TU WIEN Informatics

Improving distance learning in an object oriented modeling lecture by enhancing digital media with H5P

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Vienna, 5th December, 2022

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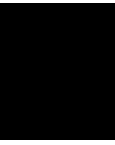_____

Andre Ogris

Acknowledgements

Abstract

In the grasp of the global pandemic students and teachers alike had to adjust to distance learning. Many new and existing tools are in use to master the problems this rapid change has brought. One of these tools is H5P which can be used to enhance videos and other learning materials to improve the e-learning process.

This Thesis will investigate how H5P works, how it can be used and integrated in existing environments and how it compares to similar tools. In addition to this it will investigate a prototype for the bachelor's lecture "Object Oriented Modelling" [1] at TU Wien to test this tool in an authentic environment.

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[1]188.391 Objektorientierte Modellierung

Contents

Introduction

Since the Covid-19 pandemic began, distance learning moved into the spotlight of most schools and universities, as students and teaching staff like professors, lecturers, teachers and tutors worldwide were often forced to stay at home. As [MDDG11] stated Distance learning is not a new invention, as it was already existing in the 1980's by sending learning materials via post and a long time before that [HE05] showed that people used different forms of correspondence education to convey knowledge over large distances. The way it was conducted on the other hand changed significantly, as new forms of communication were available to the general public. Where before various books and CDs were sent via post, now students have entire courses at their disposal, when going online.
Universities use Learning Management Systems (LMS) like Moodle[Moo22b], Canvas [Ins22], Blackboard [Inc22] and many more, to give the students and teaching staff a platform to upload and access materials like pdfs, e-books, videos. Exams can be held, and students graded on those platforms. They also provide community features, so that teaching staff and students can communicate with each other and ask questions, as they would otherwise do in a classroom.

There are tools to create virtual classrooms like Zoom[ZVC22] or Microsoft Teams[Mic22] in which classes can be held with face cams, microphones and chats. Students can listen and staff teach from anywhere which opens up possibilities to increase effectiveness.
As people are forced to use tools like these, it is all that more important to assess how they can be improved even more. They should be easy to use, accessible with cheap or already available equipment and improve the way knowledge is conveyed without the need for physical presence.

At TU Wien Bork et al. [BFS+21] showed that during the Covid-19 pandemic the Business Informatics Group [BIGB22] was able to conduct a model engineering course, which was previously held weekly in-person classes, in a distance learning format using a flipped

classroom teaching concept, while also reusing parts of the well-established teaching materials. The contents of the class were split into 20-30-minute-long videos and virtual Q&A sessions were held with interactive quizzes at the start using Zoom. Examination of the theoretical part of the course was conducted with two multiple choice tests in Moodle, the practical part with four lab assignments and two solution reviews. Students of the distance learning course where able to achieve similar results as students of in-person courses when looking at the awarded points. One of the challenges that came up during this distance learning course was how to further engage students actively in the remote setting.

H5P[Jou22b] is an open-source tool to enrich media with interactive content and additional information mostly for educational purposes. Lecture videos might be enhanced with with questions and additional content in the form of text, images or more H5P content. In the following thesis I am trying to investigate if H5P can be used to improve distance learning in general and if it can be used to improve the bachelor's lecture "Object Oriented Modelling" [1] at TU Wien specifically. More specifically I am trying to find out in what different ways teaching staff can use H5P for example for teaching or for examinations, how well they can migrate existing teaching material to H5P, what kind of benefits they would gain from using H5P, what some of the drawbacks would be and if they would use it in a university setting.

To do this at first, I am going to take a look at some existing tools and systems commonly used in distance learning, see what possibilities they provide in terms of providing teaching materials and or do examinations for students. Then I will take a more detailed look into H5P to see what it can and cannot do. After that I will give a look into the use of H5P in the "Object Oriented Modelling" lecture at TU Wien mentioned above to see how it might be used in that specific setting. Then I will provide insights into a prototype I build for the lecture and an evaluation of said prototype by professors of that lecture.

In the following thesis I will use the terms, distance learning, e-learning, online learning interchangeably, with the meaning of trying to convey knowledge with the help of the web-based technologies.

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[1]188.391 Objektorientierte Modellierung

H5P and related tools

In the following chapter I want to present current tools used for distance learning and compare their functionality to that of H5P to get a look as to where H5P might be useful and where other alternatives might be better suited. I want to take a look at what functionality these tools offer and how they work.

