STUDENT USAGE OF SHORT ONLINE SINGLE-TOPIC VIDEOS IN A FIRST-YEAR ENGINEERING CHEMISTRY CLASS

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Abstract – This study explored students' usage patterns with 5-10 minute single-topic ("short topic") videos produced solely for online use to support undergraduate students enrolled in a first-year introductory course to engineering chemistry and materials science at the University of Toronto. The short topic videos were posted as unlisted YouTube videos and made available to students using the Blackboard learning management system. Analytical data was collected from these unlisted YouTube videos. In 2016, 142 student participants completed an anonymous survey that collected information on users' perceived usefulness and the reason for using the short topic videos. In the survey responses, 70.4% of students indicated a preference for using the short topic videos to review specific content vs. full lecture captures. A total of 76 short topic videos were created with an average video length of 8:11 min. The videos were intentionally kept short, with a maximum duration of 13:46 min. View counts and feedback from the survey responses suggested that students used the short topic videos to review contents and found the videos to be a valuable learning resource. The videos were re-used as the main learning content in the online equivalent course offered in 2017 and 2018. Data collected from YouTube analytics demonstrated similar usage behavior and retention in the videos when used as the main learning resource in the online courses to when the videos were provided as supplementary resources.

Keywords: short topic video, undergraduate education, audience retention, reusable learning objects, khan-style video, online learning content

1. INTRODUCTION

Online educational resources provide an opportunity to gain insight into the learning behaviors and usage patterns with online resources by current undergraduate students. Such knowledge can be used to optimize the online learning environment to be better suited for the "net" generation currently attending university. The majority of undergraduate students are part of Generation Z, born in 1995 or later [1]. This generation is also referred to as the digital natives and the iGeneration in literature [2]. Generation Z has experienced the presence of technology and Internet from birth and has become accustomed to

communicating with technological devices from anywhere and at any time. Several studies are suggesting that individuals from this generation have different learning behaviors than those that attended University before them. For instance, individuals of this generation often multi-task during learning [3] and frequently switch tasks while studying [4]. There is a body of literature suggesting that technology driven distractions negatively affect students' learning [6]–[8]. To reduce the likelihood for these distractions to cause task switching from learning, online educational content must become more engaging to the students.

In one study the duration of the videos viewed was used as a proxy for engagement, along with student completion of post-video assessment problems [9]. Engagement was studied as a necessary prerequisite for learning, but not considered to be sufficient. One of the findings from this study was that shorter videos were more engaging to the students [9]. To further improve student engagement, the current study investigated the extent to which higher production-value multi-camera recordings of short topic videos maintain student retention during the duration of these videos. There are numerous studies suggesting that students find value in having control over the location, time, and pace of learning [5]. Therefore, the videos were uploaded to YouTube, ensuring convenient and robust access from any technological device. There is value in understanding how students engage and use online learning content, as many institutions have introduced a blended learning approach to integrate various online learning content along with the face-to-face contact time to better meet the needs of Generation Z [7],[8].

2. METHODS

High resolution multi-camera single topic videos were prepared for a first-year engineering course offered in the Faculty of Applied Science and Engineering, at the University of Toronto. A total of 76 short topic videos were prepared with an average length of 8:11 min, each covering a specific and discrete topic from the course. Examples of specific topics covered include the band theory of solids, atomic bonding, hybridized orbitals, face centered cubic crystal structure, optical transparency of solids, the Gibbs free energy, and binary phase diagrams, to name a few.

The short topic videos were recorded using three video sources and carefully edited in post-production with the intent to produce engaging videos that would hold the attention of students.

Short topic videos were uploaded to YouTube as unlisted videos and were made available to the students using the Blackboard learning management system. The analytical data collected from these unlisted YouTube videos were used to determine usage patterns. Additionally, feedback was collected from the students using hard copy anonymous survey responses with the participants degree of agreement to each statement measured by a five-level Likert scale response (1=Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, and 5= Strongly Agree). A total of 142 participants completed the survey in 2016, corresponding to 81% of enrolled students. The survey collected information on users' preference for traditional lecture capture vs. short topic videos, perceived usefulness of the short topic videos, and the reason for using the short topic videos.

The videos were reused in the following semesters in the online equivalent version of the course, with the exception of two videos that were not included in the learning module of 2017 but were included in 2018. There was an interest to assess if the short topic videos were as engaging to the students when provided as supplements to traditional chalkboard lecturing in-class, versus when these videos were used as the primary content delivery method in the online equivalent course. Data was collected on the type of device used during viewing of these videos to assess if the choice of device had an influence on student engagement, measured by average percentage of a video viewed.

3. RESULTS

The short topic videos were heavily viewed as shown in Fig. 1, with view counts scaling roughly with course enrolment. The view counts show a similar behavior from 2016 to 2018.

