Is a video used as a didactic content effective in the learning process?

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Abstract **– The tendency is for video usage to grow in coming years and it will become increasingly important for institutions that produce and use these multimedia materials for their core activities to configure their use in order to evaluate the resources needed. The production of this content requires a sophisticated infrastructure and team to manage the entire process, from recording the videos to editing to distribution. Because this process requires time and production tends to be expensive, it is important for educational institutions to assess the real benefit of using video in teaching and learning environments. Based on this finding, we used a monitoring system to verify the student behavior with regards to didactic video material offered, intending to evaluate the degree of knowledge absorption through this media, as well as their engagement with the subject. In this paper we present three experiments performed with different audiences, including classes from engineering courses. In our experiments we tried to create different scenarios that allowed us to estimate the acceptance of the teaching material in video format, in addition to its impact as an information source. The videos were made available in different situations using both a distance learning environment and a multimedia classroom. In all cases, the audience answered a questionnaire about the subject they were watching to verify the level of information absorption.**

Keywords - video, viewer engagement, learning processes.

I. INTRODUCTION

The use of different media formats as instructional material has brought many questions about the actual effectiveness of the same in the teaching-learning process. Although video consumption predictions indicate rapid growth in years to come, there are a lot of doubts about the benefits of its usage. Students, especially younger ones, tend to prefer video content, because apparently audiovisual content allows information absorption more quickly and easily. However, it is necessary to examine this aspect carefully, because this trait can vary both with the usage scenario, as with the perception and cognitive abilities of the student. In this context it is very important to be able to assess how much a particular didactic material in video format was effective in building the students' knowledge, be it an individual student or a group of students.

In recent years, we have worked to develop a system that, can be integrated with a video portal or LMS, would allow monitoring student behavior when accessing videos and map their degree of engagement with the subject and the degree of information absorption achieved. To validate such a system, we performed some experiments which proved inconclusive, given the complexity of the teaching- learning scenario.

We also developed a tool to evaluate the degree of absorption of knowledge through media consumption, as well as the engagement users present with the subject. The concept of "viewer engagement" can be used in many ways, considering aspects such as usage scenario, age, or user´s cognitive characteristics, or by verifying the degree of involvement, using interactive tools and social networks to disseminate information

or feelings about watching the video. In our case, as we are more focused on education scenarios, with computer engineering students our a tool is aimed to monitor the video consumer behavior and, from polls, posting of opinion and multiple choice tests, infer about user interest about the video and the absorption of the content [3].

So, continuing our investigation, we wish to evaluate the degree of student satisfaction with regards to different formats of teaching materials, the degree of absorption of knowledge through this media consumption, as well as the students' engagement with the subject. In our case, we have focused on education scenarios, working with computer engineering students and computer and science students. As a result, one possibility is to compare the students' opinion of a video explanation, for instance, and their results in a formal evaluation.

In this paper we present three experiments in learning and information context using video, as well others formats of instructional content, and we aim to verify the acceptance of the teaching material in video format, not to mention its impact as a source of information.

This paper is organized as follows: Section II presents related work. The monitoring system is described in Section III. The Usage Scenario is described in Section IV. Finally, the results, analyses, conclusions, and future work are presented in Sections V.

II. RELATED WORK

Projections indicate that by 2012, video use will constitute half the consumption of network resources all over the world, thus surpassing the P2P traffic, currently responsible for the greater part of network traffic. By the end of the decade, projections indicate that this percentage will fit about 90% of the network bandwidth [1].

With this forecast it is extremely important to verify the efficiency of video format in learning/teaching activities in order to ascertain its impact as an information source and the degree of knowledge absorption.

However, it is known that the absorption of knowledge is related to cognitive aspects and learning styles that may vary greatly from person to person. Ebru [4] states that the learning style can be modeled by the learning models approach, and this can be extracted based on behavioral factors, such as a user's browsing history and his/her prior knowledge. He also affirms that the use of the learning style capture tools is compatible with traditional questionnaires used to assess learning style. Other research [5] presents a system that, based on the recognition of different patterns in learning styles, can automatically adapt to the interests and knowledge levels of learners.

Brunken [8] developed a computer-based instrument that provides a direct and objective measure that integrates aspects of both working memory research and cognitive theories of multimedia learning. His work showed that there is a large variation in cognitive abilities depending on the subject's age, emotional state, and conditions of multimedia content consumption.

Zhang [7] demonstrated through his work that students in an e-learning environment that provided interactive videos achieved a significantly better learning performance and a higher level of learner satisfaction than those in other settings. Nevertheless, we believe that learning performance and satisfaction strongly dependent on the students profile and content subject, so it is important to explore other scenarios and cases.

