Integrating Interactive Videos in Mobile Learning Scenarios

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ABSTRACT

Nowadays, there is a growing variety of mobile devices and online video content that could be used to support a variety of pedagogical strategies used for different cross-context learning scenarios. In order to take advantage of these developments, this paper presents an approach that allows to integrate learning material represented as videos in mobile learning scenarios, mainly by the implementation of a mobile client that allows to consume learning material represented as small chunks of video content. The application of these ideas potentially provides new educational opportunities to support learning across different contexts. Additionally, the videos consumed by the mobile client allow the integration of interactive elements like questions that could be answered by the learner while consuming the video or additional comments that could be provided to the learner. The rationale for the integration of the interactive parts in the video is to increase learners´ engagement and therefore also to increase their involvement and participation in order to generate an active learning experience.

Author Keywords

Mobile learning, interactive videos, integration, seamless learning

INTRODUCTION

During the past decades, schools and universities started to incorporate video content in their educational programs providing teachers with an effective way to attract learners' attention, illustrate new topics, elaborate new ideas and encourage students' discussion (Sitaram and Dan, 2000). Video clips have great potential to scaffold pedagogical processes with students characterized as more visual learners (Rose and Nicholl, 1997). Technological advancements enabled the introduction of interactive video clips used for various proposes like entertainment, production, training and education. The term interactive video usually refers to a technique used to blend interaction into a films or videos. Schools were introduced with some initial form of this interactivity supported by video player devices enabling teachers to index videos segments and later manually sequence and play them during face-to-face classroom interaction (Allan, 1991). Video games implemented a more advanced form of interactive videos dedicated to entertainment and educational purposes. These games contain a set of educational scenarios illustrated with animations or videos enabling students to interact and advance along a storyline while providing them an immersive educational experience (Young et al., 2012; Barab et al., 2010).

Advancements in information communication technologies (ICT) enabled to stream high quality media via the web enabling teachers to design and share pedagogical strategies supported by interactive video clips. Recent technological advancements in mobile computing enabled teachers to introduce interactive videos across various types of communication devices with different hardware and software attributes. The extended options for consuming interactive videos across devices provided teachers with broader possibilities to design and enact cross context pedagogical strategies enabling students interacting with educational videos beyond the traditional boundaries of the classroom across physical planes in various types of situations (Hada, 2012). Authoring and consumption of interactive videos rely on innovative uses of ICT including the following elements:

- Stable web infrastructures providing a fast, reliable and efficient mass data traffic involved with video web casting
- Adequate hardware found in stationary and mobile computing devices enables users to connect to the web infrastructure in order to consume large mass of digital media content
- Modern and flexible software tools enable users to author new digital media content plus reuse and adapt existing materials. In addition there are also tools that enable users to consume the digital content
- Large and accessible database repositories accessible by the web supporting the large amount of digital content to be stored, found and used

The mentioned items used as a technological support for an educational process may improve the students' learning experience by potentially exposing students to richer and more interactive pedagogical content that could easily be adopted and adapted according to the educational needs and finally accessed anywhere at any time. These technological innovations enhance a wider scope for modes of interaction like the presentation of explorative hypermedia environments enabling students' navigation and inquiry processes (Chambel et al., 2011). In addition, the interactions could be pre-sequenced to certain temporal markers along the video's timeline providing students with quizzes or surveys types of interactions displayed according to the related segments which they watched (MacWilliam et al., 2013). Interactive videos could be semantically related to other contents existing in the web enabling students' further exploration of watched content materials beyond the scope of the video clip (Nixon et al., 2013).

