Exploring student viewing behaviors in online educational videos

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***Abstract*—Online video use in education is an expanding trend and research that focuses on how students view educational videos becomes of particular interest. In our previous work, we argued that in order to conduct a detailed analysis of the learner viewing behavior we have to deploy tools that log the learner activity and assist statistical analysis and data mining. Working towards this direction, a framework for recording and analyzing learner behavior was presented. This paper presents findings of applying this framework into educational settings.**

Keywords – video in education, viewing behavior, monitoring, video usage analysis

I. INTRODUCTION

The delivery of online educational videos in higher and K-12 education is a growing trend as depicted in a number of scientific articles and reports, for example [1]. Research that focuses on how students view educational videos becomes of particular interest. Kay [2] published a literature review on the use of online videos in education from 2002 to 2011. Several publications in this review deal with learners' behavior while watching educational videos. Most of these studies (e.g., [4]) use surveys, interviews and focus groups to obtain information on learner viewing patterns and for understanding the factors that lead to specific viewing styles.

In order to conduct a more efficient behavior analysis we argued in a previous paper [3] that we have to deploy tools that assist usage analysis and mining. In an attempt to work towards this particular direction and in order to provide the means and tools for video usage analysis and mining, we introduced a framework for analyzing learner behavior while watching and interacting with online educational videos [3].

In this particular framework we proposed (a) a method for capturing viewing activity data from linear and interactive videos (i.e. videos that require learner actions at specific points in the timeline in order to advance), (b) a suitable data model for storing information about the videos (video length, sections in the video, interactive elements, etc.) and information about the learner viewing activity (videos visited, sections watched, media actions performed, interactive elements and quiz questions attempted, etc.), and, (c) useful metrics to evaluate learner engagement and video popularity. Furthermore, two modules were introduced to aid the educator in monitoring individual learner activity. The first one assists the educator to navigate through the learner data in the database. The second one provides graphical sequence representations allowing the educator to view learner viewing or activity patterns, such as, the sequence of videos viewed by the learner (in a session or throughout the course period), sections viewed from a particular video, and, interactive items and quiz questions attempted in a specific video viewing.

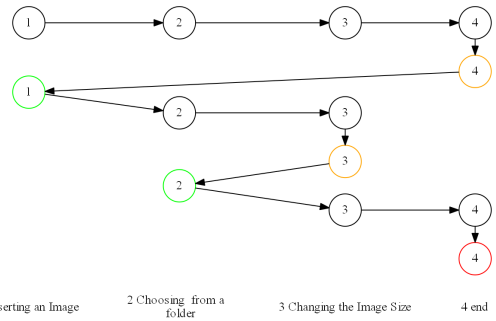

Figure 1- Sequence of viewed sections in a video

The aim of the current paper is to present the experiences gained from using this framework in educational settings to gather and analyze learner viewing behaviors, and, to compare these findings to the outcomes of research conducted by other researchers in the past. In Section II, we describe the educational settings of the experiment, present and discuss the findings, and compare these findings to similar studies that have been carried out in the past. We conclude the paper in Section III.

II. USING THE FRAMEWOK IN EDUCATIONAL SETTINGS

A. The setting

Our framework was adopted for a series of educational videos. These video lessons were created to support the course "Introduction to Computers", taught in the 1st semester and the course "Communication Technologies" taught in the 6th semester at the Department of Digital Media and Communication at the Technological Education Institute of Western Macedonia. We will refer to these courses as "IC1" and "CT6" for the rest of the paper. In "IC1" lectures and laboratory hours students are taught principles of word processors and spreadsheets using Microsoft Office Word and Excel. In the lab hours of the lectures of "CT6" students are taught web page design using the DreamWeaver software package. Both courses have obligatory attendance and the topics covered by the videos are covered in class as well with more or less the same order.

Two web pages were created for accommodating the educational videos (linear and interactive) for both courses plus links to document files for "CT6". The document files consist of text and images and cover the same topics as the

corresponding videos. These files are intended for those who wish to read rather than watch online videos.

