ANALYSIS OF THE KIND OF VIDEOS AND THEIR UTILITY IN PHYSICS SUBJECTS IN VIRTUAL AND BLENDED ENVIRONMENTS

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Abstract

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1. INTRODUCTION

[2,3].

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2. PREVIOUS SITUATION

At EUSS about half of students come from what in Spain are known as professional cycles, from which access to the university is also granted. Students from these cycles are very good in the practical part. Students who come from the bacheloriat are better in the theoretical part.

A. THE SUBJECT: ELECTRICITY

The subject “Physics fundamentals of electricity” is focused on electricity. It is a first year subject that is given in the second semester in the degrees of Industrial Engineering in Electricity, Mechanics, Electronics and Industrial Organization.

According to competences acquired in the subject, students from the professional degrees usually do not need to take the subject since it is very similar to subjects they take in their professional degree.

Although it is a second semester subject, and although students have taken a first semester of physics, because of the problems with mathematics students have, the subject is given from the very fundamentals. The subject has the following structure:

- Part I: continuous electricity, where the concepts of continuous current are given: sources, and resistances. Students are expected to know how to analyze a circuit.
- Part II: altern current. In this part a source with a sinusoidal signal is analyzed. Coils and capacitors are introduced. Although they were explained from the physical point of view in the subject of physics, here, they are introduced from the point of view of their role in the circuit. The analysis is performed by using complex numbers and graphical representation of phasors.
- Part III: triphasics current. In this part triphasic current is analysed. Equilibrated circuits, non-equilibrated circuits, with and without, neutrum, are analysed. Once again, phasors analysis is performed.
- Part IV: motors, where a brief introduction of motors is performed.

The

- **Recording video:** Recording technology has been improved over the recent years. Currently, one of the most common innovations is the use of high tech cameras in video recording. Also, high definition audio recording technology has made possible the production of distortion free, high quality, crisp sound with accurate and wide frequency level. This fact together with the accessibility of this technology from affordable and portable devices (mobiles, tablets, notebooks…etc.), currently make this kind of video, the most used in education[22].

- **Animation:** Animation is the process of creating motion and shape change. The "squash and stretch" principle is often applied in case of character animation, to create the motion illusion by means of the rapid display of a sequence of static images that minimally differ from each other. Animations can be recorded on either analogue media, such as a flip book, motion picture film, video tape, or on digital media, including formats such as animated GIF, Flash animation or digital video. To display animation, a digital camera, computer, or projector is used along with new technologies that are produced. The animation has proved its effectiveness in education when adding devices to draw the user's attention to the most important information or adding explanatory texts[23].

Figure 1: Current Technology to produce/show vídeos.

- **3D Video:** The most common approach to the production of 3D films is derived from stereoscopic photography. In it, a regular motion picture camera system is used to record the images as seen from two perspectives (or computer-generated imagery generates the two perspectives in post-production), and special projection hardware and/or eyewear are used to provide the illusion of depth when viewing the film. Some methods of producing 3D films do not require the use of two images. 3D films are not limited to feature film theatrical releases; television broadcasts and direct-to-video films have also incorporated similar methods, especially since the advent of a 3D television and Blu-ray 3D. Some studies of the use of this technology on science education have been used with successful results[24,25].

- **Screencast/Livescribe®:** Corresponds to digital recording of computer screen output, also known as a video screen capture, often containing audio narration. The latest products support more compact file formats such as Macromedia Flash and have more sophisticated editing features allowing changes in sequence, focus (zoom in - zoom out), display mouse movement and eventually audio. Screencast has proved to have great potential on distance education[26].
  Livescribe® is something similar, but it is paper-based computing platform consisting of a digital pen, digital paper, software applications, and developer tools. Central to the Livescribe® platform is the smartpen, a ballpoint pen with an embedded computer and digital audio recorder. Livescribe® pens can have the potential to afford greater opportunities to engage in 'live' reflection on problem solving performance in science, to elicit reasoning and effective strategies than audio recordings alone[27].

