A PRELIMINARY ANALYSIS OF THE EFFECTIVENESS OF STUDENT-PRODUCED VIDEOS ON THE RELEVANCE OF MATHEMATICS IN ENGINEERING

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In this paper, we provide a preliminary investigation of how first year engineering students perceive motivational resources produced by higher year students. Final year engineering and multi-media students were tasked to "make mathematics relevant" to first year students enrolled in an engineering mathematics unit through the production of instructional videos. The final year students produced six animated videos. This study is part of the more comprehensive Mathematics Relevance Project. We have previously described collaborations between the engineering and multi-media students (Loch and Lamborn, 2014), as well as how students would demonstrate the relevance of mathematics in engineering and student views on who should produce such resources (Loch and Lamborn, in press). In this paper, we investigate the effectiveness of the videos in demonstrating relevance for first year students and characteristics of motivational videos.

THE MATHEMATICS RELEVANCE PROJECT

The Mathematics Relevance Project was initiated at Swinburne University of Technology to address first year engineering students' disengagement with their mathematical studies. These studies are usually of an abstract nature with a focus on gaining problem solving and arithmetical skills rather than embedding mathematics in engineering contexts. This project has taken a novel approach by engaging higher year engineering students in collaboration with higher year multi-media students in the production of motivational resources for the first year students. The project is currently in its third iteration: In the first round, two engineering and three multi-media students produced two animations showing a range of mathematical concepts applied to the construction of a high-rise building and to the improvement of the aerodynamics of a car[1]. In the second round, three engineering students and three multi-media students produced four animations focusing on one mathematical concept each. In the current iteration, five engineering students, three animation and three film students are producing three animations and a film showing a range of concepts from the mathematics and physics curricula.

Apart from resulting in high quality resources for student viewing, this research project also seeks to identify whether higher year students are capable of producing useful resources, what they gain from this experience and what else could be done to further demonstrate the relevance of mathematics to first year students.

[1] All animations can be accessed as follows: Go to Swinburne Commons at http://www.swinburne.edu.au/commons. Proceed as guest. Search for "relevance". The videos are released under a Creative Commons license: BY, ND, NC

LITERATURE REVIEW

It has been demonstrated that videos are useful in closing the gap between weaker and higher performing students (Murphy & Stewart, 2015). Being actively involved in the production of materials can also develop and affirm student knowledge (Armstrong, Tucker & Massa 2009). Hakkarainen (2011) found that participation in the design of multi-media learning helps students to increase their understanding of subject matter. Tabor & Minch (2013) report that allowing students to explore and create their own learning resources in the form of video enhances students' engagement. Students were reported to achieve higher levels of thinking that came from creating their own learning. In a tertiary mathematics education context, Croft, Duah & Loch (2013) described the benefits for second year students from collaboration with teaching staff to improve a second year mathematics unit and they highlighted the new contributions students made to course material.

Whilst the primary focus for the higher year project students in the current study was not the development of knowledge of the mathematical concepts, the research indicates that these concepts would be reinforced and strengthened through video preparation. We were interested in whether the videos prepared by the fourth year students were useful and engaging for the intended audience.

There is little material on what makes a video engage students' attention and motivation. A search of the literature led to only one study which indicated that duration of the learning materials produced may be important. It has been found that shorter videos can impact on student motivation (Kinnari-Korpeta, 2015).

METHODS

In this paper, we look at how the resources are perceived by the first year students who are the target group of this intervention. We take a first look at addressing the research questions:

- Are the student-created resources effective in demonstrating the relevance of otherwise abstract mathematical concepts?
- What are the characteristics of a motivational multi-media teaching tool?

All students enrolled in Engineering Mathematics 1 were invited to participate in a series of surveys, starting with a general survey at the beginning of semester, five shorter surveys targeting one animation each during the semester, and a final survey with both quantitative and qualitative questions. Of the more than 500 enrolled students, 96 participated in the first survey, with dwindling numbers until the final survey which was completed by 21 students. Responses from these 21 students allow analysis of how student perception of the relevance of all mathematical topics covered in the unit changed over the semester. Overall, 16 students responded to all surveys, providing rich data on how these students compared the animations.

