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EOOC – Easy Open Online Courses
A Platform to Create and Run Open Online Courses

Okan Aydingül, Philip Mildner, Stephan Kopf, Daniel Schön, Wolfgang Effelsberg
Multimedia Technology and Computer Networks
University of Mannheim, Germany
{aydinguel | mildner | kopf | schoen | effelsberg}@informatik.uni-mannheim.de

Abstract: This article describes *Easy Open Online Courses* (EOOCs), a framework that supports generic online courses for students combined with an authoring tool for lecturers. The aim of our work is to provide a complete system supporting both the lecturer in providing an online course as well as the students using an online course in an interactive and motivating way. Setting up the system or adding a new course should require only little time and few resources. To achieve these goals, we have implemented a Web-based tool using common Web technologies like PHP, JavaScript and HTML. The content of the courses is stored in a MySQL database. A complete course with lecture recordings, online quizzes, animations, online tutorials, etc. produced with the EOOC framework is available and used by our students. A preliminary evaluation indicates that our EOOC course is well suited as a self-learning tool for students.

Introduction

There are many reasons why students need the possibility to study for their courses beyond the scheduled lecture times. They might have to work, they might be sick and have to stay at home, they can have overlapping courses or other reasons which make it impossible to attend the lecture. In order not to lag behind they need to catch up the course's contents in an efficient way. In the past *Massive Open Online Courses* (MOOCs) were introduced for this purpose and gained considerable attention. The New York Times described the year 2012 as "The Year of the MOOC" (Pappano, 2012). Currently, more than 16 million students use MOOCs in more than 2500 courses in different subjects and languages (Shah, 2014).

In general, MOOCs allow students to learn without physical presence. But there is more potential which can be exploited. Inverted classrooms, also called flipped classrooms, deliver content including lecture recordings (videos) which are watched outside of the classroom. Normally, this happens before the presence time takes place. The valuable presence time can thus be used for interactive discussions and questions about the lecture content (Mason et al., 2013), for interactive quizzes, for demonstrations, etc. In order to enhance the benefits of an inverted classroom, the self-study time at home needs to be as efficient as possible. We thus set out to investigate how MOOCs enhance the self-study time for students in inverted classroom settings. In addition, we wanted to develop an independent and flexible platform which is easy to use for the lecturer. From the students' point of view it should be easy to use, flexible and supportive. In our approach, both the students and the lecturer only need a Web browser for accessing or editing the course material.

Our aim is to allow lecturers to offer online courses with a minimal effort and thereby to be able to utilize their lecture time more efficiently. Students, on the other hand, are able to study the course material in small learning units in a comfortable environment of their choice. When they attend the presence phases they are better prepared and ask better questions. This makes the presence phase more interactive.

This article is structured as follows: We begin with an overview about related studies and systems. Next, we describe the different components of our framework and the learning elements it contains. We give a short insight into an ongoing evaluation and finish with a short conclusion and an outlook.

Related Work

Our work has two major goals. On the one hand, we want to support lecturers to use modern technologies to design their lectures and exercises more efficiently, without too much effort. On the other hand, we want to create a learning platform for students that attracts their attention and supports their understanding of the content.

In the past few years, the popularity of lecture recordings has increased a lot, and today they are widely used in higher education. Creating the recordings does not cost much effort, and it allows students to study the lecture content independent of time and place (Lampi, 2007, 2008a). Novel lecture recording systems support multiple cameras that automatically switch from the teacher to the audience or the lecture slides (Lampi, 2008b). The duration of a lecture of 90 minutes is typically too long for keeping the students' attention. Therefore, shorter video units, adjusted to the time students are attentive, should be presented to the students, as proposed by Gerbig-Calcagni (2010). We use such shorter recordings.

Flipped classrooms provide an alternative way of teaching, relying on digital resources. The main principle is that students autonomously study the lecture content by extracurricular digital resources (Jiugen, 2014). There are many reasons why a lecturer should consider a flipped classroom approach. The larger amount of material that can be covered in a single lecture is an example (Elliot, 2014). Elliot reports that students initially have problems with the flipped classroom concept because they are not used to that way of learning. However, soon, they find the activities quite helpful.