For "IC1" the material consists of 26 linear demonstration videos, 20 interactive videos and 2 videos consisting mostly of quizzes. The material for "CT6" consists of 28 linear demonstration videos, 14 interactive videos plus 28 document files. "IC1" videos were used in the fall semester and "CT6" videos in the spring semester of 2012-13.

The findings described here were obtained by querying and processing the data, by carrying out statistical analysis (using SPSS), and by observing the graphical representations that exist in the framework. A questionnaire was also handed out to the students of "IC1".

By querying the database, we found that for "IC1" 47 out of 87 students that took part in the experiment (~54%) viewed at least one video and for "CT6" the number was 146 out of the 231 (~63%). These 146 learners performed 6043 video viewings with 5331 concerning the linear videos and the rest the interactive videos. The dataset obtained for "CT6" is bigger and more suitable for getting insights into learner behaviour and in subsections D and E we will be focusing exclusively on this dataset.

B. Questionaires and logged data

A questionnaire was handed out for "IC1" on the exam day. The questions addressed issues concerning the quality and the ease of use of the video lessons. Although it is not in the purpose of this study to present the questionnaire findings it is worth mentioning that the majority of students stated that they found the quality of videos very good and certainly a better way of learning when compared to printed handouts. This fact is also confirmed for "CT6" students by examining the dataset (see following Subsection). A striking observation is that the number of students stating that they used the video lessons is in discordance with the numbers retrieved from the database. 66 students stated to have used a video lesson at least once but from the logged data it was revealed that actually only 47 did so. Gorissen & Bruggen's study [5] also concludes that it is useful to perform a triangulation of the survey data and the data logged by a system because there are differences between the datasets. Logged data gathered according to the framework described in [3] can give us much more accurate observations concerning learner engagement, video popularity and viewing patterns when compared to surveys and interviews. Surveys and interviews however can be useful when interpreting the observations.

C. Viewing videos – When and where

For both courses a large percentage of video viewings is observed in the days (and hours) preceding the exams. Around 50% of the viewings for "CT6" and 60% for "IC1" took place only in a 7 days period preceding the exam. A smaller but considerable amount of viewings is also observed in periods when an assignment was in progress. This finding is in accordance with many research papers that also found that video or audio podcast use increase dramatically before course exams (e.g., [4][5][6]).

In our setting, students watched videos mostly on working days and mainly between 14:00 and 00:00 with the peak being between 16:00 and 17:00. By analysing the visitor IP addresses for both courses, we found that more than 90% of the viewings were accessed from places outside the campus, despite the fact that students were encouraged to use the computers in the library for viewing the videos and for practising on the software packages at the same time.

Learner visits to the text versions of the exercise were also logged for "CT6". We note that the concepts in the text were described with sufficient detail using also images. However, the visits to the text files were only 475, a rather small number when compared to the 6043 video viewings performed by learners that attended the course. Students did indeed prefer video lessons to text handouts and this is again in line with the findings in [4].

D. Video viewings and Performance for the course

In order to test whether viewing videos has an impact on student grades, the dataset of "CT6" was divided in two independent groups. The first group was comprised of 85 students who did not watch any video and the second group of 146 students who watched at least one video. Then, an independent samples t-test was conducted to test whether there was significant difference in the grade received between those who viewed at least one video and those who did not view any video at all. The findings shown in Table 1 indicate that significant differences at the p=0.01 level exist in the mean scores of student grades between students who did not watch any videos and students who watched at least one video (t=3.815, p=0.000). More specifically, students who viewed at least one video received better grade (M=7.04) than those who did not view videos (M=5.68). The results for "IC1" were similar.

TABLE I. RESULTS OF INDEPENDENT SAMPLES T-TEST

Medium	Watched/Did not watch	Mean	T-statistic/
Grade	Did not watch	5.68	t=-3.815*
	Watched at least one video	7.04	

*Significant at 0.01 level

E. Viewing patterns

Researchers who focused on the behaviour of learners while watching educational videos or listening to educational audios have distinguished various viewing or listening styles.