- **Digital Storytelling:** Refers to a variety of emergent new forms of digital narratives, e.g. web-based stories, interactive stories, hypertexts, narrative computer games, audio and video podcasts, etc. This technology can help to enhance and accelerate student comprehension[28,29].

- **Hyper-Video:** Displayed video stream that contains embedded, user-clickable anchors, allowing navigation between video and other hypermedia elements. An example of software that allows adding interactivity to video is Present@[30]. Present@ is a virtual space for presentations and thesis defense, exhibitions, work order degree, etc. Coment@ (or Present@ 2.0) is the evolution of Present@ and is a tool that allows us to easily post comments embedded in the videos themselves, carrying the video one step further and making it the core of the interaction between students and students and teachers.

- **Video Conference:** set of telecommunication technologies which allow two or more locations to communicate by simultaneous two-way video and audio transmissions. It has also been called 'visual collaboration' and is a type of groupware. The interaction allowed by this kind of resources, has shown good results in practical classes for engineering students[31].

- **Others (Didactic Videos):** Any other technology for filming videos can be used for educational proposal. Thus, any video could be a didactic video, which means, a video that is not designed, specifically for educational proposal, like movies, commercials, etc. but the educator use it in class with educational purposes. A good example would be the use of parts of movies as example of physics phenomena[32].

B. CHARACTERISTICS OF VIDEOS FOR EDUCATIONAL PURPOSES

Although the kind of video most used in education is the recording video[22], it is an aim of the present paper to explore the use of the different types of videos for teaching physics at university level in e-learning and face-to-face environments (in a blended context). Therefore, after establishing the kind of videos we find, we will establish with which features can we characterize every single type of video, or we have to take into account when preparing one.

In order to perform a preliminary approach of this study, first, we needed to identify characteristics of these videos that could influence in their use as educational resources. The set of characteristics considered in this paper for classifying the kinds of videos shown on Fig. 1, have been divided in two groups, subjective, understood as those that are up to the teacher when creating a video with educational purposes; and objective, understood as those characteristics that are intrinsic to the video itself.

However, from the set of characteristics defined on table 2, we do not consider, in our research, the characteristic called “Relevance”, since the video is studied as a whole resource by itself, but not being part of other resources such as software or web applications, which can be considered in other research lines.

SUBJECTIVE CHARACTERISTIC	DEFINITION
PROPER NUMBER OF VIEWERS	The recommended number of students when using the corresponding video kind as educational resource, in order to optimize its effectiveness. For example, a videoconference is appropriate for a reduced number of people.
AUDIENCE LEVEL	The recommended educational level/knowledge of students when using the corresponding video as educational resource to optimize its effectiveness.
MAIN PURPOSE	The recommended use/s of the corresponding video as educational resource, regarding the educational aims, to optimize its effectiveness.
METHODOLOGY	The pedagogic methodology that better fits every kind of video. For example, screen capture is appropriate for a problem solving oriented methodology.

Table 1. Subjective characteristics to classify educational videos.

OBJECTIVE CHARACTERISTIC	DEFINITION
ELEMENTS	The video can content different elements, images (statics or not), audio, text, etc. This characteristic describes the main elements that will appear in the video.
MOMENT OF THE VIEWING	This characteristic defines if the video is displayed in real time, after recorded or could be any of them.
AUTHOR-VIEWER	This characteristic defines who is the author of making the video and for who audience. It could be videos made by students for other students, for the teacher as part of a task/research or the teacher for its students.
COMMUNICATION WAY	This characteristic defines if the video let the viewer to provide a feed-back, two-way communication or if the communication is only in one way.
ITEM OF THE RECORDING	The video could be focused on a digital board, the lecturer, a laboratory, etc. This characteristic defines which is/are the main items that the video is focused on.

RELEVANCE	Sometimes, the video is not used as an isolated resource but being part of others such as software. This characteristic indicates the relevance, in percentage, that the video represent on the whole educational resource used. If it is used just by itself it will represent the 100% of the resource.

Table 2. Objective characteristics to classify educational videos.

After classifying videos, we perform a user test. In the following sections we will show the methodology followed and the results obtained.