In the last couple of years, our groups have been involved in an on-going research process focused on finding, developing and integrating technological tools enabling the authoring and use of existing educational videos and use them as learning opportunities. In addition, we aim to provide students with interactive rich media content scaffolding a complex but seamless learning experience. The provided media can be consumed by students, both using stationary and mobile technologies which will encompass and potentially support students across various types of educational situations presented along the phases of organized and informal learning activities practiced across different physical, temporal and conceptual contexts (Kohen-Vacs et al., 2012, Kohen-Vacs et al., 2011). Specifically, we are exploring new ways to use and combine web technologies in order to provide teachers with an authoring tool capable to access YouTube video repositories and to add interactive features to them. In this paper, we present our recent efforts related to the design and development of a system that enables teachers to author and apply educational strategies including the use of existing videos with incorporated interactions later to be consumed by students across various types of contexts. We elaborate on the potentials of this technological solution and its use for designing pedagogical strategies to provide a seamless experience. These ideas are then elaborated and discussed for a particular case used for different pedagogical situations. The distinct conceptual, pedagogical, logistical and technological aspects described as in a list of seamless dimensions related to the activity. The different technological aspects of the proposed solution are aligned with our current research and development efforts dedicated to explore new ways to combine interactive videos across different learning settings and situations.

THE EDU.TUBE SYSTEM FOR PROVISION OF INTERACTIVE VIDEOS

The EDU.Tube system represents our recent ongoing efforts to develop an interactive video authoring environment. This system includes a web-based environment for authoring of interactions to be incorporated along the timeline of an existing video. This environment enables teachers to create and share pedagogical interactive video activities using videos stored in the YouTube environment. The authoring process of an interactive video starts by finding a URL of a movie in YouTube. It continues with the definition of data describing the activity name, the link to the movie that was previously copied, the instructions of the activity, a summary and finally an additional description of the activity. The definition of such activity will later use the pointed YouTube video in its original form encapsulated within a layer inside the EDU.Tube environment controlling the playback and interactions of the media resource via the YouTube APIs. In the following step, the teacher is presented with the authoring video player enabling him to play the addressed video clip and mark desired points of interaction along the video's timeline as points of interactions. This marking along the video's timeline retrieves temporal data related to the desired point of interaction. Data is stored as EDU.Tube information and will be later used when students will use the interactive video. Whenever the teacher decides to create a point of interaction, he/she is requested to decide about the kind of interaction by selecting and pressing one of the interaction buttons causing the video to stop while the system marks the precise time of the interaction. Figure 1 below illustrates the authoring interface of the system.

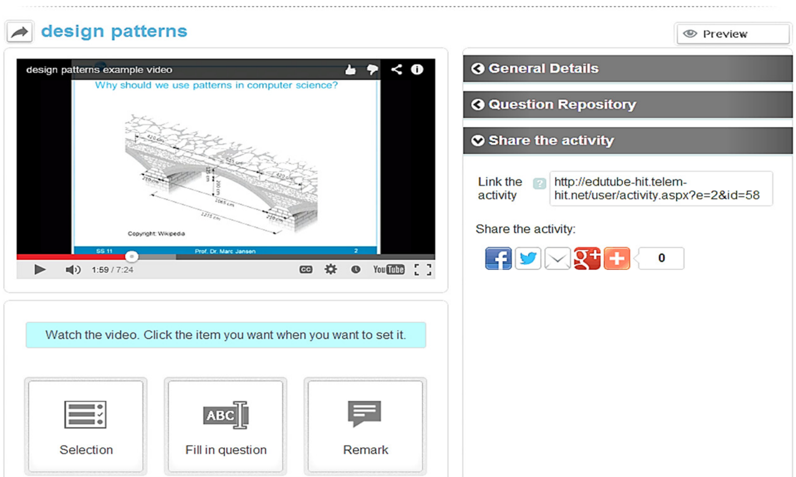

Figure 1: EDU.Tube authoring interface

EDU.Tube provides teachers with the following types of interactions:

- Selection – enables to create any type of multiple or single selection question with any number of possible options.
- Fill in question – enables to create an open text question
- Remark – enables to incorporation of static text announcements