THE EFFECTIVENESS OF STUDENT-CREATED RESOURCES IN DEMONSTRATING THE RELEVANCE OF ABSTRACT MATHEMATICAL CONCEPTS.

Students undertaking this mathematics unit were enrolled in degrees from varied disciplines. The majority of the students completing the survey were studying robotics and mechatronics, civil

engineering and computer systems. Smaller numbers of students were undertaking studies in mechanical engineering, biomedical engineering, product design and science.

The videos produced by the final year students were viewed by the neophytes at high rates, with 90% of respondents stating they had viewed all five of the videos. This is despite the fact that some of the videos were developed in areas outside a first year students' study discipline. Some students were more motivated by videos in their field of study whilst others demonstrated interest in the relevance of mathematics to broader areas of study. When asked which video was the most useful, students made comments such as:

"The construction video was the most useful because it has the most relevance to the course I am studying at the moment."

"I had never really realized how matrices applied to practical work until I saw this video."

When asked if the videos were useful in explaining the relevance of mathematical concepts to future studies, 85% of respondents answered in the affirmative. Furthermore, 76% of respondents reported that the videos were useful in explaining the relevance of mathematical concepts to their future careers. As the videos did not cover all the disciplines of study the students were undertaking, this is a positive result. Asked about attitudinal changes throughout the semester, one student responded:

"Yes, a combination of watching the videos and maths based subjects has changed the way I view the world. I always think of the mathematical concepts behind almost everything I see."

THE CHARACTERISTICS OF A MOTIVATIONAL MULTI-MEDIA TEACHING TOOL.

The videos prepared by the fourth year students were of varying duration. Two were longer (approx. 6 minutes) and three were shorter (approx. 2 minutes). Generally the first year viewers reported that they preferred the shorter videos as they were more engaging. However, there were discrepancies. Whilst some students reported that they preferred shorter, more concise videos as these provided "less chance of zoning out"; others preferred the longer videos because they provided more detailed explanation of the applications of the mathematical concepts. Students were also generally happy for the videos to be longer if they were of specific relevance to their course.

Feedback on the videos revealed that these students are very discerning viewers. This generation of students has been exposed to high quality multi-media through a variety of inputs including the internet, home theatre and live performances. There is an expectation that any graphics presented in multi-media will be of a high quality. This was reflected in comments made by students when completing their final survey.

Respondents were very clear about the characteristics they liked and those they found distracting or less engaging. Particular comment was made of the need to keep the videos modern in outlook and appearance. Narrative of the videos was also deemed to be very important. Students made specific comment if they found the voice-overs were monotone or if they didn't find the voice of the narrator appealing. Humor was the feature of one video. Whilst this was seen as a positive characteristic by some students, others reported that the speaker in this video "wasted time on weak jokes". One student stated that the background music was important, noting that it was missed when not present in all of the video clips.

The content material needs to be concise but, as one student put it, there should be no "glossing over mathematical detail". We suggest striking a balance between mathematical detail and showing the application of the concept to keep the video short. The pace of the material also needs to be considered. It needs to be fast enough to keep interest but at a level which allows viewers to keep up with the concepts presented. As one student put it, the best videos had: *"A balance between interesting scenario, good explanations and relating math concepts to the real world."*

CONCLUSION

In this paper, we have provided a preliminary analysis of first year students' views of the animated videos created for them by higher year students. The students were positive about their ability to gain information from the videos in order to improve their knowledge of the relevance of mathematics to both their future studies and careers. We have also gained a first understanding of students' views of the characteristics of motivational videos.

As a next step, we plan a thorough analysis of the data collected in the seven surveys, including matching student perception of the relevance of individual topics taught in the mathematics unit at the start of the semester with their responses at the end of semester, with particular view to the topics that were covered in the animations.

We know that students expect high quality productions. Further investigation may also include video analysis of the animations created to understand better the characteristics of a good multi-media motivational resource.

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