Gannod et al. (2008) examined how the flipped classroom model fits into the context of a software engineering curriculum. They concluded that the model is supported by both collaborative learning and distance learning but they also pointed out the issues that come along with the inverted classroom. For example, we do not know whether the students watch the lecture recordings at home or if they still come to the classroom sessions. Also, the overhead to switch from a traditional lecture to the flipped classroom model needs to be considered.

An already well established possibility to support the flipped classroom are classroom response systems (CRS). These can be used to meet the students at their state of knowledge at the beginning of a lecture (Schön, 2012a) or in the context of an exercise sheet (Schön, 2013). During a lecture, CRS questions could be used as an origin to a discussion, as it allows a truthful visualization of the students' opinions. In our approach, we used *MobileQuiz* (Schön, 2012a), a CRS already integrated into the e-learning platform of our university.

Other software tools like participatory simulations (Kopf, 2005) have been used to improve the learning success of students. A participatory simulation allows students to take an active role in a computer-based simulation. By manipulating the simulation, the students actively discover and understand the impact of their activities (Kopf, 2007). Serious games for education offer another way of knowledge transfer. Such games mitigate the motivational elements found in entertainment games to deliver knowledge in a playful manner (Squire, 2003; Wong, 2007).

Mildner et al. proposed a serious game that is intended to be used in classrooms to deliver architectural knowledge to students (Mildner, 2012). Such games where game elements and learning content are linked have a high motivational potential. However, this comes at the cost of having a specialized application that cannot be easily modified to fit other learning scenarios. Some learning games are not bound to a specific topic. The multiplayer serious game *Word Domination* (Mildner, 2014) is applicable for many subject fields; it combines a generic quiz with a multiplayer game. It comes with a Web-based authoring tool where new quiz questions can be entered without altering the actual game. A disadvantage of both approaches — the participatory simulation and the serious game — is the high effort it takes to set them up, and their cost.

With the increasing number of students, MOOCs face the problem of grading them. At some point, grading by the teacher or his assistants is not feasible anymore. There are two possibilities for grading: automated grading and peer grading (Tillmann, 2013). The authors proposed a learning platform which has an automated grading engine based on symbolic execution at the core. Their system is highly scalable and uses interactive games like "coding duels" to grade the performance of the students.

Our EOOC framework does not rely on external providers. However, there are MOOCs which do so. Pernias Peco and Lujan-Mora (2013) developed a MOOC based on Google CourseBuilder (GCB) which is an open source project of Google and offers a lightweight way to publish course material, track the student engagement, and evaluate their performance. The authors motivate their decision with higher flexibility, scalability, and availability of their MOOC. The architecture of their system has proven to be very stable and reliable but they still encountered problems when relying on external resources.