2.1   Moodle/TUWEL

The Modular Object Oriented Dynamic Learning Environment (Moodle) is an open-source Learning Management System and with 306 million users one of the most used LMS worldwide [Moo22c]. It provides a wide range of modules that can be used to improve not only distance learning but also face to face education. It is intuitive to use for students and lecturers alike and can be used to upload teaching materials in many different formats (e.g. Powerpoint, PDF, Word, MP3,. . .). As mentioned before, it is open-source which gives the community the opportunity to create new modules and review contributions of others, while also being free of charge. Moodle offers the option to hold exams online with different types of questions, like multiple/single choice, drag and drop, free text and many more. Students can submit their assignments and surveys can be held. The Forum is one of the modules and can help the communication between teaching staff and students as well as between the students themselves. Moodle is also able to handle different people with different authorities by assigning roles to users. Some of the roles available are "System Administration" to handle the technical side of Moodle as well as handle the administration of users and give support when the need arises. "Teachers" and "Tutors" may upload materials to courses, prepare exams and handle communication within a course, while "Students" can enter courses and gain access to uploaded materials and used modules. [Cav15]
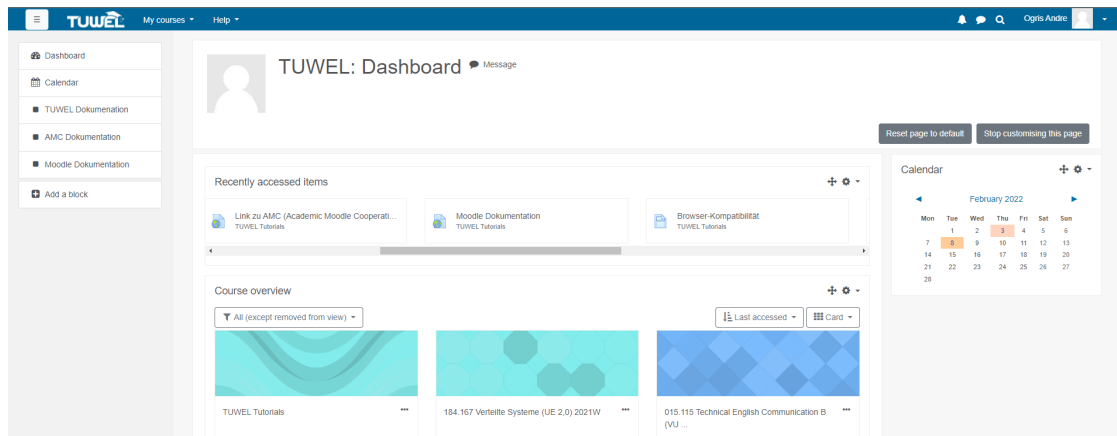
Figure 2.1: Screenshot of TUWEL

At TU Wien we use TUWEL, which is a central learning platform based on Moodle [Moo22b], in the version 3.11 (Figure 2.1). TUWEL is being maintained as well as developed by the Teaching Support Center of TU Wien and the Academic Moodle Cooperation (AMC) since the 2006 summer semester. Together they used the open-source software of Moodle and adapted it, to the needs of lecturers and students by developing new modules and functionalities [oVCC22] [Wie22b]. A few of these changes are also available for the wider Moodle community, like "Offline Quiz", "Student folder" or "Organizer" [Moo22a].

TUWEL specifically offers an implementation to use LectureTube, which is a technology based on Opencast for recordings and live streams of lectures at the university. Teaching staff can livestream and record their lectures in the lecture hall and give students on TUWEL access. This includes screen content on the presentation laptop, audio from the lecture hall's sound system, transmission of the camera image in the lecture hall and a document camera for taking pictures of real objects. Recording while livestreaming is also possible. [Wie22a]

2.1.1   Moodle/TUWEL quiz features

TUWEL offers built a built-in module to create quizzes (Figure 2.3b) that can be used for examinations and ungraded self-evaluation for students. This quiz offers various types of questions like multiple/single choice, true/false, matching answers to the question, multiple different drag and drop questions and more. Available question types can be combined to form a quiz with every question awarding an editable number of points. Creating these questions is straightforward and doesn't require programming skills. The question as well as the answers, hints and feedback can contain formatting, links, images, audio/video files and H5P files. Questions can be shuffled and going back after answering may be toggled on or off. It is possible to edit how many questions should be shown on a page at once, how much time students get to finish and how many times they can retry.

Figure 2.2: Multiple choice answers in TUWEL

Using multiple choice questions as an example, the grade awarded for every single answer in a question can be set separately from -100% to +100% and feedback can be given for every answer. It is also possible to create multiple choice questions where all or no points will be awarded.

