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A MOOC Prototype on Object-Oriented Modeling

Development, Usage and Evaluation

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MASTER'S THESIS

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Erklärung zur Verfassung der Arbeit

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Abstract

Massive Open Online Courses (MOOCs) are a new way of teaching and learning. Thousands of people participate in free online courses over several weeks. These courses do not have any registration restrictions such as a specific educational level. The content of the individual courses is provided via videos, texts, quizzes, assignments and projects. This Master Thesis investigates which presentation techniques are accepted by the students as far as teaching a Modeling Language is concerned. Furthermore, the motivational reasons for students to participate in a MOOC on Modeling Languages is evaluated.

For the purpose of this Master Thesis, a MOOC on the UML Class Diagram, which is a part of Object-Oriented Modeling, has been developed and run. Subsequently, the MOOC was evaluated based on two questionnaires and logfiles of the course itself. Finally, the results have been interpreted in order to answer the research questions.

The video style showing slides and the instructor is the most accepted presentation technique for teaching Modeling Languages. Animated handwriting shows less in-video dropouts but is not very popular with students. Projects and Quizzes are the most helpful activities for MOOC users. Most of the students take a MOOC because they are passionate about learning an interesting new topic. Gaining bonus points for the in-class lecture at the TU Wien is also a motivation driver for doing a MOOC.

Kurzfassung

Massive Open Online Courses (MOOCs) sind eine neue Art des Lehrens und Lernens. Tausende Personen nehmen über mehrere Wochen an kostenlosen online Kursen teil. Es gibt keine Aufnahmelimitierungen, wie zum Beispiel ein bestimmtes Bildungslevel, um an diesen Kursen teilnehmen zu können. Der Inhalt unterschiedlichster Kurse wird in Videos, Texten, Quizzes, Hausübungen und Projekten strukturiert dargeboten.

Diese Diplomarbeit untersucht, welche Präsentationstechniken die Studierenden bevorzugen, wenn es um das Lehren einer Modellierungssprache geht. Außerdem werden die Motivationstreiber evaluiert, welche Studierende dazu bewegen, an einem MOOC über Modellierungssprachen teilzunehmen.

Im Zuge dieser Diplomarbeit wird ein MOOC über das UML Klassendiagramm als Teil der Objektorientierten Modellierung entwickelt und durchgeführt. Der MOOC wird auf Basis zweier Fragebögen sowie Logfiles aus dem Kurs evaluiert. Zuletzt werden die Ergebnisse interpretiert, um die Forschungsfragen zu beantworten.

Die Analysen zeigen, dass der Videostil, bestehend aus Slides und Vortragenden, die am meisten gewünschte Presentationstechnik ist, um eine Modellierungssprache zu lehren. Animated handwriting zeigt weniger in-video dropouts, ist aber weniger populär bei den Studierenden. Zusätzliche Projekte und Quizzes sind die hilfreichsten Aktivitäten für MOOC-Teilnehmer.

Die meisten Lernenden nehmen an einem MOOC teil, weil sie gerne neue Themen erarbeiten. Bonuspunkte für eine Lehrveranstaltung der TU Wien sind ein weiterer Motivationsfaktor für Studierende, um an einem MOOC teilzunehmen.

Contents

CHAPTER 1

Introduction

This chapter investigates the problem of Massive Open Online Courses (MOOCs) in Section 1.1. Then we provide the aim of the work in Section 1.2 and the methodological approach in Section 1.3. Finally, we introduce the structure of this Thesis in Section 1.4.

1.1 Problem Definition

Learning methods have changed over the years, especially due to technological innovations. In today's life almost every person uses the Internet. As you can find most of the recently released books online, you do not have to go to the library anymore. Equipped with smartphones, tablets and laptops, studying is possible anywhere in the world.

Massive Open Online Courses (MOOCs) are a new way of learning. They are designed for a large number of people who are enrolled in the courses. A course is often taken by several hundreds to several thousands of persons. Compared to other learning models, MOOCs are completely open and anybody can take courses. Sometimes a fee for the course or for a certificate is collected but anybody can take the course without any other requirements such as a specific educational level. A MOOC takes place in the World Wide Web, meaning you can do it from anywhere you want. MOOCs are "replacing the human social component of learning with a kind of artificial intelligence interaction with the platform" [59].

MOOCs are struggling with very high dropout rates of students, up to approximately 90 % [12, 49]. Time plays an important role in this. Usually, a MOOC takes several weeks. In the beginning the participants are motivated but after a while the dropout rate increases. The participants need to stay motivated throughout the whole course in order to complete it successfully. The openness of a MOOC implies that there are many people taking the course with very different prior knowledge of the course's topic. Participants often fail because they expected something different or they are not interested in the subject matter anymore [57]. Another important point is the pedagogical aspect. The learning material, e.g. videos and texts, should be of good quality so that the user stays motivated to continue learning. Additionally, MOOCs usually offer quizzes to demonstrate the progress of the user's knowledge.

The following Research Questions are tackled in relation to this Master Thesis:

Research Question 1

Which presentation techniques for teaching a Modeling Language in a MOOC are accepted by the students?

Research Question 2

What are motivational reasons for students to participate in a MOOC on Modeling Languages?

1.2 Aim of the Work

The aim of this Master Thesis is to develop, use and evaluate a pilot MOOC at TU Wien in the area of Object-Oriented Modeling (OOM). Covering the whole issue of OOM would go far beyond the content of one Master Thesis. We decided to only teach the Class Diagram of the Unified Modeling Language. This is part of the course Object-Oriented Modeling, a compulsory course at computer science and business informatics curricula at the TU Wien.

Bachelor students of the computer sciences or business informatics studies at the Vienna University of Technology are gaining bonus points for accomplishing the pilot MOOC for the Object-oriented Modeling course at the university. Due to this, the motivation in the pilot MOOC will be higher and the dropout rate lower compared to other MOOCs. Aside from that, the dropout rate is expected to decrease compared to other MOOCs because the UML-MOOC only takes three weeks. However, the dropout rate might increase, as some participants lack basic knowledge about programming.

It is assumed that the preferred learning materials are the quizzes because the participants can check if they have understood the topic independently. Users who already know the topic may only do the quizzes and watch the videos afterwards if in case they have failed the quizzes. There will be two different types of videos. Firstly, there will be videos with slides where the audience will hear and occasionally see the lecturer talking. Secondly, there will be videos with animated handwriting only. It is assumed that the second video style will be preferred because it is quite new and more creative.

Although it would certainly contribute to a deeper understanding of the topic, we expect that the forum will only be used for requesting help and not for discussion. This is due to the fact that the forum activity is not obligatory in order to receive the bonus points.

Taken as a whole, the pilot MOOC of the TU Wien is expected to support the students in acquiring the necessary knowledge.

1.3 Methodological Approach

The first step is to study the literature dealing with MOOCs. The focus is on different aspects of MOOCs, on identifying guidelines for developing a MOOC and researching existing surveys and critical reflections on MOOCs. Threats and opportunities are realized.

Parallel to the literature review, we will gain our own experiences with MOOCs by taking part in different courses. We are focusing especially on the structure of the MOOCs and how they are implemented.

A questionnaire will be developed to ask typical demographic questions (age, gender, etc.), questions about the educational level of the person and his/her motivation. The questionnaire can be filled in by the participants of the course before they start with the MOOC. Filling in is not mandatory because it should not discourage people from starting the course.

A MOOC on the Class Diagram of the Unified Modeling Language (UML) is designed. It will be a three-week MOOC with videos, quizzes and a peer-assessed project at the end. Unfortunately we can not offer official badges or certificates from the Vienna University of Technology. Instead we will try to gamify the MOOC so that the user will stay motivated.

After one or more MOOC runs an analysis and evaluation is done. On the one hand we have the dataset of the log files from the users and on the other hand we have the questionnaire filled in by the participants. The focus of the analysis is on the questionnaires, videos, quizzes and the project.

The final step is the evaluation where the research questions, as stated above, are answered.

1.4 Structure of the Work

Chapter 2 introduces MOOCs in the literature and shows concepts, methods and models that were used for our MOOC prototype. We give a brief overview of the MOOC's history and present today's main platforms and their provided courses. Additionally, we highlight challenges of these MOOCs. The main focus is on instructional design and on implementation and evaluation of MOOCs.
The development and usage of our MOOC prototype are described in Chapter 3.
The evaluation of the MOOC prototype is stated in Chapter 4. Chapter 5 deals with a critical reflection on the MOOC topic, especially on our MOOC prototype on the UML Class Diagram. Finally, in Chapter 6, we highlight the most important results and provide a summary of this Thesis. Additionally, we propose future work.
In Appendix A, you can find further information of data sets we used and survey questionnaires.

CHAPTER 2

Current State MOOCs' Development

This Chapter gives an overview about MOOCs in the literature. Additionally, concepts, methods and models used in the current MOOCs' development are showed. At the beginning, MOOCs of various platforms are introduced. Then different instructional design models are proposed. These models present different frameworks which can be used to implement a MOOC. We will then briefly look at learning theories of MOOCs. Following this, we introduce some guidelines that will help us to create our first MOOC prototype. The implementation section includes important methods and aspects on how a MOOC can be realized. Finally, we express analysis methods with a focus on learning analytics, video engagement and dropouts.

2.1 MOOCs in the Literature

George Siemens is the founder of the first MOOC. He thinks that learning should take a big step forward in the 21st century where knowledge is growing and spreading fast over the world. He combines the three broad learning theories: behaviorism, cognitivism, and constructivism. Learning is not only a matter of schools and universities anymore; it is a lifelong ongoing process. People participate in MOOCs to become better at work, to refresh skills or to learn something completely new [49].

Today there are two major MOOC platforms. The for-profit platform Coursera and the non-profit open source platform edX, which both have worldwide partnerships with universities and organizations. Coursera was founded by two professors from Stanford University in 2012 [17]. EdX was founded by Harvard University and MIT [17].

We highlight popular free English-language (or with English subtitles) MOOCs of the platforms edx and Coursera. The edX courses are developed by Harvard University and MIT and the Coursera courses come from various universities or schools.
The MOOC 'Learning How to Learn: Powerful mental tools to help you master tough subjects' has the most total enrolments in Coursera's history with 1,19 millions of users. This course deals with various learning techniques. The institution behind this course is the UC San

Diego [76]. The course is taught by a professor of Engineering and a professor for Biological Studies. Both professors belong to a different field of study but work together for the MOOC. This is very typical for a MOOC.
A well-known MOOC to people who are familiar with MOOCs is Stanford University's MOOC 'Machine Learning'. The first launch was in October, 2011 on Coursera. It was the first MOOC that had over one million students.
'CS50x Introduction to Computer Science' is the most popular MOOC on the platform edX. Since October 2012, it has 350.000 enrollments and was launched by one of the founders, Harvard University. It deals with the basics of major and non-major programming skills and theory. The edX founder, MIT, released the MOOC '6.002x Circuits and Electronics' in June, 2015. It is taught by Anant Agarwal, the President of edX, and other professors from MIT [58].

Futurelearn is the first platform from the United Kingdom, founded by a private company. Futurelearn provides free MOOCs from universities in the UK and around the world. It has a partnership with the British Library, the British Council, the British Museum and other Partner Institutions.
Futurelearn's most famous course is 'Understanding IELTS: Techniques for English Language Tests', developed by the British Council. The course helps students to prepare for the International English Language Testing System (IELTS) test which is accepted by over 9000 organisations [40, 58].

Another big MOOC player is the non-profit platform Khan Academy. Its goal is to provide free education for anyone, anywhere [45]. In the MOOC 'Learning programming on Khan Academy', the videos have a speciality, so called 'talk-throughs'. While watching a video showing a code, it is possible to stop the video and play with the code yourself. This technique makes the videos very interactive. If any programming mistakes are made, hints pop up to help the user find the correct solution.

Udacity is Stanford University's second founded platform which is famous for their first course 'Introduction to Artificial Intelligence". The second popular MOOC is 'Web Development: How to Build a Blog' [58, 77].

Iversity is a European Platform which provides MOOCs from universities, institutions and also companies. Its guiding principle is 'Study Anywhere'. Iversity also offers qualification certificates for digital learning [41].

The University of Graz and the Graz University of Technology have developed Austria's first MOOC platform iMooX. It offers German courses about general and university topics [34]. In this context MOOChub has to be mentioned. It is a consortium of different MOOCs offering universities with the opportunity to provide their courses to more people and to support anybody's education. The founders of this union are the University of Graz, the Graz University of Technology and the Luebeck University of Applied Sciences [54].

A big challenge for MOOC providers is the high dropout rate due to many people enrolling in courses but then not finishing them. One of the reasons for this is that the motivation of participants might decrease over the weeks that the MOOC is taking place. Thus, many MOOCs offer badges for either finishing a part or the whole course or certificates for finishing the entire MOOC successfully. Another way to increase motivation is to gamify the MOOC so that people want to participate until the end. Motivation also depends on the quality of the offered learning

materials. In the video production there are different styles, some of which are more motivational to the viewers than others [37].

Another important aspect is cheating. In school or university exams you are not allowed to cheat. Proctored exams can be used to prevent cheating in MOOCs. Usually in the online setting of the MOOC, nobody controls the user. In the informal setting of a MOOC, cheating can also be regarded as learning [4, 15].

The IEEE CS 2022 Report predicts that MOOCs will be essential for learning and teaching for all educational levels by 2022. In the classroom there will be no typical theoretical lectures, but instead discussions with the professors about the self-studied MOOCs [2].

2.2 MOOC Types

Two types of MOOCs exist: cMOOCs and xMOOCs. Their commonalities and differences are briefly explained in the next section.

cMOOC

Connective Massive Open Online Courses, so called cMOOCs, follow the connectivist learning approach "that emphasise creation, creativity, autonomy and social networked learning" [67]. The first cMOOC was implemented by George Siemens, as stated in Section **??**. "Participants are encouraged to organize themselves and make progress in a collective, constructivist fashion" [5]. The cMOOCs' users are very motivated. They probably put in a lot of time learning [65]. In practice, the course is not well-structured because each individual has his/her own way to use the MOOC. The communication and collaboration is through different channels, especially through social media such as Twitter. The users contribute artefacts, eg. videos, blogs or posts, to the course. Knowledge growth is dependent on the interaction with media, from the construction and from the interaction within the network. In other words learners construct and reconstruct their knowledge. This is known as collective intelligence. A disadvantage of cMOOC is that there are many different communication channels, which may confuse the users too much [14, 31, 47].

There are no assignments or tests possible to measure the users' created knowledge as it depends highly on the network that creates and consumes learning [47].

According to [35], the provider of cMOOCs are more confident of learners' capacities, especially for self-organizing and for co-participating. They rely on content aggregation and peer evaluation.

xMOOC

The 'x' in xMOOCs means extension. Originally, the 'x' comes from MIT and Harvard University, which use this letter to mark the online lectures in their course catalogue. xMOOCs follow the behaviouristic pedagogical approach. [65].

They are more content-oriented and have more unidirectional approach than cMOOCs, which are student-oriented [3]. xMOOCs emphasizes mainly the learner's interaction with the content.

You can also speak about individual learning. XMOOCs contrast to cMOOCs, where the interaction with other peers is the focus as it follows the connective approach [14].

Today's provided MOOCs are xMOOCs and can be found on several platforms such as Coursera or edX [14]. The courses are provided by universities and organizations. xMOOCs are "likely to be seen as the online version of a traditional lecture" [47]. The knowledge and information comes primarily from one or several professors who are delivering the online content [35].

According to [24, p. 217] and to [5,13,63] a typical xMOOC consists of following elements:

- course structure with learning targets
- video lectures (recordings or new products)
- sequence of activities
- additional learning content according to the video lectures
- asynchronous communication possibilities (e.g. discussion forums)
- self-assessment according to the video lectures
- certificates for successful completion of the course
- an information system that provides all these contents

Other Classifications

MOOCs can also be classified based on different pedagogies [55]:

- transferMOOCs – where existing courses are transferred to a MOOC
- madeMOOCs – which are more innovative, making effective use of video and interactive material and are more quality driven
- synchMOOCs – with a fixed start and end date
- asynchMOOCs – which don't have fixed start and end dates and have flexible assignment deadlines
- adaptiveMOOCs – which provide personalised learning experiences, based on dynamic assessment and data gathering on the course
- groupMOOCs – where the focus is on collaboration in small groupss
- miniMOOCSs - which are smaller than the traditional massive MOOCs

These categories can also be mixed up together in one MOOC.

Another classification of a MOOC is the hybrid MOOC (hMOOC). This is a MOOC that is used within an institution. A hMOOC can be seen from two sides - from the alignment with the curriculum and from the institutional effort. Resultantly, a MOOC can be seen as a replacement (high recognized within the curriculum, low institutional effort), as a driver (high recognized within the curriculum, high institutional effort), as a service (not recognized within the curriculum, low institutional effort) and as an added value (highly recognized within the curriculum, high institutional effort) [60].

2.3 Instructional Design

"Instructional design is a technology for the development of learning experiences and environments which promote the acquisition of specific knowledge and skill by students" [52]. The definition of instruction is that it is "a system and has to be seen in its interdependence to the context, the content and the learning itself" [47].
According to [61], on the one hand, instructional design, also called instructional system design, can be seen as science as it follows specific theories and methods. On the other hand, it can be seen as art because the level of creativity has a high impact on the success of the design. Either way, the instructional design is very crucial in the development of a (Massive Open Online) course because the process is structured.

ADDIE Model

The ADDIE Model is the most used concept by instructional designers and builds the foundation of various other models, e.g. ASSURE [25] following [27, 47, 61]. It consists of five phases: Analysis, Design, Development, Implementation, and Evaluation. Usually, the phases build a cycle and the evaluation phase will start a new iteration.
The analysis phase sets up the goals of the course. The designers identify their target audience with a special focus on their respective skills. The subjects or topics of the course are then determined. In this phase, the preferred learning environment is also investigated. Limitations, for example technical, financial or human resources, of the instructional design are detected.
In the next stage, the design phase, a comprehensive strategy to reach the targets is planned. It should cover all main aspects of the course in detail. The learning objectives and their content are defined. Furthermore, the way how to present this content is also considered. During this phase the assessment instruments are determined.
The design phase is followed by the development phase where the course's content is produced or bought from third parties. Usually, it includes the production of learning materials and assessments.
The whole content is then tested during the implementation phase. Often so called beta tests are used where only a small self-chosen audience with few representatives give feedback on the material. Another possibility is running a pilot where participants who would take part in the course get in contact with the designed system. The pilot is exactly the same as the one that will be used in the real course. Especially in the context of MOOCs, it is good practice to have a

pilot where you can test your course with an actual audience and get feedback on it. The implementation phase takes a lot of time because of the receipt of feedback during running the course. After the implementation phase the evaluation phase follows. It compares if the results have met the expected goals. The receipt of feedback is very helpful. The evaluation should consider the reaction, the learning, the behaviour and the results. As MOOCs are self-instruction programs, the evaluation usually considers sufficiency, usability, currency and effectiveness. Sufficiency can be evaluated with a questionnaire if anything was missing in the course. Usability deals with if the platform/learning material was as easy as possible to use. A user survey can be used to answer this question. By asking the people who are responsible for the subject matter if the content is up to date, you evaluate the concurrency. Effectiveness can be measured by the users' results. The evaluation stage will influence the continuous modification of the course to get the maximum efficiency and therefore the analysis phase starts again.

ASSURE Model

Another instructional design model is the ASSURE model, as explored in [25] and [47]. It builds an extension to the ADDIE model. The acronym ASSURE stands for **a**nalyze learners, **s**tate objectives, **s**elect, modify, or design materials, **u**tilize materials, **r**equire learner response and **e**valuation.
Compared to the ADDIE model ASSURE focuses in its analyzing step particularly on the learners. The investigation will consist of general attributes of the learners, prior competencies and the learners' learning styles.
In the next stage the standards and objectives are determined. The standard defines what the learner is able to do as a result of the instruction. The learning objectives can be set with the help of a focus on the audience, the behavior or performance of the instruction, the conditions under which the behavior will be observed and to what degree the knowledge or skill will be mastered.
It is important to identify the strategies, technology and media that will lead to the fulfillment of the learning objectives during the next upcoming stage. These artifacts should support the teaching strategy.
The acronym's U stands for the 'utilization of technology, media and materials' to support the learning objectives. The five p's process can be used for this stage. The five p's stand for 'preview the technology, media and materials', prepare it, prepare the environment, 'prepare the learners' and 'provide the learning experience'.
During the next step, 'require learner participation', the instructor has to make detailed plans of how he/she makes sure that the learners will actually participate in the course.
'Evaluate and revise' builds the last step of the ASSURE model. The archived learning objectives will be compared to the planned learning objectives. This stage makes sure that there will be improvements of each ASSURE stage in the future.

Dick and Carey Model

The Dick and Carey Model is not a sequential instructional model but rather has many different direct and indirect influences as Figure 2.1 shows [26, 47].

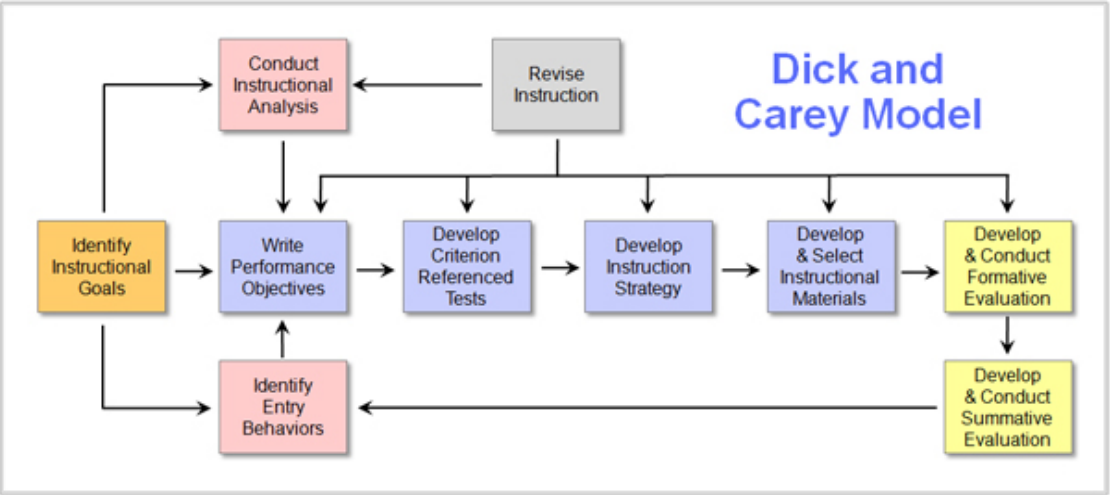


Figure 2.1: Dick and Carey Instructional Model [26]

The first step in Figure 2.1 is to identify the instructional goals. This step is missing in the two models which were explained previously. The second step is the instructional analysis where the participants' skills are investigated. The third step takes the entry behaviours and learner characteristics into account. The needed skills for taking the course are determined. Stage four is the performance of objectives. Therefore, detailed goals and objectives for the lessons are identified. The fifth stage includes the development of assessment instruments. Afterwards, an instructional strategy is developed during the sixth stage. In step seven, the instructional materials are developed and selected. The eighth step is the design and conduct of the formative evaluation of instruction. Step nine consists of the instruction's revise. The last step is the design and conduct of a summative evaluation.

Carpe Diem

Carpe Diem is a team-based approach to learning design developed by Gilly Salmon [32]. This process is carried out through workshops in teams.

"The idea behind Carpe Diem is that every moment of the time during the workshop is spent on designing something that can be put into immediate use with learners – so I use the term 'Carpe Diem' - Latin for 'Seize the Day' " [32].

This approach consists of 6 steps to gain future-oriented and student-centred learning. Those steps are organized in workshops. The first step is to work out a blueprint containing the mission and purpose of the learning. The second step is to visualize a storyboard to receive a well-planned schedule. In the third stage, a prototype in the online environment is built. E-tivities have to be developed and properly tested in real life. "E-tivities are frameworks for enabling active and participative online learning by individuals and groups. E-tivities are important for the online teaching and learning world because they deploy useful, well-rehearsed principles and pedagogies for learning as well as your choice of networked technologies" [33]. Further information about the e-tivities framework can be found in [68]. The fourth step is to check the

reality, therefore colleagues' feedback of the design is necessary. The fifth stage is to review and adjust the design. The sixth and final step is to plan the next steps including resources needed and clear deadlines, resulting in an action plan. After 2-4 weeks, the plan needs to be reviewed by the Carpe Diem teams to stay up-to-date.

2.4 Guideline

Ebner et al. [24] developed the following guideline for practitioners presented in Table 2.1. It should especially help MOOC newbies to implement their first MOOC. This guideline considers the instructional design models and the learning theories. It consists of the seven main categories: core requirements, structure, participant requirements, assignments, media design, communication and resources [24].

Cat.	Issue
1.	**Core requirements**
1.1	Attend a MOOC yourself
1.2	Consider the open character of a MOOC
1.3	Select a topic for a large community instead of a specific audience
1.4	Select the appropriate course language
1.5	Plan for a heterogeneous target group
1.6	Select an appropriate platform
1.7	Test the platform and its features
1.8	Consider the use of tools outside the platform
1.9	Provide a tutorial for MOOC-Newbies
1.10	Provide a tutorial about how to work in a forum, a chat etc.
1.11	Select supplementary tools (outside the platform)
1.12	Provide tutorials for those supplementary tools (outside the
1.13	Test all activities, assignments and tests before they go online
1.14	Promote your course
1.15	Clarify institutional guidelines concerning certificates/ confirmations of participation
1.16	Determine the desired level of interaction

Table 2.1: Checklist for the Design and Development of a MOOC [24]

The first category of the guideline offers a recommendation for the core requirements (1). Ebner, Lackner and Kopp [24] state that the experience from the learner's perspective is very important when implementing a MOOC. (1.1) This is why the first step in the guideline is the attendance of a MOOC yourself. Even if you have a high knowledge of MOOCs, the personal experiences will help greatly when implementing the first MOOC. (1.2) The open character of a MOOC needs special attention. A MOOC has its own dynamic when many people join it. (1.3) It is important to select a topic for a large community instead of a specific audience. This category targets the M of the acronym MOOC, massive. A course in which very high-

level expert knowledge is taught will probably not become massive because it is too specific of a topic. The course will not attract a community of learners and, in turn, will not become a massive course. (1.4) The teaching language is a very important factor. English is probably the most used language in MOOCs. However, in countries where people do not have enough education, there is the possibility that they are not familiar with a second language such as English. For example in Spain the English speaking level is not as high as other northern European countries. The educational level can only increase in a country through MOOCs if the users understand the MOOC's language. If the MOOC is presented in a language that is only spoken in one small country, the open character is missed. (1.5) The openness of the course implies that there is a heterogeneous target group. The instructor needs to define the scope of the group - a wider scope means a more heterogeneous target group. This category needs a lot of experience. (1.6) When offering a MOOC you need an appropriate platform. You can choose between some of the most commonly used platforms, for example Coursera or edX, or build your own platform. The main factors for choosing a platform will be the cost and supported features within the platform. (1.7) When the platform is chosen, it should be tested including its features. (1.8) A lot of tools exist outside a platform which have to be considered. In computer sciences there are some helpful tools available. A very popular tool is the use of social media. As you know, the first O in MOOC stands for online. The people who are joining MOOCs usually have a social media account with Facebook, Twitter or any of the other various social media platforms. Most MOOC users enjoy being part of a community when doing a MOOC and want to stay in touch after the MOOC has finished. Thus you can integrate social media from the beginning. The open source Codeboard offers the possibility for teachers to create a programming language exercise where the students can write, compile and run their solution. The advantage for teachers is that the students' solutions can be tested and assessed automatically. Codeboard will then transfer the results to your MOOC platform. Codeboard can be integrated in MOOC Platforms, e.g. in Coursera, in edX or Moodle [11]. Another possible tool integration would be Google Docs where many users can work on a document at the same time. Having only one Google document for the whole course would probably be problematic as it would have too many users at the same time, but you could use it successfully for smaller group works. (1.9) Offering a tutorial for MOOC-newbies is less work if you use one of the most commonly used platforms as they provide tutorials. When implementing a completely new platform the tutorial would possibly be too much work, but you should have a special focus on the well-structured user interface and provide some explanations for that. (1.10) In particular, people who do not use the Internet very often might need help with how to use a forum or chat. You should provide a tutorial of that if you think that this might cause problems or at least share a netiquette which states how the user should behave correctly in a forum or chat. (1.11) In category 1.8 tools outside the platform are considered. Now it is time to select an appropriate supplementary tool outside the platform. For example a Java Online Editor which can be used by the students. (1.12) When using a supplementary tool that is not well known by your audience you should provide an tutorial of the main features. (1.13) This category is a very important one. You should test all activities, assignments and tests before they go online, otherwise the users may have troubles and this can cause a lot of work during runtime of the MOOC for problem solving and explaining in the course afterwards. If there are too many problems during the course the users may dropout

tor that reason.If there are too many troubles, the image of your course and potentially also of your MOOC providing university will decrease rapidly. (1.14) You have to promote your MOOC as much as possible to reach the massive factor of your course. The promotion is of course easier when you host your MOOC at one of the main used platforms, e.g. Coursera or edX, because they already have a big global community of people who are interested in MOOCs. (1.15) This category states that you have to clarify institutional guidelines concerning certificates/confirmations of participation. If your institution does not allow the granting of a certificate from you institution you cannot provide it to your MOOC users. The possibility of receiving a certificate has a high influence on the number of MOOC participants because it is a motivational reason for doing a MOOC. (1.16) The last core requirement is the determination of a desired level of interaction. This category faces the questions who and how often should anybody be interacting with the platform. Is it mandatory to use the forum as a student?

Cat.	Issue
2.	**Structure**
2.1	Divide the course into equal parts (“course units”)
2.2	Think about a recognizable structure of the different units and
2.3	Divide the units into different environments (according to the objectives)
2.4	Organize the activities and assignments so that they are feasible (“time management”)
2.5	Create a preliminary course unit (“socializing”) before starting with content

Table 2.1 (Continued): Checklist for the Design and Development of a MOOC [24]

The next main category of gives a guideline for the structure (2) of the MOOC. (2.1) The course should be divided into equal parts, so called ‘course units’. Usually, a MOOC has eight to ten course units. Therefore, you should have your learning objectives in mind. (2.2) Then build a well-defined structure of your course units, which is almost the same for each unit. (2.3) Afterwards divide the units into different environments. For example at the beginning of each unit you provide some videos including some questions in between. Afterwards the user should read some text and then complete a provided quiz. (2.4) Besides the learning material you should provide activities and assignments which are feasible in time management. (2.5) Additionally, provide a preliminary course unit ‘socializing’before starting with the content. For example the MOOC users could introduce themselves in a short post entry in the forum. In this unit you can offer an introduction to the topic and provide a transparent timetable [24].

The next main category deals with the participant requirements (3). (3.1) If you provide the receipt of a certificate, the students should know the detailed requirements at the beginning of the course. For example the student has to pass each quiz with at least 50 % or he/she has to write at least one message into the discussion forum in each course week. (3.2) Announce the peer-review-rules if the course includes a peer-review assignment. (3.3) Decide if continually opened checks or a final product leads to a certificate. (3.4) Decide if it is possible to earn a certificate even if course units are skipped. Is it possible to get a certificate if someone misses

Cat.	Issue
3.	**Participant requirements**
3.1	Tell the students at the beginning the requirements for a certificate
3.2	Consider peer-review as an assessment method (announce the “peer-review-rules”)
3.3	Decide if continually opened checks or a final artefact lead to a certificate
3.4	Decide if it's possible to earn a certificate though skipping course units
3.5	Announce the average weekly work load to facilitate student time management
3.6	Define learning outcomes (“learning objectives”)
3.7	Design an appropriate quiz design
3.8	Use different question types
3.9	Provide wrong answers with feedback (thus, further information)

Table 2.1 (Continued): Checklist for the Design and Development of a MOOC [24]

an assignment? (3.5) Announce the average weekly workload to facilitate student's time management. (3.6) The definition of the learning objectives is very helpful. What does the student know after doing the course? (3.7) The design of the quiz should be suitable and well structured. (3.8) The quiz should vary in its question types. Depending on the used platform there are different question types available, e.g. multiple choice, single choice and drag and drop. (3.9) If the user has marked the wrong answer you should provide feedback for the user which includes further information about the answer. It helps students to refresh the studied content. If the quiz can be done multiple times the user can put the right answer in the next run but not only because he/she knows that this question must be ticked but rather that this answer is the correct one because of the provided information [24].

Cat.	Issue
4.	**Assignments**
4.1	Formulate assignments in a clear and understandable way
4.2	Formulate assignments according to a heterogeneous audience
4.3	Formulate assignments that stimulate communication processes
4.4	Reduce terminological problems or misunderstandings by means of a glossary for example
4.5	Be aware of a gender-sensitive language
4.6	Create assignments according to the needs of different learning
4.7	Ensure transparent assessment criteria when doing peer-reviewed assignments

Table 2.1 (Continued): Checklist for the Design and Development of a MOOC [24]

After you have considered the participant requirements the guideline covers the assign-

ments (4). (4.5) Have gender-sensitive language in mind when creating assignments. (4.6) Consider the different learning types and create the assignments according to their needs. (4.7) When you make use of peer-reviewed assignments, you should state the assessment criteria in a very detailed and transparent manner. If you do not do this, the peer-review will not be efficient for the teacher as he/she has to assess it again to ensure fair grades [24].

