
HOW SCIENCE UNIVERSITY STUDENTS USE THE VIDEO IN THEIR LEARNING PROCESS?

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Summary

Science disciplines require a high capacity for abstraction and the ability to apply knowledge for solving problems in different scenarios, making these subjects specially challenging for many students and even worse in online environments. In such scenarios, educational video has proven to be an adequate resource for the effective transmission of scientific knowledge. However, once a video has been created, it is difficult tuning videos to fit the necessities of every single student, as a teacher could do in a face to face classroom. Videos can be recorded again after getting students feedback, but it is very hard work. A better approach would be to create videos as tuned as possible to the students, but that requires to know in advance what are the students' preferences and how they learn with videos. In this work we embedded a script in the web platform where the educational videos are provided to allow monitoring students' interactions with the course educational videos (e.g., clicking the play, stop or pause buttons in the video player). The data generated by the script have been analysed to study the way students of Physics at the UOC use the educational videos in their learning process for several semesters and therefore to propose how to better fit students' needs and problems in this resource. In addition, opinion questionnaires were analysed to contrast the results risen through the monitoring, and therefore to evaluate the perception of the students regarding the experimental data.

Introduction

Nowadays, educational videos are a usual media for learners that want to acquire and/or assimilate a concrete knowledge or skill. A big percentage of teachers indicate that they introduce the video to improve the learning experience and the students report some kind of use or video creation in their learning process (Kaltura, 2015). As the use of educational videos is increasing, data indicate that students spend a big quantity of time watching videos during their courses, especially in on-line environments (Lichter, 2012).

There is a wide variety of educational videos, from the pedagogical perspective (learning aims, teaching and exposition methodology, didactic approaches, editing typology...etc.); and from the technological perspective. Thus, videos can be classified following both points of view, as follows:

- From the pedagogical point of view:

- *Lecture videos*: Normally focused in transmitting conceptual knowledge (Bethany & Wagner, 1999).
- *How-to videos*: Normally focused in transmitting procedural knowledge, which normally include some sequential steps to solve a problem or explain how an activity happens in a particular way (Bethany & Wagner, 1999; Hiebert & Lefevre, 1986).
- From the technology point of view:
 - *Livescribe® technology*: created through Livescribe®, that is a ballpoint pen capable of recording the strokes that the teacher makes with the pen and what the teacher is saying while writing.
 - *Digitizing tablets*: created through a digitizing tablet, while the writing and voice of the teacher is recorded. A Wacom® tablet has been used.
 - *Camera videos*: recorded thorough a video camera or a mobile while the teacher is giving the lesson.

The pedagogical perspective, as it is understood in the present paper, is often conditioned by the contents or the competences that the video tries to teach; and the technological perspective is often conditioned by the technology available to the teacher. However, are all the videos equally useful to students? Do students behave in the same way in front of different kind of videos? Some studies point out the benefits to study how the students watch educational videos (Kim et al., 2014; Xue et al., 2015), since monitoring, the interactions of the students with the videos can provide very useful information to improve their educational experience (Kleftodimos & Evangelidis, 2014).

The present paper analyses the behaviour of students of Physics at UOC, regarding different kinds of videos from the pedagogical perspective, and of the same technological kind. The paper is structured as follows: (a) Methodology: where the experiment carried out in this work is explained, (b) Results: where the data and results achieved from the experiments are shown, (c) Conclusions: where the main conclusions from the results achieved are discussed, and (d) Future researches: where the next steps in this research are defined.

Methodology

The methodology followed is experimentation. The experiment was performed in several steps:

1. A single teacher created around fifty videos. Since all the videos have been created by the same teacher, the teacher will not be a variable to consider. The teacher has also tested the three technologies for creating videos (Livescribe, digitized table, and camera recording) to find those with which feels more comfortable, in order to maximize the quality of the output. The videos followed the same notation and structure than written docent materials that students have available.
2. The items to be recorded in order to analyse the interaction between students and the videos were defined.

3. A script was developed to be included in the webpage where the videos are available for students. This script allows tracking and recording the interaction of students with the available videos by recording the items defined in the previous step.
4. All the videos were available to students during the semester and students were encouraged to watch them. Videos followed the same structure and order than written materials.
5. After the semester:
Data recorded was analysed, and students were asked about their opinion and feelings about the videos and about how they interact with them. Two approximations were taken: a quantitative approach, through a survey, and a qualitative approach, through personal interviews.
6. Data recorded from the interaction was compared with data taken from the survey and the interviews to analyse the coherence between the three sources.