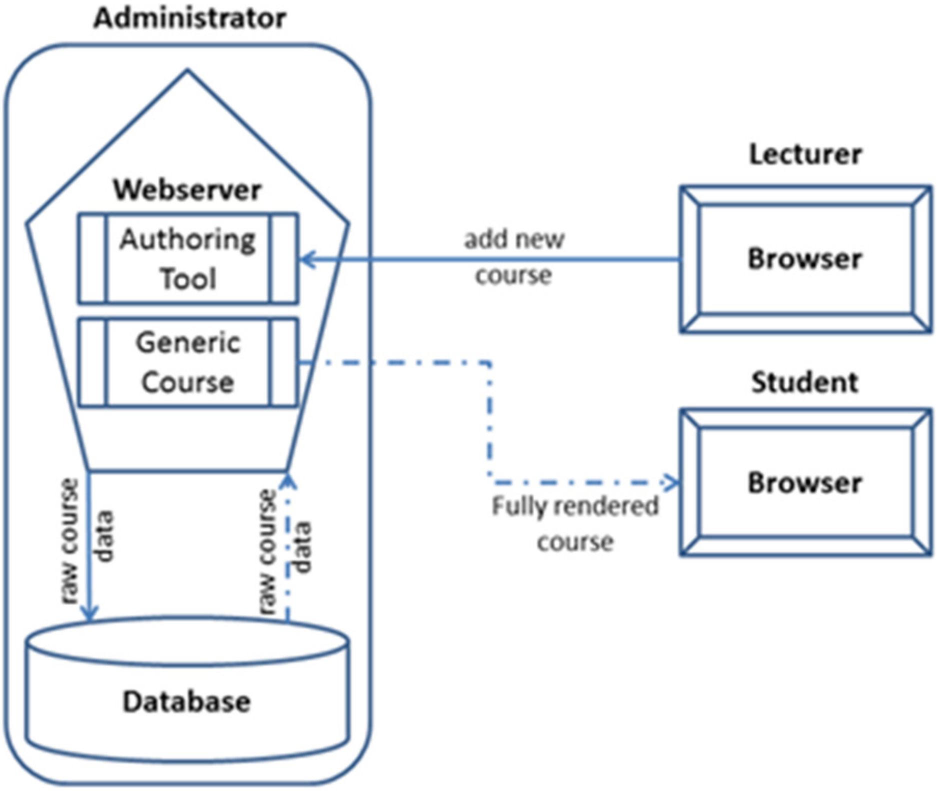

Figure 1: System overview of the Easy Open Online Course platform.

The EOOC Framework

Figure 1 gives an overview of the structure of our complete EOOC framework. Three human roles can be distinguished working with the system. The lecturer creates the course materials and the content. The student accesses the course at anytime from anywhere. Both only need a Web browser to work with our system.

The processes of creating and using a course are completely transparent to them. The third role is the system administrator who sets up the framework. Usually he is a computer scientist.

The arrows indicate the information flow when a lecturer creates a course. All the information is sent via the browser to the authoring tool. The authoring tool then stores the information in the database. The dotted arrows indicate the information flow if a student requests a part of a course, be it the welcome page, an overview or a learning unit. At the request, the information from the database is added to the generic course page. The fully rendered page is then displayed in the student's browser.

The EOOC framework is structured into different components. The first component is the *database* which is supervised and initialized by the system administrator. The system administrator is only needed once when the system is set up. An additional task of him is to set up a Web server that contains the course framework (without content).

The second component is the *authoring tool* and the generic framework for the courses. The lecturers access the authoring tool via a Web page which is written in PHP. It is possible to create new courses organized into chapters and units. Students access the generic framework and login to an existing course. The current page is then automatically filled with content from the course.

When accessing the course material, students begin at the welcome page (see Figure 2). The welcome page includes a welcome video as well as information about the course. Furthermore, a tutorial video on how to use the EOOC platform can be watched here.

The next page is the chapter overview (see Figure 3) where students find information about each chapter. After choosing a chapter the unit overview (see Figure 4) of that chapter is displayed. Each learning unit has a title and some tags giving hints about its content.

From the students' point of view, the unit is the main element of the course. Each unit contains a selection of learning elements which are discussed in the next section. The lecturer chooses which elements he or she wants to use for each unit individually.