Fig. 1. View counts from the unlisted short topic videos. Each bar line represents a given short topic video that has been colour coded by year the video was used.

In the anonymous student survey responses, more than 61% of the students reported to have watched parts of the same video multiple times. When reviewing course content, 70% of the students preferred using the short topic videos instead of lecture captures.

The average view duration was used as a proxy for student engagement in the videos. As shown in Fig. 2, a moderate negative correlation was observed between the video length and average view duration in 2016 and 2017 with $r = -0.416$ and $r = -0.519$, respectively. However, the correlation observed in 2018 was weak with an $r = -0.192$.

Fig. 2. The average % view duration of each individual video plotted against video length.

Absolute audience retention is calculated as the number of views at a particular time in the video as a percentage of the initial views. As shown in Fig. 3a, there was a loss of audience within the first 10 s in a majority of the videos. Possible factors contributing to this initial decrease in audience include students selecting the wrong video and stop watching or students skipping past a particular section of the video and moving to a later section. The retention increased in numerous videos at the half way point (at 50% duration) and near the end of the video at 95%-time points (TP). The fluctuation in retention is most likely occurring due to students rewinding or skipping small sections, all of which suggests that a significant subset of students are actively engaging in the video. Numerous videos had a retention greater than 100% at various parts of the video including at 95% TP (Fig. 3c), which can occur if students re-watch that specific part of the video.

The online courses (2017 and 2018) had a greater number of videos with a retention greater than 100% at the 95% TP, compared to the in-class version (2016). Aside from greater retention in a number of videos, there is little difference observed in the way the students used the online content.

Fig. 3. Audience retention indicating the number of views as a percentage of the initial views. Audience retention is reported at different time points (TP) across the short topic videos: (a) in the first ~10 s, (b) at 50%, and (c) at 95% TP.

As summarized in Table 1, different devices were used to view the short topic videos online, but majority of the views were on a computer rather than a tablet or mobile device. The percentage of views from each type of device was similar from 2016 to 2018.

Table 1. The percentage of views from each type of device.

	Computer	Mobile	Tablet	TV	Unknown
2016	95.23	2.10	2.60	0.01	0.06
2017	95.61	1.25	3.01	0.00	0.13
2018	94.33	1.86	3.81	0.00	0.00

A smaller distribution in the average % view duration is observed when computer devices were used in comparison to tablets or mobile devices (Fig. 4). However, a greater number of videos were watched completely (retention of 100% or greater) when mobile devices or tablets were used.

Fig. 4. Average % of each video watched vs. video length, categorized by viewing device: (a) computers, (b) mobile devices, and (c) tablets.

4. DISCUSSION

Data from YouTube Analytics can be used to study student viewing patterns and use of online video learning materials. For instance, the collected data in this study shows that a sub set of students were actively viewing these videos and watching parts of the same video multiple times. The observation is supported by the student survey responses as more than 61% of the students that completed the survey in 2016 reported to have watched parts of the same video multiple times.

With such a variety of devices now used during online learning, it is important to ensure that the videos can be viewed effectively whether a mobile device is used or a computer. In the current study, approximately 5% of the views were made from a tablet or a mobile device. Therefore, providing access to online learning material that is compatible with all device types is recommended.

The videos were intentionally kept short with a maximum duration of 13:46 min, as earlier studies have suggested higher student engagement in shorter videos [9]. A moderate negative correlation was observed in 2016 and 2017 between video length and average view duration (Fig. 2), which may suggest that a greater retention may be achieved with shorter videos. However, for the same videos a weak correlation was observed in 2018. Therefore, shorter videos may appear as more engaging, but the video length is not the sole factor that influences engagement. The inherent limitation to using % view duration as the main proxy for engagement is that it does not provide information regarding the extent of which the student is actively watching the video or if the video is only playing in the background. Looking at audience retention throughout the video better represents the students' engagement, as fluctuation in retention across a video is an indicative of the student actively interacting with the video. Audience retention can potentially be used to identify the cause that made the student stop viewing or skip given parts of the material, or even rewind and re-watch a certain section. Examples of possible reasons can include the speed of content being presented or if a topic that appears more challenging is introduced.

5. CONCLUSION

Short topic videos provide students with an opportunity for repetitive learning and engagement in specific information on their own terms. Based on the analytical data and feedback provided through the student survey responses, different sections of the videos were watched multiple times. A major benefit of preparing and using short topic videos is that the content is highly appropriate for reuse in subsequent semesters. There is an expense associated with the preparation of high production multi-camera videos, but when the contents are reused, the expense is justified. It is becoming more important to prepare online content that is compatible with different

technological devices as students are now using numerous types of devices (such as computers, mobile devices, tablets, smart televisions, etc.) to access the online videos.

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