The experiment was carried out during two semesters of 2016 in the subjects of physics from different degrees in an on-line environment (UOC). The sample are 200 students every semester.

Results

In this section, results from the three sources of data are analysed: survey, interviews and interaction recorded data.

Survey

The survey has been designed to analyse the perception that students have regarding the role that videos play in acquiring the competences of the subject. The questionnaire was focused in two variables: (a) the usefulness of the videos perceived by the students regarding other educational resources (written documents, forums or any other), and (b) the impact perceived by the students in their learning process. 51 students of the sample completed the two multi-choice questions for these two variables.

Figure 1 shows the students' perception of usefulness regarding different educational resources. As can be seen, videos are perceived as a useful resource, although written materials are considered nearly as important as videos.

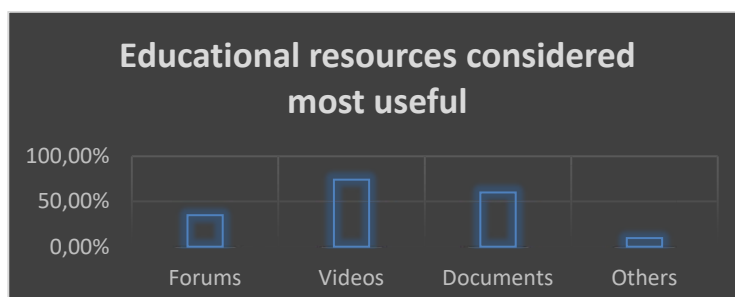


Figure 1. Educational resources considered most useful

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Figure 2 shows more specifically how videos are perceived. As can be seen, students see them mainly as a complement (nearly 70%), and less than 30% think that they should be the main resource. This result agrees with the one found in Figure 1, since most of students find documents as important as videos. These two first questions allowed to see that actually videos play a key role in the subject of physics.

In order to check the perception from students with the data recorded, students are asked several questions about how they interact with the videos:

- About the way they behave when watching videos, as can be seen in Figure 3, students feel that they normally interact with the videos rather than watching them sequentially.
- About their preferred period to watch videos, as can be seen in Figure 4, students claim that videos are mainly used during the realization of the corresponding module homework, after reading the lesson, and before the exams.