As soon as teachers complete to define the specific kind of interaction, EDU.Tube stores its information in an XML based format in a dedicated MS-SQL server. The XML branches will include a set of XML nodes containing the activity information that is later accessible in a designated tab of the EDU.Tube's interface enabling the teacher to review or edit each of his previously created interactions. As soon as the interactive video is authored, the teacher can decide to share the interactive video in various ways like a shareable URL link pointing directly to a playback environment for the interactive video encapsulating the original YouTube resource. In addition, the teacher may decide to share the link by mail or by anyone of the known social media networks like Facebook, Twitter or Google plus. The provided link will redirect the student to an appropriate playback environment adapted to regular computers or to mobile devices addressing the hardware as well as its software unique properties of the used technology. The sizes and the resolution of the used displays and the type of the operating systems were prominent factors while designing and developing of the playback clients. For example, each of the operating systems includes its affordances and challenges in terms of playing back the media content. The variety of display sizes across mobile devices should be addressed in terms of responsive design aiming to provide student with an optimized and meaningful user experience (Maniar et al., 2008). As mentioned before, whenever a link to an interactive video is accessed, the video will be displayed within an EDU.Tube regular or mobile client. In case of use in a mobile client, the required data and metadata related to the interactive video is sent from the EDU.Tube regular framework using Web Services API to the client in the dedicated mobile environment. In the next section, we will provide a more detailed description of the different technological components and the architecture of the EDU.Tube system.

THE SYSTEM ARCHITECTURE

In order to allow the integration of interactive videos in different mobile learning scenarios, a number of different tools and applications needed to be integrated in order to provide a complete learning scenario. The core of this architecture is the formerly described EDU.Tube system. This system allows providing interactive videos and furthermore also provides an editing environment for the creation of such videos. This architecture is the formerly described EDU.Tube environment, which provides a playback platform for interactive videos. Furthermore, it also provides an editing environment for the authoring of such videos. CeLS is a technological environment that supports the creations, scripting enactment and possible reuse of pedagogical strategies (Ronen & Kohen-Vacs, 2010). This environment was used in order to orchestrate the instances in which students were required to interact with videos controlled by EDU.Tube. The integration of EDU.Tube in a CeLS scenario enables the combination and use of interactive videos in a multiphase pedagogical activity (these ideas are described in more details in the coming sections). An overview of the different applications and the overall architecture of the system are shown in Figure 2.

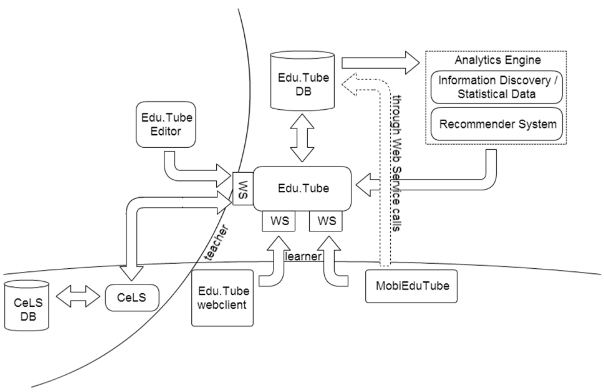

Figure 2 - The architecture of the overall system

In order to provide a solution to the challenges mentioned in the introduction, the centre of the architecture is built on the EDU.Tube environment. Every interaction with Edu.Tube is implemented by exploiting RestFul Web Service provided by the environment. Both, the mobile and the stationary Edu.Tube client utilize the provided Web Services in order to retrieve information about the educational movie clips (the information about the movie itself and the necessary metadata for the interactive elements). Furthermore, the CELS environment also interacts with EDU.Tube in order to allow an easy integration of the movie clips in the scripted learning scenarios.

From a student's perspective, these interactive videos are available via a usual website and a mobile client for interactive videos provided by the Edu.Tube approach. This mobile client is further called MobiEdu.Tube. Feedback given by the students within the interactive learning videos,is stored in the Edu.Tube database shown on top of Figure 2. The communication in the whole system is implemented based on ReSTful Web Services, in order to keep the interfaces as flexible as possible. Last but not least, some analytics components are shown in the upper right part of Figure 2. These components provide algorithms on the one hand for recommendations for different kinds of content of learning material and on the other hand algorithms that allow to do some learning analytics (Baepler, Murdoch, 2010).

