Model-Eliciting Activity (MEA) in which the students were required to develop multi-media example problems. This work in progress describes the basic objectives of the project and a preliminary assessment of its effectiveness through a thematic analysis of student reports and a student survey. We will discuss what students thought was important in multimedia example problems, show samples of what the students developed, and offer recommendations for implementing this MEA.

Course Information

The Multi-Media MEA developed by the authors was used in an introductory, sophomore level Engineering Dynamics course. The course format is three, 50-minute sessions per week in sections of 35 students. Approximately 30 sections are offered each year, serving over 1000 students of various engineering disciplines with three to five different instructors each quarter. A common final exam is administered to all students taking the class. During the fall quarter of 2008 and the winter of 2009, the authors modified the traditional lecture mode of instruction by using more active learning techniques, including collaborative learning and three opened ended projects based on the MEA concept. Supplemental materials included narrated PowerPoint example problems to be viewed by the students prior to class meetings with an attached video clip. It was in this context that students were asked to develop guidelines for making multi-media example problems and to produce an example of their own. The main goal of this project was to promote a deeper understanding of course materials by requiring them to become experts in the material that they were presenting. It was also hoped that the students would better understand and take greater ownership of their own learning.

Student Created Example Problem as a Model-Eliciting Activity

MEAs are developed according to six basic principles[1,2]. Each of these principles was addressed in the creation of the Multi-Media MEA. To satisfy the *Reality Principle*, a fictitious publishing company was the customer. Student teams were required to write a memo discussing important characteristics of multi-media example problems and create one of their own (*Model Documentation Principle*). Additionally, they wrote guidelines or procedures on how other educators should create their own multimedia examples (*Model Construction Principle*). These guidelines were to be shareable by other teams, and had to be relevant for creating other learning materials (*Generalizability Principle*). By examining their own example problem and those of

other teams, they could decide if their procedure (or model) was sufficient (*Self Assessment Principle*). Finally, the students should gain some understanding of important concepts or ideas that can be used later in their education or careers (*Effective Prototype Principle*). This might be in the form of metacognition by forcing them to think about their own learning, and/or in the Dynamics principles they address in their multimedia examples.

Results

The Multimedia MEA was presented to students in the sixth week of classes. Students worked in teams of four and were given one week to complete the assignment. For the two quarters, the project was completed by 68 teams. During the fall quarter, the teams were free to select any topic relevant to the class, and the majority chose to make an example problem based on particle dynamics. A typical example involved impact of particles with an accompanied student made video of colliding objects such as basketballs. During the second quarter, the students were requested to make examples pertaining to the Dynamics of rigid bodies. A typical example was the modeling of the lower leg kicking a soccer ball with a video. As part of a comprehensive course survey conducted at the end of the quarter, students were asked whether they felt that the project helped them in understanding course material and whether they found the project interesting and motivating. Student feedback for this project was mixed: 36% of students responded that the project helped them understand the Dynamics material, while 30% disagreed. Responses about project motivation had similar results with 39% of students feeling that the project was motivating and 40% disagreeing. Negative reporting tended to mention the extra workload that students did not feel was relevant to dynamics (e.g., PowerPoint difficulties).

In the memo to the fictitious publishing company, the students were asked to list what they though were important characteristics of multimedia example problems. A partial thematic analysis shows a wide variety of responses from the mundane importance of applying correct principles to the more complex requirement that they be “fun.” The table below lists the six most common cited “important” characteristics from the analysis of 27 of the 68 submitted reports.

Important Characteristic of Multi-Media Example Problem	**% Reported**
Effective use of Visuals (Both Video and Figures) for “Visual Learners”	70
The use of a “Real- World” Problem (often cited to make it interesting and fun)	67
Solution should be presented in a linear, systematic or logical fashion	52
Level of complexity or difficulty should be appropriate	41
Notation should be consistent between examples and with text	26
Examples should be “Clear”	26
Advanced or important concepts should be explained verbally and in detail.	26

Conclusions and Future Directions

The analysis of the memorandums was encouraging. It showed that the students had an awareness of what was important in their own and others learning. It was a little disappointing that the students did not find the exercise very motivating or overly valuable for their understanding of Dynamics. A more complete thematic analysis of all submitted work is ongoing. In general the authors found that using this project in conjunction with other MEA’s in

an active-learning based Dynamics course has led to gains by the students in conceptual understanding and on the more procedurally based common final exam.

Bibliography

1. Diefes-Dux et al., “A Framework for Posing Open-Ended Engineering Problems: Model Eliciting Activities,” 34th ASEE/IEEE Frontiers in Education Conference, October 2004.
2. Hamilton, Eric, Richard Lesh, Frank Lester, Michael Brilleslyper. "Model-Eliciting Activities (MEAs) as a Bridge Between Engineering Education Research and Mathematics Education Research." Advances in Engineering Education A Journal of Engineering Education Applications. Summer 2008. American Society for Engineering Education. 10 Feb 2009 <http://advances.asee.org/vol01/issue02/06.cfm>.