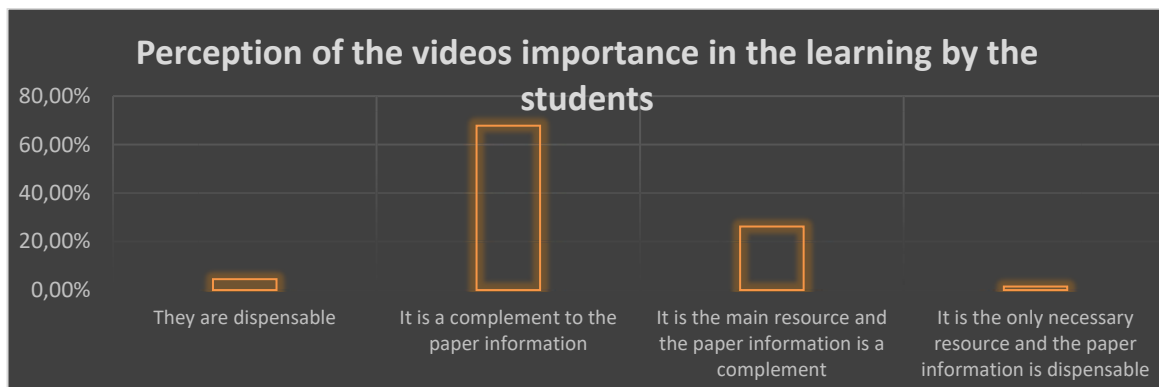


Figure 2. Perception of the videos importance in the learning by the students

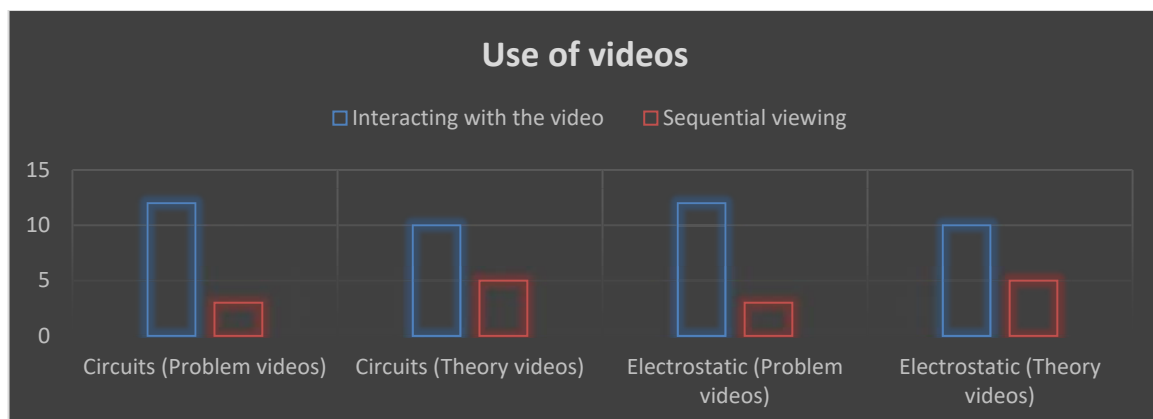


Figure 3. Graph indicating the type of use of the educational videos by the students

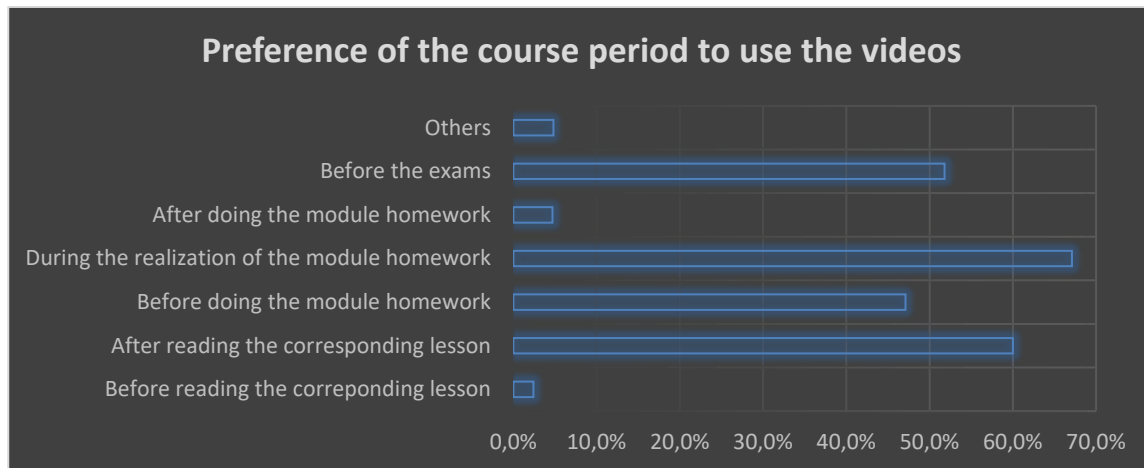


Figure 4. Preference of the course period to use the videos

Interviews

In order to increase the data and clarify some points of the questionnaire results, four students were interviewed. Table 1 summarizes the interview results, focused on the way they used the educational videos during the lessons.

Table 1: Results achieved on the interview regarding the next variable: students' perception of the videos in their education

Question	Ways of use of educational videos
Student 1	This student prefers to watch the videos in sequential way the first time, and then uses the interaction buttons to jump some parts or to stop and takes notes. Although if there is some concept difficult to understand stops and reviews this part.
Student 2	Indicates that the first time try to watch the videos in sequential way, but the second time goes to specific parts to review some particular concepts. This student prefers to watch the videos during performing the homework and before taking the exams.
Student 3	This student says that normally interact with videos from the beginning due to the necessity of reviewing concepts no understood before completing the educational video. The videos are preferable viewed during the exams period.
Student 4	This student prefers using the videos after reading the written material, but use it as a complement. The student prefers problem videos than theory videos since the student goes step by step in the process of applying the theory.

As can be seen, the interviews are in agreement with the results of the survey: students watch the videos when they are studying the subject; and although that can watch the video sequentially, they can also interact with it.

It is interesting to see the tracking of the course period when the students are watching the videos, Figures 5 and 6 show those data collected in two sequential semesters for the subjects: Electrostatic and Circuits. As can be seen, for the 1st and 2nd semesters the peaks show that the students watch the videos preferably in the middle of the course and before the exams, as some of them pointed out during the interviews.