TECHNOLOGICAL IMPLEMENTATION

In order to provide a platform independent implementation that does not need to be re-deployed for different operating systems and browsers, we decided to implement the mobile Edu.Tube client based on HTML5 and JavaScript (Baloian, et al., 2011). This provided the additional advantage that the platform independent mobile application not necessarily has to be installed on a mobile device, but that it can be used as a mobile web application. Since we wanted to consume the ReSTful Web Services already provided by the formerly described architecture, a server-based application was also necessary in order to overcome the same-origin directive (W3C, 2010) that web applications need to be compliant with in order to provide the basic security levels. This server side implementation was based on NodeJS (Hughes-Croucher and Wilson, 2013). The decision for NodeJS was basically taken here mainly due to two reasons: on the one hand this approach allowed us to use JavaScript both on client and on server side, and on the other hand, due to the asynchronous mode of operation of NodeJS, good performance results are inherent with this approach. The component representing the MobileEDU.Tube software in Figure 1 could be visualized in more detail as shown in Figure 3.

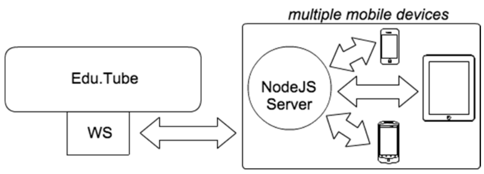

Figure 3 - Detailed view on the ModileEDU.Tube software architecture

The NodeJS based server side implementation could be seen as a proxy, according the proxy design pattern (Gamma, et al., 1994), to the ReSTful Web Service provided by the architecture described in Figure 2. From a client perspective, the implementation of the mobile application is especially developed to fit the requirements of a mobile device. In order to achieve this, User Interface components have been modelled with JQuery Mobile in order to allow a responsive design of the application. Screenshots of the workflow in the mobile application running on a mobile phone are shown in Figure 4.

