

VideoQuizMaker: A web-based tool for remixing video learning paths

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Abstract. Although MOOCs have popularized short video segments and formative assessment by means of quizzes that pop up while the videos are being played, most video lectures usually lack interactivity and adaptability to the different needs of individual learners. Keeping learner's attention in MOOCs and achieving learning objectives is difficult, even when a professional team is in charge of creating the videos. This paper presents VideoQuizMaker, a web-based tool that allows instructors to easily create adaptive learning paths composed of sequences of video segments and formative assessments in the form of quizzes. The learning path adapts to the learner, offering different video segments to each learner depending on the answers provided to the quizzes, the time spent or the score. The aim of VideoQuizMaker is to provide a personalized learning experience based on video lessons, with the objective of making online courses much more engaging by keeping learners interested, what in the end we expect will increase the learning outcomes. At its current state, VideoQuizMaker is a prototype that has been used in an introductory computer networking course at the Universidad Rey Juan Carlos in Spain. It is available online for its general use (and development) under an Open Source license.

Keywords: Video; learning paths; interactivity; adaptability; learning tools; web technologies;

1 Introduction

Video content for learning has become very popular in recent years. The amount of quality learning contents available in video format has grown significantly due to the rise, among others, of YouTube and other video-sharing websites. Khan Academy, Massive Open Online Courses (MOOCs) offered by sites such as Coursera, edX, Udacity or Miriada X, among others, offer learning materials centered on video content. But video lectures have the drawback that after a few minutes the attention of learners decreases, usually due to the non-interactive nature of the format [4]. There exists an ample research literature on the optimal use of video in learning environments and how to assess its impact and effectiveness [2, 5].

Experience gained in recent years in the areas of Formative Assessment, Peer Instruction and large scale MOOCs has taught the research community that making short videos, no matter what the quality of its production [1], and providing feedback to learners [3], are mandatory in order to increase engagement. Short videos with quizzes in between are the norm today in many MOOCs. In spite of this, dropout rates in MOOCs are alarming.

Based on this experimental evidence we think online courses can be much more engaging, even when using non-professional, traditional lecture-style video presentations. The video is a one-way channel, but by interrupting its linearity with formative assessments, we can adapt the learning path to the needs of each learner. By requesting a higher level of attention, the learner is not distracted, enabling an increase of her understanding of the content being taught, and even of his analytical skills. Thus, passive learning (presentation of new content) becomes active learning (let learners assess their understanding of the video content).

This paper presents VideoQuizMaker, a web-based tool that allows instructors to easily create adaptive learning paths composed of sequences of video segments and formative assessments in the form of quizzes. The learning path adapts to the learner, offering different video segments to each learner, depending on the answers provided to the quizzes. The aim of VideoQuizMaker is to provide a personalized learning experience based on video lessons, with the objective of making online courses much more engaging by keeping learners interested, what in the end we expect will increase the learning outcomes. In order to increase the engagement of the courses, animation and transition effects can also be added to existing videos with VideoQuizMaker.

The remainder of this paper is structured as follows: section 2 describes Popcorn Maker, the framework we have used to implement VideoQuizMaker, and introduces the functionality that VideoQuizMaker adds to Popcorn Maker. Section 3 describes the implementation of the components of VideoQuizMaker. Section 4 reviews related work and finally, section 5 concludes this paper.

2 VideoQuizMaker: an extension of Popcorn Maker

In order to focus on the key objectives of our proposal we did not program VideoQuizMaker from scratch: we have added functionality to Popcorn Maker¹, an Open Source project from the Mozilla Foundation for remixing web video and audio with images, text, maps and other dynamic web content from sources such as social networks or Wikipedia. Popcorn Maker leverages on existing Internet audio and video resources, primarily YouTube, offering the possibility to reuse millions of videos and educational resources already available on the Internet. Content remixed with Popcorn Maker can be published on the web as an HTML5 web application.

Popcorn Maker is really the combination of several projects, of which the most notable are the following: *Popcorn.js* is a JavaScript library that allows

