Implementing Student-Created Video in Engineering:

An Active Learning Approach for Exam Preparedness

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Abstract—In this case study, an active learning approach to exam preparation in engineering was investigated. The Learner Video Thumbnailing (LVT) strategy incorporated video blogs (vlogs) to reinforce course content. In this innovative method, students voluntarily choose one of two roles as either the role of a spectator (watching the vlogs) *n=69* or the role of a vlogger (creating the vlogs) *n=8* to earn extra credit on a formative exam. Data collected in this study included the vlogs, scores on the achievement questions, and a post interview of the vloggers. Difference of video development by gender were identified. The use of the LVT approach promoted improved achievement and student engagement.

Keywords—Vlog, Exam Preparation, STEM Education, gender

1 Introduction

Exam preparation in STEM typically consists of students reviewing class notes, practicing problems, reading texts, listening to instructors' lectures, and perhaps speaking to other knowledgeable students or mentors [1-3].While these approaches to curriculum review may be successful for some, other students may not benefit as fully from these methods of preparing for STEM formative exams [3].In an effort to pioneer and explore other methodologies for exam preparation, a learning activity incorporating student-created video (vlogs) was conducted in a Computer Engineering Class.

In this study, students participated in an exam preparation activity as either a vlogger (creating a vlog entry) or a spectator (watching the vlog and answering content-related questions).Vloggers volunteered to create their own two-minute videos related to a schematic or artifact covered in the course, thus earning extra credit for making the brief and creative technical video clip. In turn, the spectators in a face-to-face classroom environment watched the videos together as a classroom activity. The spectators earned credit for providing a correct response to technical questions related to the course content explained in the vlog. The intention of the vlogger learning activity was to offer an engaging and interactive means for all students to review course topics in preparation for a written summative assessment.

2 Background

Video has been employed in higher education as a means to communicate course content [1] [4], improve lab functionality [5], foster academic integrity [6], and facilitate student success [7].In some cases, the instructor authors a video and the learner observed the information [1] [8]. Student-created video (sometimes called student-authored, learner-authored, or learner-created video) has been used to engage students in documenting their understanding of the content [9]. Equally, reference [10], incorporated VoiceThreads (a video and image interaction tool) and noted that students expressed content knowledge, understanding, and reflection.

Web-based video is defined as video that is accessed online via the Internet and can be viewed on any web browser or downloaded [11] via video-sharing sites such as YouTube [12]. A vlog can be defined as a blog in which the postings are in video format. Types of vlogs differ in elements, style, and characteristics. Vlogs may contain multimedia elements including text, images, animations, video, hyperlinks, and other metadata. The judicious use of multimedia has been linked to improved learning [13]. Developing a video blog (vlog) can facilitate learners' reflective thinking [14]. Vlogging provides a visual medium for students to express knowledge, while making cognitive connections to previous knowledge [15]. Vlogging, a form of student-created video, has been incorporated in various aspects of education including formative and summative assessment in higher education [10] [11] [14] [15] [16].

As students create video content they engage in active and authentic learning [17] [18]. An active learning environment engages students in the learning process and allows them to take an active role in their own knowledge acquisition. A meta-analysis of active learning by Freeman [19] determined that students' performance was increased when engaged in active learning over lecturing alone. Potentially, authoring a video may contribute to improved content knowledge and engagement.

Research has indicated that male and females may view learning technologies differently [20]. A study of gender and Web 2.0 tools determined that female students have more anxiety using some Web 2.0 tools than males [21].However, the use of online video sharing or social networking tools were not areas where females expressed anxiety. A study of Facebook postings also indicated gender differences in posting behaviors. An investigation of Facebook video postings indicated that more males than females participated in creating and editing video [22]. Likewise, researchers [23], found that males were more likely to engage in public postings while females preferred private postings. Although these were text-based postings, inferences could be made regarding video posting on Facebook or YouTube.

2.1 Learner video thumbnailing (LVT) exam preparation approach

The LVT exam preparation approach includes incorporating video in STEM education for exam preparation. There are two roles for students in the LVT approach. The first role (vlogger) positions the student as an active learner and video creator. In the second role (spectator), the student actively watches the vlogger's video to answer content-related questions in preparation for the exam. The intent of the LVT approach

was to help students' study for the exam as well as provide them with the option of earning extra credit [24].

By definition, a thumbnail is considered a mini portrayal or summary of a larger image, concept, or idea. In that vein, vloggers would summarize key points of the course content and materials in the class in their own words and prepare a vlog using a visual representation that might have included a single still image. LVT invited student creativity and provided design latitude.