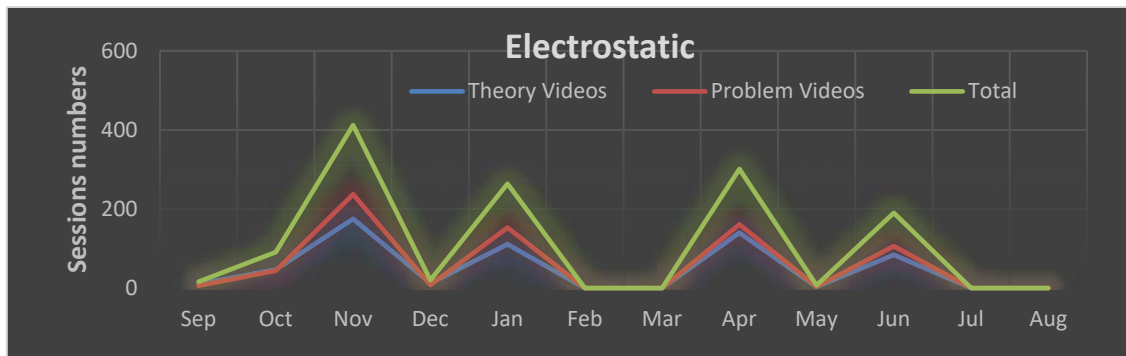


Figure 5. Number of video sessions started by the students during the two semesters for the Electrostatic subject

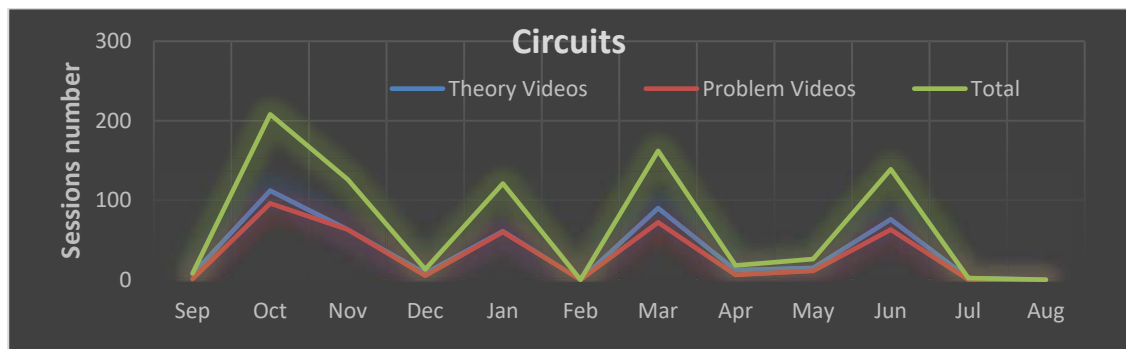


Figure 6. Number of video sessions started by the students during the two semesters for the Electrostatic subject

Data recorded

To analyse the behaviour of students with the video, 8 different types of interactions were recorded:

1. Sequential viewings: The video was watched without any interaction from the student.
2. Backward jumps: The students only jump backward during the video reproduction.
3. Backward jumps + pause-resume actions: The students jump backward and paused-resumed the videos.
4. Pause-resume actions: The students just paused and played the video reproduction.
5. Forward jumps: The students only jump forward when watching the video.
6. Backward jumps + forward jumps: The students only jump forward and backward when watching the video.
7. Backward jumps + forward jumps + pause-resume actions: The students use all the reproduction buttons when watching the videos.
8. Forward jumps + pause-resume actions: The students only jump forward and pause-resume the video.

In Figures 7 and 8, the representation of these interactions is shown for the Theory and Problem videos. Results from different parts of the subject (electrostatics and circuits) are also shown in different figures, to see if the kind of content can affect students' behaviour. In

addition, in these figures the results achieved in paper (Kleftodimos & Evangelidis, 2014) are represented for comparison reasons. In this study (Kleftodimos & Evangelidis, 2014) the authors monitored the interaction of the students with the videos for the subjects: “Introduction to Computers” and “Communication Technologies” taught at the department of Digital Media and Communication at the Technological Education Institute of Western Macedonia.