Cat.	Issue
5.	**Media design**
5.1	Chose media according to the content (“multimedia”)
5.2	Chose adequate methods according to the content
5.3	Test tools before using them to create content
5.4	Create resources as OER under a Creative Commons Licence
5.5	Use materials from the web provided you are allowed to
5.6	Produce short videos (5-10 minutes) to provide information/
5.7	Insert questions into the videos
5.8	Divide the content into small pieces of information
5.9	Chose supplementary tools that work independently from a specific operating system
5.10	Create resources that can be worked on independently from a specific operation system (e.g. create pdf instead of docx)
5.11	Create resources for different levels, standards, grades (e.g. for beginners, experts)
5.12	Use gender-sensitive examples
5.13	Create materials that can easily be read on the screen
5.14	Create barrier-free materials and resources
5.15	Create materials and resources following a consistent layout (“master template”)

Table 2.1 (Continued): Checklist for the Design and Development of a MOOC [24]

The next category investigates the media design (5). (5.1) The first step is to identify the possible media which supports the subject matter. (5.2) Afterwards choose the appropriate methods within the media to support the content. (5.5) To save time with trouble shooting, test the tools before using them to create content. (5.4) As MOOC provider it is important to have in mind that the distributed content can also be shared outside the MOOC platform without any licence fees. Therefore, create the resources as Open Educational Resources (OER). It “describes any educational resources (including curriculum maps, course materials, textbooks, streaming videos, multimedia applications, podcasts, and any other materials that have been designed for use in teaching and learning) that are openly available for use by educators and students, without an accompanying need to pay royalties or licence fees” [10]. A distributed global licence is the Creative Common Licence [10, 18]. (5.5) When using material from the web have in mind if it is licence free. (5.6) Produce only short videos which are teaching the subject matter. 5-10 minutes videos are recommended. (5.7) If it is possible in the chosen platform, insert questions into the video. (5.13) The material has to fit the used screen appropriately. (5.14) The mate-

rial and resources have to be barrier-free. (5.15) Use an continuous consistent layout for the material. [24]

Cat.	Issue
6.	**Communication**
6.1	Set up a newsletter to inform participants about the course
6.2	Create spaces for communication (e.g. open a forum or a wiki)
6.3	Encourage the participations to open groups, forums and wikis on their own
6.4	Give impetus to animate discussion processes in and outside of the MOOC
6.5	Set up (communication) rules (“netiquette” or “chatiquette”)
6.6	Create a hashtag for the course
6.7	Aggregate a newsfeed using the hashtag
6.8	Be present (perhaps with the help of an e-tutor)
6.9	Pay attention to the changed framework when planning synchronous meetings (e.g. time zones)

Table 2.1 (Continued): Checklist for the Design and Development of a MOOC [24]

The communication (6) is also an important influence of the MOOC’s success. (6.1) A newsletter is set up to inform the participants about the course schedule. This newsletter should include information about the upcoming course week and how much engagement time is needed to complete the learning materials of the week. (6.2) Different communication channels for the communication between students and between students and lecturers should be considered. A forum and/or a wiki can be implemented in the MOOC platform. (6.3) A forum or wiki thrives from the usage - the more the communication channels are used, the more students will use them and provide their own content. This is why the students should be motivated to use these communication spaces on their own. (6.4) The lecturers give input for new discussions inside and also outside of the MOOC. (6.5) Set up communication rules for a good and friendly way of communication without any thing as abuse. (6.6) Come up with a hashtag to be used throughout the duration of the course where all students can find information, material and comments. (6.7) Aggregate a newsfeed using the hashtag for people who do not use Twitter they are also able to follow the hashtag entries. (6.8) It is important to be present during the MOOC so that the students feel well-supported. An e-tutor can be deployed to support the students during the MOOC. (6.9) Attention needs to be payed to the time zones when offering, for example, live meetings. [24]

The last category is the resources (7). (7.1) Considering human resources, check the framework to see if e-tutors are available to support students. (7.2) A MOOC thrives on actual content, which should be updated from time to time when running the MOOC more than once. The creation of multimedia content needs time, which has to be planned properly. (7.3) Check the university’s/office’s IT or multimedia department to see if they have support for creating new multimedia content. (7.4) For a wider viewpoint, create a network with your colleagues.

Cat.	Issue
7.	**Resources**
7.1	Check the framework: Are e-tutors available?
7.2	Plan more time creating multimedia content (e.g. video lectures)
7.3	Contact your IT or multimedia department (e.g. support for creating multimedia content)
7.4	Create a network with colleagues
7.5	Do the MOOC in a team or invite colleagues to be guest teachers
7.6	Plan some extra time to promote the course
7.7	Plan some extra time to find resources and materials
7.8	Ask the participants for their feedback
7.9	Document your MOOC experience in social networks or on a blog
7.10	Plan some extra time to check the content (e.g. links) and to answer to student needs

Table 2.1 (Continued): Checklist for the Design and Development of a MOOC [24]

(7.5) Create a team for the production of the MOOC. For example, you can invite a colleague to hold a guest speech in a video or during a live meeting. (7.6) Take enough time to promote the MOOC and plan the promotion. (7.7) Also plan some extra time for looking for resources and materials. (7.8) Feedback is always very important, so ask the participants for their honest feedback. (7.9) You can document your MOOC experience in social networks, on a blog or write a paper about any interesting facts. (7.10) Plan extra time for proof-checking and for answering student questions. [24]

This checklist is a foundation when implementing a MOOC for the first time. Every MOOC has different requirements and focuses, which is why not every element is relevant and respected in the MOOC production.

Stacey gives the following pedagogical recommendations for MOOCs [59, p. 115]:

- "Go beyond open enrollments and use open pedagogies that leverage the entire web, not just the specific content in the MOOC platform. As part of your open pedagogy strategy, use OER and openly license your resources using Creative Commons licenses in a way that allows reuse, revision, remix, and redistribution. Make your MOOC platform open source software.
- Use tried and proven modern online learning pedagogies, not campus classroom-based didactic learning pedagogies which we know are ill-suited to online learning.
- Use peer-to-peer pedagogies over self-study. We know this improves learning outcomes. The cost of enabling a network of peers is the same as that of networking content – essentially zero.
- Use social learning including blogs, chat, discussion forums, wikis, and group assignments.

- Leverage massive participation – have all students contribute something that adds to or improves the course overall."

2.5 Implemented MOOCs

This section gives a broad overview on implemented MOOCs. Various aspects have to be considered in a MOOC. What are potential platforms to run a MOOC? What is video production like in this context? How long does a MOOC take? What kind of support is provided? How about the motivation of participants?

Platform

As stated in Section 2.1, the main MOOC platforms are edX, Coursera, Khan Academy, Udacity and Futurelearn. On the European Market, the platform Iversity is very common and in Austria the platform iMooX is worth mentioning. The platforms differ in various aspects such as the number of offered courses, the target audience and the number of disciplines.

Table 2.2 gives a thorough overview about the differences between the platforms edX, Coursera, Futurelearn and Iversity. The two main globally recognised platforms edX and Coursera provide the highest number of MOOC courses. Coursera has the most MOOCs at different universities. EdX wins the category number of disciplines. The average number of course weeks varies between 5 and 10 weeks. The weekly effort is higher in the two main platforms, edX and Coursera, than in the others [64].

Another option is using Moodle as a MOOC platform. The learning management system Moodle is brandable and allows custom analytics. Moodle has a responsive design which means that the website adapts itself depending on the screen size. Therefore, the MOOC can be done on a smart phone or tablet without problems due to the screen size. It can be self-hosted or hosted by a third party. An advantage of Moodle is that the installation process is easier than for edX. It can be installed with just one click. Moodle is customizable but sometimes it has too many configuration options which can be very exhausting and time-consuming. Unfortunately the platform is over 12 years old and the system performance leaves much to be desired with a larger number of students [29].

A lot of different opinions exist about which platform is the best one. Each of them has its strengths and weaknesses. Some are free to use, others are not. They also differ in their focus on different disciplines. Every user has to find the platform(s) which best suits his/her needs depending e.g. on the topic, the video style or the professors/universities providing the MOOC.

Mihaescu et al. [53] reported an analysis of different MOOC environments from the students' perspective. The reported advantages of Coursera's MOOCs are the following items [53, p. 420-421]:

- "The platform is adaptive and the students can follow the course from mobile devices
- The option to jump straight to the quiz if you already know a section
- Asynchronous courses are very much favoured by students, as they can study any time and anywhere

Course Description Intro Page	All 448 courses	edX	Coursera	Futurelearn	Iversity
Number of MOOC courses	448	136	222	68	22
Number of Different Universities	160	41	73	26	20
Number of Different Countries	35	15	24	6	6
Number of Disciplines	63	49	23	24	13
Average Course Weeks (weeks)	7,95	9,10	7,92	5,21	9,95
Average Number of Educators mentioned (persons)	4,30	6,10	3,60	2,40	5,70
Average weekly effort (weeks)	5,10	6,10	5,20	3,20	3,20
Average Intro Video Duration (min/sec)	2,25	2,21	2,29	2,11	2,40

Table 2.2: Platform Differences [64]

- Large quantity of courses to choose from
- Much information offered in individual courses
- Many videos have a subtitle option for English and other languages
- Almost all courses offer a certificate
- All courses have a short introduction or presentation video
- Interactive way of learning”

The next itemization states the problems of Coursera’s MOOCs reported by students [53, p. 421-422]:

- “The forum is too complex in the current context, with too many layers of information
- Technical issues during tests
- Lack of gradebook

- Lack of motivation, as tests are not sufficient for testing one's knowledge, game-like activities would help
- Difficult requirements
- Not all courses are open for enrolment
- Peer-grading is not reliable
- Deadlines are hard to fulfill
- Lack of motivation of the teacher
- No information about the abilities gained
- No search feature inside the lesson
- The lack of synchronous communication activity, where students could communicate instantly"

These two pro and contra lists highlight the possible advantages and disadvantages of the platform Coursera. Of course, these points are not exactly the same for all platforms but much of them are similar to one another. Each platform follows a different strategy and therefore has a different focus on its platform.

Video

Videos play an important role in MOOCs because they are used to present most of the learning material.

Videos are "languages to communicate using sounds and images with almost universal understanding, they have structural rules, syntax and context, to which we can access and understand through a process of deconstruction" [36]. A video can be classified into Stage-in, Shot-in and Recording and Post-production Aspects [36]. Stage-in describes "the set of all components that are placed on the stage to be seen and heard by the viewer" [36, 72]. Shot-in defines the category for everything what is needed to make a movie or video out of the Stage-in area, including technical or photographic topics [36, 72].

Table 2.3 presents a video classification for MOOCs following [36]. The first column states the areas, the second shows the categories and the third column defines some measurable indicators. The classification is divided into three areas: Stage-in, Shot-in and Recording and Post-production Aspects. The Stage-in area only has one category, which is the focus of interest (FOI). The FOI can be indicated by a teacher, a teacher and a blackboard/presentation, others, headings/credits or a cutaway. Cutaways are, for example, videos or images from an archive. The area Shot-in is divided into four categories framing (F), field size (FS), depth of field (DOI) and camera movements (CM). The framing can be centered, non-centered or oblique. Close-up, medium shot, full shot or long shot are indicators for the field size. The depth of the field can be low or high. The camera movements are static, zooming or translation/rotation. The third area, Recording and Post-production Aspects, is divided into the recording location and

the video sources. Various recording locations exist, for example studio (virtual and real sets), lecture rooms, university campus and other places. The video sources can be original footage produced particularly for a MOOC, archive images and computer graphic images. Chroma key is the simulation of any kind of images.

Areas	Categories	Indicators
Stage-in	Focus of interest (FOI)	Teacher
		Teacher + blackboard/presentation
		Blackboard/presentation
		Other
		Headings/credits
		Cutaway
Shot-in	Framing (F)	Centered
		Non-centered
		Oblique
	Field Size (FS)	Close-up
		Medium shot
		Full Shot
		Long shot
	Depth of the Field (DOF)	Low
		High
	Camera Movements (CM)	Static
		Zooming
		Translation/Rotation
Recording and post-production aspects	Recording Location (RL)	Studio
		Lecture rooms
		University campus
		Other places
	Video Sources (VS)	Original footage
		Chroma Key
		Archive images (photo and video)
		Computer graphic images

Table 2.3: Video Classification Grid [36, p. 110-111]

The cinemetrics analysis, a part of video analysis, of 26 MOOC teaser videos, selected from the platforms Coursera, edX, MiríadaX and Open2Study, in the STEM areas (chemistry, mathematics, physics, including computer science) shows that the focus of interest is a simple image of the teacher in 96,2 %. The teacher and the blackboard/presentation parallel on one screen is the focus in only 11,5 %. In 38,5 % of the sample videos the board or the presentation is showed. In 26,9 % of videos, other indicators, for example graphics or images, are the focus of interest. Headings or credits are published in 88.5 % of cases. Cutaways, videos or images from an archive are used in 76,9 % of sample videos. These segmentation results are a suspect of change in the different subject areas. In a Mathematics video, it is more important to see the formulas clearly and not only the instructor. In a MOOC video about history, a blackboard is usually not needed and more old video or image material is included.

An interesting point is that the average number and duration of centered and non-centered shots is the same but when having a closer look, it differs depending on the subject. In physics videos, the number of centered shots is 2,5 times higher than in a mathematics video. The

duration of centered shots is more than 2 times higher for Chemistry than for computer science. This behavior is mirrored for non-centered shots. The average duration of centered and non-centered shots is from 5 - 6 seconds for each shot. Oblique shots do not occur very often and mostly also have a shorter duration.

Looking at the field size shows that almost 40 % of all shots are medium shots, 26 % are close-ups, 27 % are full shots and only 13 % are long shots. The average duration of medium shots, full shots and close-ups is 5 to 6 seconds for each shot. The long shots do not appear often and have a shorter duration. Again, a high variation exists between the different subject areas.

In videos of the STEM area including computer sciences the camera position does not move frequently. The motion comes only from the fact that a image from the archive is shown. Translational or rotational movements occur 3 times more often in mathematics than in computer science or physics. Zooming is not very popular in the videos.

The most used indicator for the recording location, in the Recording and Post-production Aspects category, was the other places indicator. This was used in almost 50 % of cases with an average duration of 4 seconds. The recording location of the university campus was chosen in 36 % of investigated videos and has an average duration of 8 seconds. The classroom and/or laboratory was used in 29 % of cases with an average duration of 4 seconds for each shot. Studio shots are not very common (6,9 %), but when a studio is used, the average duration is 7 seconds. The number of videos recorded at the university campus is around 4 times higher for mathematics than for chemistry and physics and 2 times higher than for computer science. In saying this, the average duration of recorded videos at the university campus is 4 to 5 times higher in chemistry when comparing with the other location areas.

When looking at the different sources it is not surprising that the use of original images, specifically made for the MOOC teaser video is the most popular source (48 % of all cases) . Archive images also build a very important source which is used in 36 % of all cases, but they are usually only displayed for around 3 seconds. Computer graphic images are usually used in a moderation (in 19 % of all cases), and have an average duration of 5 seconds.

The focus of interest investigation in 20 introductory MOOC videos of 6 different STEM courses including computer science shows that the instructor talks on screen in 80 % of videos with a mean duration of 2 minutes and 45 seconds. The blackboard/presentation is also used in 80 % of videos with an average duration of 4 minutes and 30 seconds:

In 90 % of videos, the focus of interest in theoretical/expository videos was the teacher + blackboard/presentation, with an average duration of 41 seconds. The percentage was the same for the blackboard/presentation with a little bit longer duration of 62 seconds.

Tutorial and laboratory videos have their focus of interest on the teacher who occurs in 60 % of videos with an average duration of 57 seconds. The blackboard/presentation is again very common (80 % of videos), with an extremely long average duration of 6 minutes and 9 seconds.

Guedes Da Silva et al. [36] give the following recommendations for MOOC videos on a STEM topic including computer sciences:

- short videos (6–10 minutes long)
  - teaser (2-3 minutes)
  - introductory and expository videos (9-11 minutes)

  - tutorial videos (maximum of 7 minutes)

- dynamic (average shot length 6–30 seconds)
- personalized (by each instructor)
- focused (one topic at a time)
- use at least 3 different focus of interest

[37] explored the impact on the attention of people watching videos in relation to the presentation and production style of videos. Besides quality and content, the style is responsible for whether the people play, pause, turn off or replay a video. When running a MOOC, it is important that the participants enjoy the provided videos to continue learning.

The video production is very cost and time consuming. To maximize the student learning outcomes, the video production style has to be taken into consideration. The higher the student engagement, the more cost-effective the video production techniques are.

A video can consist of one or more presentation and production styles. It can show a slide presentation with a voice-over and then can be combined with some additional full-screens of the instructor during the slide presentation. Other styles that can be used are code, Khan-style and animated handwriting. The videos can also differ in the production area, e.g. classroom, studio or office desk.

Video Style

The different video types support the pedagogical purpose for example tutorials or lectures [46]. Lecture videos provide educational background for studying a specific topic. Generally, the video's lecturer introduces the topic, presents the content and summarizes highlights at the end of the video. Tutorials often offer step-by-step instructions for a deeper understanding of the subject matter.

The following listing is presenting some styles that can be combined in a video:

Talking Head
The video consists of a recording of the instructor.

Slides
The video consists of slides with a voice-over of the instructor.

Slides and Instructor
Also named split-screen. The video is presenting slides with a voice-over and sometimes (simultaneously) the instructor.

Code
This style is a video screencast of the instructor writing code in a text editor, IDE or command-line prompt [37].

Khan-style
This video style shows a full-screen video of an instructor drawing freehand on a digital tablet, which is a style popularized by Khan Academy videos [37]. The videos showing a black background and the freehand drawing of the instructor is in flashy colours are the most common.

Animated Handwriting
This video production style is a full-screen video of animated handwriting. The production needs a lot of time because every piece of text or picture has to be programmed. Additionally, the video can contain sound or voice.

Figure 2.2 shows an example of the animated handwriting production style.

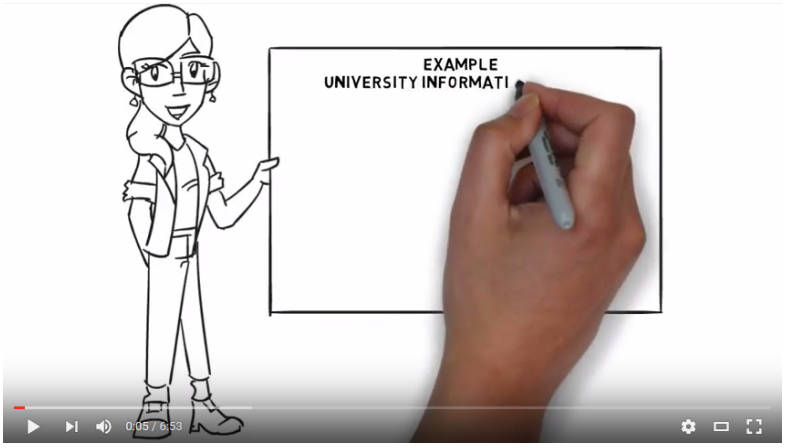


Figure 2.2: Animated Handwriting Video Production Style

Classroom
Most universities will lend a video recorder. Recording a video can be done parallel during a live classroom lecture. The production is not very time consuming because the video's cutting is omitted. This kind of video presentation is authentic for the people who know the professor. Watching a classroom video almost mirrors the experience you would get during a live classroom lecture. A disadvantage is that the video length is usually very long. [37].

Studio
A video can also show only an instructor who is filmed in a studio with no audience. [37].

Office Desk
Another production style limits oneself to close-up shots of an instructor who is sitting at an office desk. This type of video production shows no other graphical parts than the person speaking during the video. The visual component is lacking in this style [37].

Other Video Styles
Other formats are an instructor who is interviewing another expert or an instructor who is recorded at other locations related to the content, for example a historic professor in a museum. An outdoor production unrelated to the content is also possible. The animation is a cost-intensive production with software. Another video style is the webcam capture but this can lead to lower quality. A panel discussion of experts is another format idea. Several speakers or an off-voice speaker are also possible. [20, 64].

Platform Dependency
Every platform has its own strategy to use various video styles to attract their audience and to implement education theory properly. The usage of different video styles according to the used platform is investigated in Table 2.4.
The first column presents various video styles. Of course this list can be extended due to new learning theory, innovation or new technology. The gray column shows the average percentage of usage of a video style calculated by 448 courses from the platforms edX, Coursera, Futurelearn and Iversity. The last two columns display the differences of edX and Coursera in detail.
The platform edX has an average lecture duration of 9 min 49 sec which is less than the average lecture duration of Coursera with 12 min 36 sec. The overall average is 10 min 26 sec. The average lecture duration of both platforms and the overall average is long compared to the literature's guidelines [24, 36, 74]. One reason for these surprisingly high result may be that the data set is taken from September 2014 until January 2015.
A video taken in a classroom with or without students (7 %, 6 %) is not very common compared to other video styles. The trend show a higher tendency to a video produced in a classroom with students than in a classroom without students. We assume that a classroom with students is more authentic to the viewers.
A presentation of slides with or without a speaker is one of the most common video styles. Coursera (with speaker: 46 %, without speaker: 48 %) uses both video styles more often than edX (with speaker: 26 %, without speaker: 30 %). Coursera is very high above the overall average of all videos (with speaker: 33 %, without speaker: 38 %) and edX is further down than the overall average. Slides are used by almost every lecturer of an in-class lecture and therefore well-known by everybody - lecturers as well as students.
The most commonly used video style is the talking head. Similar to the video showing presentation of slides, it is well-known to lectures and students.
The video styles animation, split-screen, outdoor (unrelated to content), on location (related to content), webcam capture, several speakers and off-voice speaker are used on average between 8 % and 20 %. These last categories of video styles are partially very cost-intensive or time-consuming for the production.
As you can see in Table 2.4, differences between the platforms' usage of video styles and also between the overall average and the platforms' average occur [64].

Video Style	All 448 courses (edX, Coursera, Futurelearn, Iversity)	edX	Coursera
Average Lecture Duration (min/sec)	10min 26sec	9min 49sec	12min 36sec
Classroom with students	7%	12%	7%
Classroom without students	6%	7%	4%
Presentation slides with speaker (Picture-in-Picture)	33%	26%	46%
Presentation slides without speaker	38%	30%	48%
Computer screen, high-lightening	29%	33%	32%
Green-screen	26%	35%	25%
Talking Head (summary)	74%	78%	68%
- Talking Head/Monochrome Background	20%	23%	21%
- Talking Head/Office Background	17%	24%	16%
Animation	20%	19%	21%
Split-screen	12%	13%	14%
Outdoor (unrelated to content)	10%	9%	5%
On location (related to content)	20%	22%	20%
Webcam Capture	8%	7%	12%
Several speakers	15%	16%	9%
Off-voice speaker	16%	12%	15%

Table 2.4: Video Styles per Platform [64]

Presentation Style

Presentation styles are a visual format of instruction [46]. The presentation of text and figures in a video is an important influence to the viewers's engagement time, as proposed in [19]. Khan Academy and edX use primarily the handwritten presentation which is typically not written with pen on paper but rather produced with a digital pen and a tablet. Handwriting feels very authentic to the viewers. Especially without a classroom the handwriting in a video of an online course is received by the users as a personal connection to the lecturer. Additionally, the videos contain mostly an audio voice-over from the lecturer. Udacity produces mainly handwritten content where you can follow the lecturer's hands. The videos in Coursera's MOOCs typically have typed presentations, e.g. text in PowerPoint. This kind of presentation is more structured and everybody can read it. In videos by Coursera, you sometimes also see the lecturer talking.

Another style of presentation is "TypeRighting, that combines the benefits of handwriting and typeface" [19, p. 793].

Figure 2.3: TypeRighting [19, p. 793]

Figure 2.3 demonstrates how TypeRighting works. The lecturer handwrites the word on a tablet with a digital pen. Afterwards, the handwritten word fades out and the typed word fades in. On one hand, TypeRighting in videos by edX and Khan Academy is preferred over handwriting, but on the other hand TypeRighting is sometimes preferred over typeface. These observations conclude that TypeRighting is a better presentation style than handwriting and typeface. Additionally, a higher resolution video shows more visual quality to the viewers. These observations confirm which kind of presentation style is preferred while watching an online course video. For the use of studying or repetition of the content with reference notes, typeface is clearly preferred [19].

Length

The engagement time defines "the length of time that a student spends on a video (e.g., video watching session length) as the main proxy for engagement" [37, p. 3]. Unfortunately, it cannot be distinguished between active watchers and people who are doing something else at the same time [37].

Figure 2.4 shows box plots of the engagement time in relation to the video length in minutes on the edX platform. Red lines define the median and blue lines state the 25% and the 75% percentile. The highest engagement time is reached with a video length from 6-9 minutes. [37].

Thirouard et al. [74] observe a similar situation. After a video duration for longer than 12 minutes, the viewing rate decreases sharply. Their recommendation is to produce 6-minutes-videos.

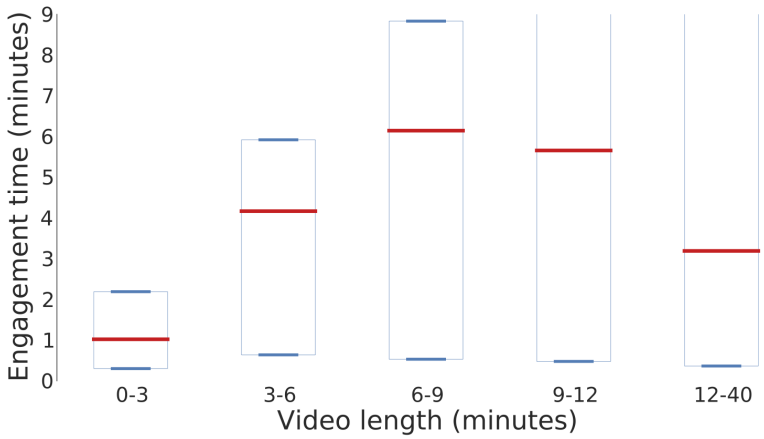


Figure 2.4: Box plots of engagement times in minutes [37, p. 4]

Instructors should keep in mind that the length of a video should maximize the viewer's engagement time. A simple takeaway point from this is that shorter videos are better [37].

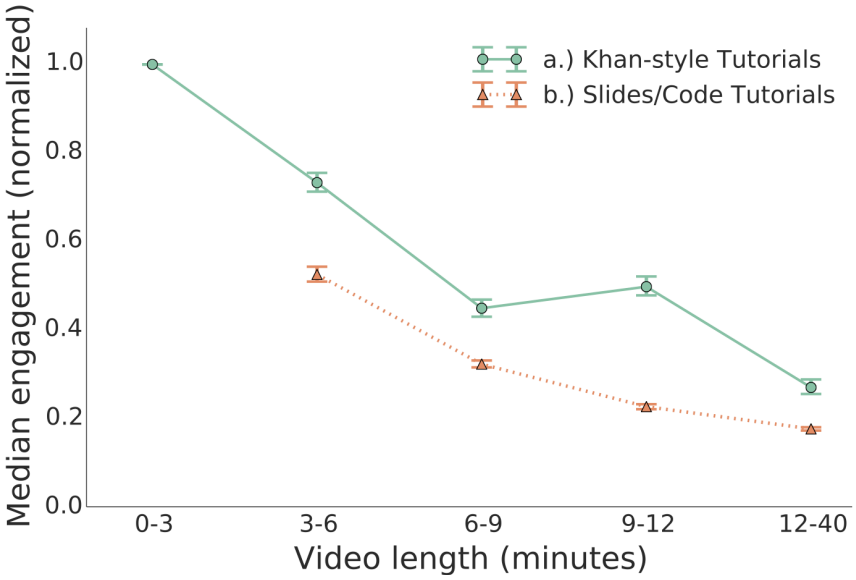


Figure 2.5: [37, p. 6]

Students engagement is usually higher when they can see the instructor talking in alternation with slides or code. The engagement time is increasing even more when using the Khan-style tablet drawing, as Figure 2.5 is presenting. Videos filmed at the instructor's office desk have been watched longer than videos recorded in a professional studio. Videos that are not filmed in a professional studio tend to be more authentic to the audience. If the videos are prepared

for the MOOC context, the users tend to watch the videos a lot longer than chopped up old lectures. [37].

The investigation of the viewing rate of videos showing slides and instructor and videos showing expert interviews displays that videos showing slides and instructor are more popular with students than videos with expert interviews. It is recommended to keep expert interview videos to a limited time, eg. less than 6 minutes [74].

Udacity provides small pieces of learning material, short lectures and interactive activities, all of which take a maximum of five minutes [23].

Another guideline from Guedes et al. [36] says that the video modules are typically between 6 and 10 minutes long.

Ebner et al. [24] recommend 5-10 minutes videos.

Video Recorded Lectures in TU Wien's Object-Oriented Modeling Course

Video recorded lectures in the Object-Oriented Modeling context have already been implemented by the TU Wien, according to [8]. During the summer months of 2010 the Business Informatics Group at the TU Wien produced its first lecture videos for the course Object-Oriented Modeling. The drivers for this project were that the main concepts of the Unified Modeling Language (UML) are not changing and that during the live classroom lecture the audience was getting smaller by the end of each semester due to time constraints. As well as the lecture, students have to join lab sessions in which they present exercises. The theoretical context of the lecture has to be repeated several times during lab sessions in case a student is ill or if he/she had to take other exams during the lecture.

The first step of the video production was the writing of a transcript of the, already existing, recorded lecture. The professors then recorded their speech as they have the expertise of the subject matter and it is more authentic for the audience. Furthermore, a printable version of the slides, with or without the whole spoken text, were made available for the students.

The feedback from the students referring to the lecture videos was very positive. On one hand side, the students can watch videos whenever they have time and it does not matter where they are. Additionally, they can repeat the video as often as they want. On the other hand, the professors do not present the same lecture every semester. The time saved by giving lectures during the semester can now be used for students who need help.

Duration

A shorter duration of the MOOC with about 4-5 weeks is better than a MOOC which takes 7-8 weeks [36]. The main reason is because of dropout rates students often get lost if it takes too many weeks.

Support

"Utilizing consistent and structured support within a MOOC results in increased levels of engagement and completion" [39]. According to [39], structured support can consist in the following way:

- A weekly Monday newsletter where the participant receive an announcement from the instructor of the MOOC. This introduces what will be covered in the unit for that week, and what the user has to do in order to complete the unit. The announcement includes a link to the unit to allow fast access.
- Highlighting the current unit of the MOOC on the homepage of the course. The user can access the current unit directly where structured support is provided if needed.
- Each unit has an identical structure including a number of content pages and a minimum of one activity. An example for this is a discussion forum or a scored quiz, which learners have to view or complete to finish the unit successfully and earn the unit's digital badge. The course instructors are virtually always present to show their students support if anything is not clear.
- Each learner who has finished the unit successfully earns a digital badge for that unit. With the weekly unit awarding the learners should stay motivated. The focus should not be on course completion because it is a lot more important that the learners finish the units that are interesting for them.
- A weekly Friday Newsletter which sums up the week's unit and reminds learners that they should complete the unit if they have not done so far. Additionally, an online webinar can be promoted in the newsletter where a lead academic summarizes the week's activities.
- Every unit includes a live streaming where a lead academic summarizes the week's activities and answers questions during the unit. For those who could not attend or want to re-watch the live online webinar, a recorded version is offered in the course.
- A forum is provided for students who need help or who have any questions along the way. The forum should be always well supported by academic stuff.
- The learners should have the possibility to monitor their progress of the MOOC.

Motivation

Motivation can be described as "internal and external factors that stimulate desire and energy in people to be continually interested and committed to a job, role or subject, or to make an effort to attain a goal" [9].

Motivation can be seen from two different perspectives. Firstly, the intrinsic motivation and secondly, the extrinsic motivation. Intrinsic motivation means that the motivational activities' focus is on the object itself. Examples for intrinsic motivation are curiosity (cognitive), incentive (emotional) and the probability of success. In contrast, extrinsic motivation is where the focus is not on the object itself but on external objects. These external objects can be positive or negative. A reward is an example for a positive extrinsic motivation. An example for negative extrinsic motivation (the opposite) is enforcement.

Intrinsic motivation has an advantage because when it is obtained once, it will exist even without any external motivation. Unfortunately, the intrinsic motivation can be only built up slowly. The loss of extrinsic motivation will not lead to further motivation.

The focus of students' long-term learning motivation should be on intrinsic motivation but for short-term leaning, extrinsic motivation is helpful [28].

Gamification

Deterding stated "gamification's guiding idea is to use elements of game design in non-game contexts, products, and services to motivate desired behaviors" [21].

Gamification has two main advantages. Firstly, a gamified activity is done more often than an activity without any gamification. Secondly, the activity is enjoyed more by the users [7].

Game elements help to support the participant's motivation, therefore their activity on the platform increases and the dropout rate decreases. The most popular game element is points, which are very common in education. In schools or universities, you often get points for homework, tests or exams. Usually, the more points you earn, the better your progress or grade. There are several activities in a MOOC that can be valued differently [78].

Willems et al. [78] proposes the following activities:

- Leaderboards show students with the highest number of points. A leaderboard puts the score of each student into a social context. On one hand, a leaderboard motivates students to study more over a longer time period. On the other hand, they can be demotivating to participants who want to be better but don't achieve it. Another type of leaderboard that prevents the demotivation shows only users that have a score as high as the user himself/herself.

- Badges are small pictures received for the accomplishment of something during the course, e.g. quizzes or projects. They are permanent and therefore cannot be removed afterwards. Badges are only a useful game element if the receipt of a badge is meaningful to the user. If someone's badge is shown to other users then it acts as a status symbol.

- A progress bar shows the user the personal progress of the whole course or of a specific task. It grows either fully automatically by the platform or the user can manually do a check mark of what he/she has done. If there are less number of steps needed to fill the progress bar, the users are very likely to fulfill the steps easily. The progress bar is a simple but effective element to motivate students to finish some tasks or the whole course.

- Levels also have an impact on the user's motivation. A higher level shows a user who has completed more tasks and in turn, the user has made more progress. Similar to badges it is important that the level of a user is public to other users in a highly social platform. In a forum the user's level can also be shown to others. The levels can be a kind of status symbol to the user.