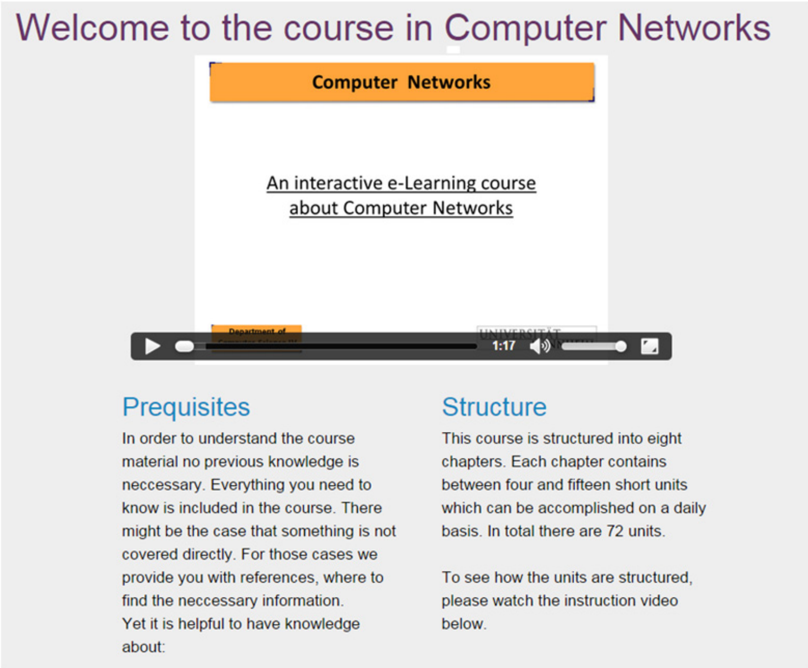

Figure 2: Exemplary representation of a welcome page

Learning Elements

To enrich their courses and to adapt the course to their needs, the lecturers can use a broad selection of learning elements. In the following, we elaborate the currently available elements. A survey conducted by Gerbig-Calcagni (2010) showed that during a lecture, the majority of the students are only attentive for about five to fifteen minutes without losing their focus. Thus we decided to tackle this problem by splitting classical lectures into small units and use multiple digital media to represent them. We put considerable effort on the recordings of traditional lectures which we subdivided into sequences of approximately 15 minutes. Each sequence is attached to a learning unit. We named this sequences video elements. The intention of this element is to show lecture recordings or other video material concerning the current unit. The video is embedded via a HTML5 video streaming player, making it available on all modern devices, including PCs, laptops, tablets and smartphones.

Supporting the videos, a slide show with transparencies is offered. The combination of videos and transparencies gives students a high degree of freedom of how to follow the lecture content, e.g., making it possible to pause the video while looking something up on one of the earlier slides.

Text descriptions may be added for each unit. The lecturer can add a unit description which is more detailed than the tags in the unit overview. An element for additional literature recommendations is also supported.

The next element is the exercise element. It gives the lecturer the possibility to add exercise questions and solutions. The solutions to each question are hidden until a student decides to access them by clicking on the question. The lecturer has the possibility to completely hide the solutions and allow students to upload their solution for review. The lecturer can activate the solutions at any time and, as a consequence, deactivate the possibility to upload solutions. This feature is meaningful if the exercise questions are graded and students have a limited time to hand in their solutions. However, as our intention is to create a self-study course, this timing feature is deactivated by default.

We have also added elements to include external Web pages into the course. Since this information can be very heterogeneous, we decided to add hyperlinks to those pages instead of embedding them. One example of such an external resource are simulations that can be used in a unit. A simulation can be an external Web application explaining the students an algorithm by the use of animations. Another example of an external element is the quiz tool which connects the students to our *MobileQuiz* application (Schön, 2012a, 2012b).

