

Learner Centered Requirements for Enhancing an Existing Software Architecture to Support Learning Using On-line Videos

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Abstract: In this paper, we describe our ongoing research focused on identifying requirements for designing, developing and deploying an environment capable to enhance educational activities relying on videos contributed by students. We present a joint effort conducted by researchers from three countries bringing their results from previous efforts focused on the interplay between learning and technology for optimizing the pedagogical exploitation of online videos. In order to reach these goals, we use data collected from 204 students where they shared their experiences and insights based on their experiences while using videos for their own learning. The presented research illustrates the transformation of these students' insights into actual system requirements. These requirements are collected and examined in order to be used for the design, development, evaluation and refinement of an existing system while aiming to deploy a mature environment enabling an optimized experience of on-line videos in educational settings. Last but not least, we discuss the benefits of our approach in the light of benefits and future challenges to incorporate videos in educational activities supported by a software architecture that relies on web technologies. Finally, we summarize and discuss our efforts in the light of future research while aiming to practice future deployment of such architecture. In these future iterations, we discuss new stakeholders possibly assisting in identifying new requirements and contributing with innovative ideas for best optimization of videos supported by TEL environments offering meaningful and appealing learning.

Keywords: Learning systems platforms and architecture, online videos, Learning Analytics, Social Media

1. Introduction

In recent years, teachers and students are increasingly experiencing the benefits of using online videos for educational purposes (Reychav & Wu, 2015). Digital videos available over the web are increasingly becoming popular as they are turning into an important alternative educational resource that support different learning activities and complement traditional classroom content (Buckingham, 2007; Spiegel, 2016). Web-based platforms play an important role in these developments as they facilitate the storage, processing and consumption of on-demand videos from anywhere and anytime. For the past decade, Technology Enhanced Learning (TEL) environments have been designed and deployed including features that enable teachers and students to integrate educational videos and to provide support to interact with them in a variety of ways. Such innovations in TEL environments provide educators with new opportunities to integrate this type of

rich media into the curricula in a wide variety of subject matters (Hoppe et al., 2016; Kohen-Vacs et al., 2016). Hence, teachers and learners interacting with such TEL environments from a wide range of cutting-edge portable devices are offered with novel opportunities to design, deploy educational approaches and used digital videos in ways that were not possible before (Lo & Hew, 2017).

Nowadays, TEL environments deployed for the web, rely on cloud services offer user-friendly experiences enabling authoring and consuming videos for various purposes from across contexts and settings. In some cases, these environments interoperate with video services like YouTube or Vimeo. Accordingly, it should be emphasized that for those settings in which videos need to be used for educational purposes require special attention in terms of content, subject matter and modes of use of this digital content (Perakakis & Ghinea, 2017). Consequently, educational stakeholders require that TEL tools and systems should be designed for exploiting these new learning opportunities (Jacob & Isaac, 2014).

In this paper, we describe our on-going research efforts related to the incorporation of educational videos into different learning paths supported by TEL environments. We seek to continue and discover new educational as well as technological requirements enabling to take advantage of existing video content found on the web (Kohen-Vacs, 2016; Kohen-Vacs et al., 2016). Currently, we are exploring how to expand and add new features to an existing software architecture that was designed to support interaction with educational videos (Kohen-Vacs et al., 2016, Smith, 2016). Our current efforts are guided by the outcomes of the interaction and data collected with more than 200 university students during the last 2 years. In our previous efforts, educators, researchers and developers have been involved in the design efforts in order to identify the requirements of such architecture (Ravenscroft et al., 2012). The specific focus of this work is to explore which new features could be added based on the benefits and challenges perceived by students using on-line videos for learning purposes. Specifically, we aim to explore students' opinions, perceptions and the type of exploitations in their daily routines including both within the educational scope as well as their usage performed beyond their learning purposes.

