Abstract

We have addressed the problems of independent e-lecture learning with an approach involving collaborative learning with lecture recordings. In order to make this type of learning possible, we have prototypically enhanced the video player of a lecture video platform with functionality that allows simultaneous viewing of a lecture on two or more computers. While watching the video, synchronization of the playback and every click event, such as play, pause, seek, and playback speed adjustment can be carried out. We have also added the option of annotating slides. With this approach, it is possible for learners to watch a lecture together, even though they are in different places. In this way, the benefits of collaborative learning can also be used when learning online. Now, it is more likely that learners stay focused on the lecture for a longer time (as the collaboration creates an additional obligation not to leave early and desert a friend). Furthermore, the learning outcome is higher because learners can ask their friends questions and explain things to each other as well as mark important points in the lecture video.

Keywords: E-Learning, E-Lecture, Collaborative Learning, Learning Analytics, Didactics, MOOC.

1 INTRODUCTION

E-learning has a lot of advantages and is often used not as a replacement but as an addition to traditional learning methods. In universities, for example, it has become quite common to enhance the teaching material with additional Internet offers, such as lecture recordings, interactive testing environments or self-tests. Lecture recordings, sometimes called e-lectures, are a very simple way to create e-learning content. There are many benefits associated with this kind of learning. One is simply taking advantage of a lecture that will be given irrespective of whether it is shown on the Internet or not. Recording and post-production do not create much work and an interference with the lecturer's time and didactics are negligible. This makes e-lectures different from Massive Open Online Courses (MOOCs), which have many other benefits that have been proven in numerous studies in the field of learning analytics but also require much more preparation than lecture recordings.

However, lecture recordings are not an equivalent replacement for traditional lectures. Even for a student who missed a single lecture in a series, watching the recording afterwards has several drawbacks. Considering that a standard university lecture takes around 90 minutes, it is unlikely that the student watching the recording will be able to maintain the same level of concentration as when sitting in a lecture hall. We have found that the average viewing duration of a ninety-minute lecture is around seven minutes. The main problems while watching the lecture recording are a lack of motivation and a dwindling focus. These problems are caused by the fact that learners are left alone with the lecture. The student gets no help, is unable to ask questions, compare written notes with a neighbor or engage in reciprocal quizzing of the material with another participant. In addition, the learner's motivation to spend time with the lecture recording has to compete with all the distractions existing in the environment.

2 PROBLEM AND MOTIVATION

First of all, we would like to clarify that we will not discuss the questions which format of lecture is the best or if learning with lecture recordings is the best way of learning or what is better. We will concentrate on the target group of university students who watch recordings of their lectures, which they have missed or want to repeat in order to prepare for the final exam or their homework. For our students at HPI there is a web portal\(^1\) that was developed within the project tele-TASK, a research project that engages in lecture recording, post-processing and distribution [1], where they can find all the recorded lectures.

\(^1\) https://www-tele-task.de
online. Being a small university institute with only three lecture halls and several seminar rooms, gives us the opportunity to record every lecture held supposing that the lecturer agrees to being recorded and having the lecture published online. So, there is a high number of 5,700 recordings of which the majority has the length of a regular 90-minute lecture. The availability of all those recordings is very advantageous assuming students have missed a lecture due to sickness or overlapping courses.

2.1 Learning alone

Learning with lecture recordings has advantages, such as independence from time and space, being able to pause, alter the playback, jump back and re-watch the last scene. But there are also some major disadvantages. In a pilot study [2] the perceived engagement level of students watching in-person lectures was notably higher (avg. rating $r = 0.776$) than for lecture theatre recording (avg. $r = 0.522$). It seems that students are less concentrated when learning with a recorded lecture. The advantages of learning with friends such as helping each other, comparing the written notes, testing each other orally are not available when learning alone at home. Of course, these would be given if students met at their friend’s place to watch the lecture together but we want to consider the remote learning case in which students are at remote locations.