2.2 Purpose and research question

The purpose of the learning activity described in this paper was to implement student-created video for exam review. The LVT approach provided all students an opportunity to extra credit on an upcoming exam. The study investigated the semester-long implementation of the video-mediated learning approach developed by one of the authors called learner video thumbnailing (LVT) [24] and answered the following research question: *How did the LVT approach to exam preparedness support students' achievement?* Presented are the techniques, tools, and rubrics utilized in this method.

3 Methods

3.1 Participants

Participants were undergraduate students from a Computer Organization and Design course in a computer engineering program at a large southeastern university. All students in the course were presented with an opportunity to earn extra credit and to participate in this study as a means of preparing for an upcoming exam. Interested students signed up to participate in the LVT exam preparation approach via the Learning Management System (LMS).

Participants could earn extra credit in one of two ways either as an observer or as a content creator. The maximum points that students could earn was three points on the midterm exam. Of the $N=100$ in the class, observers (hereafter referred to as spectators) $n=69$ (69% of the total class population) could earn up to 2 points for watching the student-created videos and answering a related question per video. The student content creators (hereafter referred to as vloggers') could earn up to 3 extra credit points on the midterm exam for creating the videos that were watched by the spectators. Initially, about 12% of the class enrollment ($n=12$) participants voluntarily chose to create vlogs. However, only 8 students (six males and two females) completed vlogs.

3.2 Context

The following study took place over the course of a semester. The Computer Organization and Design course, a three-credit hour a week, 16-week course was conducted at a large Southeastern university. Course topics included but were not limited

to: computer arithmetic, instruction set architecture, performance, data path, control unit, memory hierarchy, and I/O interface. The third author conducted the two sections of this class during the fall semester. The LVT approach was conducted in both classes. The assessments for the class included 3 exams and 4 quizzes.

3.3 Implementation procedure

The class was taught in a traditional lecture and lab format. Prior to an exam, the students were offered a means to earn extra credit on the exam. To prepare for the midterm (E1), exam 2 (E2), and the final exam (E3), students could sign up to volunteer to create a video (vlog) or attend a showing of the student-created videos by completing an online survey.

Students who chose to be vloggers were provided the following written steps for completing the video (See Table 1). Additional written guidelines included: (a) provide sufficient coverage of the topic; (b) be technically correct; and (c) the choice of style of the video would be made by the video creators. Vloggers were allowed and encouraged to use self-written notes from class, class online resources, and additional accurate Internet resource (like images, animations, and video snips) to prepare their vlog. Some students used free programs like iMovie or Windows MovieMaker to create and edit their videos. Other students used their phone or a video camera to capture live unedited video of themselves visualizing and explaining a concept. The students were then required to upload their completed video to the student's personal YouTube account for ease of viewing.

Table 1. Student-created Video Development Guidelines

Preparation Directions and Guidance
Google a few keywords related to a picture that is related to course topics in order to locate some visual aids or use visuals from course materials.
For a more technical vlog including many details.
The vlog production process from start to finish can take 30 minutes or less.There is no need to spend more than an hour to prepare the vlog, however, making the vlog involves studying course materials which can be helpful for the vlogger in order to prepare for an upcoming quiz/exam/etc.
Vloggers are allowed to use their sense of humor and have some fun parts in their vlog which will make this method an interesting and interactive way to prepare for an upcoming quiz/exam/etc.

*Note: [24]

Once the students completed and uploaded their videos on the topics related to the upcoming exam, they provided the instructor a link to their video uploaded to YouTube. The videos were previewed for content accuracy and to develop a content question for the spectators to answer after watching the video in an upcoming class session.

Next, vlogs were evaluated according to the rubric by an evaluation panel that consisted of the course instructor and the teaching assistants (TAs) $n= 3$ responsible for the course (see Table 2). The rubric provided a standard for the video design and course content explained in the vlog. The evaluation panel determined whether the

vlogger earned extra credit. If the vlog met the requirements based on the rubric, the vlogger earned extra credit. Grading of the vlogs was not based on peer reviews.