There are multiple types of drag and drop questions:

- Drag and drop into text

- Drag and drop markers

- Drag and drop image

For "drag and drop into text", a text must be filled with predefined words, that can be shuffled, chosen multiple times and contain wrong answers. Markers work the same way as images, as that a background image must be uploaded on which areas can be defined where either shapes with text (markers) or images must be dragged to. As with text questions the answers may be shuffled.

2.2 What is H5P?

H5P is an open-source tool to enrich media with interactive content and additional information mostly for educational purposes[Jou22a]. The tool itself is based on JavaScript

and produces HTML5 content that can be provided via various ways.

Providing H5P files can happen via the use of "h5p.com" and the options to either link it directly or embed it into any webpage. H5p.com also provides Learning Tools Interoperability (LTI) integration with multiple Learning Management Systems. The IMS Global Learning Consortium maintains the LTI standard, which can be used to integrate external applications with different Learning Management Systems. Moodle currently supports LTI in the versions up to LTI 1.3 as well as LTI Advantage[Edl22]. The currently supported LMS are:

- Moodle

- Canvas

- Brightspace

- Blackboard

There are also plugins available to selfhost H5P for Moodle, WordPress, and Drupal by which the usage of h5p.com is not necessary[Jou22c].

Aside from plugins mentioned above, there are several ways of creating H5P files, one of which would be h5p.com where you can create an account and have all H5P content types available. Aside from tools to create H5P content, h5p.com also provides hosting for H5P files outside of learning management systems which can be accessed for example via links. A free alternative to h5p.com would be h5p.org which can be used to create "test content" with a smaller selection of content types and a few restrictions (e.g. a 16MB upload limit for videos in interactive videos). All content created in h5p.org is publicly available as opposed to h5p.com which requires paid accounts.

Another free way of creating H5P content is the open-source tool "Lumi" which is created and managed by "Lumi Education GbR Jan Philip Schellenberg und Sebastian Rettig"[edu22b]. The source code is accessible on Github [edu22a]. Lumi is a desktop application which offers the full selection of content types with the added benefit of being free of charge, which is the reason why I used it for most of my testing. It can be used to view h5p content offline (without all online features like saving scores for examinations in Moodle) and create content offline without restrictions like in h5p.org. Lumi cannot be used to host H5P content outside of LMS, which is possible with h5p.com, by sharing links.

2.2.1 What can be done?

H5P can be used to enrich media with interactive content to improve the learning and teaching experience in an e-learning environment. This can happen in multiple ways, for example multiple choice questions can be added into a video, a picture can be enhanced

by adding hotspots that display information when clicking on them, Quizzes can be created to test students and the results can be used when grading them. It is possible to add captions to a video to improve the experience for the hearing-impaired and also when watching in loud environments. To be usable in H5P the video must be of m4v, mp4, webm, ogm or ogv format. Such videos can either be uploaded to the h5p editor directly or linked via URL from external sources like Vimeo Pro, YouTube and Panopto as stated in the Lumi desktop application

A full list of content types available with H5P can be found in Table 2.1.

Different content types can be used for different purposes. For example, Crossword puzzles (Figure 2.3c) can be used to playfully test pupils and younger children, whereas the content type Quiz (also called Question Set) can be used for students of all ages, to either give them a way to self-evaluate or to create a graded exam. If H5P content is meant to award points, Moodle can be used to give a weighted grade based on the points achieved in the H5P quiz like in the following example:

If a student gets 8 out of 10 possible points in an H5P interactive video (Figure 2.3a), and the maximum number of points is set to 100 in Moodle, then the student will receive 80 points in Moodle.

Programming skills are not necessary to create H5P content, which gives a lot of teaching staff the opportunity to use it.

It is possible to copy and paste parts or even complete H5P files into another H5P file. This means you can easily reuse questions used in a Questions set in an interactive video without having go through the process of creating the question from scratch. This creates the opportunity to create separate H5P files for every question and organise them outside of Lumi or H5P.com. This also makes it easier creating different exams with new and old questions.

2.2.2 What cannot be done

There are a few limitations when it comes to learning with H5P files. One of those is that you need to work with an environment that supports H5P, like Moodle, Blackboard or H5P.com. This means that working with H5P files completely offline, would require for the H5P file to be downloadable in the first place and then either the installation of a tool like Lumi, as H5P files cannot simply be opened and viewed in a browser. When opening an H5P file offline with the help of Lumi, all features regarding grading of Questions are not working.