- Acknowledgments can be motivational text to individual users but they should not be used too often because the students get used to it and it will not motivate anymore.

- Other game elements can be quests, virtual goods, teams, and boss fights.

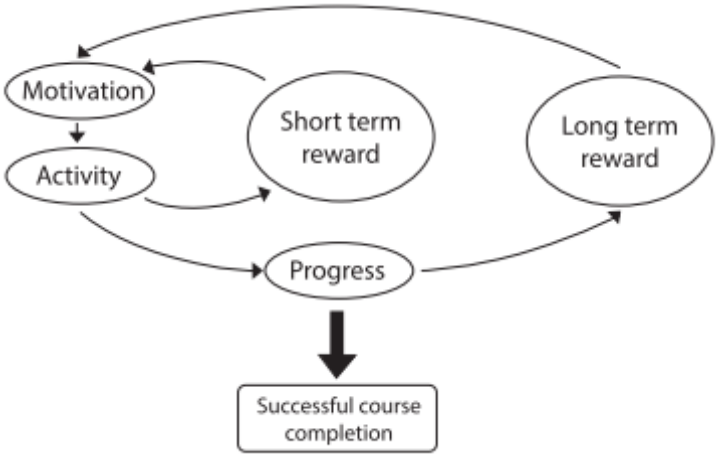


Figure 2.6: Rewarding Mechanism [78, p. 4046]

Figure 2.6 states the rewarding mechanism following [78]: A motivated user visits the MOOC and starts an activity. For the completion of that activity, the users earn, for example, their first points as a short-term reward. If the user has enough motivation, they can continue doing more activities earning them more points. After doing some activities the progress is increasing and that leads to a long-term reward. For example the user is listed in a leaderboard, gets a badge or steps up to the next level. Afterwards the user needs more motivation to finish the next activity for which they get a short-term reward. After some iterations in the inner cycle with the short term reward, the user shows enough progress for a long-term reward. If there are no activities left and the progress is fulfilled, the course is successfully completed.

Gaming the System

Another variant to engage with a MOOC is 'gaming the system', which is defined as "attempting to succeed in an educational environment by exploiting properties of the system rather than by learning the material and trying to use that knowledge to answer correctly" [4].

Different possibilities to game the system exist. For example, the student always asks for help until the tutor tells him/her the answer. In a quiz question, the participant ticks all possible answers sequentially until the answer is correct. If the quiz is only saved at the end, the user re-starts the quiz more than once to answer as many questions correctly as possible. Another possibility to game the system is chatting with course colleagues about a specific task and getting their solutions. Course registrants may misuse an MOOC with many participants to place any advertisements that may or may not have anything to do with the subject matter [4].

Automated Online Proctoring

Issued certificates for the completion of a MOOC create motivation for the participants to continue and finish the course. The virtual certificates are only recognized as legitimate if they are reliable and trustworthy. Since the participants usually download their own certificates, watermarks and logos are possibilities for proof of authenticity. A link or QR-code in the document produces more trust in the document because third parties can check online and verify if the results and scores of the document are valid. The validity of the results and scores themselves pose a challenge. It can occur that the person who gets the certificate has forged the results. As MOOC provider, you should be aware that the certificates are important to the users, especially for those who accept or give value to such documents. For universities, it is important to have trust in such certificates if they give students credit for them [75].

In 2013, 774 users of the MOOC platform openHPI filled in an online survey about how important certificates are. A third of the participants were only a 'little bit interested' in certificates, a quarter did not answer the question and only very few were for obligatory proctored exams. Users do not want to pay anything for a more trusted certificate. 45 % of participants would add their certificate to an application, 18 % would even add a confirmation of participation and only 11 % would add a more trusted certificate to their application [75].

Two different possibilities can increase the trust in MOOCs' certificates. An identity check confirms that the person owns the certificate really took the exam. These identity-controlled exams can be seen as open book exams. Proctoring makes sure that the person who takes the exam does not cheat during the exam. Proctored exams are considered as closed book exams [75].

The MOOC platforms Coursera, Iversity and edX all offer a similar identity check. Users have to take a photo of themselves with their webcam and a photo of their ID-card to verify their identity. All certificates of those platforms show validity through a verification URL. All users who have chosen the course's non-free track have to complete a final proctored exam [16, 30, 42, 75, 77]. Therefore, the platforms cooperate with a third party for online proctoring. EdX and Iversity use Software Secure, while Coursera and Udacity cooperate with ProctorU [62, 70, 75].

ProctorU is very similar to a university exam, the only difference being that the exam is taken online and not in a university exam room. Before taking the exam the examinee has to make an appointment for the exam at the ProctorU website. At the chosen time, he/she logs in into ProctorU and connects with a live proctor who will guide him/her through the exam and helps if technical issues arise. Therefore, the examinee has to activate the webcam and share his/her screen. The proctor overlooking the examinee will check his/her ID and will ask few questions to ensure the correct identity [62].

Software Secure offers more or less the same service as ProctorU. One difference of ProctorU to Software Secure is the possibility that Software Secure can be integrated directly into a learning management system (LMS), for example into the open source course platform Moodle. The exam results will be automatically transferred to the LMS [71].

2.6 Reported Evaluation

This section defines learning analytics in the beginning. We then introduce video engagement because videos play an important role in MOOCs and are therefore an evaluation focus. At the end of this section, we take a brief look at dropouts, particularly the reason for dropouts and how the dropout rate can be calculated.

Learning Analytics

Learning Analytics characterises "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs" [50].

Learning Analytics can be divided into two sections. The first one focuses on the course level. The level or object of analysis in this case are social networks, conceptual development, discourse analysis and intelligent curriculum. The second part deals with the departmental level. The level or object of analysis are predictive modelling and patterns of success or failure. In both cases, learners and faculty benefit from Learning Analytics [50, p. 34, Table 1].

The buzzword Big Data also plays an important role in this context. Big Data is defined as "datasets whose size is beyond the ability of typical database software tools to capture, store, manage and analyse" [50].

The correct analysis of Big Data creates a huge value for various kinds of users, for example organizations, governments, corporations and higher education institutions [50].

Video Engagement

Most of the subject matter of MOOCs is presented by videos. Regarding that fact, videos are a focus of MOOCs analysis.

The engagement of MOOC participants depends on the time spent watching each video and if the student has completed a self-assessment-test after watching the video. Additionally, the video production style influences the student's engagement [37]. YouTube also uses viewers' engagement as a key measurement [80].

Video engagement analysis can be divided into three general methods: implicit user data, explicit user data and content analysis. Implicit user data is produced unintentionally but gathered from available data streams, for example interaction logs. The user cannot prevent the data retrieval, except in some special cases e.g. the allowance of cookies. The most used concept in the literature is the logging of play and pause activities [46, 51, 66].

When the user knows that he/she is sharing information intentionally, we refer to it as explicit user data. This data can be collected through a survey, a membership registration form or even from a social media post [46, 51].

Another general method for video engagement analysis is the content analysis which investigates the video's visualization, speech or transcript [46].

In [48], they have investigated in-video interactions. They have asked MOOC students, after watching a video in one of two Coursera courses, how they have perceived the difficulty of the video. The videos could have been watched more than once, but the study focused on the first

viewing of the videos. The number of students who almost finished a video and responded to the posteriori survey was approximately 17.843 out of 31.880 active learners.

Dropouts

The average completion rate calculated from 100 courses released from Coursera (64 courses), edX (35 courses) and Udacity (1 course) is 6,80 %. The dropout rate is therefore 93,2 %. The more time a course takes, the higher the dropout rate tends to be [43].

Reason for Dropouts

Lack of Time

One reason for a high dropout rate is the lack of time. Some students want to do a MOOC week-by-week. Others want to receive all the content from the beginning in order to have freedom to scroll through the entirety of the content whenever they have time. Some participants download the provided learning materials for future use [6, 44]. If the MOOC's workload is generally too high, it will result in a higher dropout rate [57]. A MOOC usually takes several weeks where students learn new topics. The users only gain new knowledge if they take the time to deal with the subject matter. Watching videos takes longer than reading text, but the information is usually better retained. A forum is often not structured enough which means that the user needs more time to process the content. Additionally, there are often projects or homework offered during a MOOC that would strengthen the participant's knowledge of the subject matter but requires a lot of time, which is sometimes unrealistic if the MOOC's workload is too high.

Learner's Motivation

The lack of motivation also has a high impact on the dropout rate. Future economic benefit, development of personal and professional identity, challenge and achievement, enjoyment and fun can increase the user's motivation [44, 81]. Surveys conducted by researchers at Duke University show that student motivations typically can be divided into one of four categories [6, p. 10]:

- To support lifelong learning or gain an understanding of the subject matter, with no particular expectations for completion or achievement,
- For fun, entertainment, social experience and intellectual stimulation,
- Convenience, often in conjunction with barriers to traditional education options,
- To experience or explore online education.

No Real Intention to Complete
MOOC participants exist who do not have any real intention to complete the MOOC fully. They just want to have a overview of the attended MOOC and may download some provided material. The literature proposes that you should not consider these people in the dropout rate. Another suggested way is to define the dropout rate as percentage of people who did not fulfil their own learning outcomes [57].

Feelings of Isolation and the Lack of Interactivity in MOOCs
Another reason of high dropout rates is the feelings of isolation and the lack of interactivity in MOOC's. Feelings of isolation may be discarded with more social interaction. More interactive elements in the MOOC can be used to fight against the lack of interactivity. [44].

Course Difficulty and Lack of Support
Insufficient background knowledge and skills are also an influence to dropouts [44]. A high impact to this kind of dropout is that everybody can join a MOOC in the Internet. There are no prerequisites to fulfil [57]. Providing support will help to decrease the dropouts.

Lack of Digital Skills or Learning Skills
A user who does not interact correctly with the applied technologies of the MOOC will not complete the course successfully. Even participants who are familiar with the most technologies may drop out because they can not study a new technology in the restricted time frame. The frustration about the new, from the user unknown, technology will lead to a higher dropout rate. "The transition from theoretical learning to practical application required for the assessments" [6] is a common issue [57].

Bad Experiences
Onah et al. [57, p. 5829] gives the following examples for bad experiences in MOOCs and thus an increase of the dropout rate:

- "inappropriate behaviour of peers in forums
- lack of focus and co- ordination in forums
- depletion of study groups due to attrition
- poor quality and incorrect learning materials
- technical problems in the MOOC platform"

Expectations
Users often have different expectations in the MOOC. But if they expect either completely different course content or they overestimated their own skills, they will drop out [57].

Starting Late
If MOOC learners are starting the course late, the users are more likely to drop out. The reason may be that they have missed the beginning of the course and it is difficult to catch up to the current units. For late starters it is also more difficult to become a part of the community. Another aspect is that late starters have missed the beginning because they are potentially unorganised and therefore may not manage to complete the course successfully [57].

Peer Review
According to [57] the use of peer review can have a bad influence to the dropout rate. Users do not want to correct each other's assignments due to time reasons. Some users do not trust that the peer-review is really anonymous. Other reasons is relating to Paragraph 2.6 stating bad experiences.

Hidden Costs
Although, the MOOC was promoted as a free course, the users might have faced costs that were not stated at the beginning. The receipt of a certificate can be related with costs, as well as if the professor recommends an expensive textbook that is not freely available. Completion of the MOOC without any costs was therefore not possible for the users [44].

Dropout Rate

According to [38], the traditional method of measuring a MOOC's dropout rate to measure success does not address the learners and their different levels of motivation. The percentage measures how many enrolled students have completed a MOOC, as Formulas 2.1 shows.

$$\begin{aligned} \textbf{Dropout Rate (Traditional)} \; = \\ No\,of\;Completions \\ \div No\,of\;enrolled\;learners \times 100 \end{aligned} \tag{2.1}$$

Devlin [22] states that "applying the traditional metrics of higher education to MOOCs is entirely misleading. MOOCs are a very different kind of educational package, and they need different metrics — metrics that we do not yet know how to construct".

The success of a MOOC can also be measured with the consideration of the percentage of units completed by learners. This metric has a focus on the "micro segmented learning patterns of the diverse group of learners within a MOOC" [38].

The dropout rate of the micro segmented learning patterns is calculated by the following formulas:

$$\begin{aligned} \textbf{Total no of units that can be completed by learners} \; = \\ No\,of\;learners \\ \times No\,of\;units\;in\;a\;MOOC \end{aligned} \tag{2.2}$$

The Formula 2.2 defines the total number of units that can be completed by learners. It is calculated by the total number of learners multiplied by the number of units in a MOOC.

$$\begin{aligned} \textbf{\% of units completed} \; = \\ Total\ number\ of\ Units\ completed \\ \div\ Total\ no\ of\ units\ that\ can\ be\ completed\ by\ learners \\ \times 100 \end{aligned} \tag{2.3}$$

The next Formula 2.3 calculates the percentage of completed units. It is determined by the total number of completed units divided by the total number of units that can be completed by learners (Formula 2.2), multiplied by 100.

Another metric is the percentage of learners who completed at least one unit and therefore achieved meaningful learning.

Either the first calculation (percentage of units completed) or the second calculation (percentage of learners achieving meaningful learning) can be applied with the number of enrolled learners, who at least signed up, or with the number of active learners who are enrolled and are active (e.g. viewed at least one course page).

It is important to establish a difference between enrolled and active learners. The completion rate should only consider the active learners who did at least one activity, e.g. viewed a page. The stated metrics focus on the meaningful micro learning because the overall completion rate is not a good metric to measure the impact and the effectiveness of a MOOC.

In-Video Dropout Rate

An in-video dropout rate is "defined by the percentage of students who start watching a video but leave before the video finished playing entirely. This measurement helps the authors to compare different videos and improve them" [46]. Kim et al. [46] performed a detailed study on the influence of user's engagement to the dropout rate.

Video interaction is usually observed by different event types. The play event is produced when the user clicks on the play button. Usually, the play event also occurs when the user hops to another time position while playing a video. A pause event is the result of a user's click on the pause button or the result of hopping to another time position during a paused video.

The in-video dropout rate is defined as `1 - viewcount(n)/viewcount(0)`. The function `viewcount(t)` states the number of unique viewing sessions that include the second `t`. `n` defines the seconds from the first second `0` to the last second `n`. Due to the fact that videos start automatically when they appear, `viewcount(0)` is the maximum number of unique sessions. [46].

An in-video dropout rate average from 80 edX videos showed that 55,2 % of viewing sessions dropped out before the end. More specifically, 36,6 % of the primary 55.2 % of viewing sessions dropped out within the first 3 % of the video length. Especially at the beginning of a video, the dropout rate increased very fast, as Figure 2.7 shows. This analysis supports the theory based on facts that shorter videos are more engaging.

Students who watch the same video again are more likely to drop out mainly because they re-watch only videos or parts of videos when they have a need to.

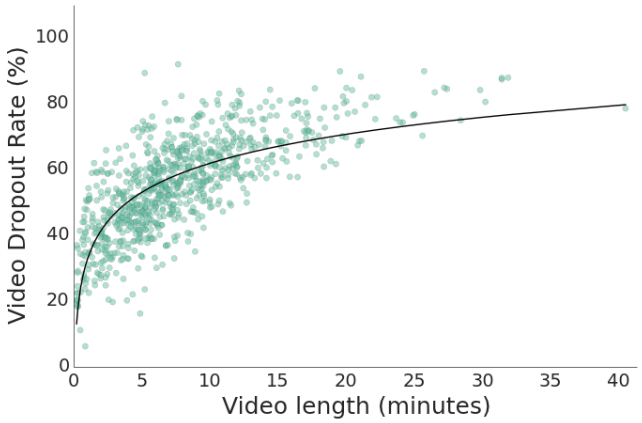


Figure 2.7: In-video dropout rate per minute [46, p. 33]

YouTube's Absolute Audience Retention report shows the viewcount(t) function for the video producers. This is the percentage of how often each moment is viewed in comparison to the total number of views [80]. A peak in this function, so called interaction peak, in online lecture videos helps to understand the dropout rate, as stated in [46]. A linear trade off exists between the dropout rate and YouTube's Absolute Audience Retention. The main goal is to have an absolute audience retention close to 100 %. The curve should be flat without any peaks throughout the whole video, which means that a few viewers dropped out during watching the video [80].

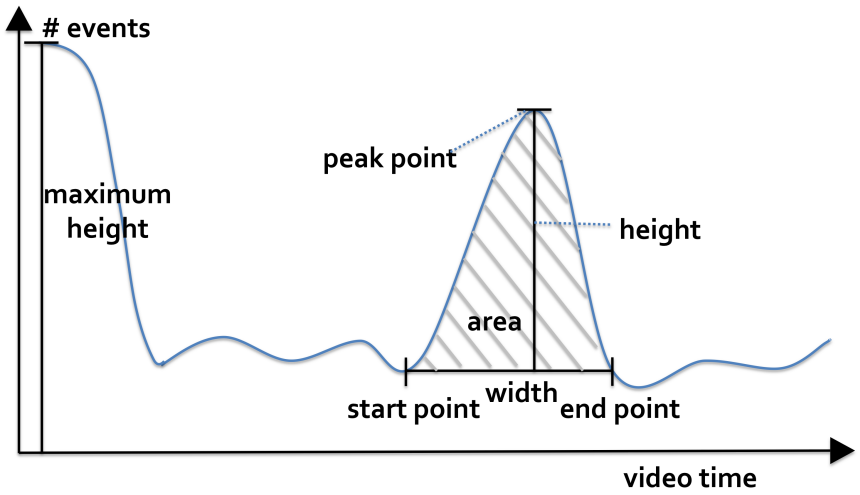


Figure 2.8: Engagement Over Time [46, p. 5]

The location of a peak is defined by three time points, as visualized in Figure 2.8: The start point shows the video time at the beginning of a sharp increase. The peak point is defined as the point of the local maximum. The end time point states the end time of the sharp decrease. The

width represents the time difference between start point and end point. The height defines the number of events which were accountable for the local maximum, the peak point.

A peak in the curve signifies an engagement change. The pattern is called temporal peaks where "a significantly large number of students show similar interaction patterns during a short time window " [46].

If the number of viewers falls sharply at the beginning of the video (during the first half a minute), the title, thumbnail and description of the video should be adapted to fit the users' expectations. A sharp decrease during the video can be explained by a specific point in the video where viewers are not interested anymore and stop watching [80].

The rise can characterize that the users have not understood the content and therefore re-watch it. This is referred to as a re-watching session peak. A play event peak arises when the number of play events increase sharply. It occurs when a viewer clicks the play button or moves the video time cursor to a new position while playing the video A decrease illustrates that the viewers have overstepped these video moments or that they dropped out completely [80].

The play event produces sharper spiky peaks and the re-watching sessions are represented by smoother, wider peaks.

In a sample of 80 edX videos in [46], 3,7 was the mean number of peaks in a video which was split into approximately half replay peaks and half play event peaks. The median width was 9 seconds. This short time of the width is explained by very time-specific events in a video. The average height was only 7,7 % of the maximum height. Looking at tutorial video only, the number of peaks was a higher compared to other videos such as lecture videos. Tutorial videos had 4,1 peaks on average per video. The normalized height of the local maximum and the normalized width from start time point to end time point was also higher in tutorials. The reason for these higher averages in tutorials is explained by the fact that people watch a tutorial more often or they replay parts of it when they have not understood a specific topic. A tutorial often contains step-by-step instructions thus the peaks occur exactly between two steps.

The comparison between first time watchers and re-watchers showed that first time watchers have twice as many peaks per video but the normalized height and width from first timers are smaller than from re-watchers. The mean video length was 7,8 minutes and a peak occurred around every two minutes [80].

"A visual transition is a change between presentation styles shown in a video." [46]. This may be a reason for a peak in the engagement over time. According to [46], 62 % of peaks in a sample of 80 edX videos showed a visual transition before, and/or after the peak. It shows that users who watch a video again start a new topic of the subject matter at the beginning of a new material or they return to content which they have not understood. In a tutorial, the users follow step-by-step instructions and if they have not understood one step, they repeat it. Other occasions for replaying a video during a visual transition are that the users only replay a brief segment or a non-visual explanation. There are five different interaction patterns of causes for interaction peaks identified and presented in Figure 2.9. The first and most popular reason is the start of the beginning of new material during the video. These peaks can also be used to cut long videos into smaller pieces because it shows that the new content is an entry to the video. Figure 2.9a presents a peak after the visual transition graphically.

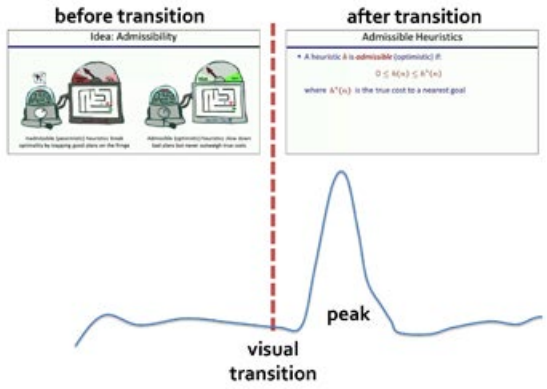
The second cause for interaction peaks is that students return to missed content. This reason

is almost as popular as the previous one, the start of the beginning of new material. Re-watchers play a video again from the start of new material such as a new topic, example or theorem. The peak appears shortly after the transition, as Figure 2.9b presents. This peak can be caused by the fact that there is a pacing issue in the video. The viewers would have needed more time to view that part of the video before the visual transition. For example, the change was too fast between the code view and the view of the result.

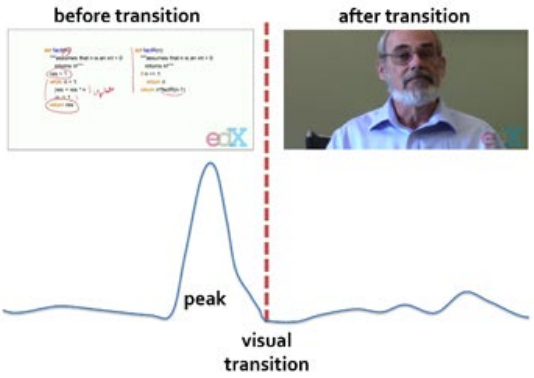
Following a tutorial step is the third reason for an interaction peak caused by a visual transition. As stated in Figure 2.9c, the peak is directly before a visual transition. This reason is similar to the reason before, returning to missed content, but it gets its own category as it is typical in tutorial videos. These videos often include step-by-step instructions. When the student has not understood a topic, he/she re-plays one or more steps.

The fourth reason is replaying a brief segment. A typical example would be the short presentation of a result. It is indicated by a peak where the result is shown during two visual transitions, as Figure 2.9d shows.

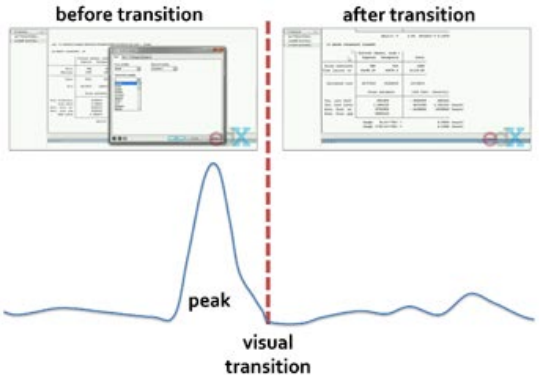
The fifth and last cause is the repetition of a non-visual explanation, as shown in Figure 2.9e. This reason is often the case, due to the fact that the video does not present the content directly on the screen, students have to replay the video if they have not understood something correctly [46].



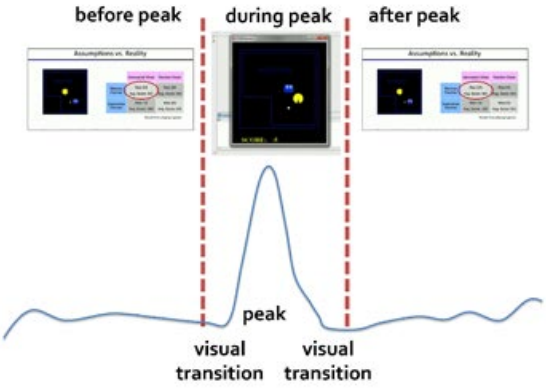
(a) Start of a New Concept [46, p. 7]



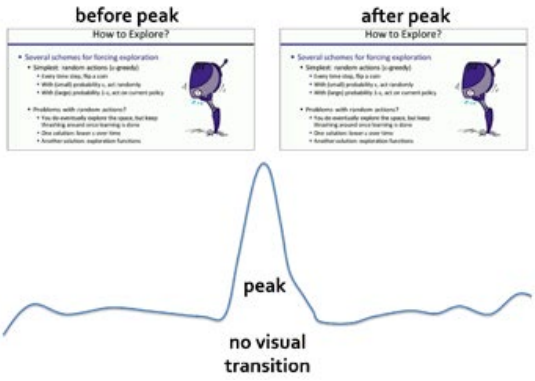
(b) Returning to Missed Content [46, p. 7]



(c) Following a Tutorial Step [46, p. 7]



(d) Replaying a Brief Segment [46, p. 8]



(e) Repeating Non-Visual Explanation [46, p. 8]

Figure 2.9: Causes for Interaction Peaks

The investigation of students' in-video dropout and video interaction leads to the following design guidelines [46, p. 39]:

- **Avoid abrupt visual transitions:** If the cause for an interaction peak is returning to missed content, make sure that the transitions are not too fast or abrupt. A way of prevention can be that you offer the content outside your video for users to more easily review the content.
- **Make shorter videos:** Shorter videos have a smaller dropout rate. The first cause, start of beginning of new content, helps to identify transitions where you can split a longer video into smaller parts.
- **Enable one-click access for steps in tutorial videos.** Instead of getting peaks when the user re-watches a step of the instruction, provide a user interface that helps students to discover the step-by-step instructions. A button for each step helps students to move to the needed step without scrolling back and forward through the video. With this improvement, you are aware of these transitions and you can focus on other peaks.
- **Provide interactive links and screenshots for highlights:** Instead of users having to replay sections, provide interactive links where they can hop to an important part of the video section. Additionally, screenshots can help students to review the watched content.
- **Consider video summarization for selective watchers:** The students' repetition of non-visual explanation in a video is very popular. Particularly for those who want to get a summary, you can offer a video that summarizes highlights from a video.

CHAPTER 3

MOOC Prototype

We have used the ADDIE instructional design model for our MOOC on the UML Class Diagram. As stated in Section 2.3, the ADDIE model consists of the stages Analysis, Design, Development, Implementation and Evaluation. In the following sections we state how we applied the ADDIE model to develop and run the MOOC prototype. After this chapter, ADDIE's last stage, the Evaluation, is explored further in Chapter 4.

3.1 Analysis

Target Audience and Motivation

Our main target audience are people of age 18-30 years who are interested in computer sciences. The target audience is studying computer sciences, Business Informatics, Information Systems or other related studies (e.g. STEM). All MOOC participants have basic knowledge in programing. The users are interested in gaining more knowledge on Modeling Languages because of self-interest in the topic, want to acquire knowledge and/or bonus points for a university course or need it for their work. Nearly all users are from Austria due to the fact that the MOOC is offered at the TU Wien.

The users know how to use a browser on an Internet-capable device which has an audio capability. The target audience is familiar with the World Wide Web, has access to it on a device of their choice and its applications for example e-mail. They know how to download and install a new software. Learning to use new simple software is easy for our target audience. YouTube is usually used without any user interface problems. The target audience is familiar with social media platforms.

Topic and Learning Objectives

The MOOC's topic is the Class Diagram of the Object-Oriented Modeling language, namely the Unified Modeling Language (UML). The subject matter covers the Class Diagram Section of

the book 'UML @ Classroom: An Introduction to Object-Oriented Modeling' [69].

The learning topics are the introduction of Structure Diagrams, the Object Diagram, the Attribute and Operation Syntax, the Association, the Aggregation, the Generalization, the Creation of a Class Diagram and the basics of Code Generation.

At the end of the course the participants should be able to understand the UML Class Diagram and use their knowledge to create a Class Diagram on their own.

Pedagogy

The MOOC is based on the behaviouristic learning approach because the lecture content is provided via learning materials and thus it is an xMOOC. The course consists of texts, videos and their transcripts, self-knowledge checks, quizzes and a peer-reviewed project. Additionally, a forum is provided to help the students if problems or questions occur.

Communication

The communication between MOOC users and lecturers takes place via the forum in the platform. E-mail will also be used to answer student's requests but it is not the preferred communication channel. The student will also receive notification messages via e-mail and through the platform.

Timeline

The analysis phase started in October 2015 and was finished by the end of 2015. The design phase took place in January 2016, followed by the development phase in February 2016. The implementation of the MOOC started with the beginning of the university's summer term in March 2016. Due to the university's schedule (influenced by holidays) the first week of providing learning materials started on the 2nd of March 2016 and the second week started on 9th of March 2016. The *Project* instructions went also online on the 9th of March, 2016. By the 23rd of March, 2016 the *Project* submission phase ended and by the 3rd of April 2016 the peer-review assessment phase was finished. The evaluation phase started right after the completed *Project* assessment and ran until the beginning of May 2016.

Limitations

The Class Diagram is taught at the beginning of the summer term's course Object-Oriented Modeling at the TU Wien. Students gain bonus points if they have done the main activities of the course. To be specific, these were the activities *Questionnaire Start*, *Quiz 1* of *Week 1*, *Quiz 2* of *Week 2*, *Project* (submission and assessment) and *Questionnaire End*. Therefore, it is important that the MOOC runs alongside the taught lessons at the TU Wien in order for the students to deepen their knowledge using the MOOC.

TU Wien has not had a partnership with any of the major platforms yet. Due to this, we cannot make use of their community to promote our MOOC. We have to build our own platform.

3.2 Design

Delivery

As the acronym MOOC indicates, the course is transferred via the Internet only. Therefore, it will be offered to the users without any restrictions.

MOOC Schedule

Figure 3.1 gives an overview on the MOOC's Schedule. The learning topics' sequence was taken from the book 'UML @ Classroom: An Introduction to Object-Oriented Modeling' [69].

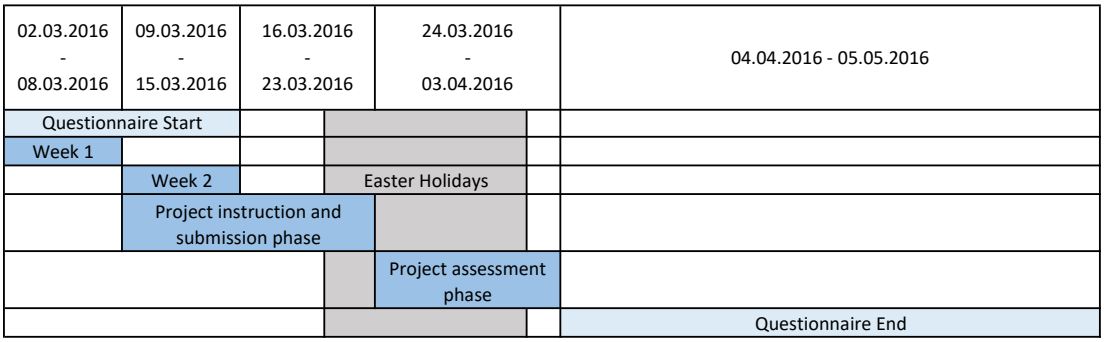


Figure 3.1: MOOC Schedule

The first week's learning material covers the topics from the introduction of Structure Diagrams, to the Object Diagram, to the Attribute and Operation Syntax and to the Association. After each lesson concentrating on one or two learning objectives, questions for self-assessment related to the studied content can be answered. Reading, watching and answering self-assessment questions takes approximately 1 hour. At the end of the learning material an overall quiz is provided. The quiz can be repeated as often as needed. Therefore, the proposed time is 1 hour. Overall, the first week requires 2 hours of independent studying.

During the MOOC's second week the users deal with the topics Aggregation, Generalization, Creation of a Class Diagram and basics about Code Generation. Additionally, the notation elements of the UML Class Diagram are provided in an overview file. During the discovery of the learning material, users can check their acquired knowledge by answering questions. Reading and watching takes approximately 1 hour and the overall quiz of the second week also takes 1 hour.

In addition to the learning material in *Week 1* and *Week 2*, users fill in a questionnaire which is needed for the course evaluation.

The *Project* instructions went online alongside the *Week 2* program especially for users who work through *Week 2* at a fast pace and want to continue earlier. Accomplishing the *Project* takes about 2 hours of the users' time. The *Project* assessment phase begins after the submission phase and requires students to review two projects of their course colleague. This assignment takes about 2 hours.

At the end of the MOOC, an evaluation phase starts where a second questionnaire is completed and the questionnaire from the beginning of the MOOC is taken into consideration. We want to highlight that the evaluation is not an original activity of the design phase but as the evaluation is important for this Thesis, we have already considered it in the design phase.

Language

The MOOC is delivered completely in English language. We want to highlight that the first O of the acronym MOOC stands for open and English is one of the most spoken languages in the World. The second reason for the chosen language is that this MOOC is part of a Master Thesis of an English master's program at the TU Wien.

Media Selection

We have chosen videos and texts as our media to arrange our content. The user gets a notification via e-mail but this is sent automatically from the forum. Electronic media is the Internet where we provide our MOOC. The advertising is primarily through social media because you can reach many people through it without paying anything.

Video

According to the video classification grid in Section 2.5, our MOOC videos have the following characteristics. The focus of interest is on the slides and the instructor in most of the videos. The framing is always centered and the field size is close-ups because we produce the videos in a small office room. We use a tripod for recording the videos due to the fact that we do not have a cameraman. Therefore, the camera movements are static. The videos are only produced for the application in our MOOC.

As we mentioned before, the video style is mainly 'Slides and Instructor'. Additionally, we do the animated handwriting style in some videos. The focus of our investigation in the evaluation part is also on the difference between those two video styles.

The video duration is a maximum duration of 6 minutes because this an ideal length time for students' engagement, according to [24, 24, 74].