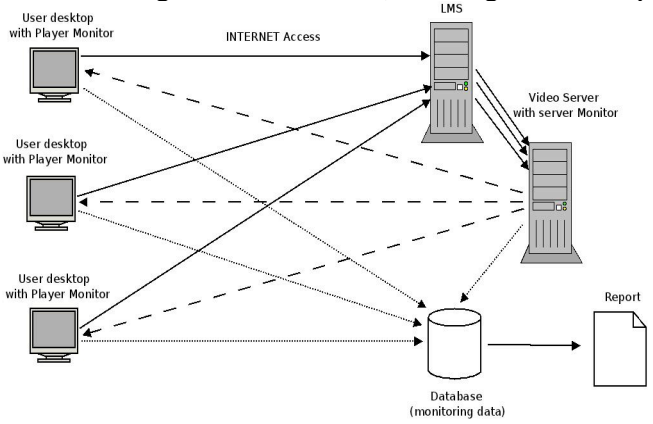
In another work [6], an objective assessment of the impact of lectures was made via the use of video clips on student learning over traditional teaching methods, which concluded that video clip usage is at least as equally effective as standard teaching lectures. But this study was done with the participation of only five students.

We believe that a greater investigation of the effectiveness of using teaching materials in video format that considers different scenarios, students' characteristics and video subjects is necessary.

III. THE MONITORING SYSTEM USED

To assess video usage, we used a monitoring system that is composed of four modules, as shown in Figure 1.

- Server module: monitors the metrics related to server;
- Application Module: responsible for metrics related to user interaction with application;
- QoE and Content Absorption Module: records the QoE and content absorption´s assessment score;
- Report Module: responsible for using the data obtained, crossing it to allow proper result analysis.



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Using the monitoring system makes it possible to get many video consumption metrics that can be classified by:

Video Player Parameters – monitored based on user interaction with video player:

- Mouse actions;
- Windows focus;
- Pause, fast forward, rewind
- Use of the Comments tool;
- Interaction with social network tools (Facebook, twitter).

QoE – check the level of user satisfaction proposing a poll;

- Related to video content quality;
- Related to video quality;
- Related to transmission quality.

Content Absorption – check how much user has learned watching video content:

- Evaluation based on test learning validation;
- Other activities to check content absorption (debates, work groups, etc).

Please, refer to [3] for more information about system implementation.

IV. SCENARIOS OF STUDY

To continue our research into the effectiveness of using videos as educational material, we set up three distinct scenarios to evaluate the use of this media. In one case, the video was compared to other formats of educational material, while the other scenarios had the main objective of observing the acceptance of the educational content in video format and the degree of absorption of that knowledge.

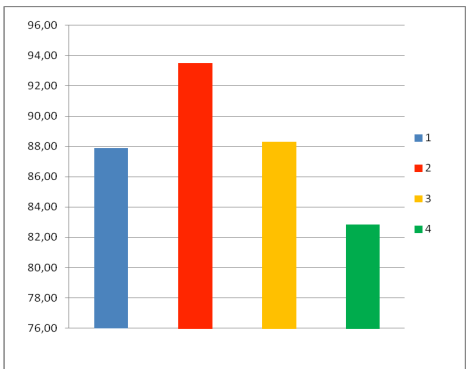
A. Scenario I:

In this experiment the main objective was to verify students' learning performance and satisfaction using different formats of content about the same subject. We considered four groups of engineering students, from the same classroom and presenting the same background, that were randomically divided, in which the subject Computer Networks was explored. For each group an activity was prepared as described below:

Group 1 – The students used a laboratory with individual computers, watched two videos, logged into the video system and responded to ten multiple choice tests;
Group 2 – Students used a multimedia room with a projector and screen, watched two videos played twice (where students could use rewind and reproduce the videos many times as they wanted), and took a multiple choice test with ten questions;
Group 3 – Students in a traditional classroom were given a text about the same subject and answered the same ten multiple choice questions;
Group 4 – Students attended a lecture about the same subject and answered the same ten multiple choice questions.

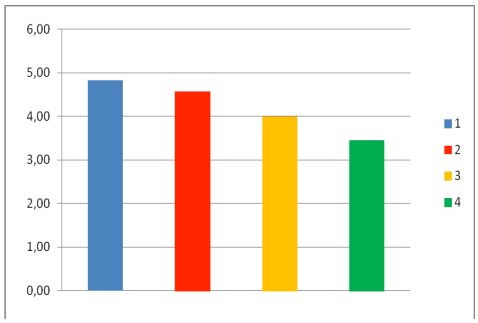
We also asked students to identify his/her absorption degree about of the subject shown, indicating 1 to 5 (1 for "not understand anything," and 5 for "completely understood everything").