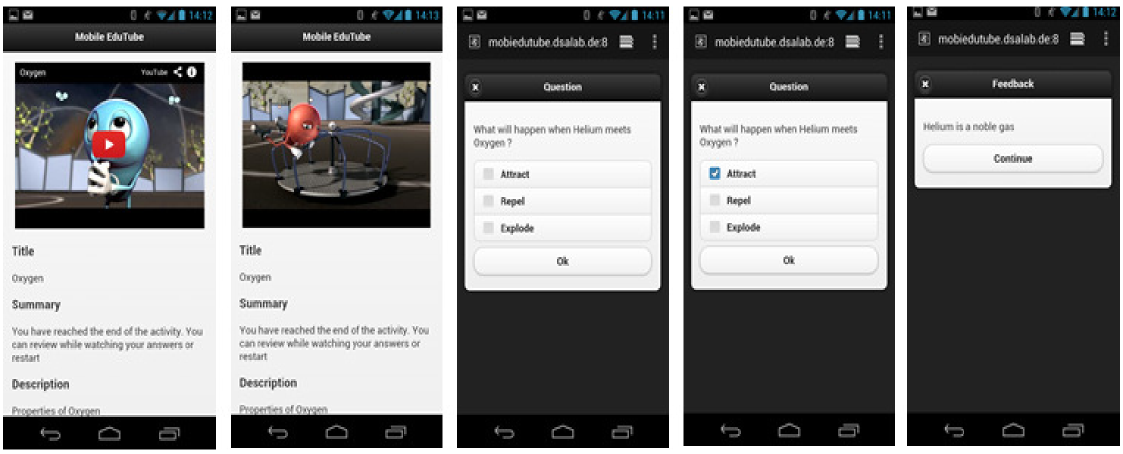

Figure 4: Screenshots of the workflow in the mobile application

First of all, mobile users have to select which interactive video he/she wants to consume. Here, the user can either use an input box at the starting page of the application in order to provide the id of the interactive video he/she wants to consume, or he can load a specialized URL in which he/she can already provide the according id of the interactive video. After the video is successfully loaded, the user can start the video and consume it until the first interaction appears. In the upper right hand side of Figure 4 a question is shown that should be answered by the user. When the user has answered the question (as shown in the lower left hand part of Figure 4) he/she could acknowledge the question and receives some feedback about the answer he/she provided. After acknowledging the feedback dialog shown in the lower right part of Figure 4, the user can further consume the interactive video until the next interaction happens. In the next section, we describe how these different technological solutions have been used for a specific learning activity to support different learning designs and tasks.

TECHNOLOGICAL INTEGRATION FOR SUPPORTING LEARNING DESIGNS

The learning activity described in this section was designed for undergraduate and graduate university courses dealing with essential terms in computer science related to design patterns and sorting algorithms. In this activity, students are requested to seek for regular videos in YouTube video resources that could be potentially related to the subject matters dealt in the courses. These video resources would later be transformed to interactive artefacts potentially fostering students understanding of these learned topics (Gilroy, 2010). The pedagogical strategy implemented in this activity aims to develop students´ ability to associate and use authentic problems by using video examples related to the subject matter presented in the courses. The learning activity includes the following phases as depicted in figure 5:

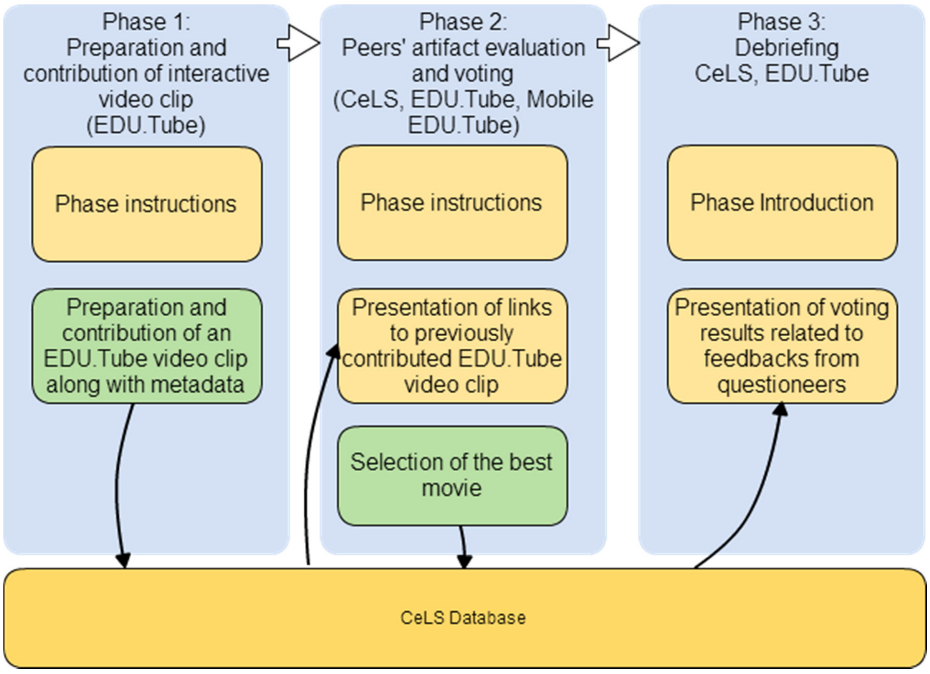

Figure 5: The flow of a learning activity supported by integrated technological environments

