# Enhancing Video-Based Learning Experience through Smart Environments and Analytics

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**Abstract.** This paper describes the potential and promising value of smart environments and analytics on the emerging area of video-based learning. In particular, we describe the contributions presented at the International Workshop of Smart Environments and Analytics on Video-Based Learning (SE@VBL) and envision the future of this research area. SE@VBL presents the current state-of-the-art in the design, development and evaluation of video-based learning systems. SE@VBL 2016 emphasized the importance and benefits of smart environments and analytics for video-based learning to support learners and instructors with the appropriate resources for improving the use of video-based learning systems. The long term goal of SE@VBL is to develop a critical discussion about the next generation of environments and analytics employed in video learning tools, the form of these environments and analytics, and the way they can be utilized in order to help us to better understand and improve the value of video-based learning. In this volume, we have included the 4 contributions, 1 keynote presentation and 1 tutorial that were featured at the workshop.

**Keywords:** Video-Based Learning, Video-Lectures, Smart Environments, Analytics, Interaction Design

## 1 BACKGROUND

The advances of technology-supported open access to education indicate an increased use of video but only when pedagogically appropriate and designed purposely to facilitate teaching and learning. From current research, it is difficult to tell what aspects of the video-lectures and video-based learning systems can have a positive impact. In order to employ videos that serve as powerful pedagogical tools, care should be taken to examine their impact on the overall learner experience. As such, the purpose of this

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workshop is to explore how smart environments and analytics can improve video-systems learning potential

Existing empirical research (e.g. [1, 3]) has begun to identify the educational advantages and disadvantages of video-based learning. However, there still remain many essential unexplored aspects of video-based learning and the related challenges and opportunities; such as, how to use all the data obtained from the learner, how to combine data from different sources, how to make sense heterogeneous learning analytics, how to synchronize and take the full advantage of learning analytics coming from different sources and so on. SE@VBL aims to support this research endeavor through an exploration of the supportive environments as well as the analytics involved to video-based learning. In particular, the objective of this workshop was to bring together researchers, designers, teachers, practitioners and policy makers who are interested in how to do research on the use of any form of video technology for supporting learning. This workshop provided an opportunity for these individuals to come together, discuss current and future research directions, and build a community of people interested in this area.

### 1.1 Video Learning Analytics

Millions of learners enjoy video streaming from different platforms (e.g., YouTube, Coursera, Khan Academy, EdX, Udacity, Iversity) on a diverse number of terminals (desktop, smart phone, tablets) and create large volume of simple interactions. This amount of learning activity might be converted via analytics into useful information [2] for the benefit of all video learners. As the number of learners' watching videos on Web-based systems increases, more and more interactions have the potential to be gathered. Capturing, sharing and analyzing these interactions (big datasets) can clearly provide scholars and educators with valuable information [2]. We also expect that the combination of various learning analytics (e.g., content metadata, learners' profile) as well as the state-of-the-art statistical analysis techniques [4, 8] will allow us to better understand complex learning phenomena by making sense of heterogeneous big learning analytics, this is of particular interest to video-based learning due to the large and complex datasets.

Since, many instructors in higher and secondary education are implementing video lectures in a variety of ways, such as broadcasting lectures in distance education, delivering recordings of in-class lectures with face-to-face meetings for review purposes; there is a huge potential to collect big volumes of learning analytics coming from different contexts and approaches. This will allow us to shed light in, various issues related to the design of learning videos as well as the role of videos in different types of instruction (e.g., flipped classroom, online courses).

### 1.2 Smart Video-Based Learning Environments

The International Association for Smart Learning Environments (IASLE: http://www.iasle.net/) provides a broad interpretation of what a smart learning environment is. In particular, IASLE states that a learning environment can be considered smart

when various innovative features and attributes like adaptation, flexibility, thoughtfulness and so on [10] are associated with the system. In a general sense, a smart learning environment is one that [spec] is likely to make a learning environment effective, efficient and engaging for a wide variety of learners with different levels of prior knowledge, different backgrounds, and different interests; hence adaptation is cornerstone of a smart learning environment. Like any other type of learning environment, video-based learning environments need to follow the same features, and while video-based learning environments are becoming more flexible, thoughtful and adaptive (e.g., Khan Academy, Udacity) as well as several new such environments that incorporate "smart behavior" are created (e.g., Adaptemy, Dreambox, SmartSparrow); there is a lack of empirical analytics-based research on how what ingredients of smart behavior can indeed increase effectiveness, efficiency and engagement.