The last step of the LVT exam preparation approach included a viewing session of the vlogs. All students enrolled in the course were eligible to participate as spectators. During the last twenty minutes of the class before the exam, students were invited to voluntarily watch the vlogs and answer the instructor-created content questions related to the vlogs. These students became the spectators referenced in the study. All questions were delivered through the class LMS and questions were answered on the spectators' mobile device immediately after watching each vlog. Spectators utilized Wi-Fi enabled laptops, tablets, or smartphones to participate and answer questions related to the vlogs. The purpose for watching the videos in class before the exam was to replace the typical instructor-led exam review.

Table 2. Panel's Perception Rubric for Evaluating Vlog

Use of Vlogging	
5 (Expert)	The vlog is professionally prepared utilizing the medium with appropriate visual aids. Video and text are used as required.
4 (Advanced)	The vlog is somewhat professionally prepared utilizing the medium. Video and text are used as required.
3 (Intermediate)	The vlog is well prepared utilizing the medium. Video and text are not used as required.
2 (Basic)	The vlog is not well-prepared utilizing the media. Video and text are not used as required.
1 (Unsatisfactory)	The vlog is not good enough and utilization of visual aids medium is not appropriate. Video and text are not used as required.
Content	
5 (Expert)	The vlog is creative, in-depth, and insightful. Sufficiently covers all the topics and is technically correct.
4 (Advanced)	The vlog is mostly creative, in-depth, and insightful. Sufficiently covers all the topics and is technically correct.
3 (Intermediate)	The vlog is mostly creative, in-depth, and insightful. Technically correct, however, does not sufficiently cover all the topics.
2 (Basic)	The vlog is somewhat creative, in-depth, and somewhat insightful. However, technically it is partially incorrect and does not sufficiently cover all the topics.
1 (Unsatisfactory)	The vlog is not creative, in-depth, and is not insightful. Technically it is partially incorrect and does not sufficiently cover all the topics.

*Note: [24]

4   Results

The content of the student-created vlogs was developed from class subject matter and existing course materials. However, some students curated additional visual content to add to their video. Eight students created eight unique vlogs that were viewed by sixty-nine spectators in preparation for a formative exam. Samples screenshots of the vlogs submitted in response to these archetypes are shown in Figure 1.Both images (A) and (B) were original archetypes suggested for use. Images (C) and (D) are screen captures of the student outcomes. The static image in (A) was a replaced with a student-developed animation in (C).

Fig. 1. Archetypes and Student Outcomes

Spectators voluntarily attended a vlog viewing event prior to an exam which was conducted during the last 20 minutes of the regular face-to-face class time on the last class day preceding the midterm exam.The students in attendance during these viewing sessions were encouraged to stay and watch the student-created videos as a review of course material that may be included in an upcoming exam. Even though the spectators had the option of leaving early from class, none of the students (spectators) who attended class the day before the exams, left the class. Instead they stayed and watched all the vlogs, even if they did not answer the content-related multiple-choice questions.

The spectators' achievement was measured by correct answers to instructor-created questions. Spectators answered a minimum of two questions from the videos that they watched. Question types were multiple choice and were at the recall or remembering level [25]. The videos with the highest score covered transistors and semiconductors. The video with the lowest score related to CPU caches (see Table 3).

Fewer spectators chose to answer the longest video on silicon wafer production. However, 82% of those who answered the silicon wafer question answered it correctly. Overall, 75% of the questions were answered correctly. Regarding the quality and characteristics of the video to related to the questions described in Table 3, the length of the videos ranged from one minute and forty-seven seconds three minutes and twenty-three seconds in length (see Figure 2).

Table 3. Questions for Vlogs Watched during Fall 2015 Semester

Question Asked	Number of Spectators Responding	Number of Correct Answers
As covered in the vlog today, which of the following elements of the periodic table is considered to be a semiconductor?	17	17 (100%)
As covered in the vlog today, what year was the transistor invented by Shockley?	35	35 (100%)
As covered in the vlog today, which of the following processors is popular for IoT devices?	24	18 (75%)
As covered in the vlog today, the correct pronunciation of the first output of the molten silicon process is:	11	9 (82%)
As covered in the vlog today, what is the yield of the semiconductor fabrication process?	17	15(88%)
"Chip binning," which lead to the so-called "silicon lottery" involves:	16	1 (6%)
As covered in the vlog today, the transistors from which ITRS node will Samsung use in its Galaxy S7 products?	14	10 (71%)
As covered in the vlog today, how many layers of photolithographic processing are required for a typical CPU wafer producing a high-end CPU? Please indicate the closest value listed below:	14	6 (43%)

*Note: [24]

In most cases, the longer the video the lower the achievement score on the question. More students answered the question associated with the shortest video in length than with the longer videos. All students that answered this question answered it correctly.

