Replacing Traditional Classroom Lectures with Lecture Videos – An Experience Report

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ABSTRACT

Lecture videos are slides enhanced with the audio recording of the lecturer's talk. Such lecture videos offer numerous advantages to the students as well as to the lecturers themselves. The former may organize their studies in a more flexible way by consuming the content of a lecture anytime and at any place as often as they want. The latter do not have to give the same lecture over and over again and may use the saved time for personal contact to the students.
In this paper, we report on our experiences with using lecture videos in the course *Introduction to Object-Oriented Modeling* offered by the Business Informatics Group (BIG) at the Vienna University of Technology. We shortly review the structure of the course and discuss the creation and integration of the lecture videos. For the evaluation of this approach, we performed an online survey where the students could provide feedback. Parts of the results of this survey are discussed and included in the paper.

Categories and Subject Descriptors

K.3.1 [**Computers and Education**]: Computer Uses in Education—*distance learning*

General Terms

Human Factors, Documentation

Keywords

Teaching Object-Oriented Modeling, Basic Modeling Course, Lecture Videos

1. INTRODUCTION

New media offer much potential for enhancing teaching at universities [1, 8]. The novel technologies give solutions for a vast number of challenges lecturers were confronted with over decades. In this paper, we show how we use lecture videos in our course *Introduction to Object-Oriented Modeling* (OOM) offered at the Vienna University of Technology by the Business Informatics Group (BIG) to improve the flexibility of the course organization for the students.
The course OOM [4] consists of two parts: lectures and exercises. Whereas in the former, the theoretical aspects of Object-Oriented Modeling are taught, in the latter, students have to solve given exercises which they have to present to a teacher during lab sessions. The concepts of Object-Oriented Modeling are presented in the lecture on the basis of the Unified Modeling Language (UML)[1], a stable, standardized modeling language. One professor presents the syntax and semantics of the UML diagrams in a big lecture hall with the help of Power Point slides. Due to the stability of the UML, the contents of the lectures have hardly been modified for years and the presentations have been the same for several generations of students. Although the attendance of the theoretical lectures is not mandatory for the students, a deep understanding of their contents is a requirement for solving the exercises. When a student misses a lecture for whatever reason, e.g., illness or the exam of another lecture, he/she has to catch up on the content by himself/herself and can not benefit from the additional examples and information presented in the lecture. Despite the additional values gained by attending the lecture, we could observe a decrease in the number of students especially at the end of the semester when the workload in other courses increases. For preparing the exercises, the students only used the lecture slides and additional text books. However, in the lab sessions it became obvious that the students who attended the lectures had a much better understanding of the course content. In consequence, a big part of each exercise class was used for recapitulating the theoretical basics instead of discussing the actual modeling exercises. Furthermore, the almost empty lecture halls are not very motivating for the lecturer, because preparing and holding a lecture is very time-consuming, even if no new content is presented.
To overcome these problems, we decided to change the concept of the course. During the summer months of 2010 we produced lecture videos which the students could watch from anywhere at any desired time instead of attending a traditional lecture. To still keep in contact with the students and give them a chance to ask questions, we additionally designed special lectures where we concentrate on demonstrating practical examples on how to use the taught concepts instead of getting caught up in teaching the theoretical basics. A similar approach was also advocated in [6] where the goal was to use the supervised time for hands-on-experiences and team work instead of passive consumption of theoretical content. We experienced that with the presented approach,

[1] `http://www.uml.org`

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even in mass lectures it is possible to consider the individual needs and specific requests to a certain extent. This confirms observations of extensive studies as presented for example in [2, 11]. A literature review on the application of lecture videos is given in [8].
In this paper, we present our experiences with this new course concept. We first introduce our course and the teaching environment and explain the need for a change. In Section 3 we describe the changes we made while Section 4 briefly covers the technical details. Section 5 discusses the experiences we had with our new approach. Finally, Section 6 concludes this paper.