- Phase 1- *Preparation and contribution of interactive video clip*: During this phase, students are presented with a specific topic computer science. Later on, they are requested to search for a short video on YouTube, which could be used as a pedagogical opportunity for exploring and learning the subject under study. The students are requested to use the EDU.Tube authoring environment in which they import the video's link and then incorporate between three to five interactions along it's time line aiming to convert it to an interactive video that could potentially be used as a learning opportunity (Tight, 1998). Students can complete this phase from anywhere using their stationary or laptop computers to access YouTube and the EDU.Tube authoring environment.
- Phase 2- *Peers' artifact evaluation and voting*: Before the actual initialization of this phase, all the interactive videos and their corresponding metadata are integrated into the CeLS database creating a repository of students' artefacts created in EDU.Tube. This integration aims to provide students with the ability to assess their peer artefacts.
These assessments are registered in the CeLS environment and provide teachers and students with the option for further elaboration. During this phase, each student is presented with seven videos created by his/her peers and being asked to vote for the three best videos. In addition, students are asked to textually justify his/her selections. This phase

could be done from anywhere using stationary computers, laptops or mobile devices to access CeLS and the regular and mobile version of EDU.Tube player.

- Phase 3 *Debriefing*: During this phase the teacher conducts a debriefing session including the presentation of example videos which were previously contributed by the students for the competition enacted during the second phase. The teacher presents the selected videos while emphasizing its attributes that potentially can transform it to a learning opportunity that could be reused in the future.

The phases of this activity are aimed to be enacted across different physical and virtual environment providing various types of learning experience reflecting the teacher's pedagogical plan and also providing students with spontaneous learning opportunities occurring while consuming the interactive video along the activity phases. In the next section, we will address the challenge of providing students with a seamless learning flow along a cross context and multiphase learning activity.

TECHNOLOGICAL AND PEDAGOGICAL DESIGNS FOR SUPPORTING SEAMLESS LEARNING EXPERIENCES

The technological support for learning activities might be crucial when considering an enactment of complex but seamless pedagogical strategy. (Tchounikine, 2011). A successful enactment of such designs could broader students' opportunities to be introduced with new learning experiences practiced across phases by various social organizations at different locations (Vogel et al., forthcoming), allowing them to switch between learning settings easily and quickly using their own ICT devices (Chan et al., 2006). Wong and Looi (2011) specified ten mobile seamless learning (MSL) dimensions that characterize possible mobile learning situations:

- (MSL-1) Encompassing formal and informal learning
- (MSL-2) Encompassing personalized and social learning
- (MSL-3) Learning Across time
- (MSL-4) Learning Across locations
- (MSL-5) Ubiquitous access to learning resources
- (MSL-6) Encompassing physical and digital worlds
- (MSL-7) Combined use of multiple type of devices
- (MSL-8) Seamless switching between multiple learning tasks
- (MSL-9) Knowledge synthesis
- (MSL-10) Encompassing multiple pedagogical models

In the previous section, we presented our design for a pedagogical activity supported and integrated by different technological tools enabling students to interact individually or in groups (MSL-2). The design, development and integration of a mobile module with the EDU.Tube environment enable the expansion of the actual scope of contexts in which the activity is being practiced. During the activity, the teacher presents students with an option to interact with the interactive movies from their stationary or mobile computers. In addition he/she also offers to interact with the videos from anywhere with the mobile EDU.Tube client using their own smartphones. Such interaction enables a combination of learning situations occurring in a face-to-face mode with other opportunities provided through digital content enabling to ease the students' switch between formal and informal learning (MSL-1, MSL-4). These interactions may take place across various activity phases enabling students to refine their knowledge and skills as they advance along the activity sequence (MSL-3, MSL-4). The nature of the activity phases demands students to search, refine and offer learning resources in the form of interactive videos which are ubiquitously located and accessed (MSL-5). During a later phase of the activity, students become peer learners as they watch, critique and judge their peers' artefacts (MSL-8). The offered interactive videos could potentially emerge from recording of a real world situation or be a digital animated representation (MSL-6) later watched by students using various types of devices (MSL-7). The structure of this activity includes the implementation of various pedagogical approaches, such as learning by teaching, peer learning and competition (MSL-10). These approaches are to be enacted along the activity phases enabling students to acquire and synthesise new knowledge (MSL-9). The following section provides a discussion about the benefits and potentials drawbacks about the presented approach with respect to the discussed ten MSL dimensions.