¹ <https://popcorn.webmaker.org/>

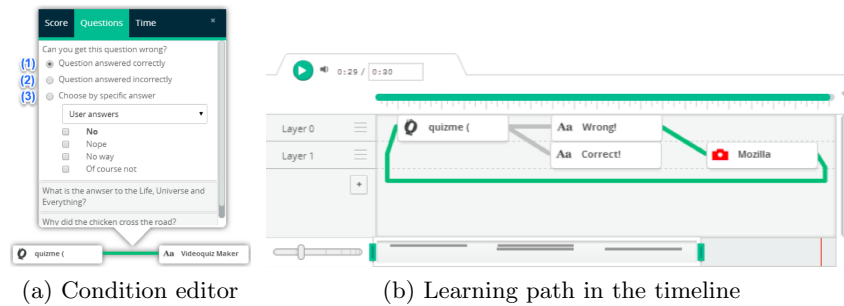


Fig. 1. Learning drawn in the timeline

to schedule events in interactive web content. *Butter* is a JavaScript framework that provides a set of user interface widgets to build the GUI of Popcorn Maker: timeline, scrubber, editors, dialogues, etc. *Cornfield* is the Popcorn Maker server. It is based on Node.js and serves content to users, and storing and publishing their projects. *Mozilla Persona*² is an authentication system for the BrowserID web-based protocol.

In VideoQuizMaker, a course is designed as a graph composed of media elements and formative assessments. Each learner navigates the graph following different learning paths, depending on the answers they provide to the formative assessments that the instructor has designed. The tool allows the instructor to specify what media elements must be shown while the video is being played. Among these media elements, interactive quizzes can appear at specified instants of time, pausing the video until the learner answers them, as is usually done in many MOOC platforms. The contents adapt to the learner, depending on the paths defined by the instructor, the answers provided by the learner, the time spent answering questions by the learner, or her score: either the paused video can resume, or an alternative video segment or media element can be played. This formative assessment enables to adapt the learning path followed by different learners depending on their particular level of understanding of the concepts being taught by the video.

The application has been tested with two small groups of learners of the university where it has been created, as described in section 5.

3 Implementation of learning paths in VideoQuizMaker

An editor for quizzes has been added to Popcorn Maker. The editor allows the instructors to create and edit questions and answers of the quizzes. The jQuizme library³ has been used to generate the quizzes. jQuizme allows to have several types of questions, such as fill in the blank, flash cards, multiple choice (list or option tabs) and true/false questions.

We have extended the jQuizme editor so that users of VideoQuizMaker can specify the conditions that trigger alternative learning paths after a quiz has been

² <http://www.mozilla.org/en-US/persona/>

³ <http://www.bateru.com/jquery/jquizme/>

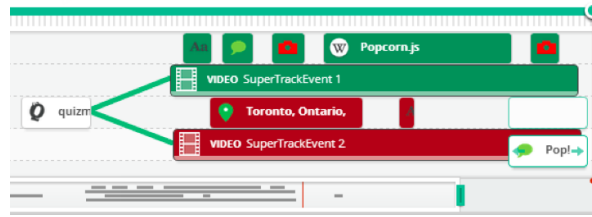


Fig. 2. Timeline showing two *SuperTrackEvents* in red and green

answered. These conditions are expressed in an editor, as a function of either the particular answers provided by the learner, the time spent answering, or the score in a learning path. An example is shown in Figure 1a. Media elements such as video segments that must be played on each learning path are placed in the tracks of the timeline. Learning paths are represented as media elements linked by lines, as shown in Figure 1b. The Kinetic.js JavaScript library has been used to implement the learning path GUI component in the timeline.

In a learning path being created the instructor can group a set of media elements that share an activation condition. For example, an instructor could specify that after watching a video segment, if a learner does not select the right answer in a quiz, a different video should be played, alongside an image with an explanatory drawing not shown on the video. The two media elements, the video and the image, have to be shown simultaneously once the wrong answer is selected by the learner. We call these sets of related media elements *SuperTrackEvents*. Figure 2 shows an example where two *SuperTrackEvents* are represented in the timeline with different colors after they have been grouped by the instructor, corresponding to two different learning paths.

Animation effects such as zoom in or zoom out can be independently defined for the different web media elements that are added to the timeline of VideoQuizMaker. For example, if after watching a video of an instructor explaining some topic, a learner does not select the right answer in a quiz, a learning path can be defined where the same video is played again, but this time minimized in a corner of the screen in order to be aware of the instructor talking, while simultaneously an image explaining in more detail what the instructor is saying is shown. Figure 3 shows the system architecture of VideoQuizMaker. A total of 7,000 lines of JavaScript code have been added to the Popcorn Maker codebase. The server side is implemented with Node.js and a PostgreSQL database. Client code runs as an HTML5 web application, composed of one only HTML file that loads Popcorn Maker and VideoQuizMaker JavaScript code.