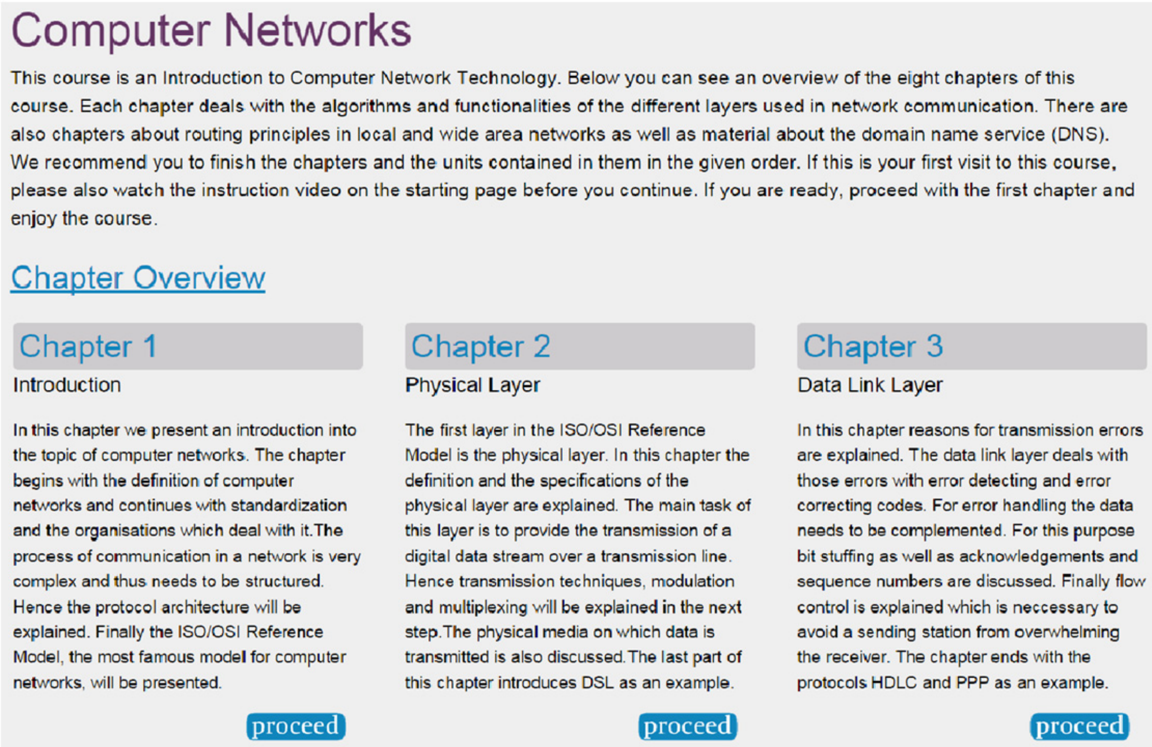

Figure 3: Exemplary representation of a chapter overview.

