

Use of Student Generated Videos to Enhance Teaching Quality in Aerospace Engineering Classes

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Abstract – Student generated contents are used to help increase student participation, engagement, excitement and learning. In this study, students are asked to generate Youtube videos of the content they learn in the aerospace engineering classes. The videos are worth a certain percentage of their grade. These videos become part of a permanent repository. The videos are made available to the next generation students for inspiration and learning. As a result of generating these videos, students learn and retain the course related material much better because describe in their own words what they have understood. Some of the challenges of this activity in engineering classes are discussed and benefits are highlighted.

Keywords: Student generated content, videos, active learning

INTRODUCTION

In this paper, the author explores the usefulness of student created short videos to enhance the quality of education in engineering classes. The videos are created as part of student design projects or extra credit activities. For this study, all students are required to generate these videos for each course they take in aerospace engineering minor program. The videos are directly related to the course topics. Students can either record their projects, discuss a topic they learned through the course, visit an on-campus or an off-campus site to capture a relevant activity or describe a theory using simulations or other aids. The author has collected these videos from students over several years. These videos have become part of a repository. Each semester, students end up with a product that they are proud of and enjoy sharing with their peers. The videos are made available on a public video-sharing website (usually YouTube.) A new batch of students taking a given course is not only required to create new videos but can also view the older videos, created by previous students, as part of the course curriculum. This provides an opportunity for students to learn from their current and former peers. It encourages them to get creative and apply the material learned in any given engineering course. It also provides a platform for free access to virtual field trips. The education videos are moderated to ensure relevance and educational value. This practical technique also helps take some load off the instructor and makes the class more enjoyable.

Surveys are given out to the student participants at the conclusion of the assignment. The questions are evaluated using a five level Likert rating scale and a few open ended questions. From the student responses, it is evident that the assignment is enjoyable and useful for participating students to learn major concepts in the course. Students found that the videos generated are useful in teaching their classmates and that this assignment can be extended to other courses. As a result of this study, the author finds that the pedagogy of using digital video projects as a means of learning through teaching helps in increasing conceptual understanding of course material, as well as useful to educate their peers.

The author hopes that after a period of time, there will be enough videos created for each course he teaches, that the entire courses will have supplemental material covered as videos. In the author's experience, students get excited about the idea of creating short videos and their learning and retention increases as a result.

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BACKGROUND AND LITERATURE REVIEW

The videos created by students are known to have significantly improved their quality of work through a process of rehearse, record, review and then reflect [1]. Henderson et. al. noticed that by encouraging students to rehearse, record, review and then reflect and then repeat the whole cycle again, students could see their own growth. Henderson found that the advantages of this activity include the following:

- Building new literacies
- Creating authentic learning experiences
- Developing conceptual understanding
- Enhancing motivation and other affective outcomes
- Promoting expression and communication skills
- Developing collaborative learning skills
- Building technology skills
- Building generic learning skills

The use of student generated videos as a learning activity is found to encourage student independence, ownership as well as motivation. As Schuck and Kearney point out “the awareness of peers as the target audience was motivating for students... and generally enhanced the authentic nature of their learning experiences” [2]. The use of student-generated video production has been reported to have several valuable learning outcomes. Schuck and Kearney [2] summarize the learning outcomes. These outcomes are adopted for aerospace classes as follows as:

- Aerospace conceptual and skill development: Concepts and skills relating to the areas of aircraft design, performance, propulsion etc.
- Communication and presentation skills: Oral, written, reading, listening, visual. Acting skills. Interviewing skills
- Organizational and teamwork skills: Organizing and planning skills; managing, leadership, negotiation and social skills
- Higher-order thinking skills: Problem-solving, reasoning, planning, analyzing, creating and questioning skills
- Metacognitive skills: Becoming aware of how one learns, reflection on own learning
- Affective skills: Enhancement of self-esteem; risk-taking; value of subject, appreciation of films; care of equipment, responsibility
- Movie making skill development and related language development: Storytelling, filming techniques, editing, publishing etc. and use of associated jargon
- Literacy skills: Including media, visual cultural and critical literacies

Shewbridge and Berge discuss benefits of student created videos such as media literacy, active learning, experiential learning, and play and motivation [3]. They emphasize the need for faculty to harness students’ natural interests to create imaginative learning opportunities for students. Other claims of enhanced learning through similar projects include enhanced motivation, higher order thinking skills, development of group work and other social skills, media and visual literacy skills, self-expression and creativity, critical and reflective thinking and self-esteem benefits [2, 3].