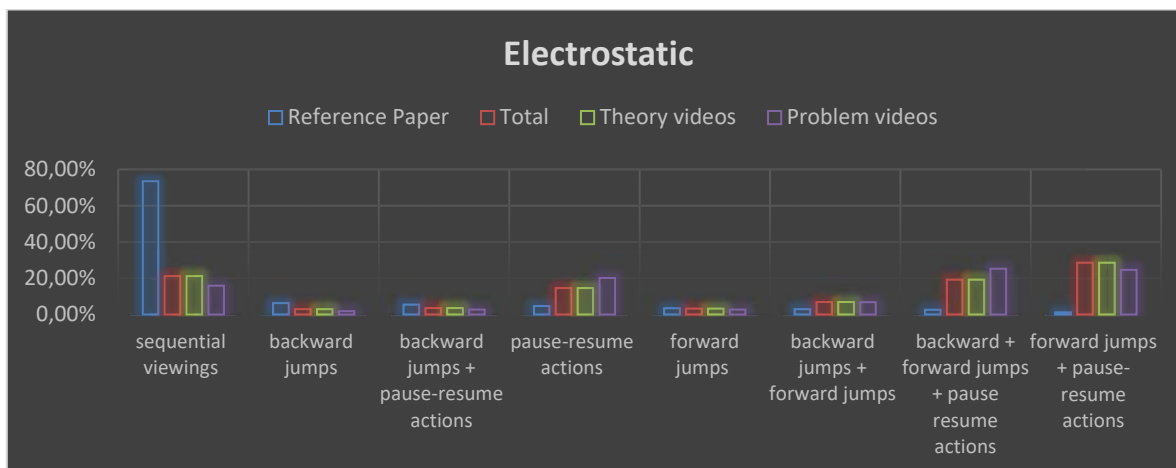


Figure 7. Students' interactions with the videos for the electrostatic subject

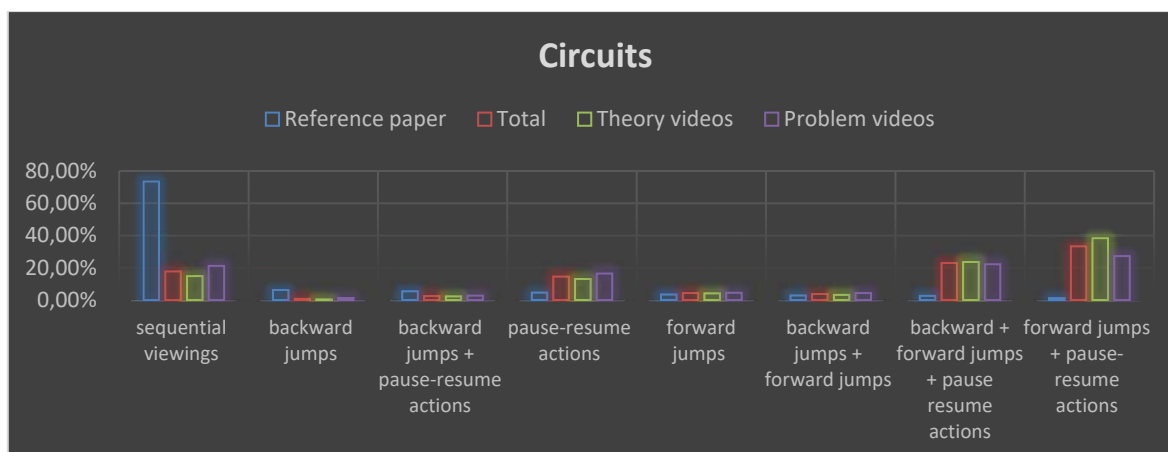


Figure 8. Students' interactions with the videos for the Circuits subject

As can be seen, in the students interact much more with the videos than in the reference study (Kleftodimos & Evangelidis, 2014). Students pointed out that they interact and review the understood concepts when watching the videos. An explanation for these differences may be that Physics subjects is a particular difficult knowledge that requires reviewing relevant concepts. This assumption is in line with Figure 4, which shows that the students feel that they need to interact with the videos to review studied material and understand difficult concepts.

It is interesting to see in these two previous figures, that students usually used almost all the interaction buttons during watching the videos. This high interaction with videos could indicate a lack of previous understanding from the students the first time they see the videos and thus, they need to stop and review the parts where the concepts they find difficult to understand are shown. So agrees with the kind of knowledge taught, which require a high

capacity of abstraction. However, it could indicate also that students use the videos as a consulting resources to review and better assimilate the information provided on paper. In further work, by tracking the number of interactions regarding the reproduction time it would be possible to see in which part of the videos these interactions are concentrated and therefore to know what concepts are difficult and need further study.

Conclusions

- Analysing the student activity on educational videos is quite important to examine viewer behaviour, since provide a more accurate information than only using questionnaires or interviews.
- The students need a higher interaction with the videos as the difficulty of the subject taught increases.
- Non-sequential viewing is the main pattern observed for the subject studied, mainly for reviewing.
- The students mainly use the videos for doing the homework, and for reviewing concepts before the exams.

Future researches

- To widen the study to add students from different environments: face-to-face and online educations and different subjects of science.
- To find out the parts of the videos where the students need to stop or review concepts.
- To use the feedback from the data collected to detect opportunity for improving the educational videos reducing the capacity of abstraction needed to understand the most difficult concepts.

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