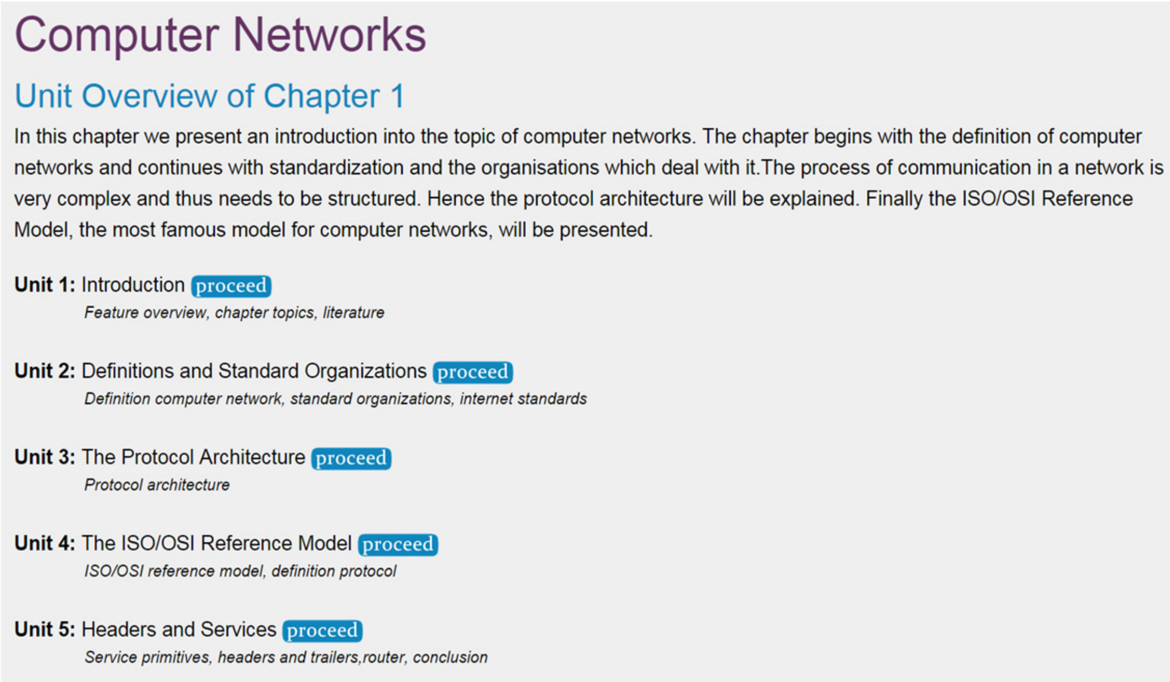

Figure 4: Exemplary representation of a unit overview.

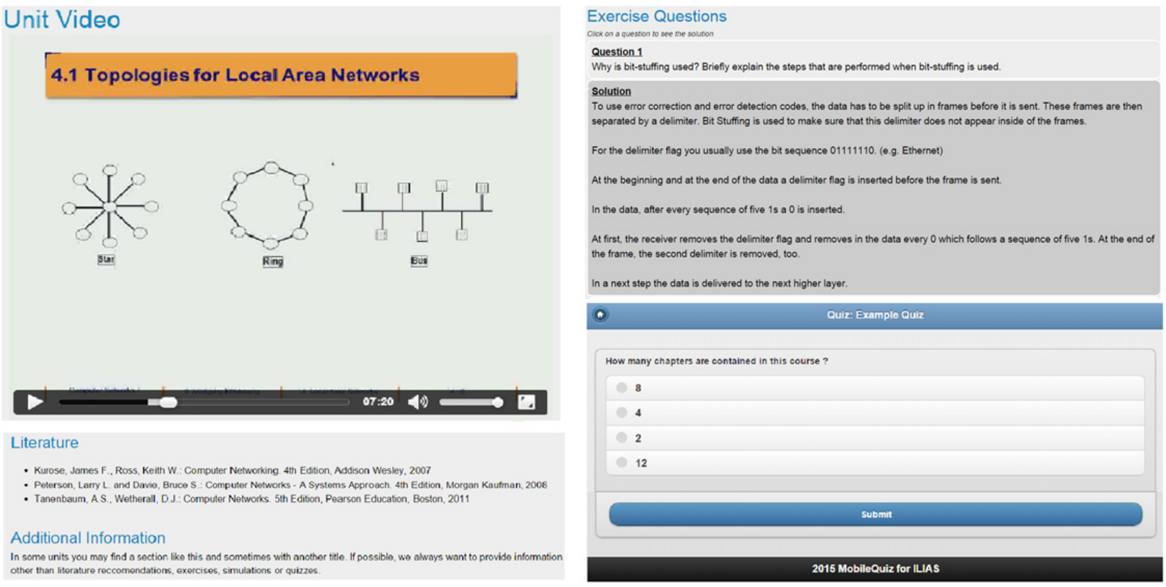

Figure 5: Example of supported learning elements. Video (top left), exercise (top right), textual description element (bottom left) and MobileQuiz (bottom right)

In order to give the lecturer enough freedom to add information to a unit, we added an element which only consists of a title and free text. In contrast to the textural description in each unit, this element is suitable to emphasize information about the specific content contained in the unit. Additionally, there is an element to add HTML code, although using this element would require more effort and knowledge on Web programming for the lecturer.

Finally, we added an element to allow the students to ask questions about each unit. The lecturers can easily access the questions and answer them via the students' email addresses. The question and answer process is only partially integrated into the platform yet, but planned for the near future. This element is especially useful for the evaluation as students are also able to give feedback about the course and each unit individually. Hence, we call this functionality our feedback element.

There are more elements existing, under development and planned. One of them is an element to allow students to publicly comment units and exchange their thoughts, similar to a forum but included in each unit.

Figure 5 shows selected learning elements of the open online course Computer Networks[1].