The graph below shows the performance of the students from four groups when responding the tests to evaluate the assimilation of the material. In graph 1, the bars represent each one of the groups and the x-axis represents the grade obtained on the test.



Graph 1: Average grades obtained by the four groups

Graph 2 shows average degree of confidence in learning expressed by the students of each of the four groups.



Graph 2: Average degree of confidence in learning

In Graph 1 we can see that the student group (group 2) that presented a higher average score (93.51) were the ones who watched the didactic video content in the multimedia room and not those who watched the videos on personal computers, where they might use the rewind functions and watch as many times as they wished. This can lead to believe that the fact of the multimedia room environment was better as there are more comfortable chairs, proper lighting and sound, projector and screen for high quality video. We can also presume that the fact that the students do not have access to other devices to access the Internet with the possibility navigation in other web sites may have been decisive in that they have paid more attention to the video content.

Another observation about Graph 1 is that students who read the text on the subject (written by the teacher) and those who attended the class, obtained the same average score. This leads to believe that the teacher was faithful passing the same information and the same quality in textual form and expository manner.

The Graph 2 we can see that the group 1, who watched the videos on personal computers, that might use the rewind function and watch as many times as they wanted, were those who felt more confident about the absorption of the information presented in the video. Also in the Graph 2 we can observe that the group that used our system was the group that presented more confidence in his/her learning process and maybe this result results from the fact that our system monitors students' actions and interact with them in the same linguage that is used in social networks and from marketing systems focused in observe users behavior.

B. Scenario II:

In this second scenario, a virtual video lecture was administered to the students in a subject obligatory to all engineers, all basic Science classes in a Computer Science Course with an explanation of a theme of medium complexity, all in the form of a video in which the student could follow the material via power point slides.

The theme of the class was the area of complex networks and the class evaluated in this example dealt with modeling networks from graphs.

The content given was of a medium difficulty, with very clear examples that gave the students all the information necessary to complete the exercises afterward.

After the class, the students answered a questionnaire for evaluation, with the intent of gauging the students' understanding of the class and whether or not they liked the virtual format. The results are displayed in Table 1 below.

Table 1 – Questionnaire given to the first group of the second year

Questions ranging from 5 (the best) to 1 (the worst)	5	4	3	2	1
Q1: What did you think of this class format, with video and individual exercises?	57	16	1	0	0
Q2: Do you prefer traditional classroom settings?	2	27	35	6	4
Q3: Would you like for this subject to be offered as distance learning class?	5	15	11	45	2
Q4: Would you like for this class to be offered as a hybrid course, mixing traditional classroom settings with some distance classes?	12	47	7	8	0
Q5: Do you think the video material was fundamental to your conprehension?	11	45	14	4	0
Q6 : Do you need to consult other sources for your learning?	4	24	21	19	6
Q7: Proposed activities were coherent with the educational material available (slides e videos)?	20	45	8	1	0
Q8: Was there a lack of clarity in the activities?	4	11	17	34	8
Q9: Did you have the patience to watch the entire video?	40	25	5	4	0
Q10: The quality of the video was...	23	42	9	0	0
Q11: The quality of the transmission was...	39	33	2	0	0
Q12: The audio quality was...	29	39	5	0	1
Q13: The audio transmission quality was...	26	44	3	1	0

We can start with the students' responses to verify some interesting details, such as the hour of this class not being the most attractive hour for the students: Monday morning at 8:00 a.m. This may lead some students to favor distance education. However, this did not occur: the great majority of the students preferred the traditional classroom setting when asked why, it was said that not being able to have their doubts resolved immediately discouraged the students.

Another interesting factor is the greater part of the students related that both the quality of the video and the sound were very good. However, even in these conditions, the students would not like for the entire class to be administered via distance education. Some distance classes were considered acceptable, meaning that a hybrid course was the most desirable for these students.

B. *Scenario III:*

This third scenario had the objective of collecting video access data, specifically the data for educational videos. The results would allow for a qualitative evaluation of the data that were being monitored, which itself would allow us to gauge the effectiveness of the monitoring system. The videos used were donated by the MAST (Astronomic Museum, *www.mast.br*) and contained documentaries and research reports relating to astronomy.

All the data presented was obtained through the monitoring service we developed. Some of the data was obtained automatically and the rest was gathered manually.