Since the vlog questions were facilitated through an LMS, the instructor was able to immediately determine if the students answered the questions correctly. The instructor addressed the results with the students to remedy misperceptions and incorrect answers. The interaction between instructor and student provided additional practice to build knowledge of key course concepts.
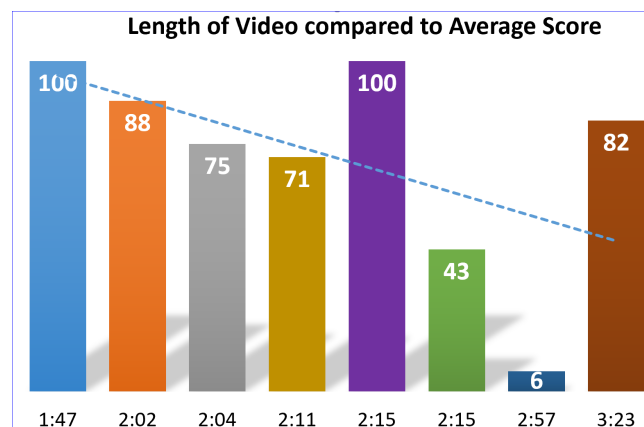
Fig. 2. Video length compared to Average Score

In follow-up interviews with the vloggers after the semester ended, these students provided their perceptions of how their achievement was impacted through the creation of their videos. The development process of creating the vlogs provided vloggers with positive perceptions of self-efficacy and increased knowledge of the content (see Table 4).

It was noted by the vloggers that they delved deeper into the content to feel confident in teaching the concept they were describing in their vlog. They felt that creating a vlog was great preparation for their exams. All vloggers welcomed the assignment. One engineering vlogger stated, "I highly recommend this as a way for students to learn about topics and, in general, computer and presentation skills."

Another vlogger noted, "The video creation experience was more meaningful than writing a paper for extra credit." There was a cross-curricular benefit for two of the vloggers as they learned more about the process and the tools for creating a video (using iMovie or uploading a video to YouTube) because of creating a vlog.

Emails, discussions, and the post surveys evidenced that students were cognitively engaged in learning more about their vlog topic, "I was most inspired to create the video than take a quiz. I caught myself thinking about the video often. "When the extra credit assignment was done, emails were received thanking the instructor for an alternative learning experience. After grades were in, participants were happy to let the videos be used in subsequent semesters.

Further, the vloggers reported the LVT approach for extra credit was novel and fostered alternative forms of expression. All vloggers self-identified their gender (male *n=6*; female *n=2)*. Gender differences were considered regarding the vlogs both in length of video and spectator achievement scores. The length of the two female authored videos were above and below the average video length of 2 minutes and 22 seconds in length (see Figure 3).

Table 4. Classified Vloggers Perceptions

	Positive	**Negative**
Perceived	"Making a vlog reinforced the topics for me as content creator."	"The hardest part was beginning the research of the topic and narrowing it down to specific details."
Self- Efficacy	"The extra credit really helped my grade which was good since I learned a lot making the video."	
		"I realized that I thought I knew my content, but I really didn't. I know it better now."
Knowledge	"I was forced to research the topic I was presenting so that I truly understood what I was talking about."	
	"Encourages self-learning,"	
Novel	"Engineering student don't get to express artistic ability and creativeness. This assignment was such a breath of fresh air compared to many of the other types of assignments/projects."	"I did not like the idea about being critiqued by others."

	"I wish there were more assignments like this in engineering, so I could feel less bored."	
Time	"The quickest part was the research."	---
	"Takes longer to edit video then to just read a few articles but I learned more."	