Evaluation

To test our system we deployed it on an Apache Webserver (2.2.22 Debian) with PHP (5.4.36) and a MySQL Server (5.5.41). We added a course to the framework by using the database user interface.

The new course covers lectures and tutorials of the topic 'Computer Networks' (CN). CN is a computer science fundamental course on the bachelor level. This English course is divided it into eight chapters with a total of 72 units. To create a new course, the information illustrated in Figure 6 is inserted step by step. First, a title, a description and additional information like requirements, structure and used technologies are necessary in text form. Additionally, the course owner can add a welcome video and also a video with instructions about how to use the course.

The next step is to create and add chapters to the course. A chapter consists of a title and a description. Finally, units have to be created and added to their chapter. A unit consists of a title, description, tags and the learning elements. All lectures, chapters, units and learning elements have triggers to show or hide them.

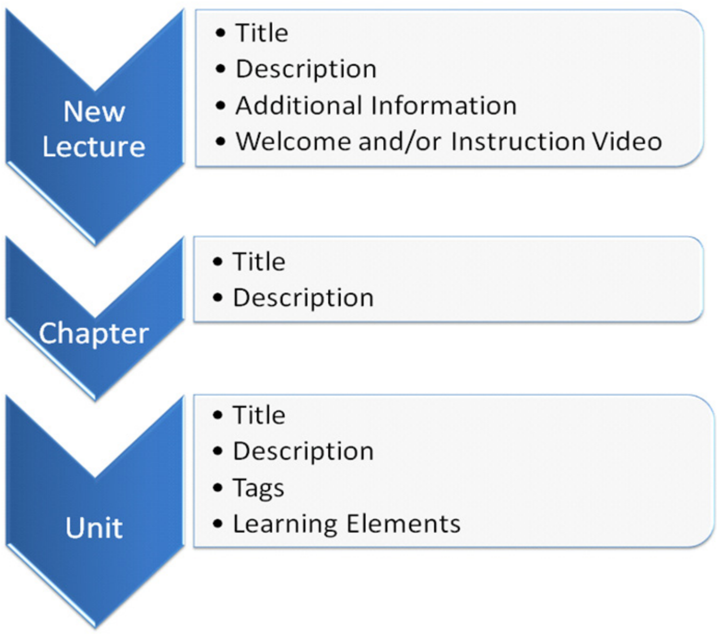

Figure 6: Information requirements to create a new course.

[1] Open online course Computer Networks.
URL: http://pi4.informatik.uni-mannheim.de/projects/courses/ComputerNetworks/

At our university, about 80 students are attending the lecture and tutorial of the master's course 'Advanced Computer Networks' (ACN). This lecture is the continuation of the basic Computer Networks lecture and builds up onto the content of the CN course. However, the bachelor course CN is not a mandatory requirement for the master course ACN. Therefore, students who did not participate in the CN course have to study that course material on their own in order to successfully complete the ACN course. We support this process by providing all the students attending ACN but especially those without a CN background with an access to our 'Computer Networks - Easy Open Online Course' (CN-EOOC).

To gather first insights on the usage of the EOOC tool, we handed out a short survey questionnaire in the tutorial class. In total, 14 students (4 female, 10 male), aged between 22 and 26 years old, all in the business informatics degree program, completed the survey. About 30% of the participants stated to have no prior knowledge about computer networks, and 15% stated to have little knowledge about the topic.

The questionnaire was divided into three parts. Firstly, there was a part with questions about the usage, structure, design and content of the online course. The scale to rate each question was a 5-point Likert scale that reached from "strongly disagree" via "disagree", "neutral" and "agree" to "strongly agree". The second part consisted of questions about the learning elements and whether the participants like them or not. We used the same scale as in the first part but added the optional answer "not applicable". This is necessary because not all units contained all learning elements. The final part of the questionnaire allowed the participants to write down their thoughts about what they liked, what they did not like, and what improvements they would suggest for the EOOC.