2. BACKGROUND

Our course *Introduction to Object-Oriented Modeling* (OOM) is offered twice per year and attended by 600-800 undergraduate students who study Computer Science or Business Informatics at the Vienna University of Technology. In OOM we teach modeling basics by introducing syntax and semantics of the following UML 2 diagrams: class and object diagram, sequence diagram, state diagram, activity diagram, and use case diagram. Despite the huge number of students, we try to avoid mass processing, but establish personal mentoring instead. The course is only awarded 3 ECTS credits resulting in a total workload of 75 hours for an average student, so the amount of time is very limited. Nevertheless we attempt to cover the theoretical background as well as the practical usage of the taught diagrams in our course.
Until summer term 2010, the course OOM was conducted in the following way. The course was divided into a lecture part and a lab part. The lecture consisted of six units covering the theoretical background of the taught UML 2 diagrams. Each lecture was given with Power Point slides accompanied by small practical modeling examples and syntax illustrations which were developed live during the lecture. For the practical part the students were divided into groups of about 50 persons. Each group met six times during the semester for a so-called "lab session" in order to discuss the solution of exercise sheets for practicing modeling. For each exercise the assistant professor chose one student who had to present and explain his/her solution. For further support, we provided various e-learning exercises including multiple-choice questions and practical modeling exercises. The students could voluntarily use the e-learning exercises to test their knowledge about the syntax and the theoretical background of the diagrams, as well as the interpretation of given diagrams and they could gain some modeling practice. If the students felt the need for more detailed reading material, we recommended them books such as [7, 9], or recently published [10]. Three exams assessed whether the students had reached the learning goals — if they understood the teaching material, as well as if they were able to apply the taught concepts to small "real world problems" [3]. A detailed description of the original course design is given in [4]. To apply the teaching concept, we used traditional methods and material such as Power Point or the blackboard, as well as more recent methods such as document cameras or e-learning. For more details on this approach, please refer to [5].
As stated before, the course OOM is taught each semester, so we had to give the same 6 theoretical lectures every single semester. In addition to that, the attendance of the lecture was very low as a lot of students learned from the lecture slides and/or books instead of attending the lectures. So we decided we should change the lecture part of our course design.

3. CONCEPT

We planned to enhance all the lecture slides with audio narration, thus producing lecture videos, as well as to provide these videos to the students and abolish the traditional lecture itself. Producing the videos is a very time-consuming process and we were not sure if the students would even prefer them over traditional lectures. Therefore we decided to do a test run with a less time-consuming method. We simply recorded the actual lectures[2] to find out if the students consider lecture videos useful and which features are important to them. The videos were provided "just the way they were" with hardly any post-processing at all. The videos turned out to be a big success. We asked the students about their opinion and they liked the videos a lot. Most students seemed to prefer them over traditional lectures, but a lot of the students also stated that they do not want to miss out on the chance to ask questions about the content of the videos in a face-to-face manner. Details about our experiences with the lecture recordings can be found in [5].
This experience motivated us even more to modify the lecture part of the course. Therefore we planned the following changes in the course design: We will use lecture videos instead of giving traditional lectures for teaching the theoretical background. In addition, demonstration sessions, where practical examples are shown and questions are answered, will be introduced.
We had submitted our idea of producing lecture videos for a contest called "Teaching Innovations Award" at the Vienna University of Technology and had won 500 student assistant working hours to support the realization of the project. So we hired two student assistants over the summer.

Lecture videos. When we decided to produce the lecture videos, we had absolutely no experience in this field and only a very limited budget. We could not afford a professional actor to enhance the slides with audio narration. This for sure would have been the preferred option, given that actors have learned how to speak and breathe properly when talking into a microphone. Another option would have been the two student assistants, but in the end we decided that the lecturers, who have given the traditional lectures in the last semesters, would be the best choice to record the videos. This had two advantages: First, we already had lecture recordings from them giving the exact same lectures, and second they have extensive knowledge in the area of the UML. To keep the workload for the lecturers as small as possible, the pre- and post-processing of the videos was mainly done by the two student assistants. They listened to the lecture recordings from the semester before and wrote down everything the teacher had said thus producing a script for the recording. The professors recorded their speech and combined it with the corresponding slides. The two student assistants then prepared the final version of the videos adding subtitles, a chapter structure and animations where necessary. Section 4 covers the actual creation process of the videos in detail.