Transcript

The videos of our MOOCs are supported by transcripts which show the slide picture and the spoken text. If the text is spoken from the instructor without showing a slide, the text is added to the previous or following slide.

Assessment Instruments

Each of the two learning material weeks has a quiz at the end. In every quiz, the user reach reach up to 100 points. The project part is divided into 50:50 - 50 points for the submission and 50 points for the project review. In summary, the participant can reach 300 points (100 points for *Quiz 1* of *Week 1*, 100 points for *Quiz 1* of *Week 2* and 100 points for the *Project*).

3.3 Development

Platform

Due to the fact that the TU Wien does not have a partnership with a MOOC platform yet, we could not publish our MOOC on a popular platform like edX or Coursera. For this reason, we had to create our own website. We have therefore chosen the software Moodle (version 3.0.2) as platform for our MOOC prototype [56].

We bought the package "Domainserver 2016"from the Austrian company World4You Internet Services GmbH. The domain name *www.mooc-uml.at* and the software Moodle (version 3.0.2) were included. A MySQL database, which is needed to run the software, is also provided in the package. The cost amounts to 35,88 € per year.

Tools

Microsoft PowerPoint is used to prepare slides for the videos. Additionally, we wrote a transcript of each slide as note in PowerPoint. For video cutting, it is important to prepare individual slides for every transition to produce a dynamic video. For example, when showing a slide with a list of four statements, four different slides are needed. The first one is showing the first statement, the second one is showing the first two statements and so on.

To record the videos, we borrowed a camera and a tripod from the TU Wien's Teaching Support Center. The camera includes a remote control which is convenient when recording videos alone as you do not have to go to the camera each time when you want to start or end recording.

Initially, we used Windows Media Player for cutting the videos. We mainly put the slides in front of the video where the viewer hears only the recorded voice and can follow on the shown slides. The free Windows Media Player is a tool used for private video cutting and not for professional video cutting. The main difficulty was that the program did not support two different video tracks in parallel. You can have only one video track and then fill in an audio track. If you want to show a screen of the instructor and slides alternately you would have to cut in different project files first and then combine them. Unfortunately, Windows Media Player crashed very often and it was not possible to use it appropriately.

Due to that fact, we changed the cutting program from Windows Media Player to Pinnacle Studio 19, which offers the possibility to have more parallel video tracks during cutting. The full version costs 60 €.

VideoScribe is a helpful software to make creative whiteboard-style animation videos. The cost for one month amounts to 24 €. We used this software to produce animated handwriting videos. The program is easy to use but when it comes to creating UML Class Diagrams from scratch it gets complex.

As you see in Figure 3.2, the white board is shown in the main frame and below every item is displayed separately. The time sequence of objects is from left to right. While playing the video, each object is written or painted on the whiteboard by an animated hand. When using the predefined objects arrow or rectangle, the animated hand easily knows how to write these

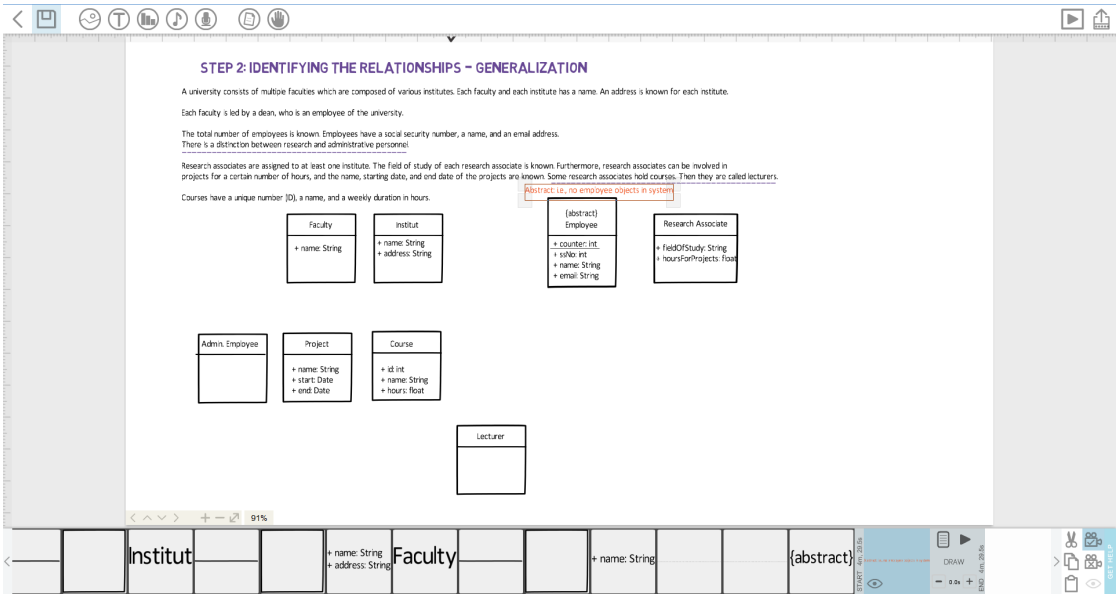


Figure 3.2: VideoScribe

objects. In larger Class Diagrams, though, many items are needed. This is why pictures of Class Diagram parts are used and the hand is painting these pictures.

Video

The learning material of a MOOC consists mostly of videos. At first, we started with the design of the concrete subject matter. As template we have used the English slides of [69] published at http://www.uml.ac.at/en/lernen.

We have kept the videos short as it is recommended in [24, 24, 74] (see Section 2.5, 2.4 and 2.5).

We wrote a transcript for each slide, which has been used.

Content

Figure 3.3 shows the course overview of the MOOC prototype about the UML Class Diagram. Users can find the navigation of the course on the top left hand side. The navigation box consists of the links to the *General* section, the *Questionnaire Start*, the *Forum*, *Week 1*, *Week 2*, the *Project* and the *Questionnaire End*. In the center of the webpage, the content is shown.

The box on the right hand side presents the user's progress. With this kind of progress visualisation the user gets instant feedback what still needs to be done. At first sight the user knows his/her current learning progress because the boxes are ticked automatically. In Figure 3.4, the user had a look at the *Timeline* and visited the *Forum* once. The *Questionnaire* of the section *Questionnaire Start* is missing.

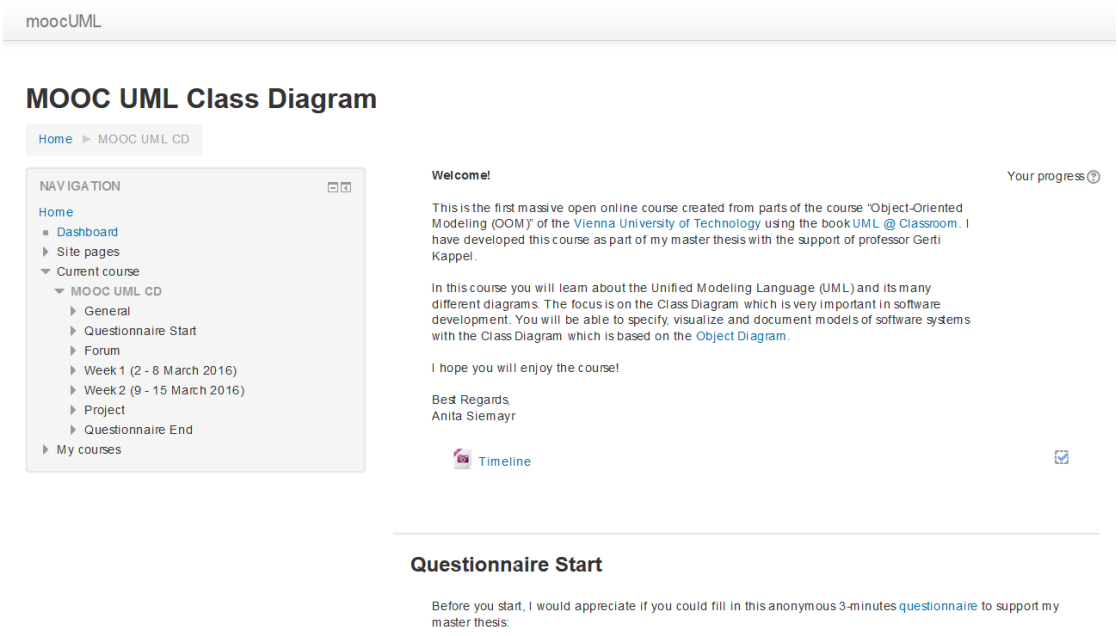


Figure 3.3: MOOC Course Overview

The course content is presented in the following figures in detail. The *General* section is always shown on the top of the content, as Figure 3.4 displays. At the beginning of this *General* section, we introduce our Master Thesis project and give an introduction to the course. Additionally, we provide a download of the course *Timeline*. The next section, *Questionnaire Start*, contains a *Questionnaire* to evaluate some questions before the course has even started. In the *Forum* section, we have set up a *Forum* for discussion on interesting topics or if anyone needs help.

Figure 3.5 shows the sections of *Week 1* and Figure 3.7 of *Week 2*. Every week has a short introduction outlining what the participant will learn in the corresponding week. The user gets additional information about the week such as the week's topics, the approximate reading and watching time and how much time he/she needs to plan for the quiz. Below, the learner gets listed the different activities of the learning week. The small illustration in front of each activity indicates the type of Moodle activity or resource. Looking at *Week 1*, the resource of *Introduction and Motivation* is a page which contains an introductory video. The activity of *Quiz* is Moodle's quiz activity. The rest of the activities are presented by Moodle's lessons.

In the lessons module, various different questions or content pages can be combined. Additionally, the instructor has the possibility to cluster activities. These clusters can be used to vary the questions for each user within a question pool. The user has to follow the pre-defined learning structure to complete a lesson. For example, the lesson *From Objects to Class Diagram* consists of three sequenced content pages where each includes a video and its transcript. Figure 3.6 shows the first content page of the lesson *From Objects to Class Diagram* including a video and its transcript. Below you can see the lesson's progress bar, which is always displayed in the lessons module. In this screenshot the progress bar shows 100 % already as the student

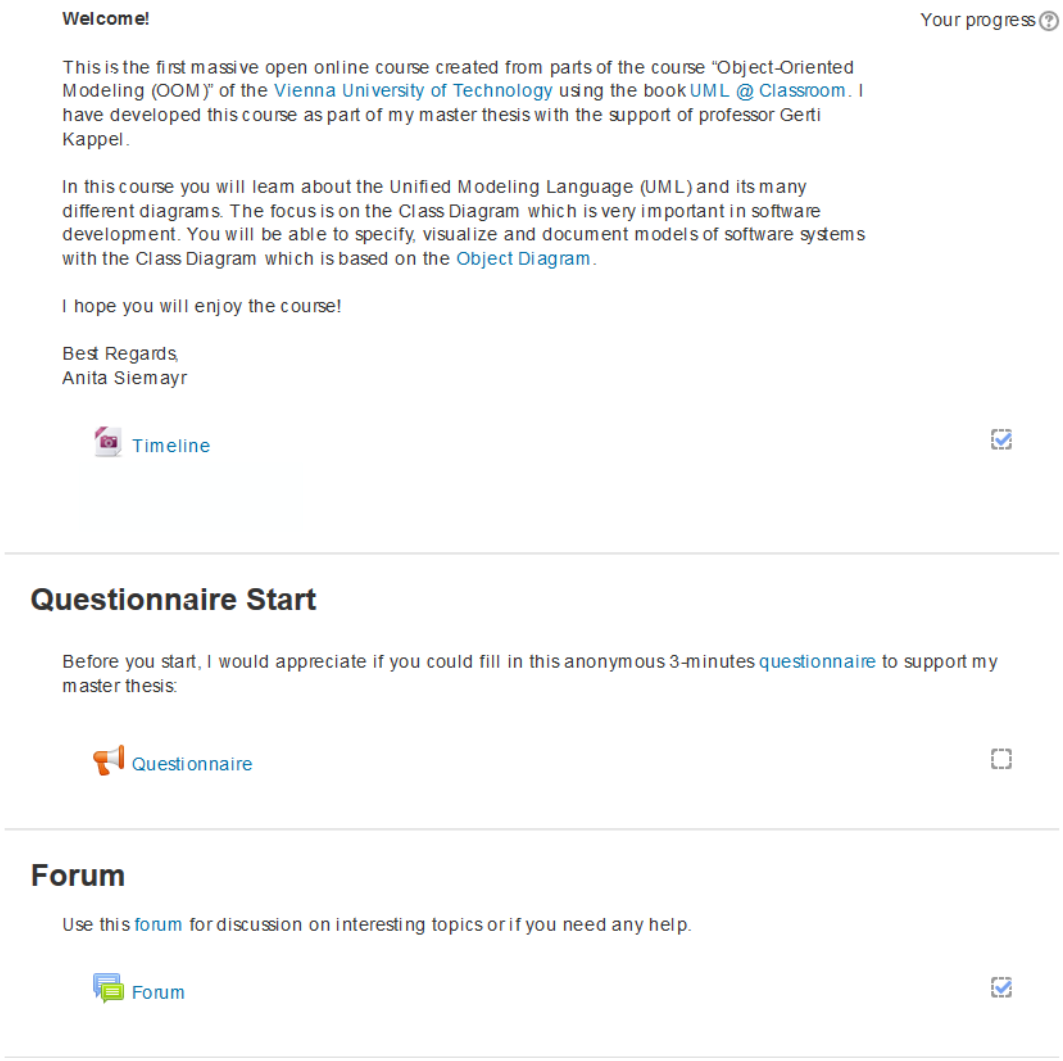


Figure 3.4: MOOC Course Content

has restarted a lessons module that she/he has already finished completely. Afterwards, the user is asked questions to finish the lesson. These questions have no impact on the granted course points. They should only help to deepen the learned content.

Due to the fact that Moodle's lessons module was not working properly in practice, we used Moodle's quiz activity in an unusual way in *Week 2*, as you can see the quiz illustration in front of the activities in Figure 3.7. It is possible to show a content page before a quiz. We have used this way to show our video and transcript directly before the questions' page. In this week you can also see that *Notation Elements* is a PDF download.

Figure 3.8 presents the peer-reviewed *Project* section, which is implemented with Moodle's

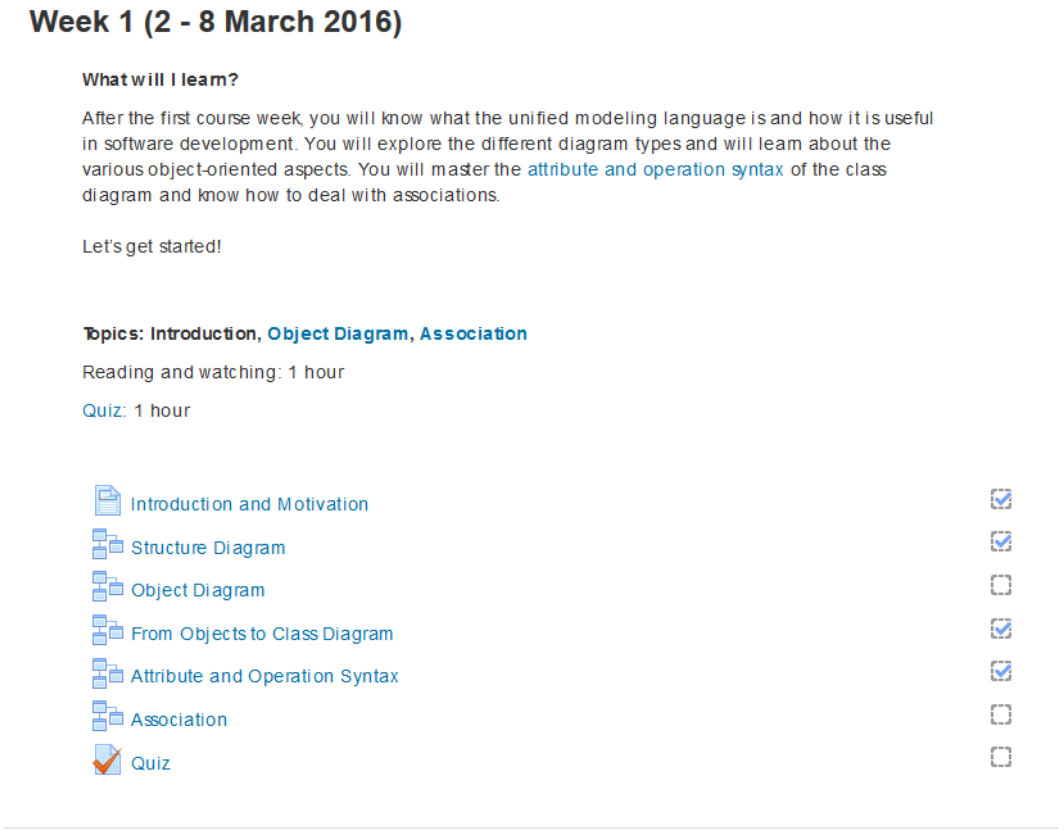


Figure 3.5: MOOC Course Content

workshop module. This module is divided into four phases which can be seen by the developer. The first phase is the setup phase. In this phase the workshop description is defined. Instructions for the submission are provided and the assessment form is edited. We have chosen that the impact of the overall project grade is half-half for submission and for assessment. In the second phase, the submission phase, the students submit their work and instructions for assessment are provided. At the end of this phase submissions per student are allocated for reviewing. The third phase is the assessment phase where each student assessed the work of three course colleagues. The grading evaluation phase is the last and fourth phase. In this phase the submission and assessment grades are calculated. You can choose which comparison of assessments you want - very lax, lax, fair, strict, very strict. There is no further explanation from Moodle how these gradings are generated. We have chosen fair as grading for the assessments.

The last part of our MOOC is *Questionnaire End*, as Figure 3.9 displays.

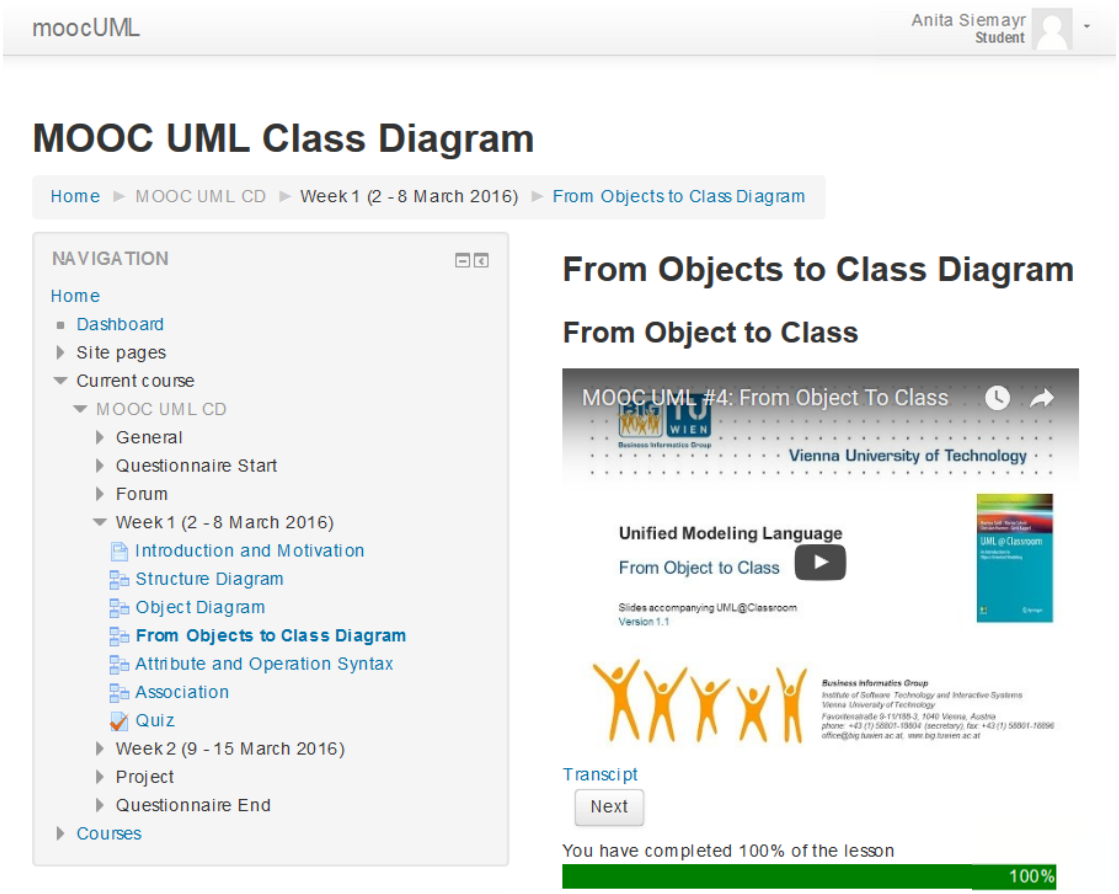


Figure 3.6: Lessons Module

Figure 3.7: MOOC Course Content

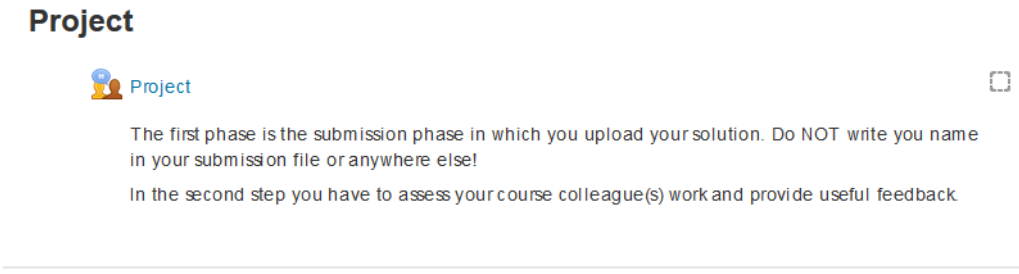


Figure 3.8: MOOC Course Content

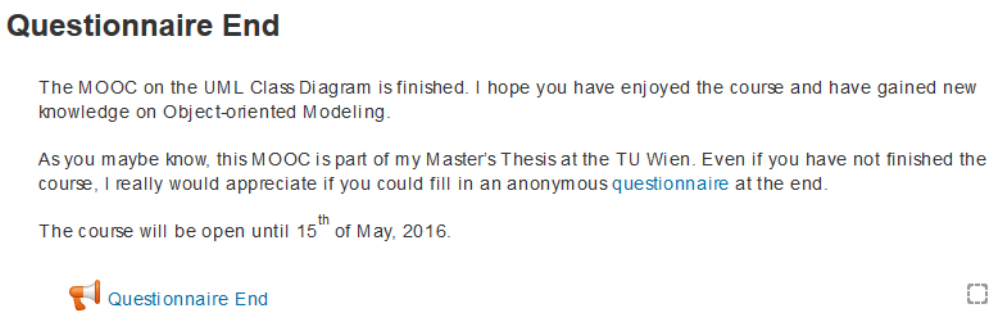


Figure 3.9: MOOC Course Content

Advertising

As the subject matter of our MOOC prototype covers the Class Diagram of the course Object-Oriented Modeling at the TU Wien, we presented our MOOC prototype at the preliminary discussion of the course at the TU Wien. Students had the possibility to gain 5 % bonus points for the course at the TU Wien if they completed five activities - *Questionnaire Start*, *Quiz 1*, *Quiz 2*, *Project* and *Questionnaire End* of the MOOC.

To attract people other than the students of the TU Wien's course Object-Oriented Modeling, we announced the MOOC prototype on around 40 Facebook groups. Therefore, we used our private accounts and joined many national and international groups that deal with informatics. We introduced our MOOC and invited the community to take part in our course.

One of our posts on Facebook got the attention of Jordi Cabot, a Research Professor of the Catalan Institution for Research and Advanced Studies. He gave us the opportunity to write a guest blog post about our MOOC on Object-Oriented Modeling for his website http://www.modeling-languages.com. Figure 3.10 presents the whole blog entry where we introduced our MOOC and invited the readers to join our course.

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Massive Open Online Course about the UML Class Diagram

By Anita Siemayr 13/03/2016 | 9:05 Posted in teaching, UML and OCL 9

Massive Open Online Courses (MOOCs) are a new way of learning. MOOCs are massive. They are designed for many people who are enrolled in the courses. A course is often taken by more than thousand persons. Compared to other leaning models, MOOCs are completely open and everybody can take courses. Sometimes a fee for the course or for the certificate is collected but everybody can take the course without any other requirements such as a specific educational level. A MOOC takes place in the World Wide Web and this means you can do it at any place you want to.

I have developed a MOOC about the UML Class Diagram as part of my master thesis with the support of professor Gerti Kappel. It is the first Massive Open Online Course created from parts of the course "Object-Oriented Modeling" of the Vienna University of Technology using the book UML @ Classroom.

In this course you will learn about the Unified Modeling Language (UML) and its many different diagrams. The focus is on the Class Diagram which is very important in software development. You will be able to specify, visualize and document class diagrams of software systems .

This MOOC is organized in two weeks of self-studying with the provided learning material and quizzes. In each week you will deal with small quizzes while you discover the learning material and there will be a weekly quiz about what you've learned.
We will provide a peer-reviewed project in the 3rd week. It takes about 5 hours to do the project and you have two weeks to hand it in. At the beginning of the 2nd week the project instructions go online. After you have uploaded your project, you have to assess a project of your course colleagues.
Additionally you can use a forum for discussion on interesting topics or if you need any help.

Everybody can join the course for free. Week 2 has begun but it is not too late for participation. Register now at www.mooc-uml.at and enjoy the course!

Tags: Class Diagram, Massive Open Oline Course, MOOC, Vienna University of Technology

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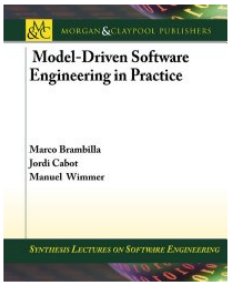

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Figure 3.10: Blog Entry

Evaluation

Questionnaire

Two questionnaires for a later evaluation of our MOOC were conducted. The questionnaires were directly provided to the students in our MOOC platform Moodle. The first questionnaire, *Questionnaire Start*, was conducted at the very beginning of the course and the second one, *Questionnaire End*, at the end of the course.
Demographic questions were included in the *Questionnaire Start* for building respondent subgroups in the evaluation. Demographic questions about the following characteristics were asked to the participants:

- age
- gender
- country and zip code
- level of education
- English speaking level
- TU Wien student
  - Bachelor student
    - computer sciences/business informatics
  - Master student
    - computer sciences/business informatics
- field of study, f.e. business/economics, education/counseling, engineering/computer sciences, etc.
- concrete studies

Additionally, questions about the motivation were included in the questionnaire:

- reasons for taking the course (online, enjoy learning about topics that interest me, enjoy being part of a community of learners, gain skills for a new career, gain skills for a promotion at work, hope to gain bonus points for the course Object-Oriented Modeling, hope to gain skills for the course Object-Oriented Modeling) [38]
- interest in a certificate or badge for course participation
- interest in a certificate or badge for course completion
- intent to complete

Questions about the helpfulness of the MOOC activities, about the presentation techniques, about students' motivation and general questions were included in the second questionnaire, provided at the end of the course.
The helpfulness of different activities during the MOOC was asked during the first question block.

- helpfulness of lecture videos
- helpfulness of self tests
- helpfulness of quizzes
- helpfulness of forum
- helpfulness of project assignment
- helpfulness of giving project review
- helpfulness of receiving project review

In the case of video styles, we focused on the difference between watching a video for fun and using a video to study. This is why the questions about the preferred video styles were asked twice, once for watching a video for fun and once for studying with a video. The focus of interest preference is asked from the following styles:

- slides
- slides and instructor
- animated handwriting

The following questions asked the preference of video's locations:

- classroom
- office desk
- studio

In the second questionnaire, we once again asked questions dealing with motivation. In this context, we evaluate if the usage order of learning material has an impact on the motivation. We investigate whether organized people are more successfully completing the course or not. The gamification of the MOOC is evaluated with a question regarding the completion tracking

boxes. The participants are asked if they have cheated during either quizzes, project or both. The next question is about the finish of the MOOC and if the respondent has not end the MOOC, additional questions about the reasons for dropping out are asked. The last questions enquired about possible improvements on our MOOC and about how many MOOCs the students have participated in.

We tried to ask only single or multiple choice questions. Therefore, we provided answers, which can be ticked by the students. For a better evaluation, we used very few open questions e.g. when asking about improvements. The complete questionnaires including the possible answers can be found in Appendix A and A.

3.4 Implementation

In this Section, according to ADDIE's implementation stage, we provide information on the run of the MOOC prototype.

Usage

The learning material of *Week 1* was provided on the 2nd of March.

The MOOC's second learning week started on the 9th of March 2016. Additionally, on the same date, the *Project* instructions went online. The students who completed the learning material of *Week 2* faster could have started with the *Project* directly afterwards without any time lag.

The forum was provided to help participants who have questions or problems during the MOOC.

We also wrote notifications to the MOOC participants to support their engagement. After the self-creation of a user's account, we welcomed our new course participant. At the beginning of each of the first two weeks, *Week 1* and *Week 2*, where new learning materials were provided, we informed the users about the upcoming topics and how long they will need to discover the learning material.

3.5 Data Collection

The evaluation takes implicit user data, explicit user data and content analysis into account, as we have stated in Section 2.6. The implicit user data is fetched from the MOOC platform, Moodle, from Google Analytics and from YouTube. Moodle and Google Analytics provide detailed log files for the course and platform respectively. The videos are hosted via YouTube which offers an analytics tool. It should be noted that these three data sets marginally differ because the videos are public to all YouTube users and not only to MOOC participants of the platform. The explicit user data is collected using the self-registration form of Moodle and two optional questionnaires, one at the beginning of the MOOC and one at the end. A simple content analysis is also provided by YouTube's Analytics tool.

CHAPTER 4

Evaluation

106 people out of 172 registered users filled in the questionnaire at the beginning of the MOOC (*Questionnaire Start*) and 48 people completed the questionnaire at the end (*Questionnaire End*).

Users

Gender and Age

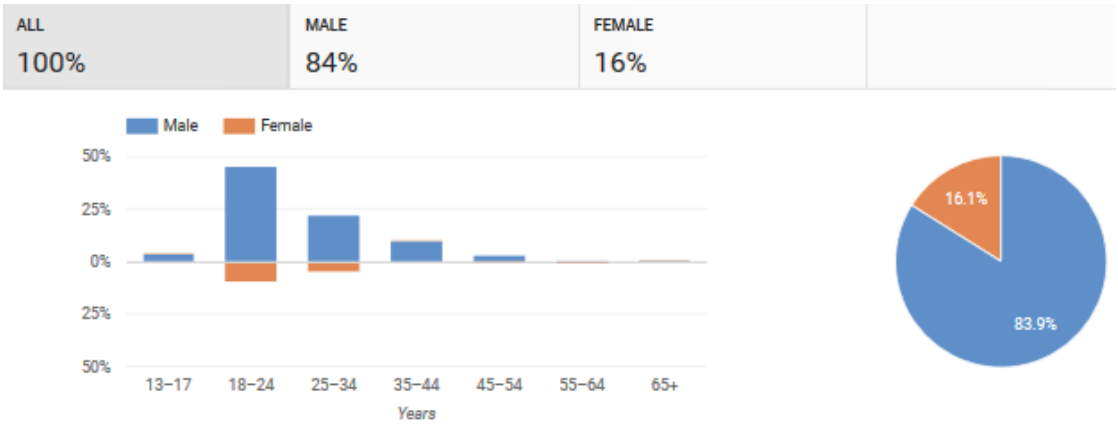


Figure 4.1: Gender and Age (MOOC UML YouTube Analysis, 1.03.2016 - 3.04.2016)

According to the YouTube Analysis of 14 videos between 1st March 2016 and 3rd April 2016, 84 % of viewers were male and 16 % were female, as Figure 4.1 demonstrates. One reason might be that computer sciences are generally dominated by men. This argument also counts for the study programs computer sciences or Business Informatics at the TU Wien. At

the TU Wien, 84 % men and 16 % woman were enrolled in summer term 2016 in the study field Computer Sciences or Business Informatics.
Comparing the data retrieved from YouTube Analysis and the Questionnaire Start, the gender and age depict only a very small difference. Namely, the percentage of women was just a little bit higher in the data of the questionnaire. The questionnaire presents 24,5 % females and YouTube Analysis shows 16 % females. The difference occurs due to the fact that the videos on YouTube are public.

Due to the fact that the Object-Oriented Modeling course at the TU Wien takes place in the second semester of the bachelor's program, it was not surprising that the mean age of participants was 22. The participant age was from 18 to 58 with an average of 25.

YouTube Analysis demonstrates that there are more men, between 35-44 years, viewing videos than the questionnaire shows as result. One reason might be that those men did not complete the questionnaire because it was an optional activity of the MOOC.

Country

Because of TU Wien students getting bonus points for doing the whole MOOC, 67 % out of 103 registered users were from Austria. 6 % were from Italy, which might be because at the TU Wien, there are students from South Tyrol which is an autonomic province in Italy where German is the most spoken language. There were 3 people from Spain and 2 from each of Germany, Hungary, Netherlands, Nepal and United States. These countries together make up 12 % of the total. The remaining 15 % are made up by one person per Country from Albania, Australia, Bulgaria, Czech Republic, United Kingdom, India, Luxembourg, Montenegro, Macedonia, Poland, Romania, Serbia, Russia, Syria and Ukraine.

Level of Education

Object-oriented Modeling is compulsory in the bachelor's program Computer Sciences and Business Informatics at the TU Wien. This is the reason that 71 % of participants out of 106 users were bachelor students, as Figure 4.2 presents, while 12 % were students of the master's program. 95 % of the Bachelor students and 31 % of the Master students are from the TU Wien. People who have already completed their university studies are presented by 7 %. 6 % of MOOC participants do not have a university study. 4 % were professors or researchers and 1 % were university support and technical staff.