Accordion	Advent Calender (beta)	Agamotto (Image Blender)
Arithmetic Quiz	Audio	Audio Recorder
Chart	Collage	Column
Course Presentation	Crossword	Dialog Cards
Dictation	Documentation Tool	Drag and Drop
Drag the Words	Essay	Fill in the Blanks
Find Multiple Hotspots	Find the Hotspot	Find the words
Flashcards	Guess the Answer	Guess the Answer
iframe Embedder	Image Choice	Image Hotspots
Image Juxtaposition	Image Pairing	Image Sequencing
Image Slider	Interactive Book	Interactive Video
KewAr Code	Mark the Words	Memory Game
Multiple Choice	Personality Quiz	Questionnaire
Quiz (Question Set)	Single Choice	Sort the Paragraphs
Speak the Words	Speak the Words Set	Summary
Timeline	True/False Question	Twitter User Feed
Virtual Tour (360)		

Table 2.1: H5P content types

It might not be an easy transition to use H5P, when using already existing PDF or PowerPoint files to teach, as they are not easily convertible to the equivalent H5P content types. To enhance these existing materials, it is necessary to create new H5P files like "Course Presentation" and then copy and paste already existing content into the new files and formatting it to create a satisfying result. As the formatting options are not as well developed as in for Microsoft PowerPoint, all these steps might create a significant workload for the teaching staff, especially when there are lots of documents to convert.

Not all content types provide the same functionality or support all other types of H5P content. For example, "Question Sets" do not support the question type "Statement" whereas, this is possible in interactive videos. "Question Sets" also do not support the content types "Image Choice" or "Image Pairing". Another inconsistency is that not all types of questions have an option to award a single point if answered correctly. "Drag the Words" questions award a point for every word in the correct position, which could make it difficult to balance points in an exam. Other content types like multiple choice questions offer an option to award a single point for the entire question.
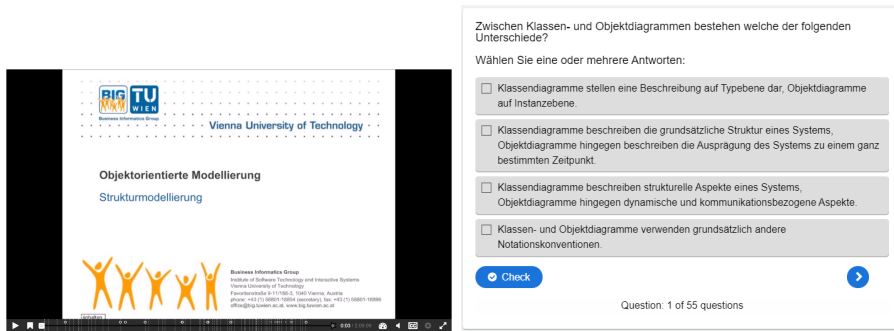
(a) Screenshot of an interactive video in H5P

(b) Screenshot of a quiz in H5P

(c) Screenshot of a crossword puzzle in H5P

Figure 2.3: Content types in H5P

CHAPTER 3

H5P in Object Oriented Modelling

In the lecture Object Oriented Modelling (OOM) at TU Wien, multiple pre-recorded videos are provided to the students, that explain six different UML diagrams in detail. These diagrams are:

- Class diagram/object diagram

- Sequence diagram

- State diagram

- Activity diagram

- Use case diagram

After watching a video, a student should be able to understand and explain the specific diagram. Additional PDF files containing the transcripts of the videos combined with the presentation slides are available, as well as ungraded self-evaluation tests.
To complete the course students must pass a multiple choice test at the start of the semester as a prerequisite. After that they have to pass 3 exams over the course of the lecture with more than 50 percent of the points on each test. They must also hand in exercise sheets regarding the different UML diagrams and will be asked to present their solutions to those assignments.
Additional lectures are given to present solutions to assignments of previous semesters as well as to answer student questions to the lecture material.

3.1 Integration in existing environments

As mentioned before, TU Wien uses TUWEL in the version 3.11 which gives the opportunity to use H5P as a plugin like in regular Moodle systems. This means H5P files of up to 256MB can be uploaded. This size limitation is set by the system administration. The goal of this course is to teach students about UML and different diagrams, as well as testing if they understand the topics they are supposed to learn. H5P offers different approaches to reach these goals.

3.1.1 Conveying knowledge

The most important aspect of this class are the existing lecture videos about the different UML diagrams. Enhancing these videos with H5P offers the opportunity to improve those videos even more as well as embed them on TUWEL, as they are currently hosted on a different website inside the TU Wien domain. The videos can be improved by adding questions for the students after each chapter to self-evaluate and rewatch if they did not understand on the first go. The existing self-evaluation tests can be used as a source of questions to be used in these videos. Subtitles may be added to reduce barriers and offer a better experience for hearing impaired students, as well as an options for students in loud environments. Bookmarks can be used to enhance navigation for videos, as the lecture videos are quite long, with the video for the class diagram being over two hours.