De Boer, Kommers & de Brock [7] noted four distinct styles of viewing behaviour: (a) linear (watching a complete video once), (b) elaborative (watching a complete video twice), (c) maintenance rehearsal (watching part of a video repeatedly), or, (d) zapping (skipping through video and watching brief segments).

Moran et al. [8] dealt with listening profiles from students that listened educational audios. They recorded listening profiles that portray different salvaging activity. They noted five profiles: (a) straight-through (listening to an audio file sequentially), (b) stop-start (performing a number of pauses and resumes, from the same point, at a number of points in the audio track), (c) re-listen (stopping and going back at specific points to re-listen portions of the audio), (d)

skip ahead (pausing and moving forward, skipping portions of the audio), and, (e) non sequential (going back and forth and listening to portions of the audio). One can see that there are similarities between the viewing and listening styles recorded by the researchers.

In our setting, we found traces from all the styles mentioned by these researchers. However, learners change viewing styles from viewing session to viewing session. We found these traces by observing the section sequence graphs generated by our framework. For example, a combination of the elaborative style (watching a complete video twice) and the re-listen (or re-watch) profile (stopping and going back at specific point to re-watch a specific portion) is observed in Fig. 1 of the Introduction. Apart from observing the sequence graphs, we also carried out data-processing in order to characterize each viewing according to media actions that took place during the viewing.

In Table II, 5331 video viewings for "CT6" are classified according to the actions encountered (e.g., the 3rd line presents the number of video viewings that contain only backward jumps).

TABLE II. VIEWINGS CLASSIFIED BY ACTIONS

	Viewings containing only	N	Percentage
1	sequential viewings	3281	61.55%
2	sequential viewings - drop off	637	11.95%
3	backward jumps	333	6.25%
4	backward jumps + pause-resume actions	292	5.48%
5	pause-resume actions	250	4.69%
6	forward jumps	182	3.41%
7	backward jumps + forward jumps	153	2.87%
8	backward + forward jumps + pause resume actions	142	2.66%
9	forward jumps + pause-resume actions	61	1.14%
		5331	

It is obvious that the sequential viewing (linear or straight-through) is by far the dominant viewing pattern. Many times, though, videos viewed sequentially are abandoned before the end is reached (sequential-drop-off). We considered a video as "dropped-off" if less than 60% of the video sections were visited.

The stop-resume and backward jump actions were encountered significantly more than the forward actions, meaning that omitting parts of the video by moving forward was less frequent. However, when talking about media actions we have to take into account that various factors may cause different viewing behaviours, for example, the video quality and the length (low quality and long videos may cause more skipping and drop-offs) and the number of ways provided by the environment for accessing video segments.

The authors in [6] also obtained in their study statistics about the media actions and the viewing profiles. Their environment provided 3 different methods of accessing video segments. Only one method (mentioned as timeline) is similar to the only method that we provided in the videos as an accessing method, which is the use of the pause and resume buttons with the parallel use of the slide bar to perform backward and forward jumps. The results of our study are similar to the results derived only by this similar accessing method. This shows that sequential viewings are dominant and that the re-watch pattern (i.e., backward jumps only) is encountered more often than the "skipping" pattern (i.e., forward jumps).

III. CONCLUSIONS

This paper reports findings obtained by using the framework described in [3]. The key findings are the following: (a) logging and analysing viewing activity is very important if we want to examine viewing behaviours; relying exclusively on interviews and questionnaires for this type of research cannot give us accurate answers about learner engagement, video popularity, and the viewing patterns followed by learners, (b) students viewed educational videos mostly to prepare for exams and to complete a given assignment, (c) there is evidence that viewing videos affected the students performance, and, (d) viewing patterns recorded by other researchers exist in our setting as well; the sequential viewing is as expected the dominant pattern and the re-watch pattern (i.e., re-watching segments) follows.

Our aim is to continue to gather data from the use of educational videos in order to conduct analysis and mining in a larger dataset. Questionnaires or interviews will be used in combination to data analysis to get a better insight into learner behavior. Our research will also focus on the impact of the viewing behaviors on the learning outcomes and on ways in which knowledge about viewing behaviors can be used to enhance the learning process.

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