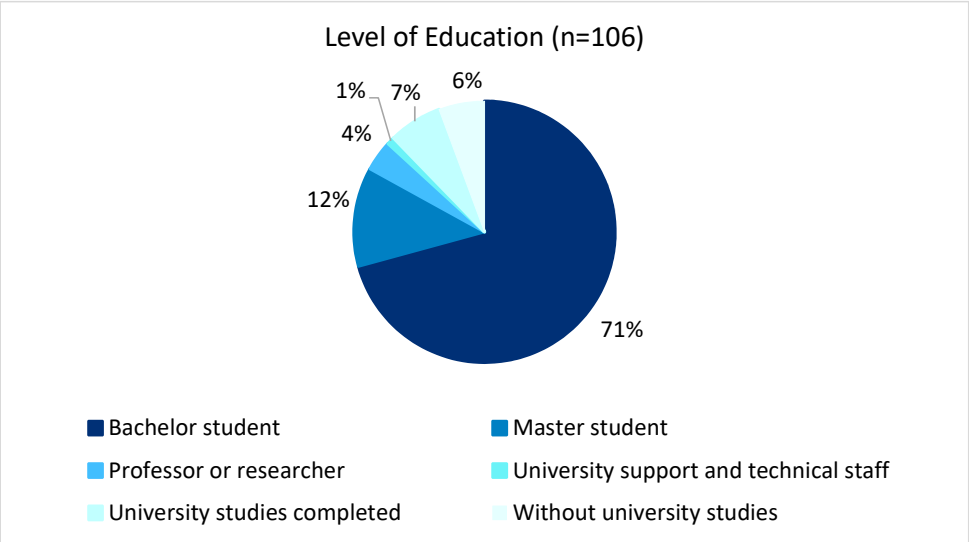


Figure 4.2: Level of Education (Questionnaire Start)

English Speaking Level

More than three fifths of participants answered in the initial questionnaire that their English speaking level is advanced or native. A third have an intermediate English speaking level and only one percentage have a beginner level.

4.1 Usage

You can find the number of sessions and the percentage of new sessions while running the MOOC prototype in Figure 4.3. On the 1st of March 2016, we had got the possibility to introduce our MOOC on Object-Oriented Modeling to the students of the Object-Oriented Modeling course at the TU Wien. Additionally, the students will get at most 5 % bonus points for the course at the TU Wien if they have completed the activities *Questionnaire Start*, *Quiz 1*, *Quiz 2*, *Project* (submission and assessment) and *Questionnaire End*.

The maximum number of sessions of the entire MOOC was reached during the MOOC's

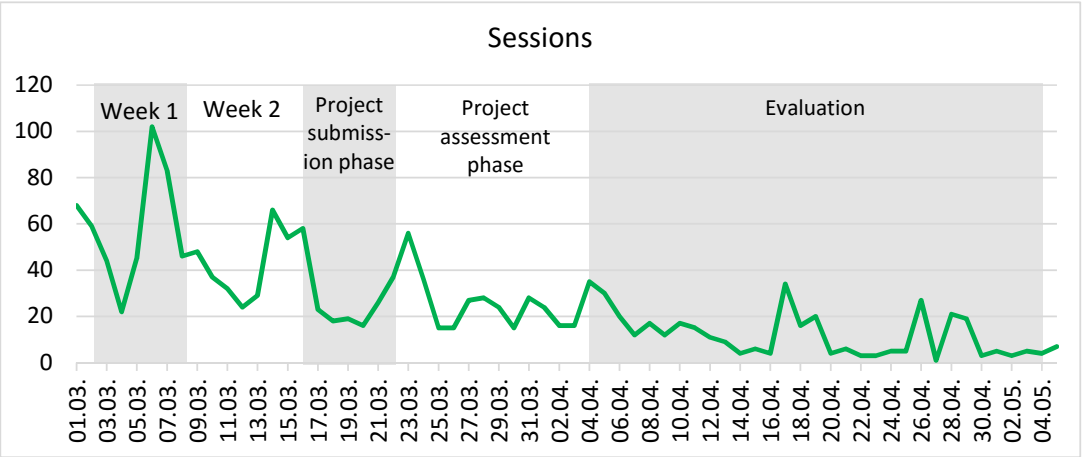


Figure 4.3: Sessions in MOOC prototype

first week. On the 6th of March 2016, the course had 102 sessions.

4.2 Activities

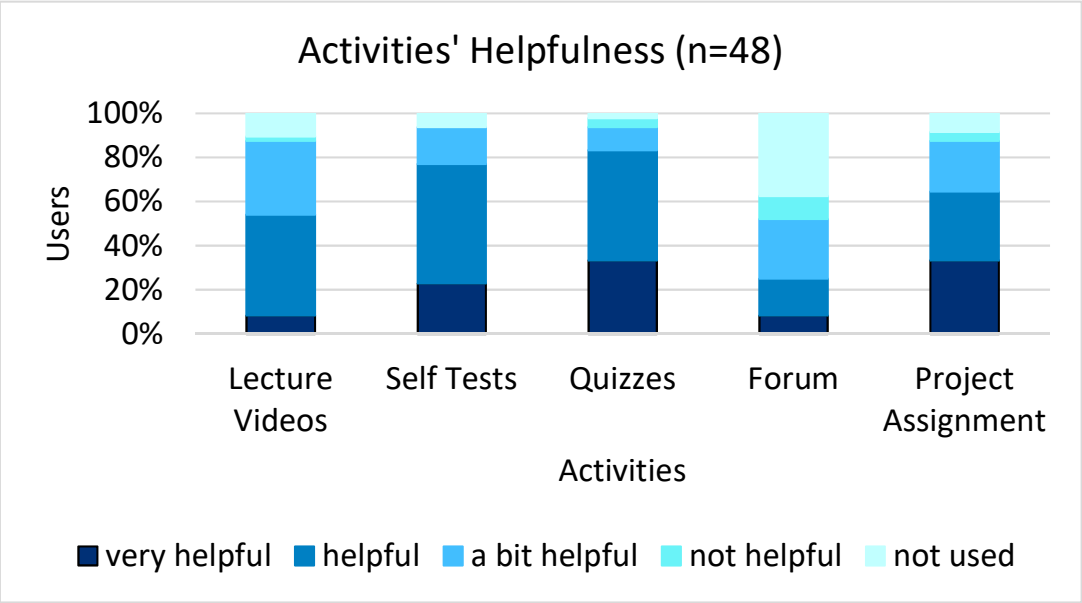


Figure 4.4: Activity Helpfulness (Questionnaire End)

Figure 4.4 visualizes how helpful each type of activity was to the students. The highest and exactly the same percentage of the category 'very helpful', reach the *quizzes* and the *project*. *Self tests* while discovering the learning material are in second place. The lecture *videos* and the *forum* was each in 8 % of students voting 'very helpful'.
The activities lecture videos, self tests and quizzes have a margin of deviation of only 8 % in the category 'helpful'. Around 50 % of students answered that these activities were helpful. Additionally, these three activities show the highest peak of the diagram. The project assignment reaches a similar score again in the category 'helpful', as in the category before. 17 % of students consider the forum as helpful.
33 % of the students consider the lecture videos 'a bit helpful'. The category 'a bit helpful' reach 33 % in the activities *lecture videos*, 15 % in the activities *self tests*, 10 % in the activities *quizzes*, 23 % in the activity *project assignment* and 27 % in the *forum* activity.
The highest score (10 %) reach the *forum* activity in the category 'not helpful'. The other activities show less than 5 % in this category. The activities *self tests* is always at least a bit helpful.
10 % of users have not used the *lecture videos*. In 6 % and 8 % of answers, the activities *self tests* and *project assignment* have not been used. Only 2 % of users answered that they have not done the *quizzes*.
Looking at the median values of each activity without considering the 'not used' category, the median of each of the activities *lecture videos*, *self tests*, *quizzes* and *project assignment* is always the category 'helpful'.
63 % have used the *forum* and their median voting was that the *forum* was a bit helpful.

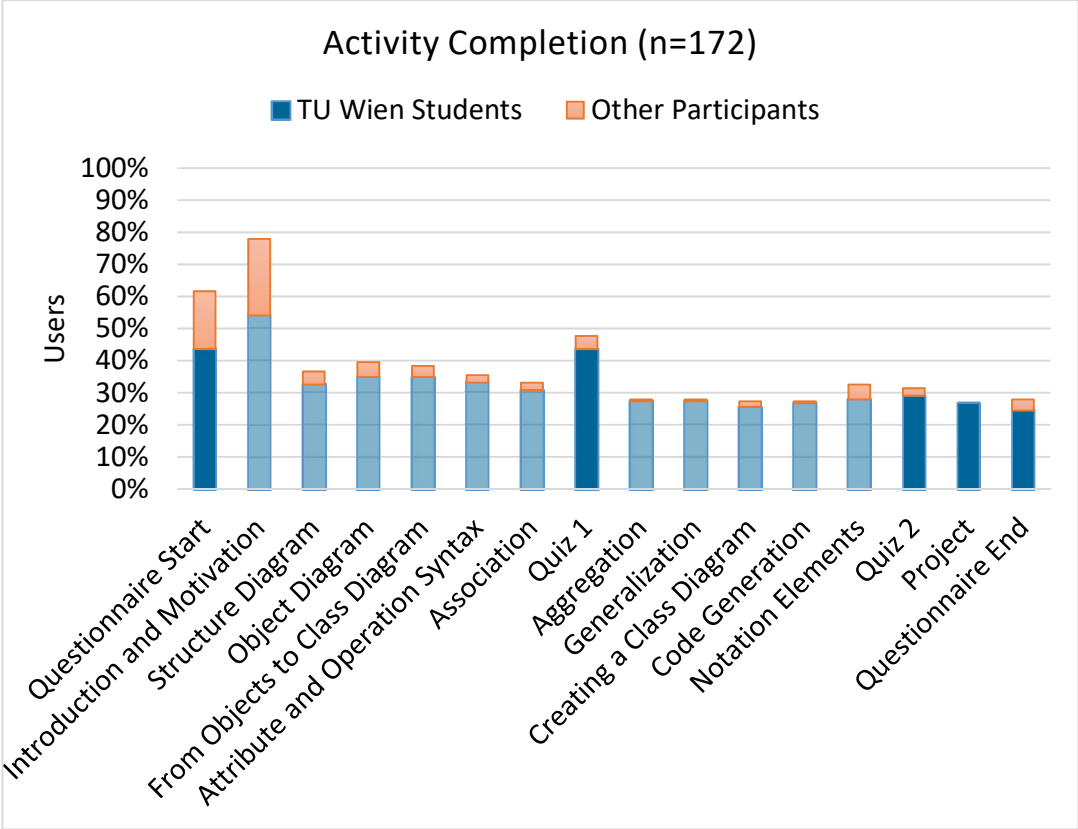


Figure 4.5: Activity Completion

The activity completion of our MOOC participants is presented in Figure 4.5. The bars are divided into TU Wien students (blue) and other participants (orange). The activity requirements for receiving bonus points are completing *Questionnaire Start*, *Quiz 1*, *Quiz 2*, *Project* and *Questionnaire End*. The dark blue bars indicate that TU Wien students get bonus points for the Object-Oriented Modeling course at the TU Wien.

The highest point is reached at *Introduction and Motivation* which was the first activity presenting learning material. After this lesson, the figure displays a drop. It demonstrates that many people only tried the first lesson and then dropped out. As can be seen in the bar chart, the number of activities completed before and after *Quiz 1* is constant. A reason for this may be that the participants completed the weekly activities at once. It is most likely that a reason for the peak at *Quiz 1* is that the completion of this activity is the second one of the requirements of getting bonus points for TU Wien students.

Almost all TU Wien students who managed to complete *Quiz 2* also did the last two parts of the course, the *Project* and the *Questionnaire End*.

The overall trend shows a peak at the beginning and then a decrease until the end of the

course, with the exception of a small peak in the middle of the course at *Quiz 1*.

4.3 Motivation

Reasons for Taking the Course

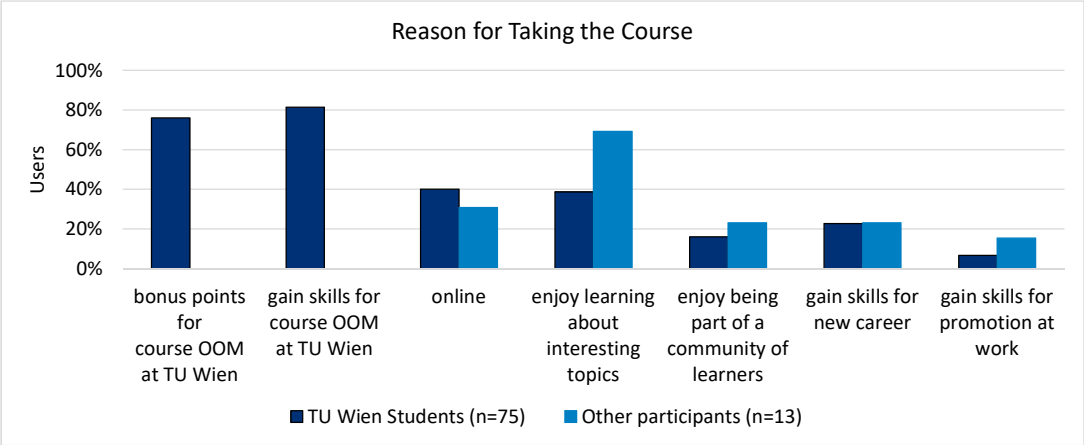


Figure 4.6: Reasons for Taking the Course

The reasons participants take the course are presented in Figure 4.6. Most of the users were from the TU Wien (75 students). These students were indicated by their TU Wien e-mail address. 13 other participants also took the MOOC. Due to the fact that TU Wien students gain bonus points for successfully completing the MOOC, we split these two groups for the evaluation of motivational reasons taking part in the MOOC prototype as it is biased.

As you can see in the diagram, there are four different increments among the TU Wien students. The major motivation for TU Wien students was gaining skills for the Object-Oriented Modeling course at the TU Wien and receiving some bonus points for the same course at the TU Wien. Approximately 40 % of TU Wien students stated that they took the course because it was online or because they enjoy learning about topics that interests them. The third stage is made up the reasons that the users enjoy being part of a community of learners (16 %) and that they hope to gain skills for a new career (23 %). The potential of gaining skills for a promotion at work was almost unimportant for the TU Wien students (7 %). We assume this is unimportant to the TU Wien students because they are focusing on studying rather than on work in their first year as a student.

When looking at participants other than TU Wien students, the bars are different: The first most important motivation is that these users enjoy learning about interesting topics. The second most important motivation was that the users like the online format. Almost equal on the third place were again the reasons that the users enjoy being part of a community of learners and that the users hope to gain new skills for a new career. The gain of skills for promotion at work is

more popular for users which are not TU students. This is possibly due to the fact that these users are already working.

Approximately three quarters of users (76 %, n=106) answered that they have the motivation to complete the course. 21 % are not sure if they complete the whole course and only 3 % do not intend to complete the course.

Organised People

Figure 4.7 displays how organised our MOOC participants think they are in their private life, at work or in their studies. 19 % of participants think that they are never or seldom organised. One quarter is sometimes organised and one quarter often organised. Most of the questionnaire participants, specifically 31 %, consider themselves as almost always organised, . As stated in 2.6, unorganised people may drop out easily. We highlight that in our case, most of the people are organised in their private life, at work or in their studies.

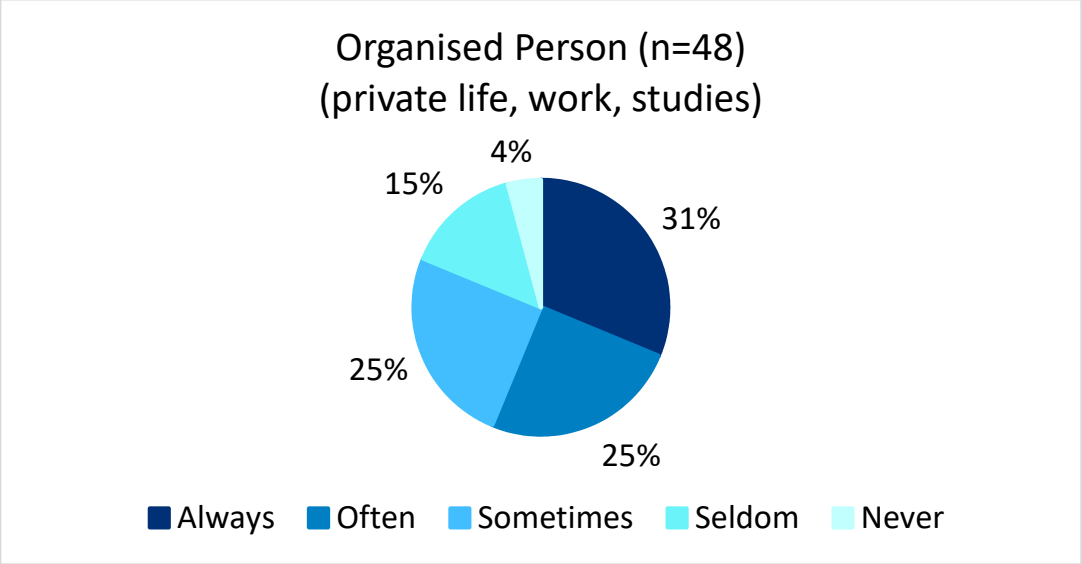


Figure 4.7: Organised People

The correlation between orderliness and completion/non-completion of learners is presented in Figure 4.8. As you can see, almost all bars are dark. This means that nearly all people, who have filled in the questionnaire at the end of the course, have (almost) finished the MOOC successfully. We want to highlight that almost all learners who think that they are always an organised person have finished our MOOC.

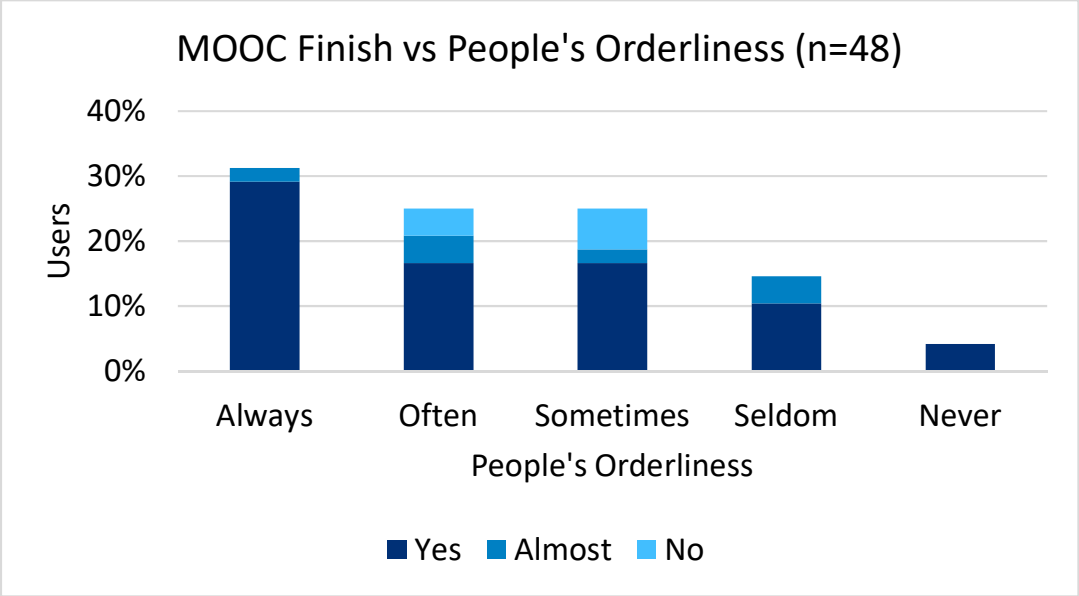


Figure 4.8: Organised Person vs. MOOC Finish

Order of Learning Material Usage

The investigation of whether or not the students the students have used the learning material in the order of which it is presented in the MOOC is illustrated in Figure 4.9. Most of the people (40 %) have almost always used the learning material in the order in which it is presented. 21 % have used the learning material often and 21 % only sometimes in the provided order. 18 % have never or seldom used it in the order in which it is presented in the MOOC, which is quite a number.

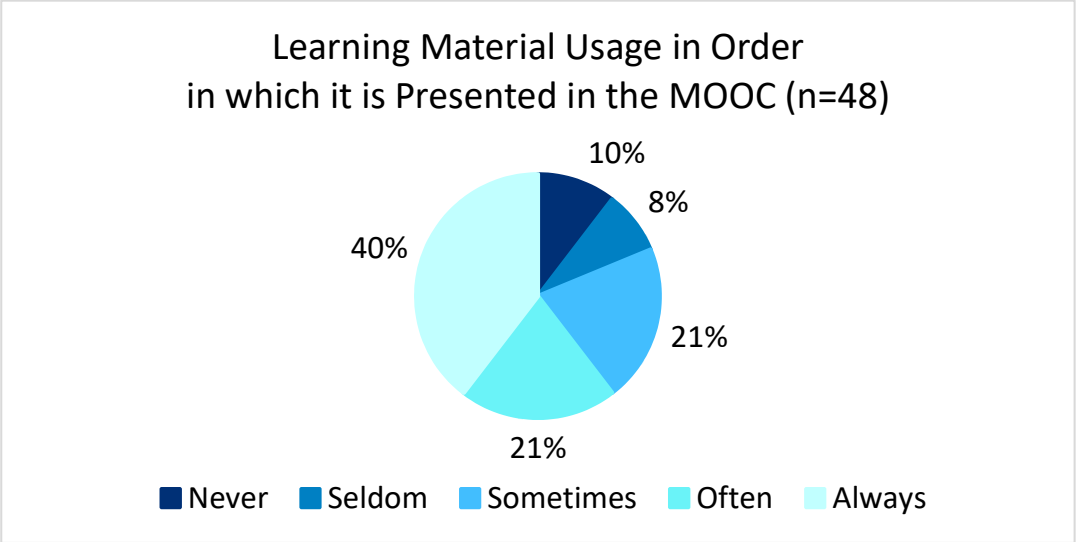


Figure 4.9: Order of Learning Material Usage

Gamification

Game elements help to support the participant's motivation, therefore their activity on the platform increases and the dropout rate decreases. Figure 4.10 illustrates if the MOOC participants have considered the completion tracking boxes. 65 % of users have almost all activities ticked and 21 % have some ticked activities. Only 15 % have not considered the completion tracking boxes.

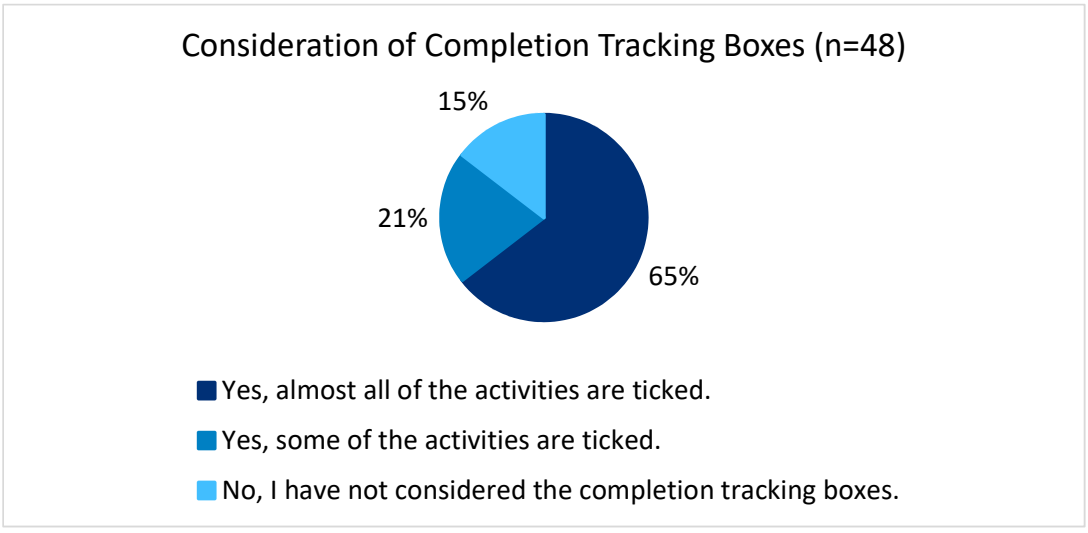


Figure 4.10: Consideration of Completion Tracking Boxes

Cheating

The investigation of cheating showed that 50 % of students have not cheated at all and 50 % have at least cheated once, as Figure 4.11 presents. Most participants answered that they have cheated during the quiz(zes), to be exact 40 %. 6 % have cheated during the project and the quiz(zes). Putting them both together, 46 % have cheated during the quiz(zes) which means almost every second student has cheated during a quiz. 4 % of participants have cheated only during the project.

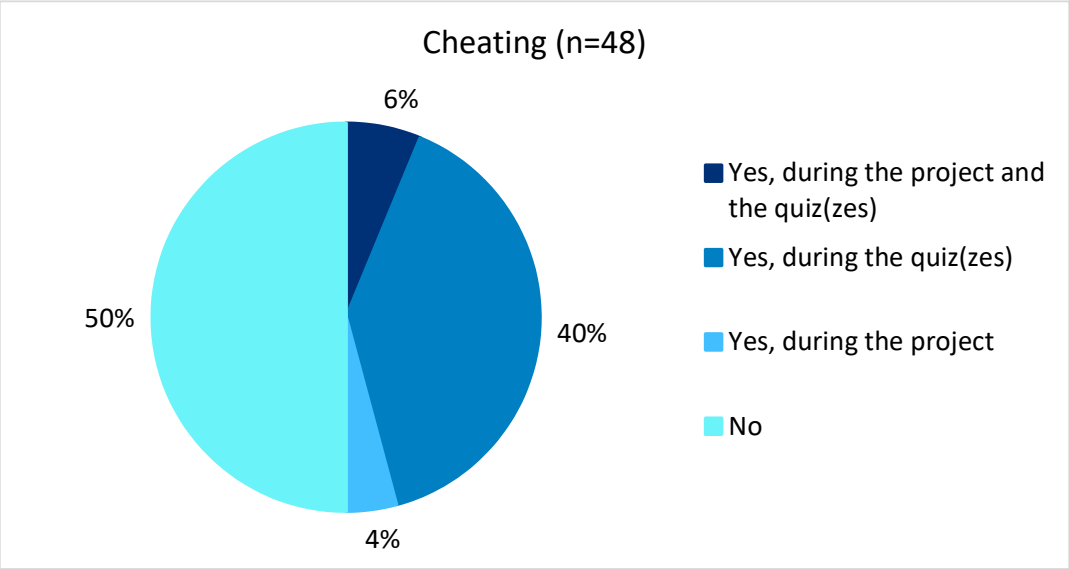


Figure 4.11: Cheating

Certificate or Badge

Almost 60 % of users (n=106) would be interested in receiving a certificate or badge for course participation. When it comes to a certificate or badge for course completion, for example if at least 50 % of the quizzes are successfully completed, around 70 % of people who are taking the course are interested.

Dropouts

75 % of our MOOC participants intended on completing the course but unfortunately almost the exact opposite was the result, with 73 % dropping out.

Figure 4.12 deals with the participation level of the MOOC prototype users. It is divided into five different kinds of users. 6 % have registered but they have never done any activity. The largest segment shows that 51 % of participants have dropped out after *Quiz 1*. Later, 16 % of users dropped out after *Quiz 2*. 46 participants, 27 %, joined the MOOC after *Quiz 2* and

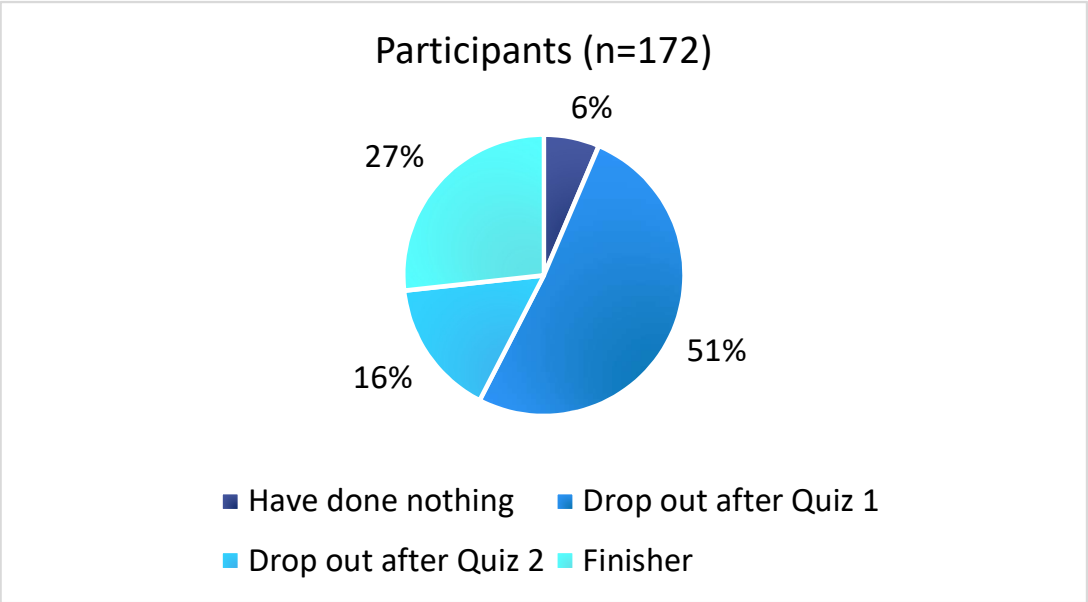


Figure 4.12: MOOC Dropouts and Finisher

managed the project part. Altogether we face a dropout rate of 73 %. The pie-chart provides strong support for the theory and practice that the dropout rates of MOOCs are extremely high.

The last activity of users who dropped out during the course is presented by Figure 4.13. The visualization shows three peaks: During the first weekly session from *Introduction and Motivation* to *Association*, we identify a peak at the beginning and a peak at the end. Directly after the first activity *Introduction and Motivation*, most of the participants gave up. We assume that these users registered in the MOOC but they had other expectations and have never continued the course. The peak at the end of the first weekly session could be explained by users who only tried the *Quiz 1* because they are not restricted in terms of the sequence of activities during the week. After the attempt of *Quiz 1*, they dropped out. The second week began with *Aggregation* and ended with *Quiz 2*. The week's beginning started off with a very low number of dropouts. The activity *Notation Elements* was a PDF file which presented clearly arranged notation elements of the UML Class Diagram. For 5 % of participants, the download of the PDF was the last activity in the MOOC before they dropped out. We want to highlight that these users may have done nothing else other than downloading the PDF before they have dropped out; therefore they are considered students who dropped out shortly before the end of the MOOC. Only 7 % of participants dropped out after doing *Quiz 2*. One reason may be that people who have come a long way will not quit right before the end.

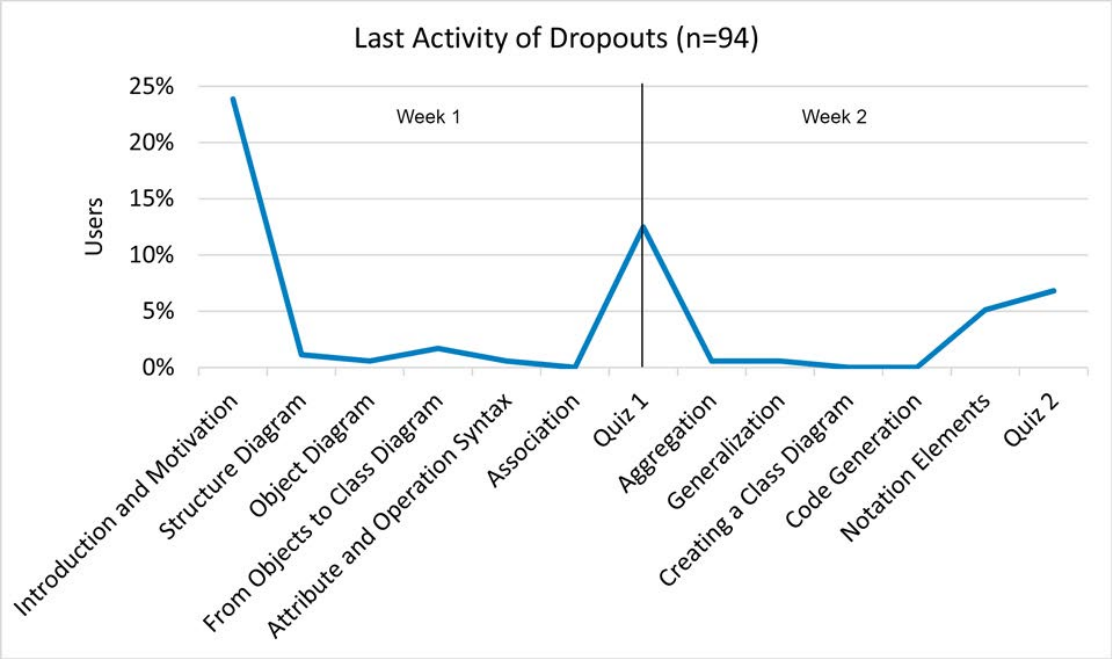


Figure 4.13: Last Activity of Drop outs

As introduced in Section 2.6, the micro segmented learning patterns should also be considered in calculating the dropout rate. The percentage of units completed and the percentage of learners achieving meaningful learning are calculated.
For the calculation of the percentage of units completed, we use the variables *EL*, which stands for *enrolled learner* and *AL1*, which means *active learners* who have viewed at least one page.
For the calculation of the percentage of learners achieving meaningful learning, we change *AL1* to *AL2*, which means active learners who have done at least one unit.
The variables are defined the following:

$$\begin{aligned} No\ of\ learners\ (EL) &= 172 \\ No\ of\ learners\ (AL1\ (viewed\ at\ least\ one\ page)) &= 166 \\ No\ of\ learners\ (AL2\ (done\ at\ least\ one\ unit)) &= 140 \\ No\ of\ units\ in\ a\ MOOC &= 5 \end{aligned} \tag{4.1}$$

The number of learners are extracted from Moodle's log report. *EL* are identified by the event name 'User enrolled in the course'. *AL1* are collected with the event names that include 'viewed'. *AL2* are calculated with Moodle's activity report. We have five units in our MOOC (*Questionnaire Start*, *Week 1*, *Week 2*, *Project* and, *Questionnaire End*).
The results of $Total\ no\ of\ units\ that\ can\ be\ completed\ by\ learners$ are calculated with the use of the variables. We investigate the difference between micro segmented learning patterns.