"Course Presentation" (Figure 3.1) would be the equivalent of PDF or PowerPoint files and can be used to add even more information than already existing materials. Questions for self-evaluation can be added the same way as for interactive videos. Videos and audio can be embedded as well as anchors. They can be placed on one slide to navigate to another for more specific information on a topic, especially if that topic is complex. On the other hand, Course Presentations come with the downside of the need to completely recreate already existing materials in H5P. If there is a lot of material as there is for OOM, then this task can require a lot of effort.

"Interactive book" can be used to consolidate the existing transcripts, quizzes, regular as well as interactive videos for the students in a single place in the form of a digital book. If "Course Presentations" were created they could also be placed in the book. An automatically created table of contents would help with navigation between individual pages as well as navigation on a single page.
"Interactive book" suffers from the same drawbacks as the "Course Presentation", meaning that existing PDF or PowerPoint files cannot automatically be imported into it. Again, this creates a workload for teaching staff if they want to create H5P content this way as opposed to using just the existing materials.

Figure 3.1: Example of a "Course Presentation"

H5P files can be downloaded from TUWEL if the specific option is ticked, by the TUWEL course administrator. This gives the option for students to work and study offline, but as mentioned in the Section 2.2.2 this comes with a set of obstacles, as opposed to regular video, PDF, or PowerPoint files. As H5P cannot simply be viewed in a browser, students need to use other ways to work with those files. One relatively simple and cheap way would be to download Lumi [edu22b] and use that program to view the downloaded files. They would not be able to be graded when answering questions in those H5P files, but as long as they are used solely for self-evaluation this doesn't matter.

3.1.2 Examination & self evaluation

All the previously mentioned H5P content types can also be used for examination as well as self-evaluation for students, as can all H5P content types, that award points. As mentioned in the previous chapter, points achieved in H5P can be used to calculate a weighted grade in TUWEL/Moodle.

Teaching staff can adjust if some H5P content should be graded and if that's the case, they can set the maximum number of points. They can also choose not to grade at all, which would give students an opportunity to use these materials as self-evaluation after studying and before tests

In Object Oriented Modelling students need to hand in an assignment, to finally be registered for the course. Currently that assignment is a multiple choice test at the start

of the semester. As long as they did not hand in that online test, they can unregister from the course. An option to engage students into OOM, can be to create a short interactive introduction video, with a few questions at the end as their first assignment. This could help motivate students to pay attention, while also replacing that multiple choice test. Another way of using H5P for examination, can be to use the Quiz (Question Set). The Quiz could be used to replace the existing multiple choice test in TUWEL or like the existing self-evaluation tests available for students. This content type is a collection of multiple questions including following content types:

- Multiple Choice

- Drag and Drop

- Fill in the Blanks

- Mark the Words

- Drag the Words

- True/False Questions

This limited amount of question types is one of the limitations of the H5P quiz, TUWEL test graded and ungraded offer a better selection and interface than the one of H5P.

CHAPTER 4

Prototype

As Object Oriented Modelling already uses videos to teach students and offers self-evaluation tests, I decided to build a prototype of an interactive video that incorporates the self-evaluation test as well as added a few extra features provided by H5P.

4.1   Prototype for Object Oriented Modelling

The interactive video is based on already existing lecture videos provided by the teaching staff to the students. Using H5P the video with the topic of "class diagram" was enhanced with questions from the self-evaluation test, so that students can check their understanding of the curriculum. These questions were added after different sections to quiz the students for the just watched topic without having to open any other resources.

When creating the interactive video, I used Lumi and uploaded the existing lecture video about class diagrams provided by OOM, to the program. To add questions, I dragged them from the toolbar onto the screen, edited the display time and entered the question text and answers. Some images are added as part of the question. The size of these images can be increased to help visibility. The questions are displayed as buttons, to not obstruct the screen if a student doesn't want to answer them. If such a button is clicked, the question opens, and the student can answer it. If they ignore the buttons they will disappeared after a previously specified time.