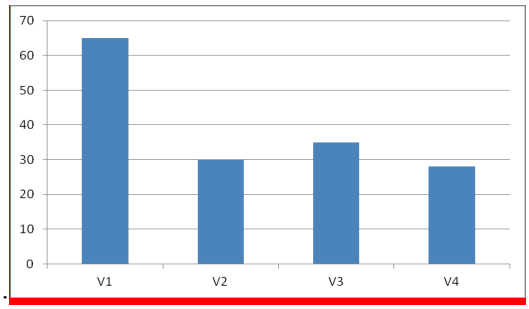
In the experiment, four videos provided by the MAST were used. The following results were gathered for V1, V2, V3 and V4:

V1: Becoming Familiar with the MAST library. [Duration: 05:22]
V2: International Environment Day – Do your part and make a change! [Duration: 14:15]
V3: Preservation: What is it worth? It's worth it for you! [Duration: 16:35]
V4: Creating national territory through cartography during the 1940s and 1950s. [Duration: 23:45]

In the case of video, given the cost associated with maintaining this sort of application and producing adequate material, it's important to guarantee that the videos will reach the targets they strive for.

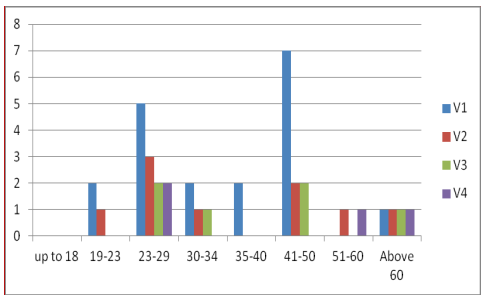
More than following a trend, which is the more frequent use of video contents, it's important to understand if this subject matter in a video format is being explored effectively.

A total of 158 accesses were recorded, distributed according to the data showed in Graph 3. One interesting observation is that video V1 had the greatest number of accesses. This may be in virtue of the video dealing with a simpler theme or because it was the shortest video. Probably these both factors reflected in the result observed and the same arguments can explain the lowest number of access of V4 video as it is a longer and denser video, factors that could discouraged viewers of V4 video

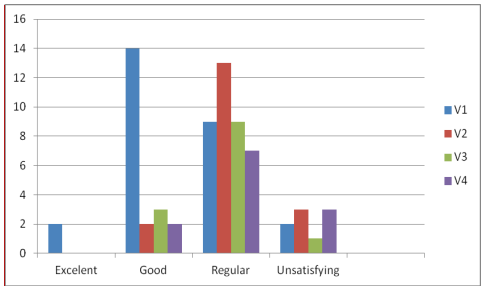


Graph 3: Number of access for each video

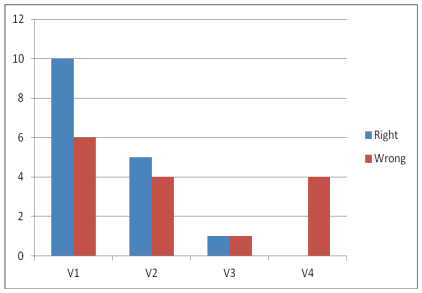
The next graphs show some detailed results from questionnaires that were applied.



Graph 4: Age range of people who consumed the video



Graph 5: satisfaction of people who consumed the video



Graph 6 Results obtained with questions about the content of the videos

In this scenario we observe a greater variety of results from user profiles with respect to age, to the satisfaction indicated by them. We observed that few people answered the mequestions that have been posed on the contents of the videos.

V. CONCLUSIONS AND FUTURE PROJECTS

In this paper we presented some scenarios that used didactic video contents used in educational environments aimed to observing the engagement and behavior the students faced to educational video contents. In some scenarios we used a tool we developed using the concept of "viewer engagement" (from marketing field) to monitor the video consumer behavior and, from polls, posting of opinion and multiple choices tests, infer about user interest about the video and the absorption of the content [3].

In the first scenario we can conclude that students from the Group 2 that watched the didactic content in a very confortable videoconference room, presented a better performance from the others 3 Groups indicating that the environment and characteristics physical space that students watch to a didactic video content as also the impossibility of distraction from because of other sites or other applications, in case of

Internet environment, can interfere in students' comprehension and consequently in their performance.

In the second scenario we observed that the great majority of the students preferred the traditional classroom once they reported the lack of interaction and delay in answer of eventual questions and even in good conditions of transmittion and quality of the video and the audio content the students prefered a blended class format. Finally in the third scenario we observed that results according to user profiles with respect to age and to the satisfaction showed mostly that they perceived the videos as regular contents.

From these 3 scenarios and considering the constant growth of video use in the Internet we can conclude the importance of observing viewers engagment and its satisfaction in watching video contents. Specially in didactic environments it is important to continue to observe the effectiveness of video use in students' learning process and we concluded that is only from this observation that we can improve ours materials. We plan to continue our researches by expanding with new scenarios and with a larger number of students.

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