This is why the formulas have to be repeated with every type of learner.

$$\begin{aligned}\textbf{Total no of units that can be completed by learners (EL)} &= \\ No\ of\ learners\ (EL) & \\ \times\ No\ of\ units\ in\ a\ MOOC & \\ = 172 \times 5 &= \\ 860 &\end{aligned} \tag{4.2}$$

$$\begin{aligned}\textbf{Total no of units that can be completed by learners (AL1)} &= \\ 166 \times 5 &= \\ 830 &\end{aligned} \tag{4.3}$$

$$\begin{aligned}\textbf{Total no of units that can be completed by learners (AL2)} &= \\ 140 \times 5 &= \\ 700 &\end{aligned} \tag{4.4}$$

The calculation of the variable $\%\ of\ units\ completed$ uses the $Total\ number\ of\ units\ completed$, which have to be calculated in advance.

$$\begin{aligned}Total\ number\ of\ Units\ completed = & \\ Total\ number\ of\ completions\ of\ Questionnaire\ Start + & \\ Total\ number\ of\ completions\ of\ Week\ 1\ (Quiz\ 1) + & \\ Total\ number\ of\ completions\ of\ Week\ 2\ Quiz\ 2 + & \\ Total\ number\ of\ completions\ of\ Project + & \\ Total\ number\ of\ completions\ of\ Questionnaire\ End = & \\ 106 + 82 + 54 + 46 + 48 = & \\ 336 &\end{aligned} \tag{4.5}$$

The $Total\ number\ of\ completions\ of\ unit\ XY$ is received by Moodle's activity report. The last step is to calculate the $\%\ of\ units\ completed$ for each type of micro segmented learner.

$$\begin{aligned}\textbf{\% of units completed (EL)} = & \\ Total\ number\ of\ Units\ completed & \\ \div\ Total\ no\ of\ units\ that\ can\ be\ completed\ by\ learners(EL) & \\ \times 100 = & \\ 336 \div 860 \times 100 = & \\ 39,07\ \% &\end{aligned} \tag{4.6}$$

$$\textbf{\% of units completed (AL1)} = \\ 336 \div 830 \times 100 = \\ 40,48\ \% \tag{4.7}$$

$$\textbf{\% of units completed (AL2)} = \\ 336 \div 700 \times 100 = \\ 48,00\ \% \tag{4.8}$$

There is only a slight difference in the result of $\%\ of\ units\ completed$ between *enrolled learners* and *active learners* who have viewed at least one page (*AL1*). Almost every person who enrolled in the course viewed at least one page. The dropout rate for *EL* is 60,97 % and for *AL*, who have viewed at least one page (*AL1*), it is 59,52 %.

The percentage of learners achieving meaningful learning is higher than the percentage of units completed. The dropout rate decreases to 52 % when looking at the result of *AL*, who have completed at least one unit (*AL2*). The dropout rate decreases almost 10 % when comparing *EL* and *AL* who have done at least one unit. It seems that there is a correlation between the micro segmented learner patterns and the dropout rate.

Reasons for Dropout

There are various reasons for dropping out during a MOOC, for example loss of interest, loss of motivation to continue, technical or content-related shortcomings or personal reasons, as Figure 4.14 presents. Most of the people who dropped out had other reasons. They told us that the deadlines were too short and that they did not have enough time to do the MOOC but saved the learning materials, which they intend to use in the future. Personal reasons also had a high impact for the students who could not finish the MOOC. Some of our users had technical or content-related issues.

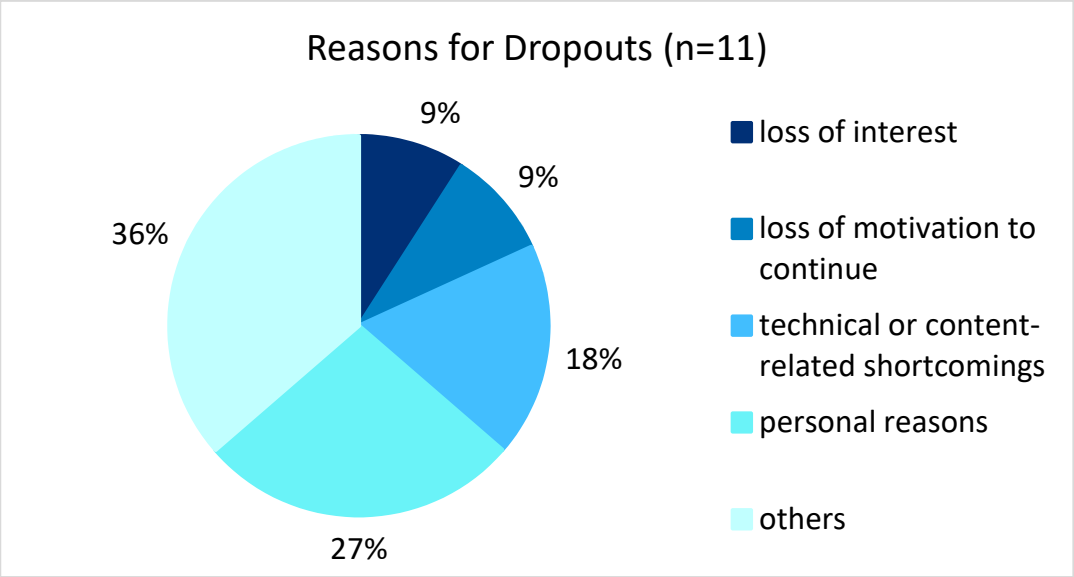


Figure 4.14: Reasons for Dropout

4.4 Videos

Audience Retention

As stated in Section 2.6, audience retention is an indicator for in-video dropouts. Looking at the audience retention of a video, the lecturer may know which video parts were unclear to the audience while watching a video and may have caused an in-video dropout. If a YouTube webpage including a video is opened, the video starts automatically. That is why the line starts always at 100 %. The higher the graph's line in total, the fewer viewers have dropped out while watching the video.

We show you some practical examples with our MOOC videos. The data set is retrieved from YouTube Analytics in the time period between 1st March, 2016 and 5th May, 2016.

Figure 4.15 presents a moderate downward trend. This trend typically shows that nothing was unclear. The dropouts are caused by reasons other than the video design.

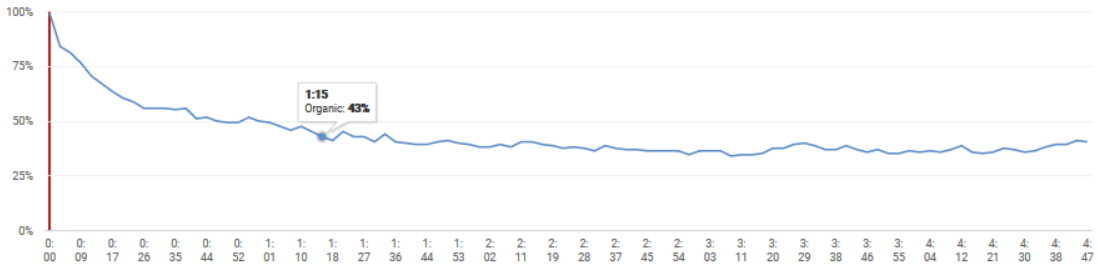
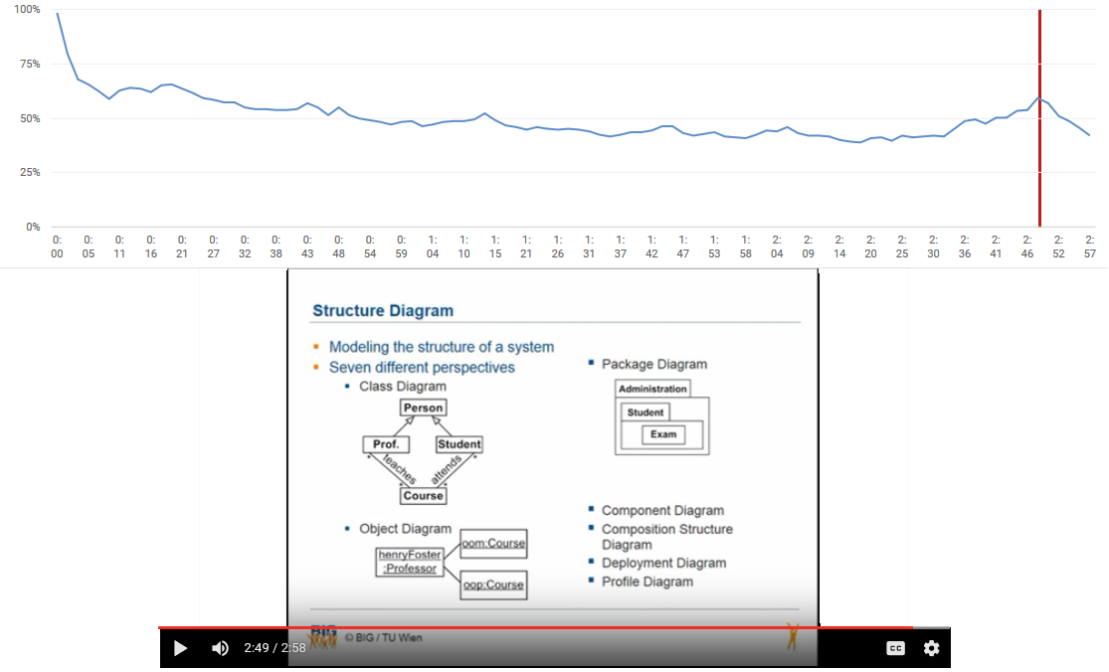


Figure 4.15: Audience Retention of Video 'Introduction'

The investigation of the audience retention of the Structure Diagram video shows a little peak at the end of the video, as Figure 4.16 illustrates. Before (Figure 4.16a) and after (Figure 4.16b) the peak is a visual transition, which indicates that students returned to missed content.

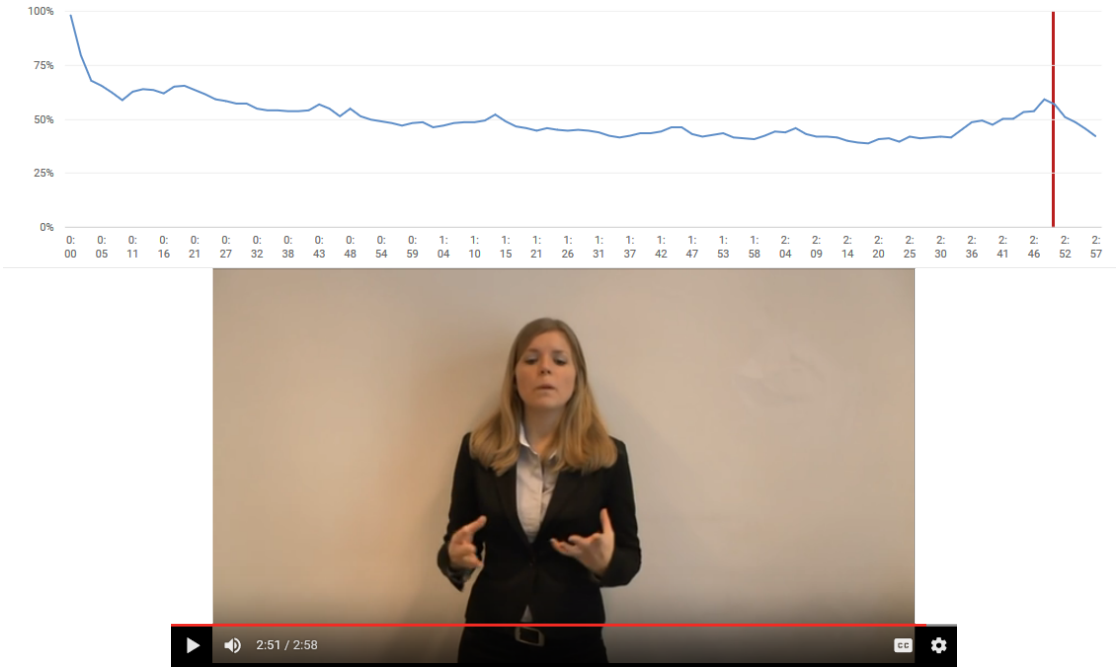


(a)

Figure 4.16: Audience Retention of Video 'Structure Diagram'

Figure 4.17 also shows an upward trend which is very usual. That means that we have nothing to declare in detail of the Object Diagram video.

In Figure 4.18, you can see that the graph is generally higher than we had before in the figures of videos' audience retention. In our animated handwriting styled videos, we have a higher and thus better overall audience retention compared to videos showing slides and instructor. This is an indicator that less students dropped out while watching this video.



(b)

Figure 4.16 (Continued): Audience Retention of Video ‘Structure Diagram’

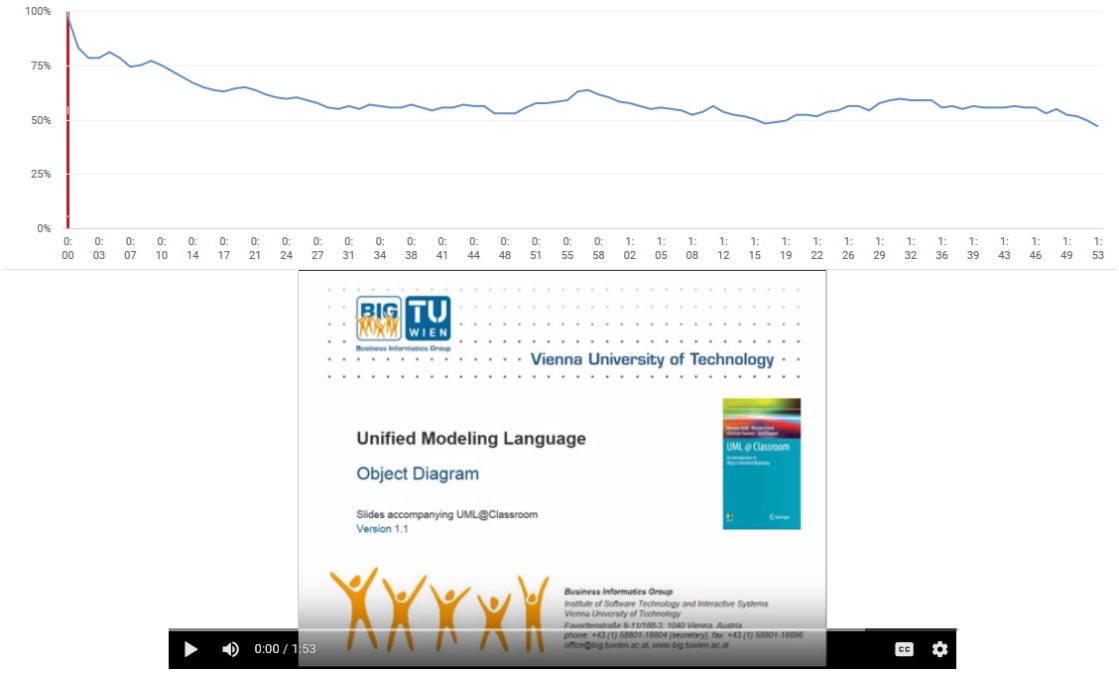
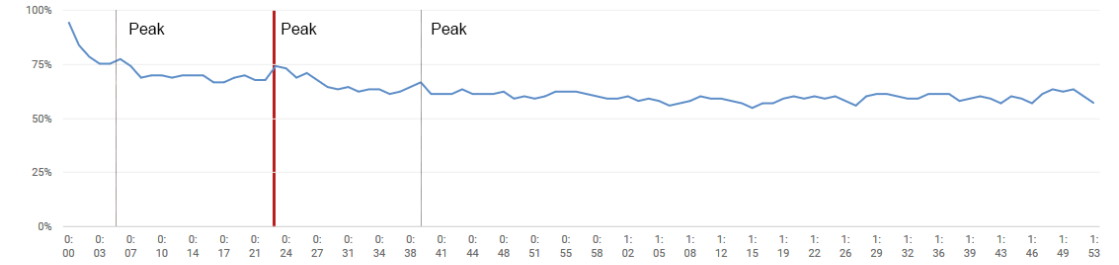
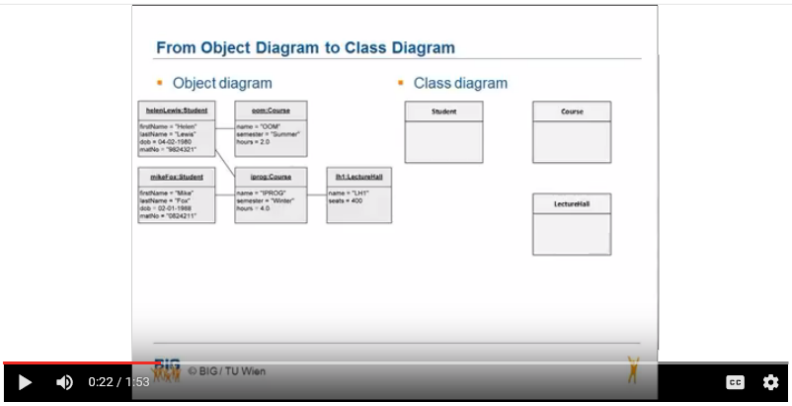


Figure 4.17: Audience Retention of Video ‘Object Diagram’

Figure 4.18: Audience Retention of Video ‘Class Creation: Example University’

Figure 4.19 presents an example of audience retention related to a non-visual explanation. As you see, during the little peak the slides are not changing at all (Figure 4.19a and Figure 4.19b). It indicates that the verbal explanation is repeated by the viewers.





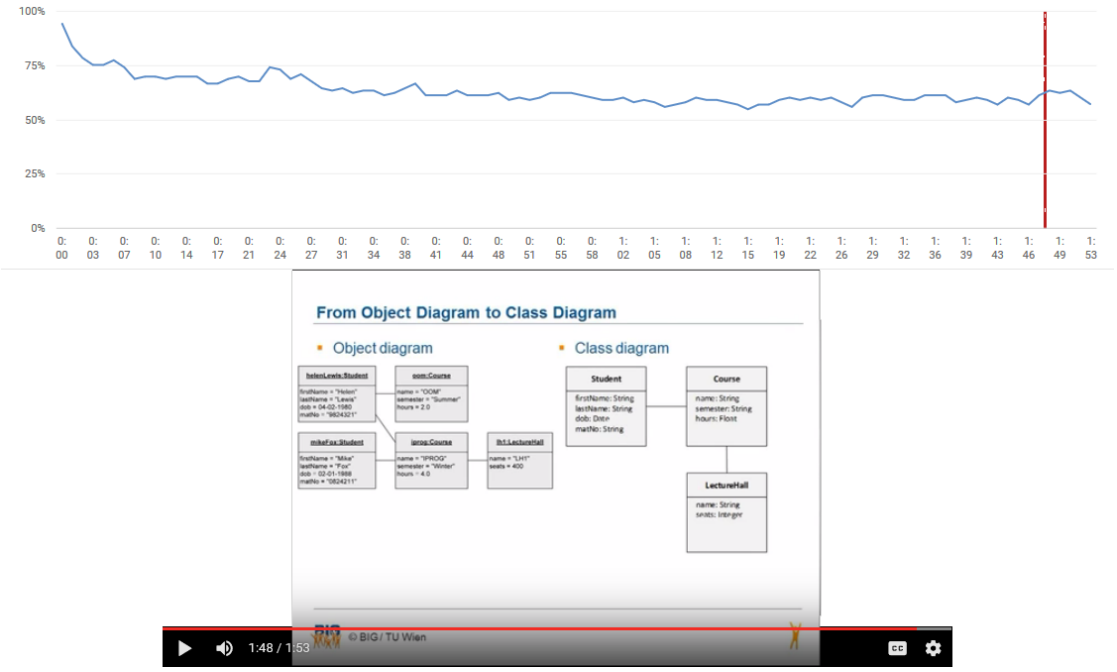
(a)

Figure 4.19: Audience Retention of Video ‘From Object Diagram to Class Diagram’

As Figure 4.19c illustrates, at the end of the video ‘From Object Diagram to Class Diagram’, the audience retention graph line rises a little bit. The reason may be that the slides are showing a tutorial example and at the end of the video the full solved example is presented.

(b)

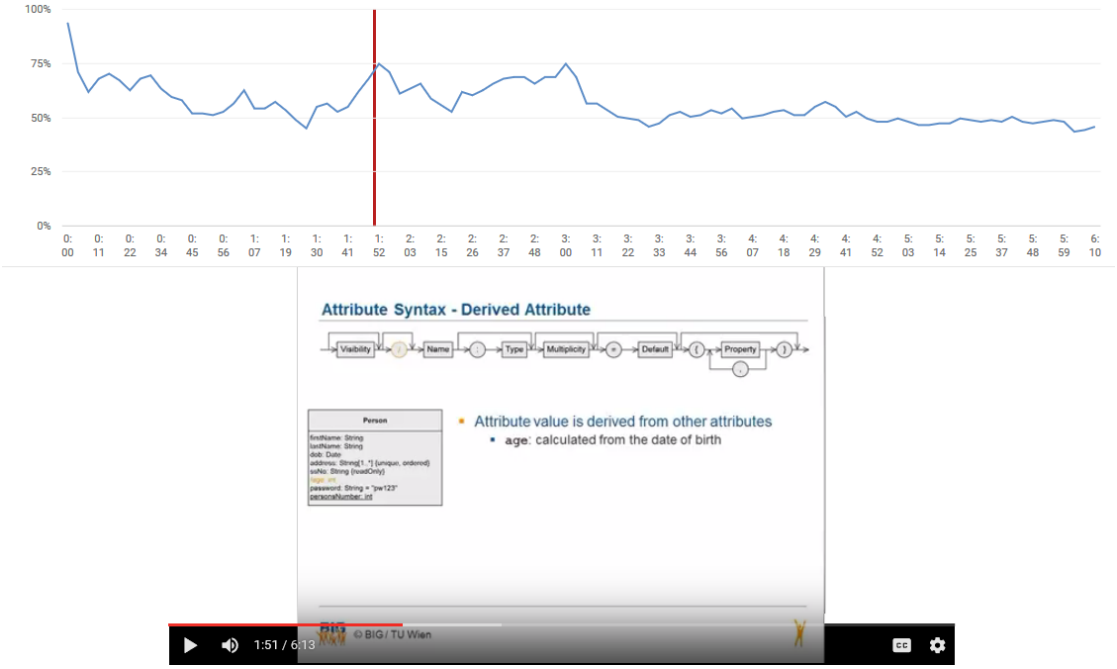
Figure 4.19 (Continued): Audience Retention of Video ‘From Object Diagram to Class Diagram’



(c)

Figure 4.19 (Continued): Audience Retention of Video ‘From Object Diagram to Class Diagram’

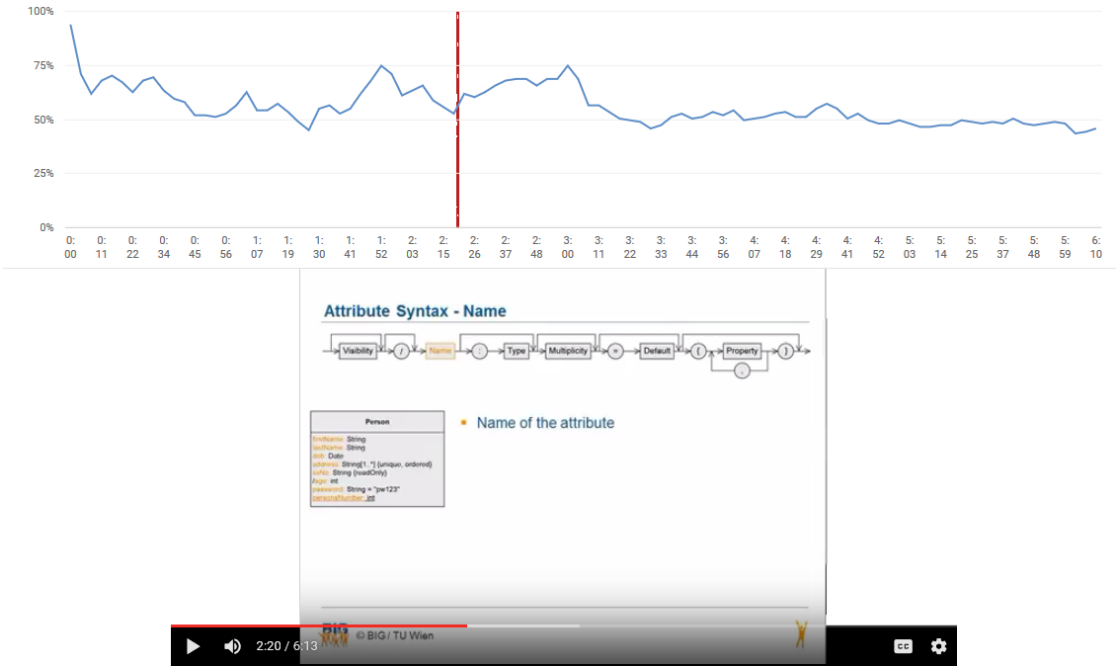
According to Figure 4.20, the video of ‘Attribute And Operation Syntax’was not clear enough for the viewers because the graph line fluctuates a lot. Figure 4.20a and Figure 4.20b display a peak due to a visual transition in the video.



(a)

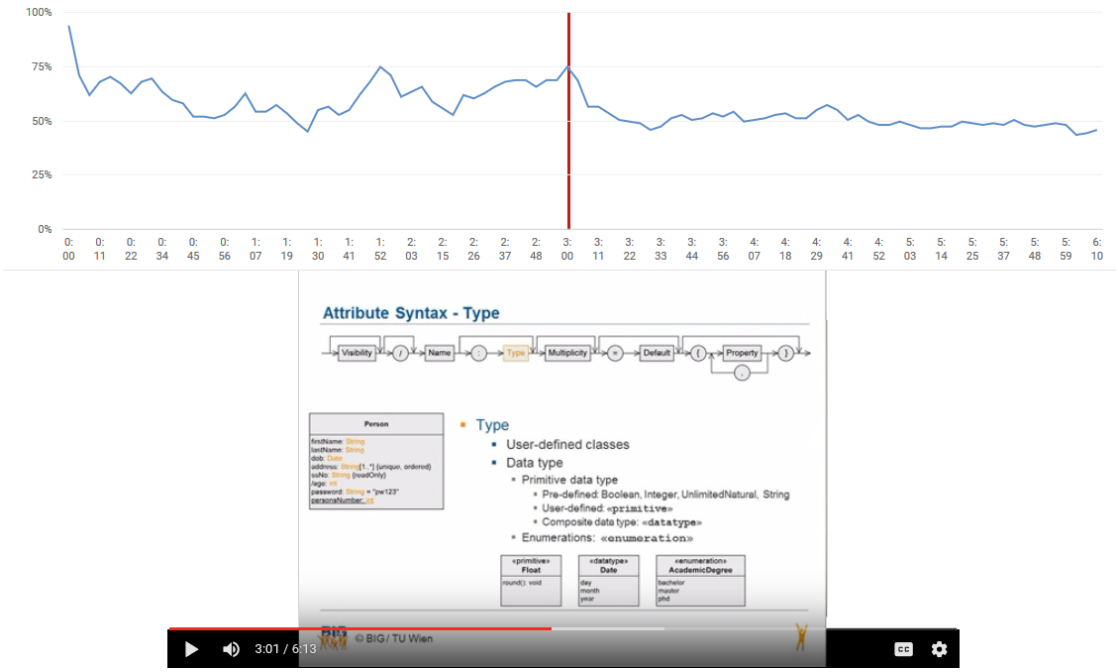
Figure 4.20: Audience Retention of Video ‘Attribute And Operation Syntax’

Figure 4.20c and Figure 4.20d again show a peak due to a visual transition in the video explaining the Attribute and Operation Syntax.



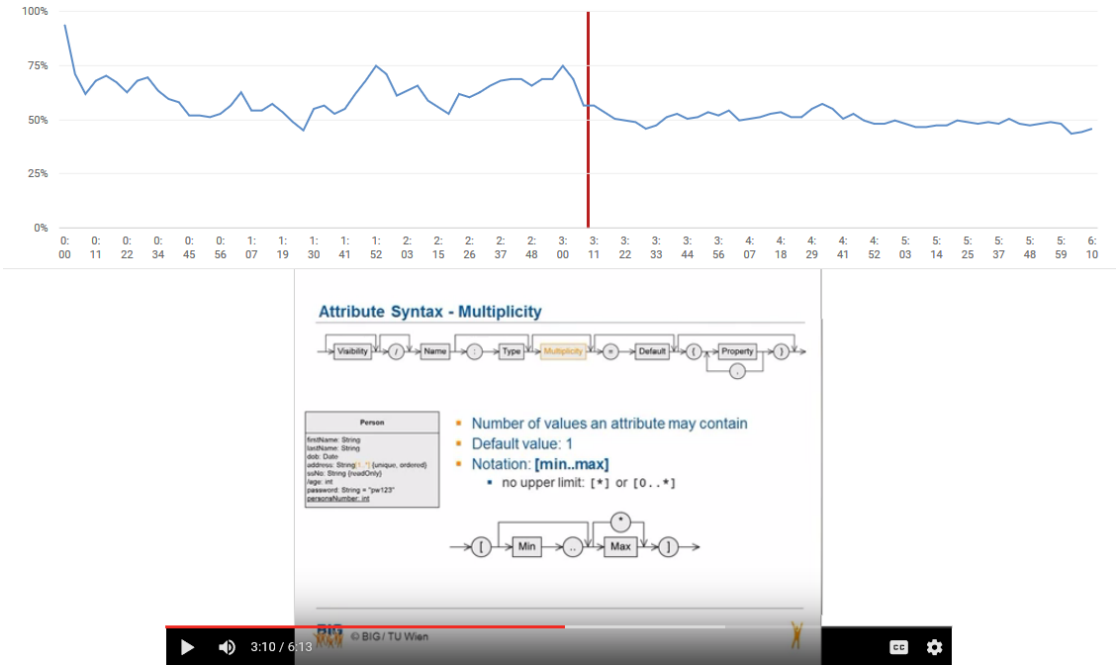
(b)

Figure 4.20 (Continued): Audience Retention of Video ‘Attribute And Operation Syntax’



(c)

Figure 4.20 (Continued): Audience Retention of Video ‘Attribute And Operation Syntax’



(d)

Figure 4.20 (Continued): Audience Retention of Video ‘Attribute And Operation Syntax’

A non-visual explanation, but verbal explanation, causes the audience retention graph line peak in Figure 4.21.

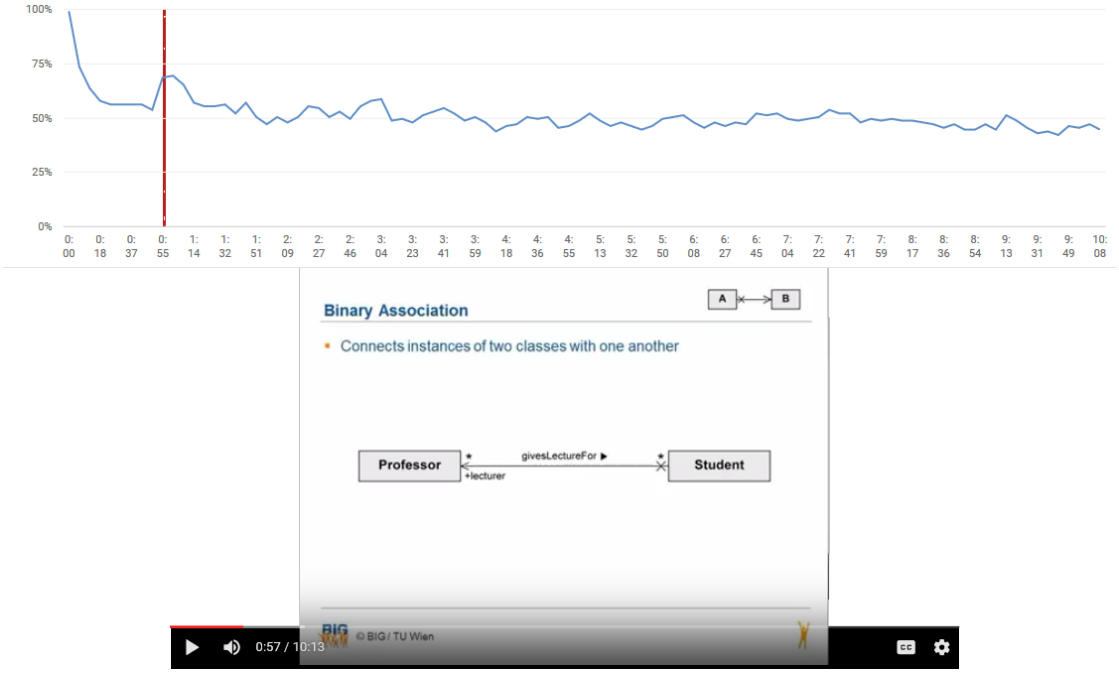


Figure 4.21: Audience Retention of Video ‘Association’

The next Figures 4.22, 4.23 and 4.24 display the audience retention graphs of videos that we have not mentioned above. The graphs show a continuously downward trend, similar to examples shown above.