The questions are positioned after relevant parts of the video, to check if the student understood the topic right away. If the answer is wrong a button will be displayed to redirect the student back to the section of the video that explains the concept. If a student chooses not to click the buttons but still wants to navigate back to a specific
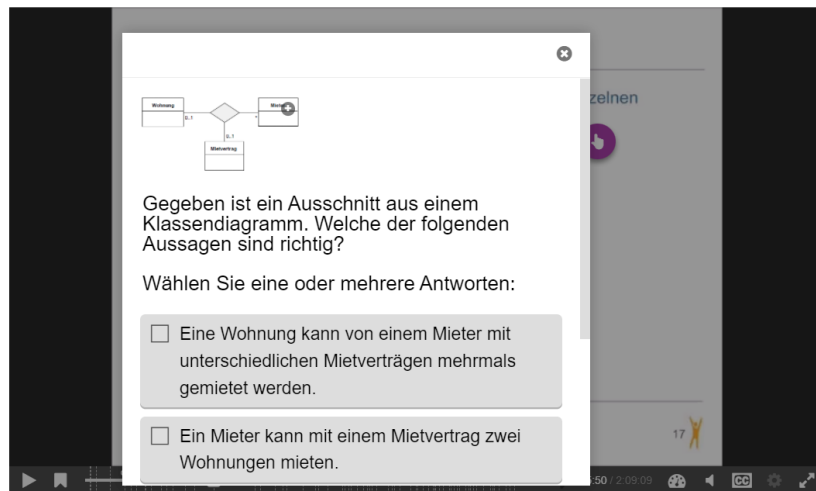
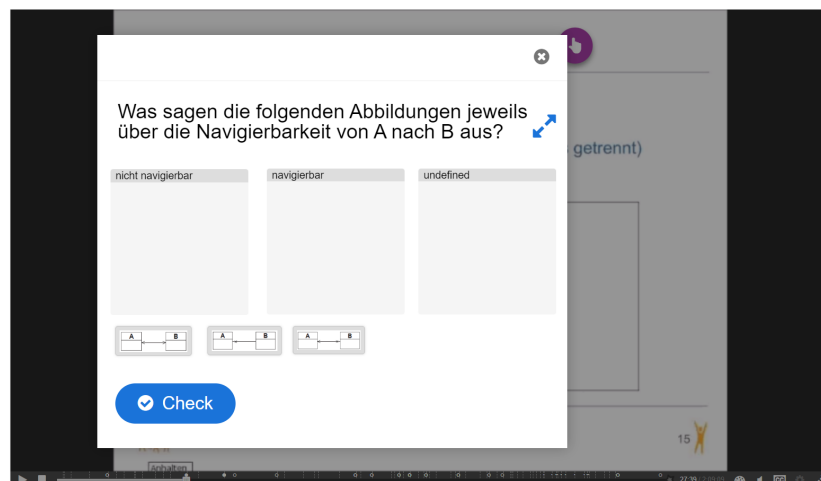Figure 4.1: Viewing a multiple choice question in an interactive video

Figure 4.2: Drag and drop question in an interactive video

section, they can do so by using the bookmarks which are placed at the start of slides used in the video.

One of the types of questions I used in this prototype is multiple choice (Figure 4.1). In this example students are shown an image of a class diagram and 4 statements of which one or more might be correct. In this case they must select the two correct answers without also selecting any wrong ones. If they answer correctly, they can continue with the video, if they answer wrong, they get the option to rewatch the section "Association: Multiplicity" where the concept was explained. This is optional and the students may choose to continue watching the video.
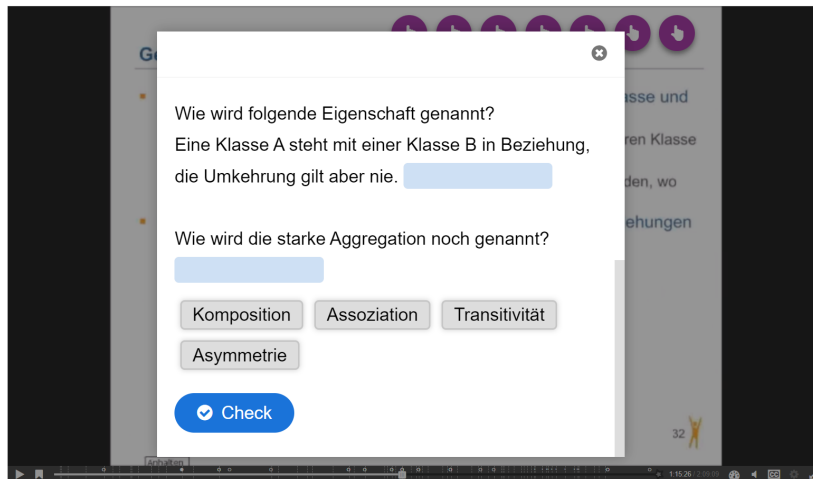
Figure 4.3: Drag text question in an interactive video

Another type of question used in the prototype is drag and drop image. An example of this is shown in Figure 4.2. Here students are shown three images of class diagrams and are asked about their navigability from "A" to "B". They have to drag the images in the correct boxes in this case these are "not navigable", "navigable" and "undefined". If they drag all images in the correct boxes, they can continue with the video. If drag an image in the wrong box, they get the option to rewatch the section "Association: Navigability" where the concept was explained. This is optional and the students may choose to continue watching the video.

