EEGRC Poster: Using Super Heroes to Relay Biomechanics Principles in Education

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Ana is a PhD candidate and National Science Foundation Graduate Research Fellow in Mechanical Engineering at the University of Delaware. She received her Bachelor of Science degree in Biomedical Engineering at the University of California, Davis. Currently, she studies the mechanics and energetics of walking under varying gait intensities with the intent of contributing to the design and prescription of orthotic and prosthetic devices. Ana was awarded the Graduate Student Teaching Assistant Award in 2016 by her department and is a Teaching Assistant Fellow for the Center for Teaching and Assessment of Learning.

Dr. Jill Higginson, University of Delaware

Dr. Higginson is an Associate Professor in the Departments of Mechanical Engineering and Biomedical Engineering at the University of Delaware. The fundamental objective of her research group is to improve the understanding of muscle coordination for normal and pathological movements through coupled experimental and simulation studies. In recognition of her contributions, Dr. Higginson was awarded the College of Engineering Outstanding Junior Faculty Award in 2014 and the Excellence in Teaching Award in 2015.
Students (n = 16) worked in pairs to prepare the following educational materials to describe a biomechanics concept aimed for high school students:

1. Short educational video uploaded to YouTube® describing biomechanics concept and corresponding in-class learning activity.
2. Lesson Plan with step by step directions for completing corresponding in-class activity (i.e. worksheet, thought problem, demonstration) along with list of materials/costs.

Students were provided an example lesson plan and video based on the ASB K-12 Outreach Expo [2], resources to video editing software, and a grading rubric (Figure 2). The instructor of record graded all projects based on the video and lesson plan submitted using the rubric. Overall, students showed creativity in applying the biomechanical concepts (Figure 3). The instructor of record addressed any misconceptions and errors in the students’ biomechanical analyses in a written comment with the grade. Despite varying projects, average total scores for the topic, video, time, analysis, and cost per the rubric were 9, 9, 10, 9, and 10, respectively. The authors noted loss of points in the clarity of video category was most often due to unclear relevance of the biomechanics concepts to super heroes.

**BACKGROUND**

Recent literature has supported student-centered learning to promote positive learning outcomes and encourages students to take ownership of their learning [1]. There has been a recent push by the American Society of Biomechanics (ASB), as evidenced by the first annual National Biomechanics Day and 2016 K-12 Outreach Expo, to compile and present ‘hands-on’ biomechanics demonstrations and hands-on activities to get K-12 school age students excited about Science, Technology, Engineering, and Mathematics (STEM) by showcasing the field of biomechanics to the general public [2]. In a new class offered by the University of Delaware Mechanical Engineering department entitled the “Biomechanics of Super Heroes”, the authors developed a group project to encourage student-centered learning through the medium of biomechanics and super heroes.

**OBJECTIVES**

The aim of this study was to develop, implement, and evaluate a student-centered learning project for students to create a video and lesson plan that could be used or recreated by high school teachers to describe biomechanics principles through the medium of science fiction and super heroes.

**RESEARCH DESIGN**

Students (n = 16) worked in pairs to prepare the following educational materials to describe a biomechanics concept aimed for high school students:

1. Short educational video uploaded to YouTube® describing biomechanics concept and corresponding in-class learning activity.
2. Lesson Plan with step by step directions for completing corresponding in-class activity (i.e. worksheet, thought problem, demonstration) along with list of materials/costs.

Students were provided an example lesson plan and video based on the ASB K-12 Outreach Expo [2] (Figure 1), resources to video editing software, and a grading rubric (Figure 2). The instructor of record graded all projects based on the video and lesson plan submitted using the rubric.

**RESULTS**

A list of biomechanics concepts and science fiction medium used by students is listed in Table 1. Overall, students showed creativity in applying the biomechanical concepts (Figure 3). The instructor of record addressed any misconceptions and errors in the students’ biomechanical analyses in a written comment with the grade. Despite varying projects, average total scores for the topic, video, lesson, time, analysis, and cost per the rubric were 9, 9, 10, 9, and 10, respectively. The authors noted loss of points in the clarity of video category was most often due to unclear relevance of the biomechanics concepts to super heroes.

**CONCLUSIONS**

Overall, this video project used a student-centered learning strategy and a fun medium of fictional superhero characters to promote outreach education in the STEM curriculum. Students presented creative applications of biomechanical concepts learned in class, which supports one of the ABET student outcomes for students to have “an ability to apply knowledge of mathematics, science, and engineering” [3]. Instructors replicating this project may consider having students submit a storyboard in order to give feedback on the relevance of the biomechanics concepts to super heroes prior to the final submission. Future work may implement these lessons to high school classrooms and assess student outcomes as a result.
Students also completed a peer evaluation based on the Oral Communication Valid Assessment of Learning in Undergraduate Education (VALUE) rubric from the Association of American Colleges and Universities (AACU) [4]. Figure 4 shows the adapted VALUE rubric which students completed for each presentation.

![Figure 4. Adapted peer evaluation rubric based on Oral Communication VALUE rubric from AACU [4].](image)

All groups received an average score of 4 from their peers in each category except for the “What’s in a Lever” group which received a 3 in Organization and Delivery with students commenting on the lack of clarity in the video. The authors noted that not all comments from students were reflected in the peer evaluation scoring. For example one student commented on “Is Elastigirl ‘Stretchier’ than a Rubber Band” that the “material seemed a little complicated for the target audience” but proceeded to give the group a 4 in Language. However, several students commented that the videos in general were “fun and engaging”, “great, fun, and interesting”, and a “good demonstration of the activity”.

**REFERENCES**


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Intelligence is a privilege, and it needs to be used for the greater good of people. *Doctor Octopus*