Engineering education has traditionally been taught deductively. A lesson or topic starts out with principles or concepts, and then gradually works its way into applications and problems [7]. The deductive lecture based approach that has traditionally been used needs to be evolved in order to cater to a new generation of students. These students are inherently more adept to electronic media, especially considering the popularity of sites like YouTube. Today’s students belong to the internet generation. These students have had technology as part of their lives practically since birth. These tech savvy learners call for new more interactive method of teaching, and are often classified as ‘active-learners’ [7].

Like many other disciplines, aerospace engineering is a hands-on field. There is plethora of resources and knowledge available online for students to explore and learn from. When they are given a chance to use this

knowledge to create something of their own, they are likely to not only learn the material but also retain it for extended periods of time. One student's findings or experience online, in an aircraft museum, a cockpit of an aircraft, an airshow, or at an aircraft manufacturing or operations facility, amongst others, when captured in video, can then be shared with the entire class and the next several generations of students. This experience not only earns the student credit towards their grade, but also helps them and others develop in their fields. Students are able to announce arguments of their own to add value and represent their learning [4].

METHODOLOGY

This study focuses on the third and fourth year aerospace engineering minor students at the Southern Polytechnic State University. Although videos were generated by students of previous batches, the opinions gathered for this study are those of the students in the aircraft propulsion and helicopter theory courses taught in fall 2013 (n=15). The students work as individuals or in teams of two to three to produce a two-minute video about a topic they learned in the corresponding course or its applications. Over a six-week period, students research, shoot and edit their videos on the selected topics. This task is an example of the program's broader commitment to aerospace education, and integrates well with other teaching and research activities, including the aerospace engineering website [5]. Students are encouraged to come up with new ideas to capture in the video to explain the concepts they learned in the class. Students have used ideas of role playing, simulations, voice over Power Point, model representation, and capturing actual footage of related events, amongst other models to create their videos. As part of the instructions, students are encouraged to share what they have learned in the course. For up to 10% of the total grade in a class, they are asked to prepare and upload a YouTube video of no longer than five minutes (typically two minutes) that explains a concept that they have mastered in the course. They are asked to be creative and present their idea in a compelling and entertaining manner. They are also told that a library of these videos will be collected and will help future students. They are especially encouraged to use off-campus resources (e.g. aerospace museums, aircraft manufacturing / maintenance facilities, airports, airshows etc.) They agree that their videos become part of a repository, which might be used by future students who take this class. They are asked to make the videos simple to understand by using real world examples and acts. They are required to ensure that previously covered topics are not repeated. Each video must be unique and original. They have a total of six weeks to prepare the videos. Students are not given any instructions on the use of video recording or editing technology but are allowed to creatively and autonomously develop their short videos and assumed roles independent of the instructor in choosing the technology. The videos are shown to all students on the last day of the semester. The videos are then linked on a shared website and made publically available [5]. Each student is given a survey asking them about their experiences [6]. The desired outcome of this study is to determine the effectiveness of using video media to enhance conceptual learning in aerospace related courses. The underlying pedagogical principles include learning by teaching, active learning, cooperative learning, and peer to peer learning.

Video creation as part of learning revolves around three main concepts: study, composition, and assessment [7]. The study occurs as students research a topic and start creating clips for the video assignment. The composition happens when students take their clips and try to create a coherent video. The assessment is when faculty critiques the videos and gives feedback. The goal of this approach is to increase the student understanding of the materials and to encourage students to contemplate different theories and explore new ideas of teaching. It is hoped that students will also learn by watching the videos created by their peers. The process of creating a video is learner centered. It imposes more responsibility on students for their own learning than the traditional lecture based deductive approach [7]. In order to effectively create a video on a subject, one must completely comprehend the topic.

The social media site like YouTube is an effective tool for teaching shared contents. Students create and upload videos without feeling that they are studying or doing work. Videos can be created to be enjoyable. Students can watch videos over and over again until they understand the material. These videos can be put in a playlist to create a coherent list of topics covered as videos in the course. It is a way for students from all over the world to learn any material. In addition, viewers can leave comment. This forms a platform for communication between the creator and viewers – thus creating a community feedback system. If the video created by a student or a group is unique and valuable, it can be used as an in-class aid to help introduce and teach the topic to the students. The author uses previously generated videos in his classes as part of the classroom activity and encourages students to view them after class.