4 Related work

Major MOOC platforms such as Coursera, Udacity, edX or TED-Ed provide tools for adding quizzes to videos. Educanon⁴ and EDpuzzle⁵ are commercial web-based tools that allow to reuse video content from YouTube or Vimeo for

⁴ <https://www.educanon.com/>

⁵ <https://edpuzzle.com/>

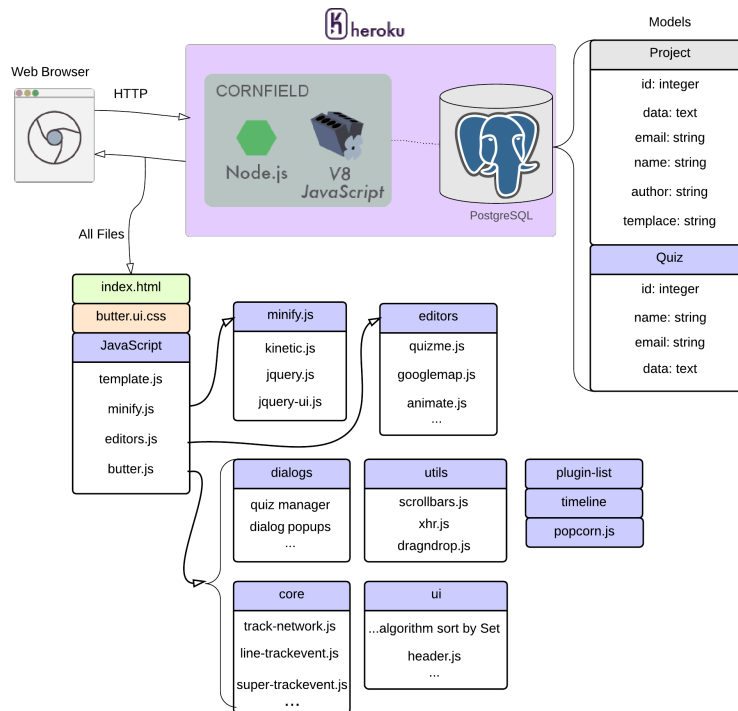


Fig. 3. VideoQuizMaker architecture

educational purposes. Both allow to add quizzes to provide an experience similar to traditional MOOCs. The possibility to include multiple media elements provided by Popcorn Maker, and the possibility to define learning paths that VideoQuizMaker adds to Popcorn Maker is not present in these tools. Adobe Captivate⁶ is an eLearning authoring tool that enables non-linearity of content based on input from users, offering a functionality similar to the one provided by VideoQuizMaker. Tools exist as well that can manage learning paths: ALEKS⁷ or the Khan Academy knowledge map⁸.

5 Conclusions and future work

Beyond current practice in MOOCs, VideoQuizMaker extends Popcorn Maker to define alternative learning paths based on the answers the learner provides to quizzes that interrupt the flow of the video at predefined points in time. The aim is to keep learners interested, what in the end we expect will increase the learning outcomes. As a preliminary validation of this hypothesis, we designed an experiment where a professor, with no previous exposure to VideoQuizMaker, designed a lesson using VideoQuizMaker. Two randomly chosen groups of learners were used for the experiment. One of them had to watch the whole video,

⁶ <http://www.adobe.com/products/captivate.html>

⁷ http://www.aleks.com/about_aleks/Science_Behind_ALEKS.pdf

⁸ <https://www.khanacademy.org/exercisedashboard>

and then answer questions about the subject taught, as a form of final summative assessment. They were allowed to go back and forth, or to repeat the whole video as many times as they wanted. The other group of learners had to watch the same video, but remixed by the professor, who used VideoQuizMaker to add quizzes and define alternative learning paths. Once the learners of this group had finished watching the video, they had to do the same final summative assessment, answering to the same questions that the other group. Based on these preliminary tests the authors conclude that the application experience for the professor is satisfactory and the effectiveness of the application in the learning process can be high. To test this hypothesis larger scale tests are underway. The professor answered a questionnaire about usability of the tool, indicating that it was easy for her to learn how to use VideoQuizMaker. As future work we plan to test VideoQuizMaker with a larger group of learners in order to validate the hypothesis that enabling alternative learning paths increases both engagement of courses and learning outcomes.

Currently the adaptation is based only on answers to the questions. As future work we plan to make use of a profile of the learner to improve the adaptability of the learning paths. Right now data generated while the learner is watching videos and answering quizzes in VideoQuizMaker is not being processed. We plan to implement techniques for automatically analyzing answers to quizzes provided by learners, as well as the paths followed, and the time spent watching videos and answering quizzes. We expect to provide feedback to learners based on the learning paths they have followed, in order to offer the learner a selection of the topics she is ready to learn at any given moment. We also plan to offer feedback to professors that will enable them to redesign learning paths based on the data analyzed. Finally, the authors plan to integrate VideoQuizMaker with NetLab, a web-based remote lab for simulating computer networks so that data obtained in NetLab network experiments can determine the learning path followed in VideoQuizMaker lessons.

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