3. METHODOLOGY

The videos used for testing were prepared but several teachers of the subjects, with no professional multimedia background. The kinds of videos were the following:

- Recording video: this kind includes the teacher explaining in front of a blackboard, as well as similar videos from YouTube where the teacher explains in front of the camera or perform some experiments.
- Animation videos: the prepared animated videos combined animations with videos available in YouTube, but with the sound added by the subject teacher in order to give coherence to all the project.
- Screencast/livescribe videos: these videos were prepared with several technologies: a digitalizer tablet, a tablet, a digital blackboard and a livescribe®.

We have chosen these kinds because they are the most common educational videos.

Regarding the subjective characteristics, the videos chosen accomplish the following items:

- Proper number of users: the complete classroom.
- Audience Level: students of first year degree of Industrial Engineering Studies and Computer Science. Engineering students came from blended environment (EUSS) and computer science students came from a total virtual environment (UOC).
- Main purpose: the purpose of the videos were reinforcing the regular classes. Therefore, it would be possible to follow the course without the videos and was up to the students to use them.
- Methodology: the methodologies used have been: giving lessons, problem solving and real examples.

Regarding the objective characteristics, we find:

- Elements: there were four kinds of videos: teacher appeared solving a problem in the blackboard or making some experiments; theoretical explanations combining screen capture, animations, etc.; problem solving using screen capture or Livescribe®. It is important to note that Livescribe® allowed downloading the pdf with the problem solved.
- Moment of the viewing: videos could be visualized at any moment.
- Author-viewer: videos were created only by teachers and the target audience were students.
- Communication way: the only feedback allowed was sending e-mail's to the teacher.
- Items of the recording: the blackboard, the teacher and the experiments.

The methodology used to analyze the videos is interviewing several students with different roles. All of them were in a physics subject:

- A student from a virtual university (UOC) that had access to all the videos during the semester.
- A student from a face-to-face university (EUSS) that had access to all the videos during the semester and could attend classes.
- A student from a face-to-face university (EUSS) that had access to the videos, but could not attend regularly to classes.

Since this is an exploratory study, there were a generic question: which kind of video do you prefer? Then, there were some questions for every kind of video: which merits do you find for this kind of video?

Which drawbacks or problems do you find for this kind of video? Do you watch the videos completely, and/or stopped and moved when watching it? Do you watched videos more than once? Do you think that videos saved you time? What do you think about duration of videos? What do you think about the teacher appearing in the scene? (Only in face-to-face environment) Do you think that if videos would cover all the items of the subject, it is possible to not attend classes? And finally, do you want to add any comment?

4. RESULTS

From the interview we found the following results, regarding every single question.

- Which kind of video do you prefer? All interviewed students agreed that the most useful videos were problem solving LiveScrive®/screencast videos where a problem is solved. They all emphasized the quality of the explanations and the added value they represented.
- Which merits do you find for this kind of video? Regarding the problem solving LiveScrive®/screencast, the main merit was the quality of the explanations and the possibility of watching the resolution at the appropriate speed in order to adapt to their own learning speed. Regarding videos with people showing something, students emphasized the relationship between theory and everyday experience. About theoretical videos, with or without animations, they all agree that having read the theory information or having attend to classes, they are O.K. but have little added value.
  It is important to note that the technology used for the creation of screencast videos were transparent for students. They did not realize that several technologies were used and only emphasize the utility of the video.
- Which drawbacks or problems do you find for this kind of video? No students found any drawback at all. They agreed that the worst is there are so few videos. They also complain about 20 – 30 minutes videos, that the find too long. One of the student complained about the quality of the draws. Regarding theoretical videos that combined several sources, a student complained about the lack of uniformity and the lack of quality image of some YouTube videos.
- Do you watch the videos completely, and/or stopped and moved when watching it? Students usually watched theoretical videos completely. The behavior was different regarding problem solving videos: they usually solved the problem while watching the video and stopped it when they needed more time; or went back when something was not clear. Regarding theoretical videos, some students performed other tasks while watching the video and sometimes have to rewind. However, sometimes students watched the video are twice its speed.
- Do you watched videos more than once? Regarding this item, face-to-face students did not re-watched videos, but virtual student usually watch it two or three times.
- Do you think that videos saved you time? All students agree that videos made them save time and would have need quite more time to get the same result without the video (or even probably would have not get the same level of comprehension).
- What do you think about duration of videos? All students considered that until 10 minutes is O.K. mainly in problem solving videos because they usually are also solving the problem. 20 minutes videos would be too long.
- What do you think about the teacher appearing in the scene? Here we find again a difference between virtual and face-to-face environments: in face-to-face environments students find no sense to seeing the teacher, and even think that can distract them; nevertheless, in virtual environments, the interviewed student found pleasant to see the teacher.
- (Only in face-to-face environment) Do you think that if videos would cover of the items of the subject, it is possible not attend classes? The interviewed students find the video complementary to classes. Therefore, they would attend to classes. However, in case that attending to some classes would be difficult for them (because a stress situation at job), having videos available can make them to not attend.
- Extra comments: One student suggested that would have been useful to show how the calculations with complex numbers were performed with the calculator. Other extra comments were:
  - No student downloaded the pdf with the resolution in LiveScribe® videos.