RESULTS AND ANALYSIS

On the due date of the project submission, videos are shown to all students in class. Students are then given a survey about their experience. Both qualitative and quantitative questions are asked in the survey. 15 students participated in the survey in fall 2013. When asked how making the videos help in learning the course material, students responded:

'I had to have a thorough understanding of the material to present it'

'I really had to think about how everything worked to understand how I could explain how it works'

'I had never uploaded a video to YouTube so I learned how to better use the technology available'

'Seeing concepts work validates learning'

'It helped me see concepts in action'

'[It] helped with creative thinking and networking'

'When you prepare to create the video, doing the research helps to gain more knowledge'

'We researched the topic we were making video [about] and came across a lot of new things – so we learned new things'

'Making the video helped reinforce our knowledge of helicopters [in Helicopter Theory class] and some of their parts'

'I taught my group members some of the features of Power Point'

'I expanded the knowledge I had previously gained in the class, I also learned YouTube technology'

As can be seen from the student responses, the video helped them get a deeper understanding of the material. As the saying goes, 'the best way to learn something is to start teaching it.' This project gave students an opportunity to explain in their own words the concepts they had learned. They had to think and internalize the material to be able to explain it. Some students created computer simulations and were able to demonstrate the concepts in action. This encouraged creative thinking. The exercise also helped them network with their colleagues and others outside the class. One group visited a local airport facility to capture a few pictures – which not only helped them see the practical application but also helped create new connections. Some students had to do research beyond what was taught in the class so they learned new things. Additionally, they learned video capturing and editing techniques.

When asked about the challenges of making the videos, students quoted:

'Putting the video on YouTube was challenging'

'Finding time to go to the filming location'

'I had no previous experience with making videos and I had very little time this semester to learn'

'Meeting up at the same time for all team members'

'Just figuring out how to convey subject matter creatively'

'Making the video – we had little experience in making videos or editing'

'Solidworks [software used for simulation in video] crashed a lot which made project take longer'

'Video editing, access to equipment'

Most of the challenges quoted by students are related to learning to use of technology. There is currently no course in the engineering curriculum that teaches students how to create their own videos and upload them. If this assignment is found to be worthwhile and its efficacy is proven through thorough analysis of student learning, then the addition of video creation and editing can be recommended as part of the engineering curriculum. Communication skills can be improved by practicing to create good videos. Students got a chance to create and re-create videos which, although was a challenge, helped improve the communication skills.

Another question is about the new knowledge learned while making the video, the students related:

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'There are many different turbo prop configuration [in aircraft propulsion class]'

'Learned how gas turbine engine works'

'Truly it bettered my understanding of what I have learned, I did learn how to use YouTube'

'I learned about video editing'

'I gathered a greater knowledge of the topic since I had to present it'

'[I learned about] Labview for wind tunnel, Power Point video maker'

'[I learned about] elastomeric bearings, Bell 407 rotor hub assembly'

'I learned about a few theoretical subject matters and how they could be proved practically'

'We learned about how some rotor assemblies work and some ways to reduce stress on the blades'

'I gained more knowledge about the topics of my videos'

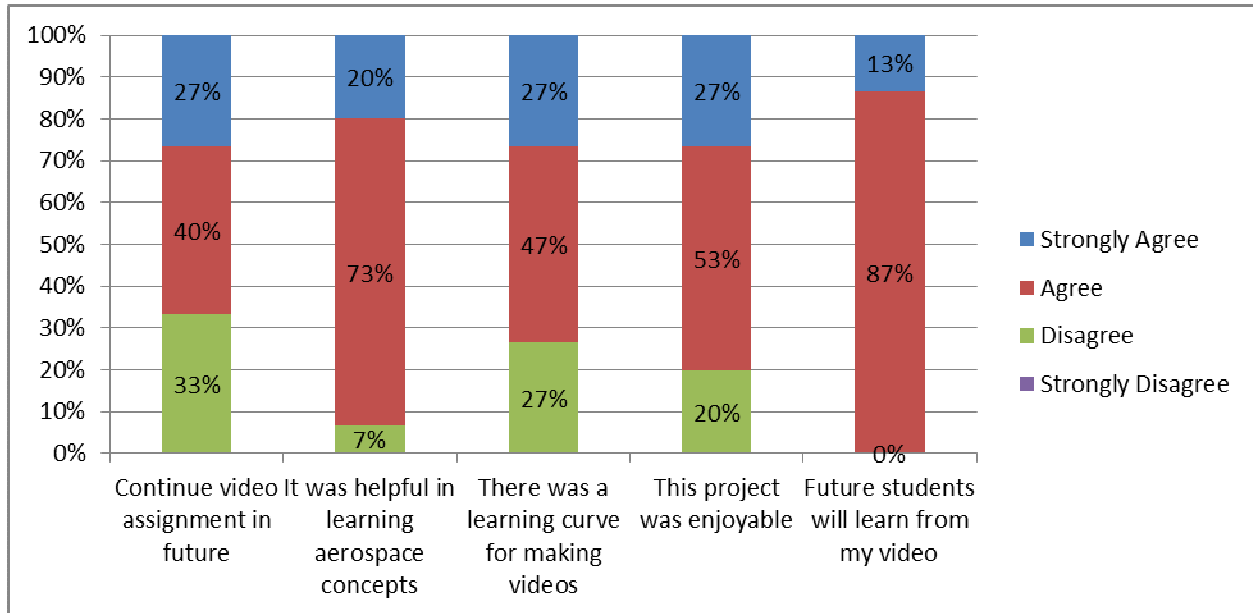
'Our video made me realize how complex an actual rotor hub is – in addition to the various real life hinge assemblies'