## 2 Objectives

In order to employ videos and integrated video-based systems that serve as powerful learning tools, care should be taken to examine the impact on the overall learner experience. As such, the purpose of this workshop is to explore how smart environments and analytics can improve video-systems potential to enhance learning experience. In particular, our research is guided from the following five objectives:

O1. What might next generation of smart environments and analytics enhanced video learning tools look like?
O2. What kind of data can be collected from video-based learning environments?
O3. How these data can help us to better understand and improve the educational value of video-based learning?
O4. How emerging data analyses techniques (e.g., machine learning, fuzzy set/Qualitative Comparative Analysis) as well as data visualizations can help us to provide reflection and insights to learner, teacher, manager, researcher, etc?
O5. How can the affordances of video-based learning coupled with learning analytics and help instructors to redesign their teaching materials and practices

## 3 CONTRIBUTIONS

The contributions of SE@VBL covered several topics, such as tangible technologies, computer science and programming education, empirical examinations, augmented reality applications in schools and best practices to foster creativity in learning. The workshop proceedings are freely accessible from CEUR-WS series (http://ceur-ws.org/).

In particular, Wachtler et al., [12] present an innovative application, which adds different forms of interactivity to learning videos (e.g., multiple-choice questions, communication channels with the instructor). Furthermore, in order to be able to unveil learners' patterns and behaviors Wachtler et al. have implemented exploratory visualizations and conducted examinations. Early insights indicate common patterns behind

dropping out as well as suggest enhancements to increase the learning performance and learners' attention.

Turro et al., [11] describe experiences from applying flipped classroom model (FCM) to Universitat Politècnica de Valencia. The described program has been carried out in two semesters, with video-materials being selective. The authors described a comparison between the video-supported and non-video-supported FCM. The empirical results indicate that students like video-materials as a primary instruction tool, and video-supported FCM group of students has better overall results in the appreciation and engagement.

Kleftodimos and Evangelidis [6] describe an environment for teaching "image editing techniques". The video-based environment was used in educational settings and a dataset of learner activity behavior was analyzed. Indicators from this dataset were used in a clustering scheme to obtain groups of learners with similar characteristics (e.g., viewing and activity behaviors). The clustering scheme distinguish between learners that seem to have completed the assignment without any problems and those who encountered problems.

Pappas et al., [8] utilize complexity theory in order to identify different types of learners that use video-based learning. This study combines learners' demographics with learners' experience in a conceptual model in order to explain the adoption of VBL technologies. The proposed model is tested and validated through a survey on 260 VBL users, by implementing fuzzy-set Qualitative Comparative Analysis (fsQCA). The findings indicate eight configurations of learners' demographics and learners' experience that lead to high intention to adopt VBL. The results take a step further the literature of VBL by taking a different approach and implementing a different methodology, which has recently started to receive increasing attention.

In a tutorial offered from Pappas et al., [7], the basic guidelines on how to implement configurational analysis in the context of learning analytics were provided. A step by step approach on the fuzzy set qualitative comparative analysis (fsQCA). In learning analytics research we systematically use symmetric statistical methods. Building on the theory of complexity and configuration theory, fsQCA analysis was suggested in order to gain a deeper understanding of the data, which may lead to explaining and predicting different learning phenomena as well as to the creation of new theories.

## 4 CONCLUSIONS AND THE WAY AHEAD

The roles of 1) analytics on helping individuals to make sense of the learning procedures and the 2) smart environments on providing feedback and diverse "smart" functionalities have drawn the interest of many scholars and practitioners in the last years. In particular, analytics have proven their ability to help us to understand (make sense) many complex learning phenomena in the past [9]. However, comparing with research on text and discourse analytics, the research on video analytics is still on an early stage. Video analytics have an enormous potential, especially given what is currently happening around MOOCs and adaptive video-based learning systems. As most of the current

learning systems are using videos as their primary content delivery mechanism, research on learning systems will heavily influence video-based learning research. So we believe that the topic of SE@VBL is very timely with great potential. This potential will grow as learning platforms, like Coursera and Edx make their data publicly available to the research community as well as integrate more "smart" qualities like, system's ability to: achieve recognized goals and objectives, adjust to different situations and make appropriate adjustments.

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