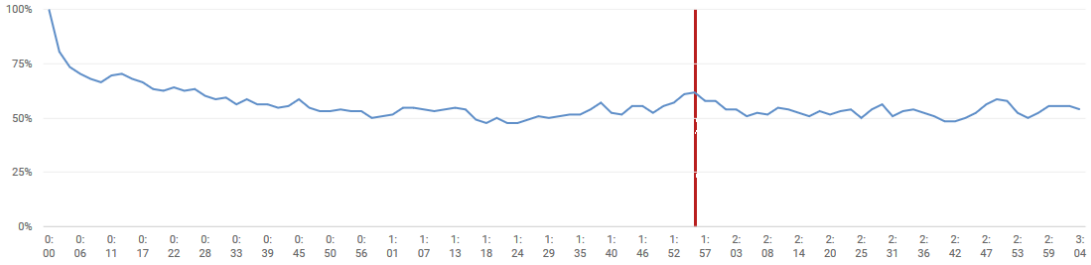


Figure 4.22: Audience Retention of Video ‘From Object To Class’

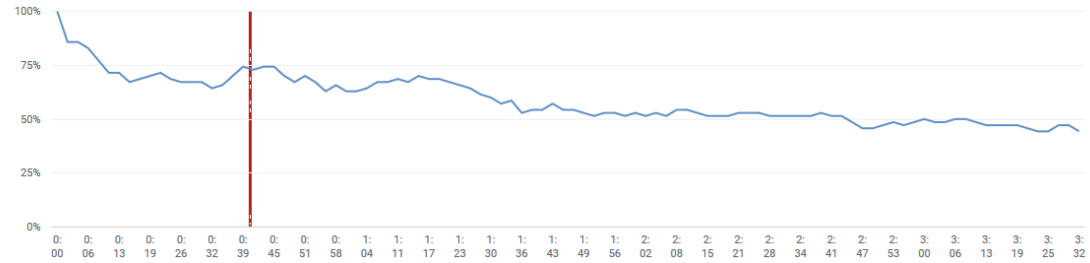


Figure 4.23: Audience Retention of Video ‘Aggregation’

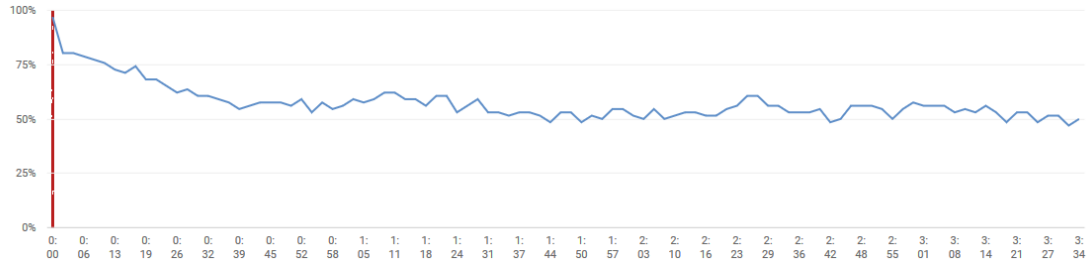
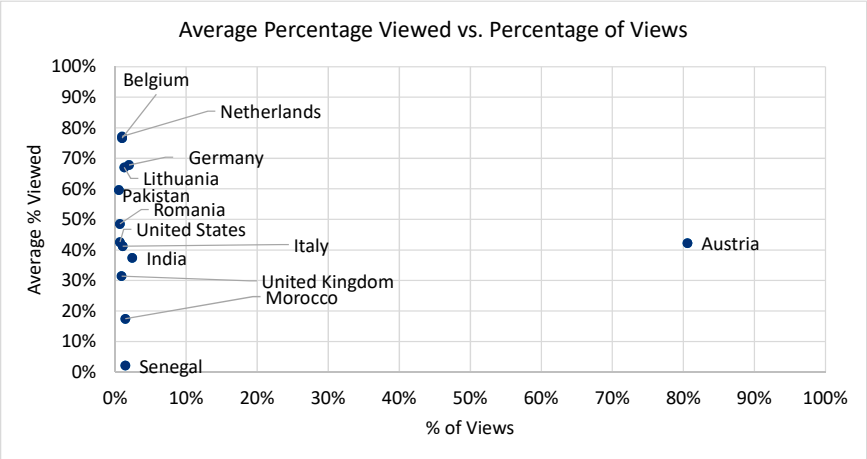


Figure 4.24: Audience Retention of Video ‘Generalization’

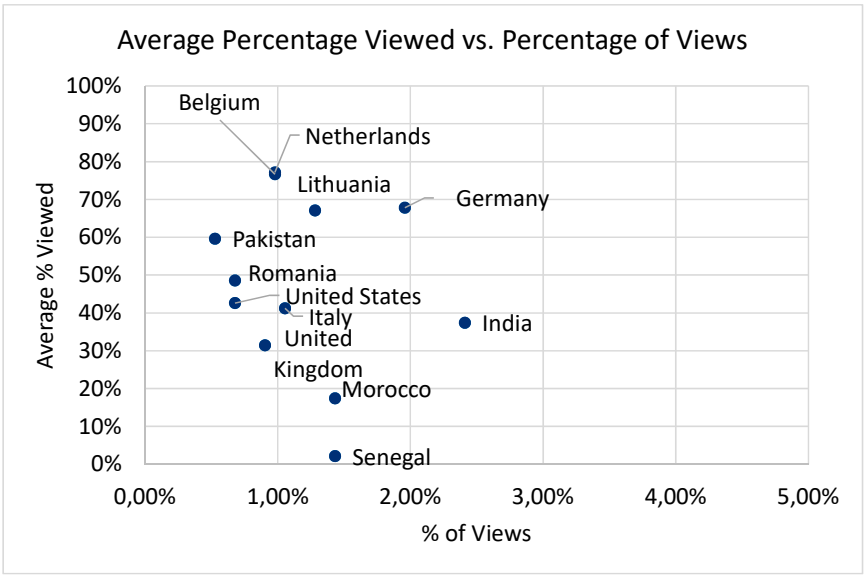
Every video needs to be investigated when inconsistencies occur.

Views

In Figure 4.25 we investigate the percentage of views in comparison with the average percentage of viewed video time. Comparing these two characteristic numbers, the best point would be in the top right corner. The second best position of a country would then be in the top or in the right of the scatter chart. According to YouTube’s Analytics, we had views from 23 different countries. When opening a video in YouTube it is played automatically. For that reason some countries have a very low number of views and the average percentage of viewed watch time tends to be zero. To delete such data points we have chosen the videos with the 15 most views and with the 15 highest percentage of viewed watch time.
Figure 4.25a presents a scatter chart of a country’s average percentage of viewed watch time against a country’s percentage of views. Due to the fact that our MOOC was promoted at a course of TU Wien, Austria illustrates the highest percentage of views. To be specific 80,5 % of MOOC video views took place in Austria. While investigating these views, we found that 42 % was the average watch time of viewing a video. The other chosen countries indicate fewer views but some illustrate a high average percentage of viewed video watch time. For further inspection Figure 4.25b highlights these countries by excluding the data point Austria. Netherlands shows the highest average percentage of viewed video watch time. The percentage of views was 1 %, that is 13 views, who have watched an average of 77 % of a video. Belgium’s data point is nearly the same. Germany had 26 views, overall 2 % of views, and an average of 68 % of the videos watch time was viewed. India shows the second most percentage of views after Austria and had



(a) Average Percentage viewed vs. Percentage of Views



(b) Average Percentage viewed vs. Percentage of Views excluding Austria

Figure 4.25: Watch time (YouTube Analytics 1.03.2016-3.04.2016)

approximately the same average percentage of viewed video watch time.

Video Style

Figure 4.26 and 4.27 demonstrate the preference of watching a video from the different presentation techniques. The preference of studying via a video is investigated in Figure 4.28 and 4.28.

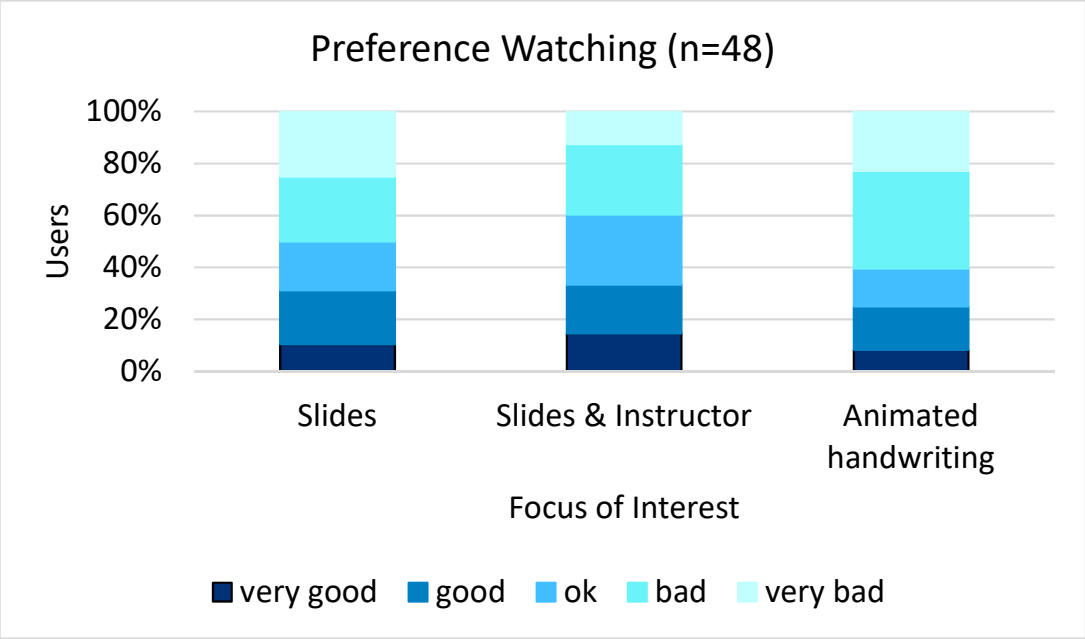


Figure 4.26: Preference Watching (Questionnaire End)

Approximately 30 % of students think that watching a video that uses only slides, slides and the instructor or animated handwriting is very good or good. In 20 % of cases, the students answered that these presentation techniques are ok. Students who are unhappy with these presentation techniques, as presented in Figure 4.26 by the categories 'bad' and 'very bad'. The presentation technique slides and instructor shows significantly the smallest rejection compared to the techniques slides and animated handwriting. The result of animated handwriting is very interesting because the Audience Retention Graph of YouTube's Analytics shows that videos with this style have less in video dropouts. Additionally, these videos are the most viewed videos on YouTube. More than half of the people answered that it is bad or very bad watching such a presentation technique. The best performing presentation technique in this diagram is the combination of slides and instructor, followed by only slides and lastly by animated handwriting.

The location preference of watching a MOOC video is presented in Figure 4.27. In average 40 % of students prefer watching a video recorded in a classroom, at the office desk or in a studio, shown by the categories 'very good' and 'good'. The most liked recording location is the office desk. 20 % of students think that these locations are ok for a video. The categories 'bad' and 'very bad' present that 40 % of students dislike videos produced in a classroom, at the office desk or in a studio. Recording in a classroom has the most dislikes of listing to such a video.

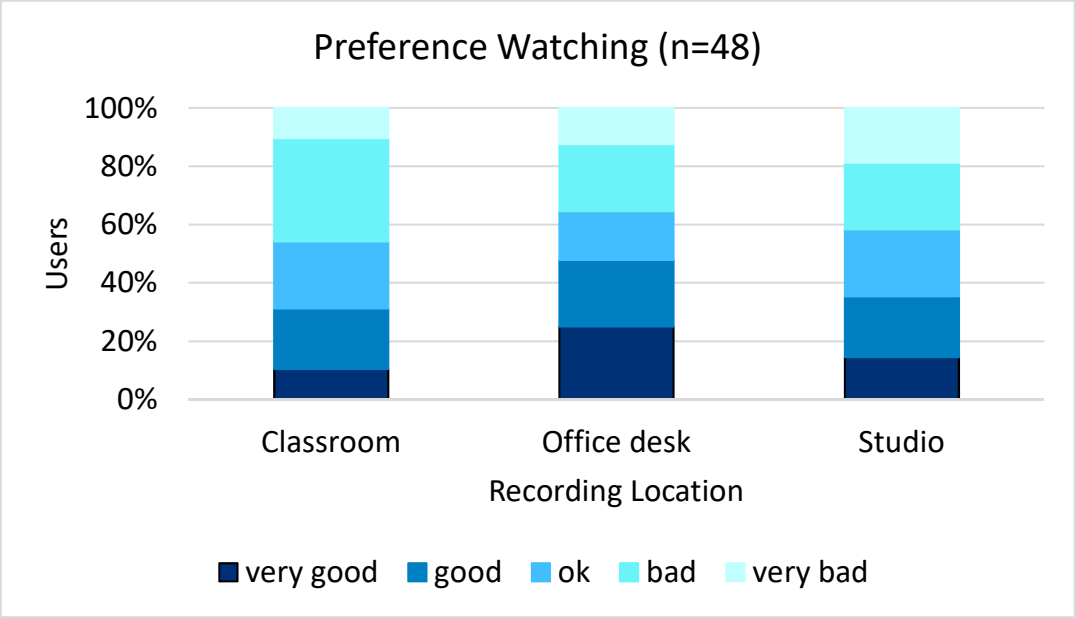


Figure 4.27: Location Preference Watching (Questionnaire End)

In summary the best recording location for listening is the office desk, followed by the classroom and the studio.

In Figure 4.28, the preference of presentation techniques of a MOOC video for studying paints a different picture. The presentation technique that only shows slides in a video shifted approximately 10 % from the categories ‘ok’ to ‘bad or very bad’. Animated handwriting is disliked more when watching a video for studying than just for fun. In total, the best presentation technique for studying via a video is the combination of slides and instructor.

Looking at the preference of recording locations of a MOOC video, the classroom and studio together gained around 15 %, compared to the preference of only watching the video. The dislike of these two categories is reduced in comparison with only listening to the videos, as you can see in the categories ‘ok’ to ‘bad or very bad’.

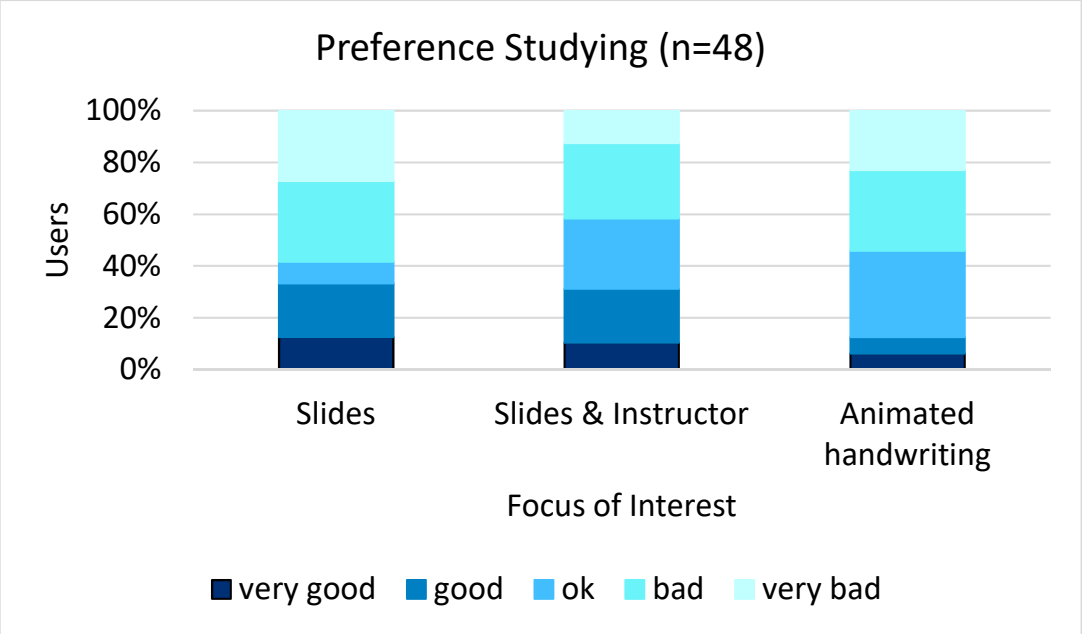


Figure 4.28: Preference Studying (Questionnaire End)

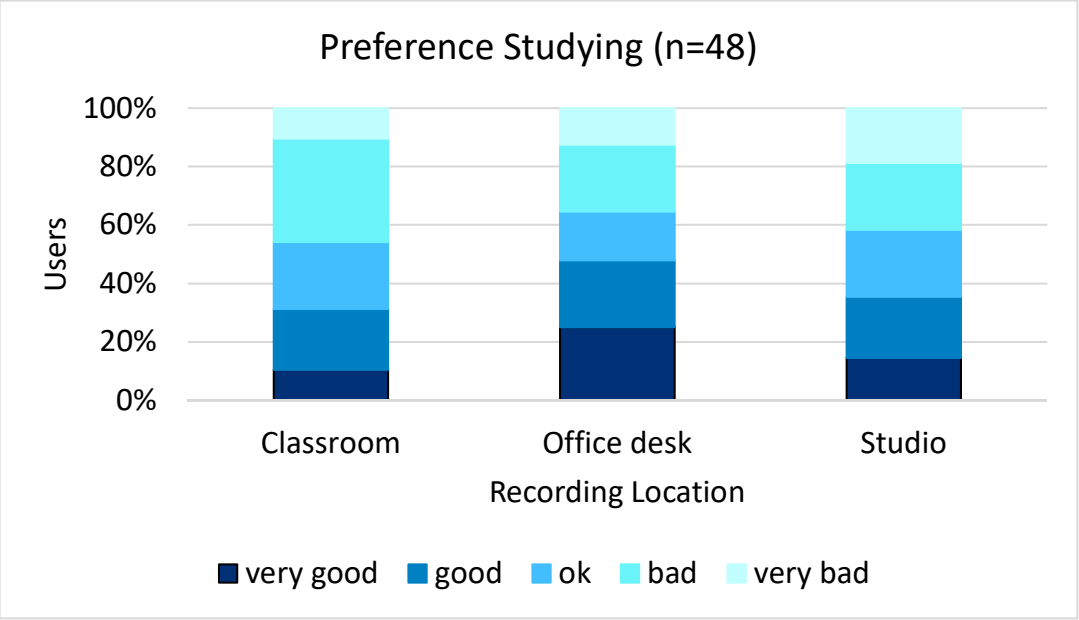


Figure 4.29: Location Preference Studying (Questionnaire End)

Devices

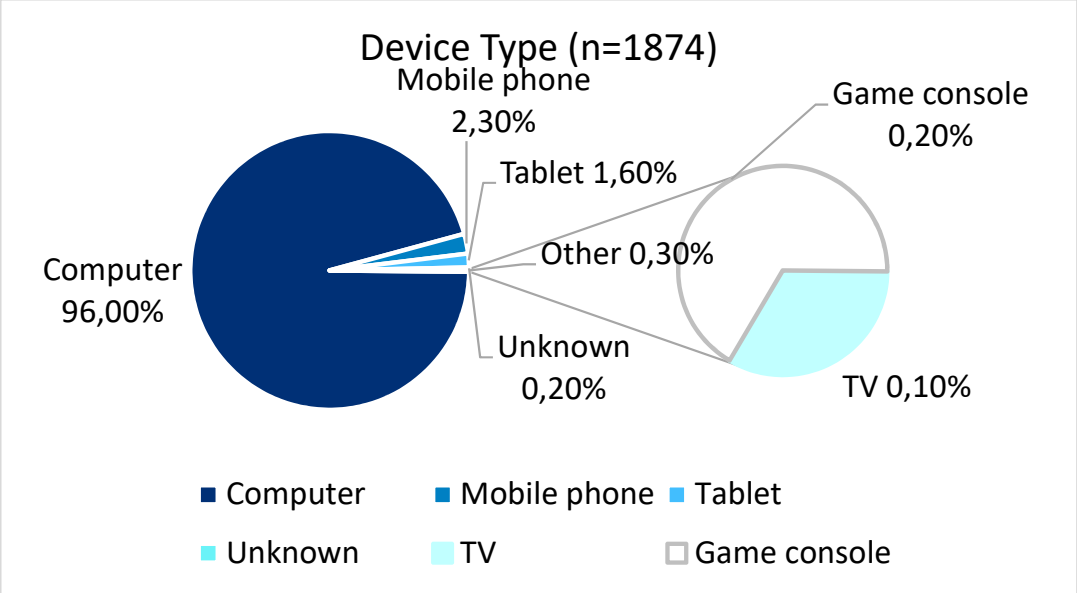


Figure 4.30: Device Types (YouTube Analytics 1.03.2016-3.04.2016)

Most of the videos were viewed on a computer (96 %), as Figure 4.30 demonstrates. Mobile phones and tablets show almost a similar average percentage of views. The providing of a responsive design means that there should be no design or handling problems, no matter which device type the platform is displayed. The small display can be problematic, particularly on a mobile phone. Nobody watched any videos via a game console.

4.5 Improvements by Students

We provided an open question in the questionnaire at the end of the MOOC to ask the students about improvements. Half of the students who filled in the questionnaire answered this optional question.

4 students gave feedback that the spoken English should be more fluid, that the quizzes were not clear enough and that they would like to have a higher number of quizzes. 3 people had security concerns. 2 participants would like to have other UML diagrams included in the MOOC or a MOOC about the other UML diagrams. Other comments were:

- There should be more videos and animations including in-video questions.
- The audio quality should be improved.
- The project deadline should not be expanded.

- One user thinks that Moodle is not the right choice as a platform and suggested one of the major platforms.
- Some students just wrote a compliment that they liked the MOOC.

CHAPTER 5

Critical reflection

This chapter deals with the critical reflection regarding the research questions, with a focus on the dropout rate. Finally, we provide lessons learned.

5.1 Presentation techniques

The student's preference of a video style differs depending on the reason of why he/she is watching a video - just for fun or for studying purposes. The number of students in the outcome of the *Questionnaire End* did not differentiate hugely between watching a video or studying with a video in general. In both cases, videos showing slides and an instructor are favoured by the students. Videos showing slides with a voice-over perform significantly better when the viewers watch it for fun.

We did not expect that approximately half of the students would say that the preference of the video styles are 'bad' or 'very bad' in all different kind of variations. In our opinion, slides are well established in learning due to good feedback from this kind of learning material.

The audience retention graphs of our MOOC videos have shown a significantly higher overall audience retention in those showing the animated handwriting style than in videos showing slides and an instructor. The participants of the pilot MOOC did not share the same opinion as the audience retention graphs states when they filled out the video styles preferences questionnaires. It seems that people's feeling about that topic differ from the reality.

5.2 Motivational Reasons

The investigation of reasons for participating in a MOOC shows a very similar result as in [38] if we cut away the two more categories considering the TU Wien context. The most popular reason for taking a MOOC is that people enjoy learning about interesting topics. This is the reason for 70 % of our pilot MOOC users and for 53 % people on average participate in the MOOC on 'Dementia' or on 'Digital.Me'in [38]. The online format is the reason for about 30 %

of students in our MOOC and for 12 % in [38]. Something interesting to note is that the users of [38] do not take the MOOCs because they enjoy the community.

72 % of MOOC participants examined in [1] chose their course because the topic was interesting. We also came to the conclusion that this is the strongest reason for taking a MOOC. In [1], 14 % of participants chose the course because they want to gain skills for their daily life.

Dropout Rate

As stated in Section 1 and 2.6, dropout rates of MOOCs are very high, up to approximately 90 %. Compared to other MOOCs, our dropout rate was far lower: Three quarters of our MOOC students intended to complete the course at the beginning, but unfortunately the motivation to complete the pilot MOOC was not enough for many participants and dropout rate of our MOOC was 73 %. The main reason for this strong deviation is that bachelor students of the Object-Oriented Modeling course at the TU Wien gained bonus points for doing the whole MOOC. Additionally, students also gained skills which may be helpful for the course at the TU Wien.

According to [38], their calculated percentage of units completed is on average 20,87 % for enrolled learners and 32,03 % for active learners who have viewed at least one page. In our MOOC the percentage of units completed for enrolled learners is 39,07 % and for active learners it is 40,48 %. Firstly, our results are higher than those compared with [38]. Secondly, there is only a slightly difference between the unit completion percentage of enrolled and active learners. The calculated percentage of learners achieving meaningful learning in [38] is on average 44,99 % for active learners who have completed at least one unit. In our MOOC it is 48,00 %, which is again higher.
We assume that these results are caused by the bonus points for TU Wien students. Due to that fact, the results of different calculated dropout rates are biased but might be a good indicator for successful motivation.

5.3 Lessons learned

SSL Certificate

As our MOOC prototype is on Object-oriented Modeling, most participants are interested in information sciences and know that a SSL certificate is a de facto standard for a website. Our domain does not include a SSL certificate for financial reasons. Nevertheless, a SSL certificate would cost an additional 1,9 € per month. A SSL certificate would be a benefit for the website to increase the data security, to gain more trust of the users and to achieve a better Google search placement [79].

Apache Web Server

At the beginning when we were advertising our MOOC, we received feedback that the self-registration at our Moodle Platform was not possible. At this point we could not face the problem because some of the TU Wien students and other people had already registered. We double-checked the Moodle adjustments. We then corresponded via email with a kind man who was

trying to register from the USA and who was happy to help us. Originally we thought that browser or Internet settings could be the problem, but then we found out that it was a country specific problem. When people clicked the button “Log in”in the USA, they could only see a pop-up window which allowed them to authenticate the platform (see Figure 5.1) but the entire step for the creation of a new account was missing (see Figure 5.2).

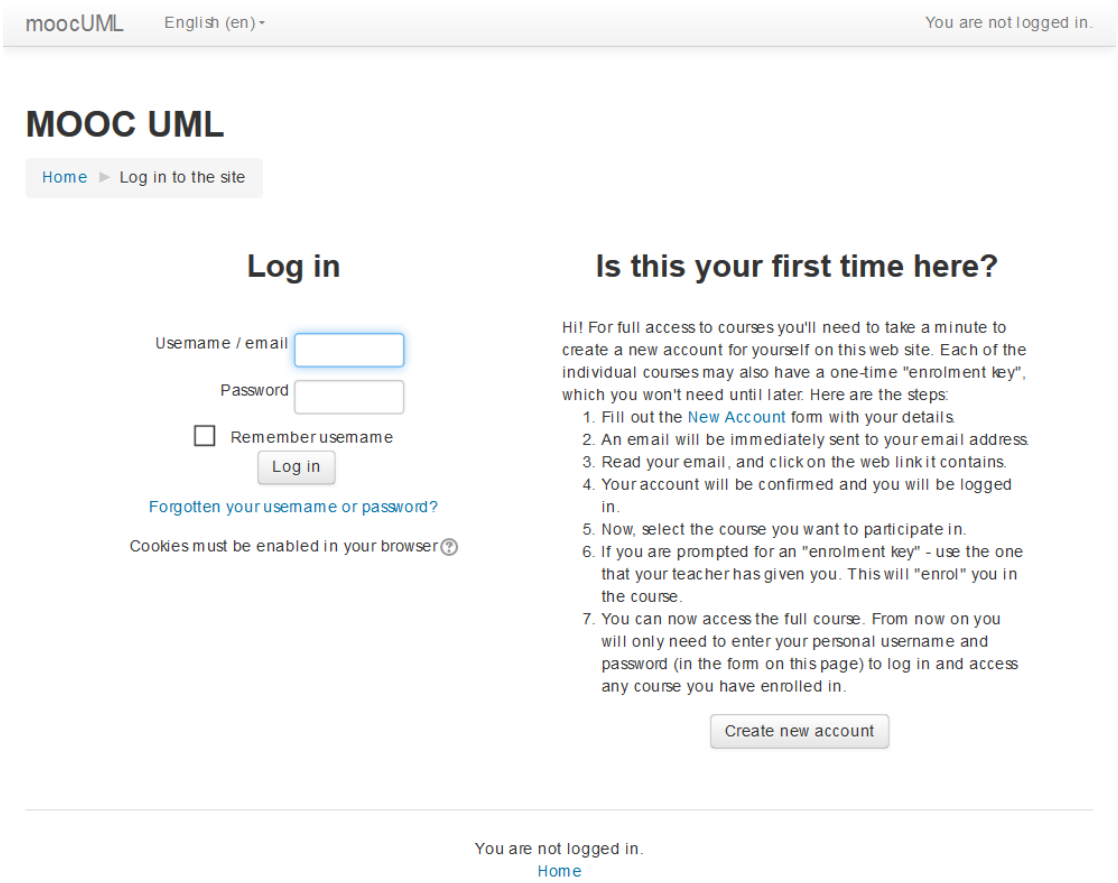


Figure 5.1: Login Austria

The software Moodle was included in the domain server and could be installed automatically. Thus we have asked the community of the German Moodle forum moodle.org for help. After five days, we got the answer to our specific problem. The .htaccess file used by the Apache web server had the directive setting `Allow from env=show_no_dialog`. The `Allow` directive defines which clients are allowed to access the server. Only if the environment variable `show_no_dialog` is set then the client gets access. This variable is not set in the USA and causes this specific problem. The solution was to change the directive setting to `Allow from env=Allow from all`. After this modification, all hosts have been allowed to access the web server [73] and users have been able to register at the platform.

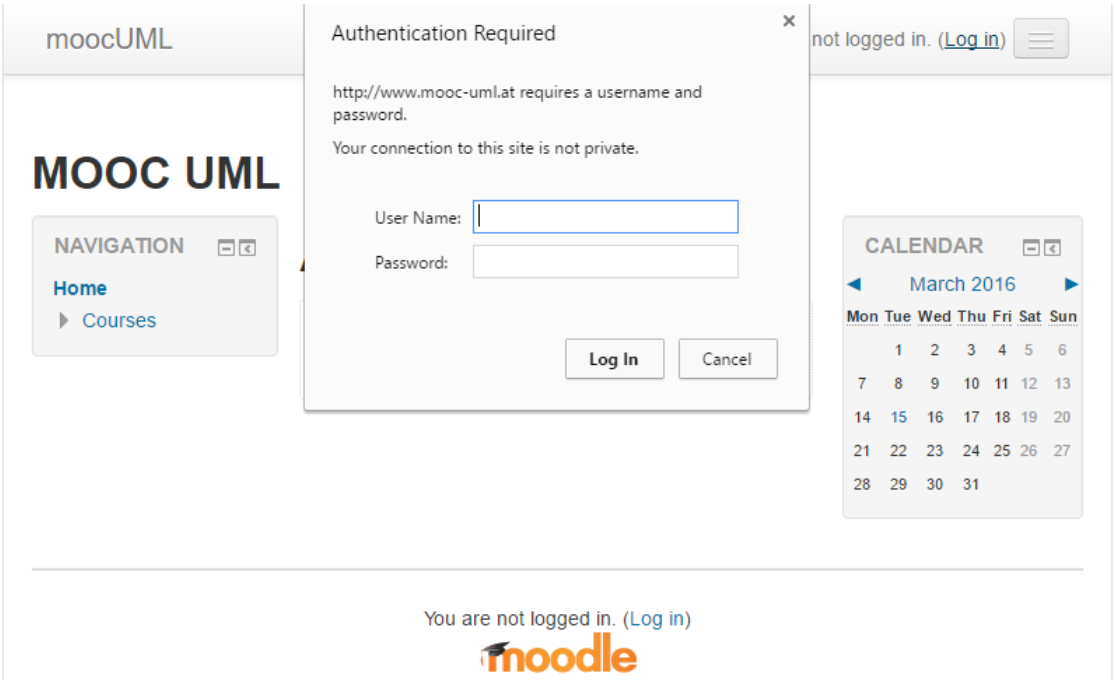


Figure 5.2: Login USA

Animated Handwriting

When using the predefined objects arrow or rectangle in the software VideoScribe, the animated hand easily knows how to write these objects. In larger Class Diagrams, though, many items are needed. This is why pictures of Class Diagram parts are used and the hand is painting these pictures. The animated hand does not know that it should only write the black lines of the picture, e.g. UML Class Diagram, and not the white background. Thus, the hand's movements are not correct. Generally, a lot more time is needed when producing creative videos with VideoScribe than producing videos showing slides only or slides and instructor.

Anonymity in Peer-Review

The implementation of the Project was done with Moodle's workshop module. The Project consisted of two parts: Firstly, the submission phase, where the users had to upload their project. We let the students know that they should pay special attention to not writing their name in the submission file. After the submission phase, the users had to assess three of their course colleagues' projects. Some users have criticized that the author's name can be written in the meta data of the PDFs. The troubleshooting to provide full anonymity to the users should include the deletion of the all meta data. Unfortunately you cannot change the submission PDFs in Moodle before the assessment phase begins.

Lessons Module in Moodle

We have faced problems with the *Lessons* module in Moodle. Firstly, it was not possible to include the latest question types, for example drag and drop questions. The new question types have been more interactive and thus more interesting for the users. Secondly, the self-assessment part includes a cluster of questions. The sequence of question within a cluster can be random. Unfortunately, these clusters have not been working properly. Thirdly, the lessons module was not very practicable for setting up the content. For example, easy switching between instructor and student view was not possible. Students have reported that the module had some mistakes in its handling but we as instructors could not reconstruct their complaints. Finally, the lessons module in Moodle is deprecated soon.

Forum

The forum has 18 discussion topics. It was only used to ask the lecturer about problems that have occurred. For example, the users informed us about spelling errors or asked us when anything was unclear during quiz or self-assessment questions. Unfortunately, it was not used for social interaction between course participants and we did not take actions to encourage and motivate students to participate in the forum, except for announcing the forum. We assume that this is caused by students who want to gain bonus points for the in-class lecture at the TU Wien. Furthermore, a forum where students post further information about a topic is not well established at the TU Wien. The lack of interactivity in the course can have a negative impact on the dropout rate. A forum can help to address these problems. Another reason may be that the students have used other self-organised social media interactions e.g. Facebook groups.