2.2 Collaboration via chat

In lots of MOOCs, the learners can discuss the subject matter and ask questions. Usually, there is a forum, a group chat or the possibility to connect outside of the MOOC platform via Facebook, Google Hangouts, Skype or other instant messaging services. There are many ways to connect with fellow learners, even when learning with lecture video platforms instead of MOOCs. But the problem here is that the learners have to leave their focus on the lecture video whenever they want to write something in their communication with a fellow learner. So, either the learner switches to the chat or even picks up a smart phone to write a new chat message which comes with a context switch and often losing the thread of the lecture. A fictional dialog between two students could be as shown in Fig. 1.

Another issue is the anonymity when learning online in a chat-based way. It is likely to misunderstand the learning partner’s utterances and explanations. In this work, we will not solve this issue, but we will show a way of improvement to it.

One of the advantages of e-learning, which, at the same time, can be a disadvantage, too, is the fact that collaborative online learning is often asynchronous. That means that both learning partners are not active at the same time. Therefore, the process of collaboration is often tedious as the reactions of the
peers do not arrive in real time. But still, the non-binding nature of this form of collaboration is sometimes comfortable as learners do not feel to be put on a spot so much and communication even between people from different time zones is possible.

Another drawback is that of the low communication “richness” [3]. When only chatting in textual form, nonverbal communication is missing. But nonverbal aspects of a communication process would be important to prevent misunderstandings and to deliver more (“richer”) information than only text. Also the perceived effort of textual communication is much higher when writing everything on a keyboard.

Students who want to work on a project together or want to learn with video lectures need more than just a chat function.

3 PROPOSED SOLUTION

We have addressed the problems of independent e-lecture learning with an approach involving collaborative learning with lecture recordings. In order to make this type of learning possible, we have prototypically enhanced the video player of a lecture video platform with functionality that allows simultaneous viewing of a lecture by two learners on their own computers. This idea has previously been mentioned by [4], and [5]. While watching a video lecture online, synchronization of the playback and every click event, such as play, pause, seek, and playback speed adjustment can be carried out between two or more learners who have access to a computer with Internet connection and agreed on learning together. We have also added the option of annotating slides. With this approach, it is possible for learners to watch a lecture together, even though they are in different places. In this way, the benefits of collaborative learning can also be used when learning online. Now, it is more likely that learners stay focused on the lecture for a longer time (as the collaboration creates an additional obligation not to leave early and desert a friend). Furthermore, the learning outcome is higher because learners can ask their friends questions and explain things to each other as well as mark important points in the lecture video.

3.1 Lecture Video Platform

In order to build a prototype and test our ideas and theories, we used the lecture video portal of the Hasso Plattner Institute which is shown in Fig. 2.

The platform has existed for more than ten years already and has constantly been updated modernized ever since. At the moment, there are more than 5,700 recorded lectures organized within more than 470 lecture series. A series or collection is for example “Internet Security WT 2015/2016”. The lectures are also available in the form of 22,000 podcast episodes (cut at the lectures’ chapter marks). Many of them are also offered on iTunes U.
3.2 Together.js

To extend the lecture video platform used we applied and altered together.js\(^2\), a library developed by Mozilla for adding collaboration tools and features to existing websites. This is, in brief, done by synchronization of events in web browsing. It can detect interactions with the Document Object Model (DOM) such as clicks, etc., and mouse movement, which can thus be used for pointing at things or, in our case be extended to offer drawing on or underlining the lecture slides. Everything detectable is being synchronized with the connected peer or peers. Mouse clicks on a subpart of the website that is not part of the DOM cannot be detected, for example interacting with a Flash-based video player which appears to together.js as a single element of the website, but does not offer any additional information about what was done exactly (press on play, pause, seek, skip to the next chapter). This is one of the reasons why we decided to leave or feature-rich Flash-based video player and turned towards the development of a HTML5-based video player whose buttons are all accessible to together.js via the DOM.

Some of the additional features are the possibility to draw things and having an audio chat through the use of WebRTC\(^3\).

3.3 Integration and Extension of the Existing Functionality

Together.js comes already with lots of functionality to watch videos simultaneously. In our case, we even have two videos, the lecturer and the presentation, that have to be synchronized.

Fig. 3 shows how two learners watch a lecture together and collaboratively annotate the slides. Also, it is visible where the other one’s cursor is at the moment. Every action taken here is synchronized with the other learner’s view.