- Students usually watched the videos when the exam or any other evaluation step was coming.

5. DISCUSSION AND CONCLUSIONS

In the present paper we have shown three proposals of classification of videos, regarding the kind of videos, their pedagogical characteristics (that we called subjective) and their intrinsic characteristics (what we called, objective). Three kinds of videos (recording video, animation and screencast/livescribe videos) have been tested in the physics subject in a real environment. The tests have been carried on in a virtual environment at UOC and in a blended environment at EUSS. At UOC students were studying the degree in Computer Science and at EUSS the degree in Industrial Engineering.

The study has been performed by interviewing three students: one virtual, one face-to-face who attended classes, and one face-to-face who not attended classes usually. All interviewed students found videos very useful and agreed that they saved time to them and their only true complaint was they wanted more videos. They even looked for extra videos at YouTube or Vimeo. However, all interviewed students agree that video is a complement to regular material/method, and they do not see them as the center of the subject. They even say that videos are more useful when watching at them after studying or attending classes.

All interviewed students answered that the most useful videos were those in which a problem is solved. In these videos, they usually solved the problem at the same time and, therefore, combined the video with an action from them. On the other hand, the subject evaluated is problem solving oriented, which can explain their interest. Nevertheless, they claim that those videos were very well explained and solving the problem at the same time helped to understand theory. It is important to note that they did not notice the different processes of creation. This is key for teachers since they could choose the more efficient system for them, without losing pedagogical effectivity.

However, although teachers can choose whatever system they want to create screen capture/Livescribe® videos, they have to be aware of quality, because it is key for students: all students agree that videos were so useful because of the quality of the explanations, and the only complain came from the quality of the draws and letter. Therefore, as Kuomi[21] says, quality is something that is clue in docent videos.

Regarding environment, the main differences between face-to-face and virtual environments are: 1) virtual students like to see the teacher in the video; and 2) virtual students watched videos more than once, probably because face-to-face students have also the opportunity to attend classes.

Taking all these items into account the main conclusions are: 1) videos are useful for students and save time to them; 2) it is important to take into account quality of the explanations and duration of the video; 3) videos are more effective when students perform some action related to the video when watching at it and when they are tuned with assessment; and 4) teachers can make screen capture videos by using the more efficient technique for them without loose of pedagogical effectivity.

However, we have seen that students are in a problem solving assessment content, and that they watched the videos mainly when are near an assessment. Therefore, more works should have to be done in order to see if the kind of assessment affects the behavior of students regarding videos, as well as the kind of video they find more interesting.

The results obtained in this paper are a first step in a research that will study the influence that has the use of different types of videos and their characteristics in the teaching of physics at university level in e-learning and blended environments. After establishing the kind of videos, the next step will be to study how interaction through video will be possible, by using hypervideos will be studied: including some actions within the video maybe can increase their interest in theoretical videos. On the other hand, some tests should have to be performed in order to establish some relationship between assessment and video. We expect the results of this research allow us to conduct a thorough classification of enriched videos and a development of a guide that allows the university community taking decisions and propose their own adaptable elements for videos, so the teaching of physics subjects in particular, and of fundamental sciences in general, could be more effective.