Own Name Behind

To promote the MOOC, the course needs to be advertised, especially when not using one of the main MOOC platforms. Mainly, we have used the social media platform Facebook. Therefore, a Facebook account is needed for advertising the MOOC in Facebook groups. It is not professional when a fake account is used. That is why we used our private account. The consequence was that many people wanted to add us as Facebook friend. We are flattered that so many people wanted to get in touch with us. On the other hand, our private profile would not have been private any more as it would have contacts that are not personally known. For further MOOCs we recommend to use an account from the TU Wien or to create a lecture/course-specific well-supported account.

Video Cutting

The recording of a video is done fast but the video cutting needs a lot of time. This is especially time consuming when you realize during the cutting process that you want to change a spoken text and/or a slide, meaning you have to start recording and/or cutting again.

An example of a video change would be that you want to add a statement to a list of several statements. A transition after each statement is used and therefore several slides are needed, which then are cut together (including a voice-over) to compose a video. If the statement is

added at the end you need one new slide, but if you want to add it at the beginning or in the middle of the list you need to change several slides. Of course, the voice-over also needs to be cut into the video. If slide numbers are shown, a new slide in between the slide set would cause a change to every slide afterwards. For this reason we have not shown slide numbers, even when it is best practice.

When giving an in-class lecture, you can change slides whenever it is required without a big loss of time.

Changes in a video require a lot of time and equipment, for example a camera with a tripod, an appropriate room for recording the video and the program for cutting the video, therefore all changes should be considered carefully.

Language

Although this MOOC was completely in English some users wrote in German in the forum or at the project. Especially, the review of a German written project submission would then be very difficult for a reviewer who does not understand German. In a future MOOC we recommend that the project instructions state precisely that the submission and review have to be done in English.

CHAPTER 6

Summary and Future Work

This Master Thesis aims to investigate which presentation techniques in a MOOC on Modeling Languages is accepted by the students and what the motivational reasons for students to participant in a MOOC are.

For this reason, we introduced instructional design, a term that deals with the development of learning experiences and environments and can be either seen as science or as art. In this context we presented several models, such as the ADDIE Model. The acronym ADDIE highlights the main phases of this approach, namely Analysis, Design, Development, Implementation and Evaluation. Other models are the ASSURE Model, which is an extension to the ADDIE model, the Dick and Carey Model with direct and indirect influences and the team-based Carpe Diem approach.

Learning theories have a high impact on MOOCs. In the beginning, the MOOCs follow the connective learning approach which is known as cMOOCs. This kind of student-orientated MOOC focuses on the network itself. The users consume, create and share knowledge within the network and the instructors stay in the background. These MOOCs are not well structured because every user has his/her own way to work through the content.
Since the MOOCs introduction, the MOOCs have mainly changed from cMOOCs to xMOOCs. xMOOCs follow the behaviouristic pedagogical approach. These MOOCs are content-orientated and can be seen as the online version of a traditional lecture. The knowledge and information comes primarily from one or several professors and not from the students themselves, as it is the case in cMOOCs.

Examples for well-established MOOC platforms are edX, Coursera, Khan Academy and Futurelearn. On the European Market, the platform Iversity is common and in Austria, a platform named iMooX is most popular. Another possibility is using open-source Moodle as a MOOC platform.

During ADDIE's analysis phase, we defined our target audience, the topic and the learning objectives of the MOOC prototype.
One result of the design phase was the MOOC schedule which consists of two learning weeks and a project in a sequence.

The outcome of the development phase was that we use the open-source Moodle as the platform and what tools we used to produce the MOOC prototype. We have also created two questionnaires to be done during the design phase.
The implementation phase shows the sessions of our MOOC prototype of each day. Naturally at the beginning of the MOOC, there are more sessions than at the end.
The evaluation phase reveals insights based on two questionnaires and logfiles for the course including the videos. Most of our MOOC participants were Austrian male bachelor students with an advanced or native English speaking level.

Videos are the most common pedagogy to transfer knowledge to students in a MOOC. Thus, many classifications exist to cover up all different purposes. Mainly, the videos differ in their focus of interest, framing, field size, depth of field, camera movements, recording location and video sources. Depending on the studies and also on the platform, some video categories are more popular than others.

MOOC videos should have a maximum duration of 10 minutes. They should be dynamic with an average shot length between 6 and 30 seconds and should have a personalised touch by each instructor. Each video should focus on one topic at a time.

We highlight that the presentation and production style of videos has a big impact on the engagement time, which measures how long people are watching a video. Currently, the most popular video styles are videos showing slides with a voice-over or videos showing slides and the instructor or showing code. The Khan-style is well known as it shows an instructor drawing freehand on a digital tablet in flashy colours on a black background. Animated handwriting is a relatively new video production style where the viewer sees a full-screen video of animated handwriting that is a software animation.

Our MOOC users do not generally think differently when they think about their preferred video style in relation to the purpose of watching the video, eg. for fun or for studying purposes. The most popular video style is showing slides and the instructor sequentially. Due to also watching the instructor, the students feel like they have more of a personal connection to or conversation with the instructor. Additionally, students are used to this kind of presentation as slide presentations are used in most lectures at university. On the one hand, animated handwriting video style is not well accepted by participants of the MOOC on Modeling Languages, but on the other hand our analysis showed that the user's engagement is actually higher as at the other video styles. Animated handwriting is like a painting where you paint small pieces here and there. This is why it may be too unstructured for the students and it is not possible to print the different steps sequentially on paper.

A classroom, studio or office desk are well-established recording locations. The investigation of the preferred recording location showed that when considering their preferred video recording location, participants see no difference between watching a video or studying with a video. The office is the best video recording location for videos of Object-Oriented Modeling. The studio is a little bit less preferred than an office desk, and the classroom is the least preferred, but the students can see nearly no difference.

MOOCs are struggling with very high dropout rates. The reasons for dropouts are varied, such as lack of time, no real intention to complete the course, feelings of isolation and lack of interactivity, course difficulty and lack of support, lack of digital skills or learning skills, lack of

learner's motivation, other expectations, hidden costs or peer review. Thus, a user's individual motivation plays an important role at the beginning and during the MOOC. The main reasons for around 80 % of the TU Wien's students for taking the MOOC are that they gain skills for the Object-Oriented Modeling course and the long time reward in the form of bonus points for the Object-Oriented Modeling course. On a similar scale, the reasons for about 40 % of TU Wien students are that the course takes place online and that these students enjoy learning about interesting topics. The third group shows that the reasons for about 20 % of TU Wien students are gaining skills for a new career and enjoying being part of a community of learners. The latter reason is particularly interesting because the students did not actually find the forum a very helpful course activity, but this was the only point where they get to interact with other students. TU Wien students are not very interested in gaining skills for promotion at work as less than 10 % voted for this reason. Looking at participants other than TU Wien's students, the most important reason for taking the MOOC on the UML Class Diagram is that they enjoy learning about interesting topics (around 70 %).

The gamification of a MOOC can help to increase the user's motivation in regards to a rewarding mechanism. Points are well established in education. Other well known possibilities include leaderboards, badges or progress bars. The MOOC pilot on the UML Class Diagram uses points to measure a grade. Additionally, the progress of activities is shown by completion tracking boxes in the course overview. For only 15 % of participants, this kind of short term reward was unattractive. Progress bars were visible during activities and show another short-term reward of the rewarding mechanism model.

As expected, the most helpful learning activities were the quizzes where students could check whether or not they have understood the learning objectives of the studied week. Self tests while discovering the learning material and the project assignment were also very popular with the students. Only half of the students found the provided lecture videos helpful. The reason may be that the students already had enough knowledge about the video's content. The forum was not well accepted, as we have discussed in detail. Most of the MOOC participants had used the learning material in order in which it was presented in the MOOC. Almost all users had considered the completion tracking boxes during their engagement.

Three quarters of our MOOC students intended to complete the course at the beginning, but unfortunately the motivation to complete the pilot MOOC was not enough for many participants and 73 % dropped out. The majority of them dropped out after watching the first video of the MOOC. The main reason for people dropping out during our MOOC on Object-Oriented Modeling Languages is the lack of time. Personal reasons and technical or content-related shortcomings also had a high impact. Some of our users did not finish the MOOC because of the loss of interest and the loss of motivation to continue.

In addition to the typical dropout rate, which measures the percentage of how many participants have successfully completed the MOOC in relation to the enrollments, the in-video dropout rate measures the percentage of students who start watching a video but leave before the video finishes playing entirely. The investigation of in-video dropouts showed that there are higher dropout rates in longer videos, re-watching sessions and tutorials. Even more interesting is the students' engagement over time while watching a video where the instructor can identify confusion of the viewers with the help of interaction peaks.

Another interesting point is the fact that more students who think that they are always, often or sometimes organised in their private life, at studies or at work, have successfully completed the course than participants who think that they are seldom or never organised.

A certificate or badge for course participation would motivate more than the half of our MOOC students. A certificate or badge for course completion would motivate even more of our participants. For this reason, we highly recommend the use of certificates or badges.

A number of restrictions of our study and areas for future research should be considered The participants in the MOOC prototype were mostly students between 18 and 24 years old. They were mainly bachelor students of the TU Wien because they gained bonus points for the Object-Oriented Modeling course for completing the MOOC successfully. Almost all users participated via computers.

Future research investigates further presentation techniques for teaching a Modeling Language in a Massive Open Online Course. Therefore, the movement of the MOOC prototype onto one of the main platforms, edX or Coursera, should be considered.

We think MOOCs will not replace other learning methods but will additionally support the classical leaning approaches. We are, however, convinced that MOOCs will be a very important learning method in the future and that they will continue to gain more and more attraction by learners and teachers.

APPENDIX A

Appendix

Current State MOOCs' Development

MOOC Completion Rates

Course	Platform	Start date	Number enrolled	% completed	Assessment type	Data source
14.73x The Challenges of Global Poverty	EdX	2013	39759	12%	Auto grading only	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382296
2.01x Elements of Structures	EdX	2013	12243	7%	Auto grading only	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382291
3.091x Introduction to solid state chemistry	EdX	2012	28512	7%	Auto grading only	http://web.mit.edu/newsoffice/2013/mitx-spring-offerings-0131.html
3.091x Introduction to Solid State Chemistry	EdX	2013	12276	4%	Auto grading only	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382293
6.002x Circuits and Electronics	EdX	2012	46000	7%	Auto grading only	http://web.mit.edu/newsoffice/2013/mitx-spring-offerings-0131.html
6.002x Circuits and Electronics	EdX	2013	29050	4%	Auto grading only	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382295
6.00x Introduction to Computer Science and Programming	EdX	2013	72920	5%	Auto grading only	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382322
6.00x Introduction to Computer Science and Programming	EdX	2012	84511	7%	Auto grading only	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382288
7.00x Introduction to Biology	EdX	2013	37977	9%	Auto grading only	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382325
8.02x Electricity and Magnetism	EdX	2013	41307	4%	Auto grading only	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382328

Table A.1: MOOC Courses [43]

Course	Platform	Start date	Number enrolled	% completed	Assessment type	Data source
8.MReV Mechanics ReView	EdX	2013	16787	6%	Auto grading only	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382297
A Beginner's Guide to Irrational Behaviour	Coursera	2013	142839	3%	Auto and peer grading	http://moocmoocher.wordpress.com/2013/02/13/synthesising-mooc-completion-rates/comment-page-1/#comment-519
A History of the World since 1300	Coursera	2012	83000	1%	Peer grading only	http://www.crikey.com.au/2012/12/18/mass-revolution-or-mass-con-universities-and-open-courses/?wpmp_switcher=mobile
Aboriginal Worldviews and Education	Coursera	2013	20966	16%	Auto and peer grading	http://www.ocw.utoronto.ca/wp-content/uploads/2013/08/Open-Utoronto-MOOC-Report-August-2013.pdf
Aeronautical Engineering	EdX	2014	10328	4%	Unknown	Personal communication
An Introduction to Operations Management	Coursera	Unknown	87000	5%	Auto grading only	http://coursetalk.org/coursera/an-introduction-to-operations-management
Artificial Intelligence Planning	Coursera	2013	29894	2%	Auto grading only	http://www.era.lib.ed.ac.uk/bitstream/1842/6683/1/Edinburgh%20MOOCs%20Report%202013%20%231.pdf
Astrobiology	Coursera	2013	39556	19%	Auto grading only	http://www.era.lib.ed.ac.uk/bitstream/1842/6683/1/Edinburgh%20MOOCs%20Report%202013%20%231.pdf
Biobased Products	EdX	2014	9606	4%	Unknown	Personal communication
Bioelectricity - a quantitative approach	Coursera	2012	12000	3%	Auto and peer grading	http://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/6216/Duke_Bioelectricity_MOOC_Fall2012.pdf
Calculus One	Coursera	2013	47000	4%	Auto grading only	http://thelantern.com/2013/08/ohio-state-offers-6-online-courses-general-public-coursera/
Computational Investing, Part 1	Coursera	2013	25589	5%	Auto grading only	http://augmentedtrader.wordpress.com/2013/01/27/mooc-student-demographics/
Computational Investing, Part 1	Coursera	2012	53205	5%	Auto grading only	http://augmentedtrader.wordpress.com/2013/01/06/about-mooc-completion-rates-the-importance-of-investment/
Computing for Data Analysis	Coursera	2012	50899	13%	Auto grading only	http://simplystatistics.org/2012/10/29/computing-for-data-analysis-simply-statistics-edition/
Crafting an Effective Writer: Tools of the Trade	Coursera	2013	40000	7%	Auto and peer grading	http://wcetblog.wordpress.com/2013/08/06/creating-an-effective-mooc/
Creative Programming for Digital Media and Mobile Apps	Coursera	2013	78600	3%	Auto and peer grading	http://www.londoninternational.ac.uk/sites/default/files/governance/ltas13/ltas13.3_mooc_statis
Credit Risk Management	EdX	2014	20925	3%	Unknown	http://www.emoocs2015.eu/sites/default/files/Papers.pdf
Critical Thinking	Coursera	2013	75884	9%	Auto grading only	http://www.era.lib.ed.ac.uk/bitstream/1842/6683/1/Edinburgh%20MOOCs%20Report%202013%20%231.pdf
CS50x - Introduction to Computer Science I	EdX	2012	150349	1%	Auto grading only	https://blog.cs50.net/2013/05/01/0/
Data Analysis	Coursera	2013	102000	5%	Auto and peer grading	http://moocmoocher.wordpress.com/2013/02/13/synthesising-mooc-completion-rates/comment-page-1/#comment-283
Databases	Coursera	2011	60000	11%	Auto grading only	http://wp.sigmod.org/?p=165
Delft Design Guide	EdX	2014	13503	1%	Unknown	Personal communication
Drinking Water Treatment	EdX	2014	10543	3%	Unknown	Personal communication
Drugs and the Brain	Coursera	2012	66800	7%	Auto grading only	http://ata-sci-tech.blogspot.co.uk/2013/02/drugs-and-brain.html
E-learning and Digital Cultures	Coursera	2013	42844	4%	Peer grading only	http://www.era.lib.ed.ac.uk/bitstream/1842/6683/1/Edinburgh%20MOOCs%20Report%202013%20%231.pdf
Energy 101	EdX	2013	35000	13%	Unknown	http://www.linkedin.com/in/jgarcia3rd
English Common Law - Structure and Principles	Coursera	2013	41045	6%	Auto grading only	http://www.londoninternational.ac.uk/sites/default/files/governance/ltas13/ltas13.3_mooc_statis
Equine Nutrition	Coursera	2013	23322	36%	Auto grading only	http://www.era.lib.ed.ac.uk/bitstream/1842/6683/1/Edinburgh%20MOOCs%20Report%202013%20%231.pdf

Table A.1 (Continued): MOOC Courses [43]

Course	Platform	Start date	Number enrolled	% completed	Assessment type	Data source
First Year Teaching (Elementary Grades) - Success from the Start	Coursera	2013	16000	26%	Peer grading only	https://www.edsurge.com/n/2013-10-14-coursera-teaches-teachers-anywhere-anytime
First-Year Composition 2.0	Coursera	2013	21934	1%	Peer grading only	http://chronicle.com/blogs/wiredcampus/lessons-learned-from-a-freshman-composition-
Functional Programming	EdX	2014	38029	5%	Unknown	Personal communication
Functional Programming Principles in Scala	Coursera	2012	50000	19%	Auto grading only	http://docs.scala-lang.org/news/functional-programming-principles-in-scala-impressions-and-statistics.html
Gamification	Coursera	2013	66438	8%	Auto and peer grading	http://www.youtube.com/watch?v=E8_3dNEMukQ&feature=youtu.be
Gamification	Coursera	2012	81600	10%	Auto and peer grading	http://www.youtube.com/watch?v=NrFmiqhBep4
Generating the Wealth of Nations	Coursera	2013	28922	2%	Peer grading only	http://signsofchaos.blogspot.co.uk/2013/07/an-assessment-of-mooc.html
Greek and Roman Mythology	Coursera	2012	55000	5%	Auto and peer grading	http://moocmoocher.wordpress.com/2013/02/13/synthesising-mooc-completion-rates/comment-page-1/#comment-274
Heroesx: The Ancient Greek Hero	EdX	2013	43563	3%	Unknown	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382246
HLS1X: CopyrightX	EdX	2013	500	39%	Unknown	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382332
Human-Computer Interaction (studio track)	Coursera	2012	29105	3%	Auto and peer grading	http://reflectionsandcontemplations.wordpress.com/2012/07/14/review-of-the-coursera-human-computer-interaction-course/
ICT in Primary Education: Transforming children's learning across the curriculum	Coursera	2014	9000	4%	Peer grading only	http://www.lkl.ac.uk/cms/files/jce/reports/anatomy_of_a_mooc_for_teacher_cpd_ucl-ioe.pdf
Image and video processing - From Mars to Hollywood with a stop at the hospital	Coursera	2013	40000	10%	Auto grading only	http://cit.duke.edu/blog/2013/06/looking-back-on-image-and-video-processing/
Internet History, Technology and Security	Coursera	2012	46000	10%	Auto and peer grading	http://www.slideshare.net/fullscreen/csev/internet-history-technology-and-security-grand-finale-lecture-20121001/7
Introduction to Aeronautical Engineering	EdX	2014	15820	4%	Unknown	http://www.emoocs2015.eu/sites/default/files/Papers.pdf
Introduction to Artificial Intelligence	Udacity	2011	160000	13%	Auto grading only	http://fm.schmoller.net/2012/07/peter-norvigs-ted-talk-about-the-ai-course.html#more
Introduction to Astronomy	Coursera	2012	60000	4%	Auto grading only	http://hdl.handle.net/10161/6679
Introduction to Genetics and Evolution	Coursera	2012	33000	5%	Auto grading only	http://today.duke.edu/node/93914
Introduction to International Criminal Law	Coursera	2013	21000	7%	Auto grading only	http://www.cleveland.com/metro/index.ssf/2013/07/case_western_reserve_universit_9.html
Introduction to Machine Learning	Coursera	2011	104000	13%	Auto grading only	http://www.theatlantic.com/business/archive/2012/05/the-big-idea-that-can-revolutionize-higher-education-mooc/256926/
Introduction to Mathematical Thinking	Coursera	2013	58300	7%	Auto and peer grading	http://moocmoocher.wordpress.com/2013/02/13/synthesising-mooc-completion-rates/comment-page-2/#comment-1092
Introduction to Mathematical Thinking	Coursera	2013	27930	7%	Auto and peer grading	http://fm.schmoller.net/2013/06/second-report-from-keith-devlins-itmt-course.html
Introduction to Philosophy	Coursera	2013	98128	10%	Auto grading only	http://www.era.lib.ed.ac.uk/bitstream/1842/6683/1/Edinburgh%20MOOCs%20Report%202013%20%231.pdf
Introduction to Sociology	Coursera	2012	40000	3%	Peer grading only	http://www.nytimes.com/2012/11/20/education/colleges-turn-to-crowd-sourcing-courses.html
Introduction to Water Treatment	EdX	2013	29088	2%	Unknown	http://www.emoocs2015.eu/sites/default/files/Papers.pdf
JusticeX	EdX	2013	79787	7%	Auto grading only	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382248

Table A.1 (Continued): MOOC Courses [43]

Course	Platform	Start date	Number enrolled	% completed	Assessment type	Data source
Learn to Program - Crafting Quality Code	Coursera	2013	53974	6%	Auto and peer grading	http://www.ocw.utoronto.ca/wp-content/uploads/2013/08/Open-Utoronto-MOOC-Report-August-2013.pdf
Learn to Program - The Fundamentals	Coursera	2012	80000	10%	Auto grading only	http://www.ocw.utoronto.ca/wp-content/uploads/2013/08/Open-Utoronto-MOOC-Report-August-2013.pdf und http://moocmoocher.wordpress.com/2013/02/13/synthesising-mooc-completion-rates/comment-page-2/#comment-1090
Learn to Program - The Fundamentals	Coursera	2013	80000	10%	Auto grading only	http://www.ocw.utoronto.ca/wp-content/uploads/2013/08/Open-Utoronto-MOOC-Report-August-2013.pdf und http://moocmoocher.wordpress.com/2013/02/13/synthesising-mooc-completion-rates/comment-page-2/#comment-1090
Listening to World Music	Coursera	2012	36295	6%	Auto and peer grading	http://moocmoocher.wordpress.com/2013/02/13/synthesising-mooc-completion-rates/comment-page-1/#comment-271
Malicious Software and its Underground Economy - Two Sides to Every Story	Coursera	2013	40925	6%	Auto grading only	http://www.londoninternational.ac.uk/sites/default/files/governance/ltas13/ltas13.3_mooc_statistics.pdf
Maps and the Geospatial Revolution	Coursera	2013	47000	7%	Auto and peer grading	http://moocmoocher.wordpress.com/2013/02/13/synthesising-mooc-completion-rates/comment-page-2/#comment-631
Mathematical Biostatistics Bootcamp	Coursera	2012	15930	5%	Auto grading only	http://www.washingtonpost.com/blogs/college-inc/post/grades-are-in-for-a-pioneering-free-johns-hopkins-online-class/2012/11/14/1bd60194-2e6b-11e2-89d4-
Mathematical Biostatistics Bootcamp	Coursera	2013	21916	10%	Auto grading only	http://moocmoocher.wordpress.com/2013/02/13/synthesising-mooc-completion-rates/comment-page-1/#comment-537
Medical Neuroscience	Coursera	2013	44980	2%	Auto and peer grading	http://cit.duke.edu/blog/2013/07/coursera-medical-neuroscience-week-3/
Metadata	Coursera	2013	27000	5%	Auto grading only	http://www.aaai.org/ocs/index.php/ICWSM/ICWSM15/paper/view/10526
Neural Networks for Machine Learning	Coursera	2012	49550	3%	Auto grading only	http://www.ocw.utoronto.ca/wp-content/uploads/2013/08/Open-Utoronto-MOOC-Report-August-2013.pdf
Next Generation Infrastructures	EdX	2014	16091	3%	Unknown	http://www.emoocs2015.eu/sites/default/files/Papers.pdf
Next Generation Infrastructures 2	EdX	2014	6233	4%	Unknown	Personal communication
Pattern-Oriented Software Architectures for Concurrent and Networked Software	Coursera	2013	30979	5%	Auto and peer grading	http://moocmoocher.wordpress.com/2013/02/13/synthesising-mooc-completion-rates/comment-page-1/#comment-541
PH207x: Health in Numbers	EdX	2012	61181	8%	Auto grading only	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382242
PH278x: Human Health and Global Environmental Change	EdX	2013	53340	5%	Auto grading only	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2382242
Principles of Microeconomics	Coursera	2013	35814	2%	Auto and peer grading	https://moocmoocher.wordpress.com/2013/02/13/synthesising-mooc-completion-rates/comment-page-2/#comment-1234
Responsible Innovation	EdX	2014	10824	4%	Unknown	Personal communication
Ser más creativos	Coursera	2013	51833	12%	Auto and peer grading	http://moocmoocher.wordpress.com/2013/02/13/synthesising-mooc-completion-rates/comment-page-2/#comment-1028
Sewage Water Treatment	EdX	2015	10725	4%	Unknown	Personal communication
Social Network Analysis	Coursera	2012	61285	2%	Auto and peer grading	http://moocmoocher.wordpress.com/2012/12/
Social Psychology	Coursera	2013	200000	4%	Auto and peer grading	http://moocmoocher.wordpress.com/2013/02/13/synthesising-mooc-completion-rates/comment-page-2/#comment-865

Table A.1 (Continued): MOOC Courses [43]

Course	Platform	Start date	Number enrolled	% completed	Assessment type	Data source
Software Defined Networking	Coursera	2013	53000	1%	Auto grading only	https://twitter.com/feamster
Software Engineering for SaaS	Coursera	2012	50000	7%	Auto grading only	http://www.theatlantic.com/technology/archive/2012/07/what-its-like-to-teach-a-mooc-and-what-the-hecks-a-mooc/260000/
Solar Energy	EdX	2013	57091	5%	Unknown	http://www.emoocs2015.eu/sites/default/files/Papers.pdf
Solar Energy	EdX	2014	28564	5%	Unknown	Personal communication
Solving Complex Problems	EdX	2014	32424	4%	Unknown	Personal communication
Sports and Society	Coursera	2013	19281	8%	Auto grading only	http://cit.duke.edu/blog/2013/07/duke-sports-and-society-mooc-wraps-up/
Stat2.1x Introduction to Statistics - Descriptive Statistics	EdX	2013	52661	16%	Auto grading only	http://stat2x.blogspot.co.uk/
Statistics - Making Sense of Data	Coursera	2013	62488	5%	Auto and peer grading	http://www.ocw.utoronto.ca/wp-content/uploads/2013/08/Open-Utoronto-MOOC-Report-August-2013.pdf
Surviving Disruptive Technologies	Coursera	2013	16000	4%	Peer grading only	http://campustechnology.com/Articles/2013/09/05/Assessment-Tools-for-MOOCs.aspx?Page=2
Technicity	Coursera	2013	21000	2%	Peer grading only	http://thelantern.com/2013/08/ohio-state-offers-6-online-courses-general-public-coursera/
The Camera Never Lies	Coursera	2013	47893	3%	Auto grading only	http://www.londoninternational.ac.uk/sites/default/files/governance/ltas13/ltas13.3_mooc_statis
The Social Context of Mental Health and Illness	Coursera	2013	23491	6%	Auto and peer grading	http://www.ocw.utoronto.ca/wp-content/uploads/2013/08/Open-Utoronto-MOOC-Report-August-2013.pdf
Think Again: How to Reason and Argue	Coursera	2012	226652	2%	Auto grading only	http://cit.duke.edu/blog/2013/06/preliminary-results-on-dukes-third-coursera-effort-think-
Water & climate	EdX	2014	6705	4%	Unknown	Personal communication
Writing II - Rhetorical Composing	Coursera	2013	30000	2%	Peer grading only	http://thelantern.com/2013/08/ohio-state-offers-6-online-courses-general-public-coursera/

	Count
Coursera	64
EdX	35
Udacity	1

Mean	7%
Dropout rate	93%

Table A.1 (Continued): MOOC Courses [43]

MOOC Prototype

Implementation

Questionnaire Start

Questionnaire Start

1. **Age**

2. **Gender**
   Mark only one oval.
   - female
   - male

3. **Country**
   Mark only one oval.
   - Dropdown with all countries

4. **ZIP Code**

5. **Level of Eduction**
   Mark only one oval.
   - Bachelor student
   - Master student
   - Professor or researcher
   - University support and technical staff
   - University studies completed
   - Without university studies

Table A.2: Questionnaire Start

6. **What is your English speaking level?**
   Mark only one oval.

   - ◯ Beginner
   - ◯ Intermediate
   - ◯ Advanced
   - ◯ Native

7. **Are you a student of the Vienna University of Technolgy?**
   Mark only one oval.

   - ◯ Yes
   - ◯ No

10. **Fields of study**
    Mark only one oval.

    - ◯ Art/Communication/Humanities
    - ◯ Business/Economics
    - ◯ Education/Counseling
    - ◯ Engineering/Computer Sciences
    - ◯ Law
    - ◯ Life Sciences
    - ◯ Medicine
    - ◯ Health Sciences
    - ◯ Social Sciences
    - ◯ Physical Sciences
    - ◯ Other

11. **What are you studying? (e.g. Business Informatics)**

Table A.2 (Continued): Questionnaire Start

12. **Reasons for Taking the Course**
Tick all that apply.

- [ ] online
- [ ] enjoy learning about topics that interest me
- [ ] enjoy learning about topics that interest me enjoy being part of a community of learners
- [ ] gain skills for a new career
- [ ] gain skills for a promotion at work
- [ ] I hope to gain skills for a new career
- [ ] I hope to gain skills for a promotion at work

13. **Would you be interested in a certificate or badge for course participation?**
Mark only one oval.

- ◯ Yes
- ◯ No

14. **Would you be interested in a certificate or badge for course completion (f. e. min. 50 % of quizzes)?**
Mark only one oval.

- ◯ Yes
- ◯ No

15. **Do you intend to complete the course?**
Mark only one oval.

- ◯ Yes
- ◯ Maybe
- ◯ No

Table A.2 (Continued): Questionnaire Start

Questionnaire End

Questionnaire End

1. **Lecture videos were**
   Mark only one oval.
   - very helpful
   - helpful
   - a bit helpful
   - not helpful
   - not used

2. **Self tests were**
   Mark only one oval.
   - very helpful
   - helpful
   - a bit helpful
   - not helpful
   - not used

3. **Quizzes were**
   Mark only one oval.
   - very helpful
   - helpful
   - a bit helpful
   - not helpful
   - not used

Table A.3: Questionnaire End

4. **Forum was**
   Mark only one oval.

   - very helpful
   - helpful
   - a bit helpful
   - not helpful
   - not used

5. **Project assignment was**
   Mark only one oval.

   - very helpful
   - helpful
   - a bit helpful
   - not helpful
   - not used

6. **Giving a project review was**
   Mark only one oval.

   - very helpful
   - helpful
   - a bit helpful
   - not helpful
   - not used

7. **Receiving a project review was**
   Mark only one oval.

   - very helpful
   - helpful
   - a bit helpful
   - not helpful
   - not used

Table A.3 (Continued): Questionnaire End

What kind of video style do you prefer to WATCH for fun?

8. **Slides – Slide presentation with voice-over**
   Mark only one oval.

	1	2	3	4	5	
very good	◯	◯	◯	◯	◯	very bad

9. **Slides & Instructor – Slide presentation with voice-over and sometimes full-screen video of an instructor**
   Mark only one oval.

	1	2	3	4	5	
very good	◯	◯	◯	◯	◯	very bad

10. **Animated Handwriting video - full-screen video of an animated handwriting**
    Mark only one oval.

	1	2	3	4	5	
very good	◯	◯	◯	◯	◯	very bad

11. **Classroom – video captured from a live classroom lecture**
    Mark only one oval.

	1	2	3	4	5	
very good	◯	◯	◯	◯	◯	very bad

12. **Office Desk – close-up shots of an instructor's head filmed at an office desk**
    Mark only one oval.

	1	2	3	4	5	
very good	◯	◯	◯	◯	◯	very bad

Table A.3 (Continued): Questionnaire End

13. **Studio – instructor recorded in a studio with no audience**
Mark only one oval.

	1	2	3	4	5	
very good	⬭	⬭	⬭	⬭	⬭	very bad

What kind of video style do you prefer to STUDY with?

14. **Slides – Slide presentation with voice-over**
Mark only one oval.

	1	2	3	4	5	
very good	⬭	⬭	⬭	⬭	⬭	very bad

15. **Slides & Instructor – Slide presentation with voice-over and sometimes full-screen video of an instructor**
Mark only one oval.

	1	2	3	4	5	
very good	⬭	⬭	⬭	⬭	⬭	very bad

16. **Animated Handwriting video - full-screen video of an animated handwriting**
Mark only one oval.

	1	2	3	4	5	
very good	⬭	⬭	⬭	⬭	⬭	very bad

17. **Classroom – video captured from a live classroom lecture**
Mark only one oval.

	1	2	3	4	5	
very good	⬭	⬭	⬭	⬭	⬭	very bad

Table A.3 (Continued): Questionnaire End

18. **Office Desk – close-up shots of an instructor's head filmed at an office desk**
Mark only one oval.

	1	2	3	4	5	
very good	◯	◯	◯	◯	◯	very bad

19. **Studio – instructor recorded in a studio with no audience**
Mark only one oval.

	1	2	3	4	5	
very good	◯	◯	◯	◯	◯	very bad

20. **I have used the learning material in the order in which they are presented in the MOOC.**
Mark only one oval.

	1	2	3	4	5	
completely	◯	◯	◯	◯	◯	not at all

21. **I am an organized person (private life, work, studies).**
Mark only one oval.

	1	2	3	4	5	
completely	◯	◯	◯	◯	◯	not at all

22. **Have you considered the completion tracking boxes on the right hand side of each activity (e. g. lesson, quiz, resource, project)?**
Mark only one oval.

- ◯ Yes, almost all of the activities are ticked.
- ◯ Yes, some of the activities are ticked.
- ◯ No, I have not considered the completion tracking boxes.

23. **Please be honest: Have you cheated (e. g. talked to a course colleague about a specific task, repeated quiz questions until you had all points) during the MOOC?**
Tick all that apply.

- ☐ Yes, during the project
- ☐ Yes, during the quiz(zes)
- ☐ Yes, during the project and the quiz(zes)
- ☐ No, I have not cheated.

Table A.3 (Continued): Questionnaire End

24. **Did you finish the MOOC?**
Mark only one oval.

- Yes
- Almost
- No

25. **Why did you not finish the MOOC?**
Mark only one oval.

- loss of interest
- loss of motivation to continue
- technical or content-related shortcomings
- personal reasons
- others

26. **How could this MOOC be improved?**

27. **How many MOOCs have you participated in?**
Mark only one oval.

- This was my first MOOC.
- 2-4
- 5-7
- >7

Table A.3 (Continued): Questionnaire End

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