The drag and drop text question type was also used in the prototype. In Figure 4.3 students get a description of a property of a class diagram like "What is strong aggregation also called?" and have to drag the correct answer into the text. As with other questions they may choose to rewatch a section of the video if they answer incorrectly, in this case the section "Aggregation" or they can choose to continue watching the video.

The video also shows code snippets in some parts. To help copy these code snippets, text fields have been placed in the video with the same code that is on screen (Figure 4.4). This may motivate students to try using the code and help them understand the topics better. The text fields are displayed as buttons similar to the questions, but with a different symbol.
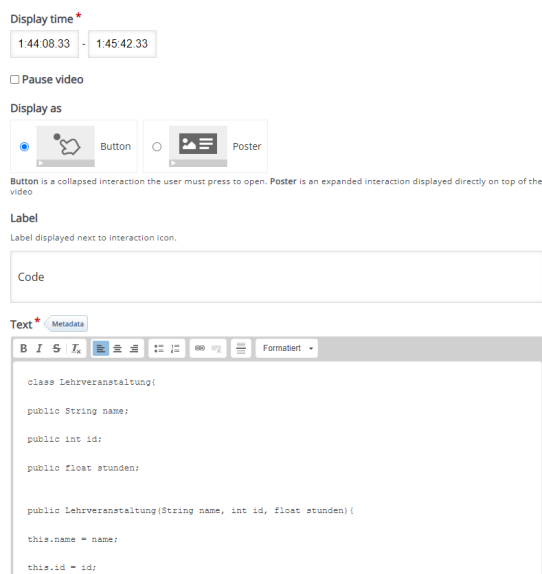
Figure 4.4: Editing a textfield in an H5P interactive video

To make the video more inclusive to hearing impaired students I created captions in the form of a WebVTT file. I created the captions by hand using notepad++ saved them to a .vtt file and loaded them into the H5P file with Lumi. These captions can be toggled on and off when accessing the video.

I also encountered some problems while working on the prototype, for example loading and saving the large video takes a long time compared to smaller videos and other content types. Frequent saving was necessary, as Lumi sometimes froze, became unresponsive and needed to be restarted which leads to loosing all changes made after the last save.

It is possible to copy and paste complete H5P files or parts of them from one file to another in Lumi, which works most of the time but sometimes images got lost when copying Questions to the prototype, this led to reuploading the images to the questions in the video.

When creating bookmarks, you are not able to change the timestamp after the bookmark is created. To work around this, I had to delete the bookmark and remake it at the correct timestamp.
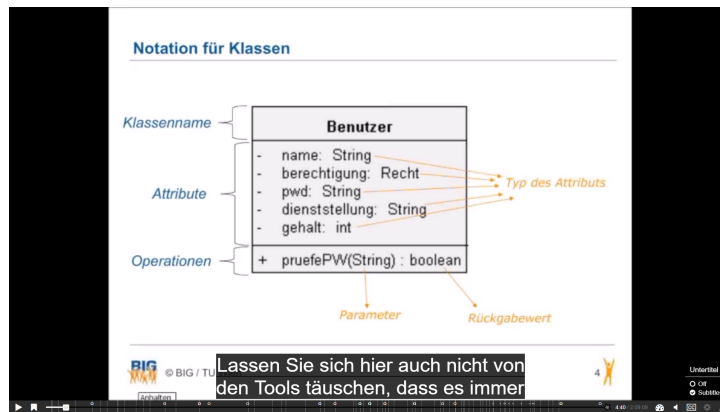
Figure 4.5: Captions in an interactive video

4.2 Integration in Moodle/TUWEL

After creating an H5P file of the interactive video, the next step is uploading that file to TUWEL. To add an H5P file to TUWEL you need editing rights for the course and turn editing on. Like with other Moodle activities you can add a new H5P file by clicking "Add an activity or resource" and select H5P in the following list. This prompts a screen where an H5P file can be uploaded with a name, description, and multiple options.