3.3.1 Adjustments to the playback speed

The used video player offers the possibility for adjusting the playback speed. Depending on the recorded lecturer, it can be helpful for the students to watch the lecture with a higher or lower playback speed than of the original recording. This also depends on the learner’s personal preferences and the difficulty of the topic. We had to extend the functionality of together.js to be able to synchronize speed adjustments during playback and as initial setting when a second or further learner joins the session.

3.3.2 Invitation to collaborate

As all lecture videos have a page of their own, it has to be made sure that the invited learner gets redirected to the correct video page. After that, the synchronization of events can be started properly. In together.js invitations can be sent through the generation and exchange of a special URL as it is done for example at openHPI [3]. The recipient of the URL can then join the session. This is not that comfortable as users have to copy and paste the link and exchange it via another means of communication. We elaborated on that topic and came up with a more user-friendly way of inviting friends. A user can invite a friend if he is logged in and knows the other’s user name or complete email address. For usernames there is an autocomplete function, but for email addresses we decided to only accept complete ones as it otherwise might be a risk of privacy loss due to a potential systematic retrieval of email addresses.

\(^2\) https://togetherjs.com/

\(^3\) https://webrtc.org/
Invitations can now be seen immediately during browsing on the lecture video platform as shown in Fig. 4 or on the invited user’s personal profile page as shown in Fig. 5. There she can either join or decline the session or decide later.

**Fig. 4** Incoming invitation during watching another lecture

**Fig. 5** List of existing invitations for the logged-in user.

## 4 EVALUATION

In this work, we showed that it is possible to enhance a video learning platform with functionality to watch video lectures together in sync, annotated the slides collaboratively and have an audio chat at the same time. This suggests the assumption that the learning experience and outcome of learning with lecture recordings can be improved if the presented ideas are applied to video-based e-learning platforms and used by the learners. However, as this project is still in an early stage where the prototype has not been tested with high numbers of users, we do not have enough user data to corroborate the theory. Then it will also be possible to dive deeper into the topic of group awareness which has not been in our focus yet.
An improvement that we have made to the standard functionality is the invitation system that not only offers the possibility to share a special URL but also offers to send invitations to friends as long as we know their email address or username.

The possibility to draw and highlight things in the lecturer’s slides video is also new and is more advanced and in-place than for example electronic notes to lectures as our lecture platform has offered for years already [6].

The described approach is reproducible and can be applied to all video portals which have a video player that is based on HTML and JavaScript. It would not work with a video player based on Flash or Silverlight as the navigation events that have to by synchronized among the connected learners, cannot be detected by together.js or similar techniques.

5 FUTURE WORK

However, there is still room for future work. For example, the ideas and code could be applied to our MOOC platform, openHPI, where we have various courses with 10,000 learners. Here, the collaborative aspect is a bit different as there are more users and usually shorter videos followed by self-tests, but there is also lots of interest in learning together with friends and colleagues [7]. In this context, we can generate even more research questions and challenges, for example the question how to intelligently arrange groups with matching students to learning groups or based on what aspects such as quiz results, social and educational background they can be suggested to each other as tandem learning partners. Also, it might be possible that we have learners who learn best if they have a by all appearances unsuitable learning partner. Older learners, for example, might be even more motivated if they have a mentoring role partnering with a younger learning partner (kōhai or protégé) they can explain things to and the younger ones might serve as an additional motivation and inspiration to the more experienced ones.

We should also have a look on how to automatically detect learning difficulties. There might be distinct patterns in the learning process detectable by the navigation and communication behavior that can be found and made available to tutors or the learners themselves. This could be used to work on increasing the completion rate of MOOCs, which are normally significantly lower than those of traditional (offline) courses. But still, we want to emphasize that a course’s completion rate is not the one and only measure to evaluate a course’s success [8].

Inside the MOOC platform, we should conduct a user study and ask the learners about their experiences with the new technology and their wishes and concerns. Additionally, we should match the usage of this way of collaborative learning with the learning results and the points achieved in the course.

As we can already use the audio chat functionality WebRTC offers, it would be obvious to implement a video-based chat, too. Of course, then there would be even three videos at the same time (lecturer, presentation, chat), but with today’s state-of-the-art computers the computing power of those would not be an issue.
REFERENCES