Spectators scored higher on the comprehension questions related to the male-authored vlogs as opposed to the female-authored vlogs. Spectators' achievement scores averaged 80% for male-authored vlogs. In turn, the spectators' achievement scores averaged 40% for student-created video by females (See Figure 3). The elements included in the videos varied by gender. By percentage, more males than females included animations, pop-ups, images, and other media.
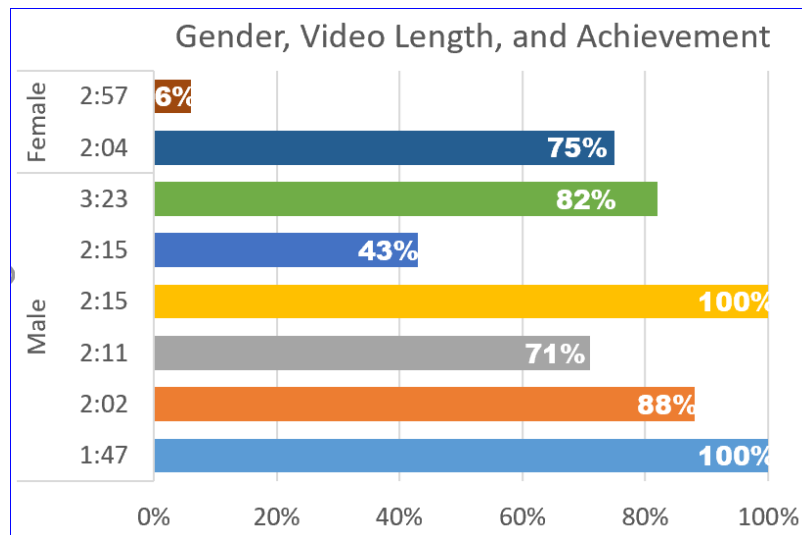

Fig. 3. Length of video by author's gender

However, the sound quality of the videos created by the females was clear and easy to hear as opposed to the audio heard on the male-authored vlogs. It was noted that both females seemed to read their scripts, whereas the audio for some of the males was delivered in a natural conversational manner.

5 Discussion

The LVT approach to exam preparedness supported student achievement for both the spectators and the vloggers. The spectators were afforded a multimedia recap of previously taught material and overall answered the questions with 75% accuracy. The vlog review provided a means to clear up misconceptions that can often happen in STEM learning [1].Spectators scored higher on questions that were related to vlogs that were shorter in length. The achievement finding may be related to other research

that students prefer shorter videos [1] [9]. The vloggers' achievement was supported in that they had to actively interact with the content to ensure accuracy and to make sure they could explain complex content [1]. The cross-curricular benefit of learning video tools may have long-term benefits given that the skill is transferable to other learning contexts [26].

Gender equity issues related to the use of technology have long been a concern [20].When considering the gender of class enrollment, the participation percentage of female vloggers was greater than male participation. However, it should be noted that no one referenced their gender as a reason they participated as a vlogger. While past studies have noted that gender may be a factor for using learning technologies [21], this does not seem to be the case in this study. However, the style of the vlogs differed by gender. Males tended to add additional elements and moved beyond the basic requirements of the extra credit assignment, whereas the females produced a vlog more in keeping with the basic requirements and progressed in a linear flow. The difference in the vlogs by gender supports previous findings of difference in posts by gender [22] [27].

Spectators' achievement scores were higher on questions derived from male-authored vlogs as opposed to female-authored vlogs. The gender of the spectators was not reported, although most spectators were male. Caution should be observed related to this finding as the achievement score difference may be related to the additional multimedia components [28] included in the male-authored vlogs. More research is needed to understand gender findings and video in STEM. Assumptions should not be generalized to other populations as the size of the population was a limitation and there was inequitable representation of females.

In this study, vloggers noted the physical time it took to develop a vlog was more than they initially anticipated when they started the vlog, which concurs with other related video findings [9].In some cases, the vloggers were absorbed in the creative production of their vlog content. Implications for educators include scheduling sufficient time for students to complete a vlog or video and reminding students that video development and revision may take more time than they may expect. Vloggers indicated that they were actively engaged in the vlog making process and this may be because vloggers chose to participate and may not be the activity itself as choice influence attitudes and effort [29].

6 Conclusion

The LVT approach for exam preparedness demonstrated a method for incorporating active learning in a large undergraduate engineering course. The importance of the study broadens the literature on the use of vlogs and active learning in STEM contexts. Both vloggers' and spectators' achievement were actively supported through the development of vlogs (vloggers) and by watching the vlog and answering questions (spectators).

There were noted gender differences in the development of the vlogs. Spectators' achievement was greater when viewing shorter in length than longer in length vlogs.

Spectators' achievement was better when answering male-authored vlogs versus female-authored vlogs. Caution should be considered regarding the findings as the results may be related to the use or non-use of multimedia elements in the vlogs [30] [31]. Further, these findings may not be generalizable to other populations and situations and need further investigation. In conclusion, these engineering students indicated they thoroughly enjoyed creating and viewing vlogs in preparation for their midterm exam and based on previous video watching research, studies like this should continue [32].Based on this case study, other engineering and STEM courses may want to consider adapting the LVT approach for exam preparation.

7   References

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