POTENTIALS AND DRAWBACKS OF THE PRESENTED APPROACH

In this paper we proposed an architecture design including the integration of different ICT tools aiming to supporting teachers and students along the enactment of multiphase and seamless learning experience. Specifically, we presented the EDU.Tube environment and its actual implementation in a specific educational setting as an integrated environment with its mobile module which is orchestrated by CeLS. Furthermore, we presented a multiphase learning activity including interactions related to the ten MSL dimensions to be used in different learning settings. In this section, we provide a further analysis for some of the MSL dimensions in terms of their potentials and drawbacks as reflected from the proposed activity presented in the previous section.

The nature of the EDU.Tube environment aims to enable teachers and students to search, adopt and adapt regular YouTube videos that may describe casual, authentic and real life situations not necessarily meant to be used as educational opportunities. In this sense, the possible adaption of such type of YouTube video clip potentially enables teachers to conduct learning activities including digital content that was not conceived for use in formal educational settings. Educational videos enhance the students' abilities to switch between formal and informal learning experiences (MSL-1). As mentioned before, there may be some activities involving various phases requiring students' shift across different physical locations. In such cases, the MobileEDU.Tube client could also be used. The mobile use of the environment still presents meaningful challenges in terms of designing an interactive video that provide students with an experience that might be meaningful and contextualized to their physical location (Sotsenko et al., 2013) (MSL-4). The use of mobile devices presents numerous challenges requiring designers and developers to cope with UI aspects aiming to offer users a meaningful educational experience presented on small-scale displays. In this respect, video content should be adapted to environmental and hardware conditions while considering the large amount of detailed information to be presented including detailed videos along with interactive and related texts while aiming to optimize the mobile educational experience.

Another aspect that is also related to the mobile device is the use of mobile EDU.Tube across various types of hardware supported by different operating system requiring a development process which aims to offer similar functionalities and accordingly provide a similar user experience across the different types of technological environment (MSL-7)(Giemza et al., 2012). The integration of regular EDU.Tube and its mobile environment as part of a larger pedagogical strategy should be further elaborated while addressing the educational, logistical and technological interrelated aspects of such integral implementations (MSL-8). Finally, we would like to point out that spite of the fact that the different MSL dimensions address the mobility term, many of our actual and previous experiences with design and enactment of multiphase and cross context pedagogical strategies could be associate with most of the MSL dimensions while not be necessarily using mobile devices at all. In these cases, the dimensions are still applicable as the students are still experiencing seamless learning across contexts supported by technological and network infrastructure enabling the encompassment of content related to the activity across various devices which are not necessarily mobile.

OUTLOOK AND FUTURE WORK

The approach described in this paper has already been used in academic courses at two universities during the spring and summer term 2013. Here, in total over one hundred students worked with the solution and evaluation data of its usage has been collected. However, the analysis of this information still has to be performed. The use of the presented systems supported the enactment of two instances of a pedagogical scenario that was adapted and adopted for using interactive videos on mobile devices and laptop and stationary computers. The MSL dimensions were addressed through the architecture that included the use and reuse of interoperable content supported by various technological tools. The CeLS environment was used to orchestrate the actual enactment of the interactive videos along with the learning path. This enactment is part of our on-going efforts to offer and present teachers with a technological approach which enables them to reuse existing video content found in YouTube and transform them into interactive digital content to be combined in their multiphase and cross context learning activities.

Additionally, in this paper, we have shown that the integration of different components (CELS, EduTube, MobileEduTube, etc) in one architecture, along with the use of interoperable content provided by these components, allows for the design and use of flexible tools that can be fitted to the different MSLs discussed earlier. Another aspect of our future work is the integration of the interactive videos in standard Learning Management Systems (LMS) like Moodle. Here, in the light of the scripted approach provided by CELS, standard LMS systems may provide an additional infrastructure component able to host and consume learning materials in a highly sophisticated way.

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