Discussion

The results of the questionnaire show that all participants used the online course. About 80%, answered with "agree" or "strongly agree" to the question whether they used the course regularly. The same number of participants also enjoyed the course and stated that the handling was easy. The majority of about 72% liked the design of the pages but think it can get improved. Some participants answered that the unit size was a bit too long, and that the course did not fully supply their required knowledge for the course ACN.

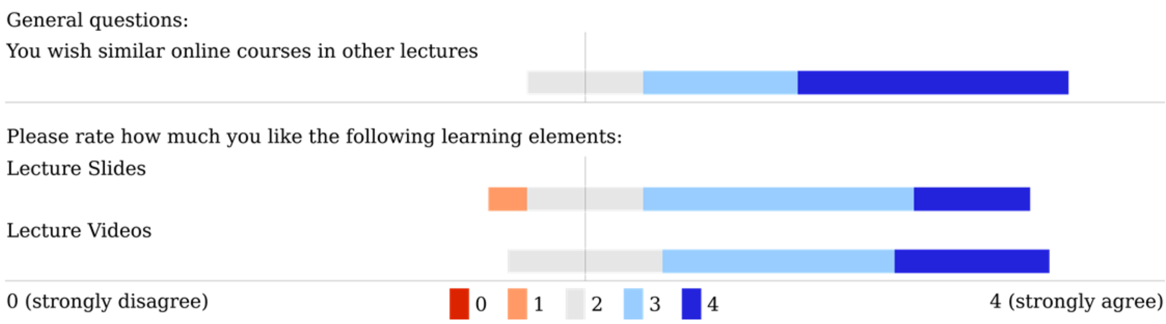

Figure 7: Excerpt of the results of the questionnaire.

In the comments about what they did not like, students explained this rating with the additional workload they had, since they technically worked on two lectures at the same time, as well as with the knowledge they had prior the beginning of their course. Almost all participants (80%) want to see similar online courses in other lectures. The other 20 % answered the corresponding question with "neutral". In Figure 7 some of the results are graphically illustrated.

Considering the learning elements, the results clearly show that the lecture recordings and slides were liked most. More than 70% of the participants liked them whereas the rest had a neutral opinion. Only in one case a participant did not like the lecture slides. About 40% did not work with the exercise questions, the quizzes and the feedback element. According to the textual answers in the questionnaire, the reason for this was again the additional workload for the ACN course, or the students worked with units that did not have such elements. The remaining 60% liked those elements but slightly less than the lecture recordings and slides.

The participants liked the possibility to study the lecture material when and where they wanted. They were pleased by the basic structure and found the course very helpful. We conclude that our tool is well suited for a stand-alone application in a self-learning course or as supplementary material in a flipped classroom scenario. To further motivate students to take part in the course, gamification elements could be added in the future (Deterding, 2011).

Conclusion and Future Work

We have designed and implemented a complete framework to create and run open online courses. A large number of different learning elements are supported such as lecture recordings, lecture slides, quizzes, questions, etc. A complete online course has been created with our framework which is regularly used by students. First evaluation results indicate that the concept, usability and functionality is appreciated by the students and the teachers.

The course we have created seems to have an appealing and intuitive design, an adequate tutorial and the possibility to customize its content. Our framework allows the lecturer to create a new course without using support from an administrator. From our point of view, creating the online course was fast and easy as long as the lecture content was available. Lecturers should start with lecture recordings and slides and add other content as soon as it is ready. Since units or even entire chapters can be hidden or added during the semester, getting started quickly and adding more content without distracting the students is possible.

First feedback from students was quite positive. An extensive survey is planned for the upcoming semester. Then, the online course will run in parallel to the computer networks lecture. The lecture will be held in the format of a flipped classroom. During that time we will be able to investigate the full potential of the EOOC. An evaluation from the lecturer's point of view is planned after the authoring tool is more complete. When several courses are used in parallel, a measurement of the scalability of the system is also planned. In the near future, we will also ask administrators to test the system and its deployment process. For this purpose we created a short user manual which will be given to the test candidates.

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