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7. REFERENCES

[1] Sunal, Dennis W.; Hodges, Jeanelle; Whitaker, Kewin W.; Freeman, L. Micheal; Edwards, Leo; Johnston, Ronald A.; Odell, Micheal (2001). Teaching Science in Higher Education: Faculty Professional Development and Barriers to Change. School Science & Mathematics, May 2001, Vol. 101 Issue 5, p246.

[2] Ulriksen, L., Madsen, L. M., & Holmegaard, H. T. (2010). What do we know about explanations for drop out/opt out among young people from STM higher education programmes? Studies in science education, 46(2), 209-244.

[3] Troelsen, R. (2011). Frafald på de videregående uddannelser. Hvad ved vi om årsagerne? Dansk Universitetspædagogisk Tidsskrift, 10, 37-44.

[4] Allen I. E. & Seaman J. (2013). Changing course: ten years of tracking online education in the United States. United States. San Francisco, CA. [Visited the 9th of May, 2015]. http://www.onlinelearningsurvey.com/reports/changingcourse.pdf.

[5] Levy, Y. (2007). Comparing dorpouts and persistence in e-learning courses. Computers & Education, 48(2), 185-204. doi:10.1016/j.compedu.2004.12.004.

[6] Grau-Valldosera, J., Minguillón, J. (2011). Redefining dropping out in online higher education: a case study from the UOC. LAK '11. Proceedings of the 1st International Conference on Learning Analytics and Knowledge, ACM New York.

[7] Luzón Marco, M. J. (1994). "A Functional-Semiotic Analysis of Visual Aids in Scientific Discourse." Miscelánea 15: 367-90.

[8] Scharrenberg, J. (2011) ¿Qué son los medios sociales? (Comunicación y Social Media). http://scharrenberg.net/2011/05/socialmedia-redessociales/ [Visited the 14th of May, 2015].

[9] Moran. M, Seaman J. & Hester T.K. (2011) Teaching, Learning, and Sharing: How Today's Higher Education Faculty Use Social Media. http://files.eric.ed.gov/fulltext/ED535130.pdf [Visited the 14th of May, 2015].

[10] Astrom R. (2011). Advanced acoustic demonstration videos for higher education: Longitudinal wave motion. J. Acoust. Soc. Am. 129, 2646. http://dx.doi.org/10.1121/1.3588821.

[11] Lichter, J. (2012). Using YouTube as a Platform for Teaching and Learning Solubility Rules. J. Chem. Educ., 2012, 89 (9), pp 1133–1137. DOI: 10.1021/ed200531j.

[12] Chasteen S.V. (2012). Videos on effective group work and clicker use in physics instruction from the Uniwersity of Colorado Science Education Initiative and the Uniwersity of British Columbia Carl Wieman Science Education Initiative, STEMvideos.colorado.edu. Phys. Teach. 50 , 189. http://dx.doi.org/10.1119/1.3685129.

[13] Herron, C., Cole, S. P., Corrie, C. & Dubreil, S. (1999). The Effectiveness of a Video-Based Curriculum in Teaching Culture. The Modern Language Journal, 83, iv, 0026-7902/99/518-533.

[14] Shephard, K. (2003). Questioning, promoting and evaluating the use of streaming video to support student learning, British Journal of Educational Technology, 34 (3), (in press).

[15] Gómez, C.D.I. & Pérez, C.R. (2013). Del vídeo educativo a objetos de aprendizaje multimedia interactivos. Tendencias pedagógicas, ISSN 1133-2654, Nº 22, 2013 , págs. 59-72.

[16] Mutlu Bayraktar, Duygu and Altun, Arif. (2014). The effect of multimedia design types on learners' recall performances with varying short term memory spans. doi: 10.1007/s11042-012-1257-z.

[17] Pereira, Marcus Vinicius, Barros, Susana De Souza, De Rezende Filho, Luiz Augusto C, Fauth,Leduc Hermeto De A. (2012). Audiovisual physics reports: Students' video production as a strategy for the didactic laboratory. Physics Education, 47(1), 44-51. doi:10.1088/0031-9120/47/1/44.