In TUWEL downloading the H5P file for the interactive video prototype is enabled. Grading is disabled, but it would also be possible to enable it and adjust how many points a student could reach, as well as how many points there are needed to pass, and which attempt would count in case of grading. Grading options are:

- Highest grade

- Average grade

- Last attempt

- First attempt

- Don't calculate a grade

CHAPTER 5

Evaluation of the prototype

To evaluate my prototype, I showed it to the professors of the Object Oriented Modeling lecture. For feedback we had a meeting and a feedback form. The goal was to answer 3 different questions:

1. Questions about the usability of the prototype

2. advantages and disadvantages about using H5P in OOM in general

3. Would they use the prototype in OOM

To the questions about understanding how to use the prototype the answers were divided. Sometimes it seemed unintuitive to click on the button to open the questions when they were entered as popups. When answering the "drag and drop" questions it was not always clear on what to do to solve them if they haven't encountered that type of question before. The "tip" button used to hint to the answer was not always identified as such, instead it looked like a hint for usability, which was not the case.

In regards of technical difficulties, it seems that some users have long loading times when jumping between timestamps for different questions or when going back to rewatch some parts of the video, which could be because of the large file size. This was not the case for all users. They also criticised that not all of the prototype fit on the screen if not in full screen mode. This would lead to missed questions when they were placed close to the edge of the video.

Another point of criticism was that size of elements like questions and text seemed arbitrary. Text was sometimes too big, images to small. For drag and drop questions the target fields seemed bigger than necessary. All this combined leads to an unproper look

for the user. There were also too many clustered on a few slides. Instead, they should be more evenly spread between the slides.

Having an immediate way of checking learning progress for students was mentioned as an advantage. Some not yet implemented features would also be appreciated by the professors. For example, having questions with images and having the answer selectable in the image itself.

They do not intend to use the prototype in the lecture as it is now, as it would not fit the planned restructuring of teaching materials for upcoming semesters. The plan would be to include shorter (about 20min long) videos to teach shorter self-contained topics instead of one very long video for a complete diagram type. They agreed that the prototype showed some possibilities of improving these videos in the future, as shorter videos could solve some of the problems encountered with the current prototype, like file size issues, long loading times and long response times. Especially the teaching and self-assessment aspects might help to improve the lecture in the future, while the examination aspect did not convince them right away.

CHAPTER 6

Conclusio

6.1   Results for "Object Oriented Modeling" at TU Wien

As mentioned before, the prototype showed some problems that can be encountered especially in the setting of the OOM lecture at TU Wien and will not be used in the lecture itself.

Compared to that H5P could be a nice addition to OOM for several reasons. Currently there are already videos in use that can be enhanced with H5P. In the near future those videos will be replaced with shorter more specific videos which also means that some of the problems encountered with the prototype should not be a distraction anymore. These new shorter videos also provide a chance to produce them with the use of H5P in mind without too much extra effort needed.

On the other hand, it seems that interactive videos as the most exclusive feature of H5P compared to other distance learning tools would fit great into the lecture and using it might lead to an improved learning experience for students.

As there are already quizzes available on TUWEL for students to self-evaluate question sets and similar H5P content types don't offer a huge amount of potential to improve. Fixing some of the problems (like the limited selection of content types in a question set) and inconsistencies encountered could lead to change that assessment in the future.

Further research with more prototypes and student participation would certainly help find out how much H5P could improve the lecture.

6.2   General results

In general, H5P has a lot of potential when it comes to improving distance learning and teaching in general, but there are also some problems that may be improved upon in the future.

The conversion from existing teaching materials to H5P content is not always straightforward. For example, converting PDF and PowerPoint files, which are quite common, take quite some effort and cannot always be recreated perfectly with the currently existing content types. This problem also offers the opportunity to enhance teaching materials as they should be kept up to date with recent scientific findings and technological updates anyway.

When creating H5P content there are a few difficulties on the way at the moment. When working with larger files loading and saving in Lumi takes quite some time and other free editors might not offer to use large files in the first place. The user interface can also be improved in a few places, like when bookmarks cannot be edited and have to be deleted and recreated to be changed. Some features are not available in all similar content types, for example editing the achievable points for "Drag the Words" questions. Adding "Image Choice" Questions to question sets would also make the "Question Set" content type more attractive as a testing tool. Fixing these issues would certainly help to make the creation of content less frustrating and more consistent.

One of the positive things about H5P is that it doesn't require programming skills or a lot of technical expertise to create simple H5P content. This and the fact that it is free and open source makes it easily available to any lecture at universities that already use one of the supported content management systems.

It is also very versatile as H5P can be used for teaching and examination of students alike. With creativity and practice H5P offers a lot of different ways to provide content for teaching staff and students of many different fields.

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