The paper is organized as follows. In the next section, we describe the settings in which the research takes place and we present the main two research questions that guided our work. We proceed and describe the results of data we collected from surveys focused on university students in engineering programs and their perceptions related to the design, deployment and exploitation of digital videos and tools that can be used in their educational settings. Then, we consolidate their responses and try to transform them into learner's requirements needed later for our design and deployment efforts. We further proceed and contextualize these requirements in terms of design models for supporting the creation of a number component that can support different learning activities. We also examine if and how these requirements could be integrated in an environment we have previously developed (Kohen-Vacs, 2016; Kohen-Vacs et al., 2016; Ravenscroft et al., 2012). Finally, we conclude this paper with a summary and conclusions followed by possible research directions of our future work.

2. Context Settings and Research Questions

In this research, we consider interdisciplinary requirements addressing pedagogy as well as technology related aspects. From a methodologically perspective, our research efforts are guided by Design-Based Research (DBR) (Collins et al., 2004; Kohen-Vacs, 2016). We explored students' perceptions attending study programs focused on engineering. Their perceptions are explored according to the following Research Questions (RQ) addressing the exploitation of videos in and beyond their traditional and educational settings. In order to further explore and investigate these topics two research questions have been identified and are formulated as follows:

- (RQ1): *What are the challenges and benefits perceived by university students using online videos resources to support different educational activities?*
- (RQ2): *What pedagogical and technological features could be added to those videos and on-line systems distributing them in order to facilitate and enhance the exploitation of these digital assets?*

In order to start exploring the mentioned RQs, we started first by gathering some relevant information that could help us to comprehend the techno-social contexts and settings experienced by students in their classroom and beyond them. Accordingly, we invited more than 250 university students to reply to a survey carried out during their classroom sessions during the academic years 2015-2016. Of those, 204 students have replied to our survey. The range of ages of the students that answered this survey was between 19 to 26 years old. Students from each year attending different cohorts of engineering programs (six years of study) at the National Technological University of Argentina, campus of San-Nicolas (FRSN) participated in this survey. These students represented different groups each attending five different specializations of engineering study programs including: *Industrial Engineering*, *Electrical Engineering* and *Electronical Engineering*. Additionally, other groups of students attended studies focused on *Mechanical Engineering* and *Metallurgical Engineer*. In Table 1, we specify the number of students while including their distributions across six years of studies while also specifying their distributions between males and females. The number of students that submitted their replies from each year aim to represent the entire population attending courses across the engineering study programs (including the indicated gender's distribution).

Table 1

Students Distribution across 6 years of study programs focused on Engineering

Year	Study Program	Industrial	Electrical	Electronical	Mechanical	Metallurgical
	(♂/♀)					
1 st		11 (9/2)	11 (9/2)	10 (8/2)	10 (8/2)	10 (8/2)
2 st		11 (9/2)	11 (9/2)	10 (8/2)	10 (8/2)	10 (8/2)
3 st		8 (7/1)	8 (7/1)	8 (7/1)	8 (7/1)	8 (7/1)
4 st		4 (/3/1)	4 (/3/1)	4 (/3/1)	4 (/3/1)	4 (/3/1)
5 st		4 (/3/1)	4 (/3/1)	4 (/3/1)	4 (/3/1)	4 (/3/1)
6 st		4 (/3/1)	4 (/3/1)	4 (/3/1)	4 (/3/1)	4 (/3/1)
Total per study program		42 (34/8)	42 (34/8)	40 (32/8)	40 (32/8)	40 (32/8)
Overall				204(164/40)		

As implied, we conducted a survey while providing students with opportunities to share and reveal their pre-assumptions, perceptions and insights as experienced during their formal and informal educational tasks in which they use video content. The surveys were conducted with the students before and following to their lesson sessions. Students that replied to our survey were required to address five main topics examined different aspects of their ideas and insights. The leading topics corresponding to various categories including, the frequency in which videos were used, the purpose of use as well as the reliability perceived from these videos. In addition, we examined the added values of these audio-visual resources as perceived by students. The data extracted from these surveys will be presented in the next section and will be further elaborated in the fourth section. Specifically, the topics addressed by the students in the survey correspond to their perceptions of opportunities and challenges related to use of videos to scaffold learning processes (RQ1). Additionally, topics addressed by students also align to discovery of requirements associated to pedagogical aspects as well to technology corresponding to learning supported by TEL environments encompassed by online videos (RQ2). Specifically, the topics in the survey were presented to the student along these five questions:

- *How often do you use online videos in order to address challenges tackled during your daily routines?*
- *What are your perceptions on online videos usable as educational materials?*
- *How often and in what method do you verify information retrieved from educational videos?*
- *In what way, do you think that educational videos available online could be improved in order to facilitate their exploitation?*

- *Do teachers invite you to use videos for your learning purposes? If so, with which frequency?*

These questions presented in the surveys represent our approach intending to capture students' insights, perceptions and natural habits of use practiced in their everyday activities and not necessarily within the formal framework of education. We want also to emphasize that during our previous research, we focused only on formal frameworks of education in which learning was mainly orchestrated by teachers. In the following sections, we present the results and analyses of the students' answers. Our approach was to use this information in order to elaborate and transform those answers into initial requirements for refining our existing architecture. We use these results, extracted into preliminary requirements as base-line in order to elicit a design and a deployment effort towards an optimized exploitation of videos incorporated in educational settings supported by TEL.

3. Presentation of Results

In the previous section, we presented several topics needed to be addressed by students participating in the mentioned survey. We began and asked them about their utilization habits related to online videos used in order to cope with challenges tackled during their daily routines. We found that 75% of the students admitted that they search for online videos when seeking for solutions to daily and casual problems. In the next phase of the survey we proceeded and asked about the students' perceptions in relation to the possible exploitation of online videos for pedagogical purposes. About 33% of the students declared that they use videos in order to encompass and support the classroom session. They also reported that they exercise this unofficially as video resources are not considered as official means to scaffold learning processes in the courses they take. In addition, all of them specifically pointed over at YouTube as their main resource of audio visual content. We assume that the actual percentage of YouTube users might be even higher if considering that Google is exploited as main search engine that is automatically associated with YouTube (Bauckhage et al., 2015). Next, we intended to check whether and how students verify information watched in a spotted video. Thus, we intended to check if and how students verify the educational information found in videos with other audio-visual content they find. Accordingly, we found that more than 40% of students always verify the information contained in a spotted video with another video. Another similar group used this approach with some frequency. In other words, we can say that 80% of the students frequently use another video resource to validate the information from a video with other audio-visual resource found in the web.

Finally, 33% of students declared that teachers never used or told them to watch videos in or for their classes. Some similar portion claimed that in very rear cases teachers instruct them to use videos. Consequently, about 2/3 of the students almost do not perceive any encouragement from their teachers to intend and use educational opportunities that may be consisted in videos available online. This result may imply on a conceptual gap between teachers and their students about the potential benefits of online videos for education. It is not surprising that more than 66% of the students' express great desire to increase the exploitation of videos during their classroom practices. They considered that further introduction of online and educational videos could increase their understanding on the subject matter and related materials and therefore benefit their learning gains and knowledge. In the following section, we continue and elaborate on these results while also starting and addressing some of the core aspects described in the research questions.

4. Further analysis of results towards the identification of requirements

In this section, we further elaborate on the findings presented in the previous section. Specifically, we found that practices consisting exploitation of educational videos during studies emerge from habits practiced during their daily routines (Balakrishnan & Gan, 2017). We found that such utilization emerges from students themselves and its further encouraged by the influence coming

from the social networks they are part of. In addition, it should be mentioned that we did not find a necessary influence of teachers over their students. Furthermore, we found that in some cases, students may not inform their teachers of regular usage of educational videos for classes they teach them. In some extreme cases, students may even intentionally hide exploitation of educational videos from their teachers. Some students reported that they may decide on such approach due to their fear that teachers may not appreciate them. Furthermore, they declared that such usage of videos may cause them to be tagged by their teachers as less motivated to study and even to be considered as less serious.