[18] Sue MG, Voegeli D, Harrison M, et al. (2003). Evaluating the use of streaming video to support student learning in a first-year life sciences course for student nurses. Nurse Educ Today. 23(4):255–261. doi: 10.1016/S0260-6917(03)00014-5.

[19] Cofield J. (2002). An assessment of streaming video in web-based instruction. In: Annual Meeting of the Mid-South Educational Research Association, Biloxi. University of Montevallo, Montevallo. http://files.eric.ed.gov/fulltext/ED471348.pdf. [Visited the 14th of May, 2015].

[20] Vavra K. L., Janjic-Watrich V., Loerke K., Phillips L. M., Norris S. P. and Macnab J. (2011). Visualization in Science Education. ASEJ, Volume 41, Number 1, January 2011. http://www.ualberta.ca/~lphillip/documents/asej-22-30.pdf. [Visited the 14th of May, 2015].

[21] Koumi, Jack. (2006). Designing video and multimedia for open and flexible learning. New York [etc.]: Routledge. ISBN: 041538303x.

[22] Kolås L., Robin M., Hugo N, Nord-Trøndelag. (2012). University College, Norway. World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education, Oct 09, 2012 in Montréal, Quebec, Canada ISBN 978-1-880094-98-3.

[23] Lowe R., Schnotz W. (2007) Learning with Animation: Research Implications for Design. Cambridge University Press New York, NY, USA ©2007, ISBN:0521617391 9780521617390.

[24] Kaufmann H. & Schmalstieg D. (2003). Mathematics and geometry education with collaborative augmented reality. Computers & Graphics Volume 27, Issue 3, June 2003, Pages 339–345.

[25] Henn, J.S., Lemole G.M., Ferreira M.A. T., Gonzalez L. F., Schornak M., Preul M. C and Spetzler R. F. (2002). Interactive stereoscopic virtual reality: a new tool for neurosurgical education. Journal of Neurosurgery. January 2002 / Vol. 96 / No. 1 / Pages 144-149.

[26] Pinder-Grover, T. ; Center for Res. on Learning & Teaching, Univ. of Michigan, Ann Arbor, MI ; Millunchick, J.M. ; Bierwert, C. (2008). Work in progress - using screencasts to enhance student learning in a large lecture Material Science and Engineering course. Frontiers in Education Conference, 2008. FIE 2008. 38th Annual. DOI: 10.1109/FIE.2008.4720446.

[27] Hickman M. (2013) Engaging students with pre-recorded 'live' reflections on problem-solving with Livescribe pens. Research in Mathematics Education. Volume 15, Issue 2, 2013. DOI:10.1080/14794802.2013.797738.

[28] Robin B. R. (2008) Digital Storytelling: A Powerful Technology Tool for the 21st Century Classroom, Theory Into Practice, 47:3, 220-228, DOI: 10.1080/00405840802153916.

[29] Barrett, H. (2006). Researching and Evaluating Digital Storytelling as a Deep Learning Tool. In C. Crawford et al. (Eds.), Proceedings of Society for Information Technology & Teacher Education International Conference 2006 (pp. 647-654). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE). Retrieved May 18, 2015 from http://www.editlib.org/p/22117.

[30] Bretones E., Perez-Navarro A., Conesa, J., Marín, A., García M., Moya C. & Finney N. (2014). Transits/Coment@: An Interacttive tool to annote videos. EDULEARN14 Proceedings, 978-84-617-0557-3, 2340-1117. Pag. 2262-2271.

[31] Long J., Chenery K. L., Stannard W. B., Fitzgerald, K. J. (2013). Use of web-conferencing software to enhance practical learning for distance students in a first-year Engineering course. Australasian Association for Engineering Education. Conference : (24th : 2013 : Gold Coast, Qld).ISBN: 9780992409913.

[32] Quirantes, A. (2012). "Física de película" (movie physics) an example of the use of movies in frist course university teaching. Revista Electrónica de Investigación, Docencia y Creatividad, 1, pp. 88 – 102.