'Any time I explain any concept, I always learn. I don't know if I could say I learned anything new, but strengthened my previous understanding'

From the student responses, it is clear that several students gained new knowledge by creating educational videos. Others improved their understanding on the material covered in classes or available in the text books. Students had to work proactively to find information or understand it to be able to explain it. By explaining concepts, they learn themselves. Some students explored areas that were not discussed in class or were latest developments in a given field. This was useful not only for the students who created the videos, but for all the other students in class because the videos were shown to everyone in class.

For the quantitative questions, a 5 level Likert rating scale from 1 (strongly disagree) to 5 (strongly agree) is used. The results obtained from the survey are shown in Figure 1.

Figure 1: Summary of survey results



The survey results indicate the value of the student generated video assignment in the aerospace engineering classes. By generating these videos, students are able to learn the material they are teaching in the video. 93% of the students either agreed or strongly agreed that the video creation assignment helped them in learning the aerospace

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engineering concepts. Almost 70% of the respondents suggested that the video assignment should be continued in the future classes. A number of students had to learn how to create, edit and upload the videos because they had never done a similar exercise before. 74% of the students thought that there was a learning curve associated with the video creation part of this exercise. Most of the students enjoyed creating the videos with over 80% either agreeing or strongly agreeing with the statement. All the students thought that the work they had done was valuable and that the future students would be able to learn from the material they had created. It was also noticed that students shared their creations with their friends and colleagues as the number of views for each video consistently went up as the days past after the assignment due date. This indicates that the students did not forget about their work but instead felt pride in it and promoted it. This encouraging trend leads the author to believe that this exercise should continue and expanded to other larger classes.

To get a full picture, an open ended question is given at the end where students are allowed to give general comments. Student responses are as follows:

'I think there could be a significant bonus if an excellent video is made – if the video remains a requirement'

'I feel there could be a better way to learn, but it did help for sure'

'Not assigning a specific topic was very helpful'

'I had no experience producing videos, so this made the assignment very frustrating from my experience'

'Have the groups communicate about the topics to avoid duplication'

'Personally, there was a very large learning curve for making a video, thus the experience was not enjoyable'

As can be seen from the open question responses, students valued the assignment and wanted even higher credit for the video assignment. Some indicated that their videos would be improved if the weight of the assignment was higher – indicating that they were willing to put more time and effort. A few students did not see a value in this assignment and thought that the material could have been learned in other ways. Some found the experience frustrating because they could not figure out how to create the videos. A few good suggestions also came out of the survey. One student indicated that the students video topics should be discussed in class so everyone knows what others are working on and duplications can be avoided. This suggestion will be incorporated in future assignments.

CONCLUSIONS

In this research, the value of student generated YouTube videos is analyzed in aerospace engineering classes. Student created contents have been successfully used in other disciplines and numerous advantages of this assignment have been documented. For this project, students are given a few weeks to develop videos based on the material they learned in the classes. It is observed that most of the students enjoyed the activity and reported that they either gained new knowledge or better understood the knowledge covered in classes. A few students critiqued or questioned the efficacy of the assignment and mentioned that it was frustrating for them because they had not been taught how to create videos. For future studies, these suggestions need to be incorporated in classes. Also a more thorough and in-depth analysis is warranted to see the potential of this assignment in bigger classes where more data can be collected and analyzed. It is the hope of the author that after a few years, a large database of knowledge will be captured in the form of these student videos, which can be used as complementary material to the traditional course contents covered in aerospace engineering classes.

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