In other cases, participating students addressed their search and evaluation processes of educational videos was carried out regardless of their teachers and in some cases without having a good knowledge on the domain of study being focused. They perceived this search practice as variable and align and relevant to their professional formation conducted in their university studies. They added and mentioned that this search and evaluation is considered by them as a necessary skill that should be considered as part of a process of academic and intellectual development. Finally, students declared that they share the results of these searches with other students in order to enable mutual benefit from these audio-visual contents. In the results of the survey, students pointed out to exploited videos that are available in regular channels stored in platforms like YouTube or Vimeo. Thus, students claim that they do not tend to seek for audio-visual materials in platforms that are officially devoted for education like Khan Academy, Coursera or Udemy.

We end this section by addressing the data extracted and elaborated from the students' replies from the survey and transform them into concrete requirements addressing pedagogical as well as technological aspects of learning supported by online videos. Specifically, we demonstrate here how various requirements emerge from students' answers including the following: (Req-1) requirement to facilitate adoption of new videos available on the web in order to offer them as valuable and educational resource to teachers as well as for peers. In addition, we also include (Req-2) to enable optimized incorporation of contributed and audio-visual resources along learning paths needing further improvements in terms of vivid, meaningful and appealing illustrations as possibly offered in videos. We also bring (Req-3) a requirement for sharing and reusing these online videos across learning paths while offering grater exploitation and impact of visual resources found on the web. Finally, we suggest (Req-4) to exploit the search of videos as a practice by itself as an educational opportunity possibly implemented along educational strategies such as Collaborative Learning (CL) (Stahl, 2015). For example, searching videos according to a certain classroom mission could be conducted as a ranking competition between students in they are required to justify their impressions about audio-visual content spotted by their peers. In the next section, we summarize our findings while discussing the mentioned requirements including their affordances for enabling enhancement of an existing architecture offering support for statements corresponding to the four and mentioned requirements (Kohen-Vacs et al., 2016).

5. Summary, Discussion and Future Efforts

As mentioned, in this phase of our efforts we found that the use of on-line videos could be originated from various resources aimed at both, social as well as for educational purposes. Accordingly, we presented here the outcomes of a survey presented to 204 students exploring those issues. Our research efforts also rely on previous investigation focused on exploring architectures for enabling teachers to conduct official activities supported by online videos. Here, we emphasize that we join our previous experiences in terms of learning and technology in order to investigate new and best approaches for enabling deployment of architectures based on learners centered requirements. We accordingly, formulated two research questions including RQ1 dealing with challenges and benefits perceived by students using online videos resources to support different educational activities. We found that the majority of the students exploit videos that were adopted from their causal and social lives and use them in their educational practices. In addition, we found that in many cases teachers are not aware about this type of audio-visual exploitation originated beyond the boundaries of his/her formal teaching. Consequently, in some cases teachers may lose opportunities to expand and improve their educational activities conducted in classrooms as they are not aware of those opportunities to incorporate new and appealing videos in their pedagogical pathways. As mentioned,

we also have explored RQ2 addressing the pedagogical and technological features that could be added to those videos and on-line systems in order to facilitate and enhance the exploitation of these digital contents. Having in mind the mentioned for the previous RQ, we further encourage performing a deployment effort facilitating the adoption, refinement and integration of educational videos (also from casual resources). Furthermore, we emphasize that process of seeking for a video could be converted into an educational and appealing quest that enhances meaningful learning. The requirements that were found and elaborated within this paper along with the proposed architecture and its components provide some indications about the potential of incorporating students' input in the design of TEL solutions.

In our coming efforts, we will start to deploy a refined solution based on new insights collected from students and described in this paper. We will use this data in order to further explore ways to incorporate existing video content identified by the students into our evolving platform.

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