Demo sessions. The duration of the produced lecture videos is shorter than the traditional classroom lectures had been,

[2] `http://www.big.tuwien.ac.at/external/OOM.html`

because the usual disturbances during a lecture as well as questions from the students and elaborations from the professors were omitted. This resulted in about 5 hours free classroom time that we could now use for other purposes. We wanted to give the students the chance to ask questions about the videos, but based on former experience a "Questions and Answers Lecture" usually resulted in very few people actually attending the lecture asking very few questions. In addition to that, we also wanted to make the course more in step with actual practice than it had been before.
So we created a new concept we call *demo sessions*, where practical examples are demonstrated and questions are answered. The attendance is not mandatory and if a student wants to demonstrate a possible solution to one of the exercises, he/she is rewarded bonus points. Otherwise the professor or assistant professor giving the session demonstrates the solution. Table 1 shows the integration of a demo session into the semester schedule. The shown pattern is repeated five times, covering all five taught UML diagrams. One semester only has about 14 weeks (after subtracting public holidays and lecture-free time), so the five blocks are interlaced, e.g., the video of the second diagram goes online in the same week as the lab session for the first diagram takes place. Clearly, the demo sessions are only useful if the attending students have at least watched the video before and in the best case they have also already looked at the practical exercises.
When we asked the students about their opinion about the demo sessions, many of them stated that they liked the videos combined with a chance to personally ask questions and discuss the practical usage, but they would not want to completely miss out on "face-to-face time". Section 5 gives more details on our experiences and the students' comments. We regard the demo sessions as a very important part of the whole concept. Lecture videos are well suited for teaching theoretical basics of any kind, but they have their limitations when teaching practical aspects. When teaching modeling you also have to teach the approach on how to develop a model. This could also be done by videos using animated slides, but we think that a more interactive approach such as our demo sessions is more efficient when teaching modeling. Giving the students the possibility to ask and discuss questions will always be necessary. When teaching subjects that do not require giving practical examples, some kind of wrap-up sessions where the topics of the videos are summarized and questions are answered might be more suitable than demo sessions.

Week X	*Teacher Activities*	*Student Activities*
X – 2	Video online	Watch video
X – 1	Demo session exercises online	Prepare solutions
X	Hold demo session	Attend demo session Participate in discussion Ask questions Demonstrate a solution
X	Lab session exercises online	Prepare solutions
X + 1	Hold lab session	Attend lab session Demonstrate a solution

Table 1: Time schedule for one diagram

4. VIDEO PRODUCTION

The production of the lecture videos was conducted in three steps, whereas the first two steps were carried out in parallel: (1) Transcription of the existing lecture recordings, (2) Evaluation of software enabling the creation of the lecture videos, (3) Production of the videos.

Transcription. In a first step, the spoken text of the existing lecture recordings was transcribed slide-per-slide. Additionally, the resulting text was enhanced by correcting slips of the tongue, incorrect word orders, and similar errors happening when giving a presentation. Nevertheless the characteristics of the text remained untouched. Thus a script for the audio narration of the slides was produced which still contained the personal touch of the lecturer concerning the choice of words and the way of explaining the concepts. The transcribed text of each slide was also added as note to the corresponding Power Point slide. Thus we were able to provide the students with printable slides including the whole spoken text for each slide using the Notes Page view of Power Point.
The transcription was carried out by the two student assistants and took about 110 hours.

Software evaluation. We had no former experience in producing lecture videos, therefore we conducted a software evaluation in parallel to the transcription of the recorded lectures to find out which software fits our needs the best. The functional requirements driving this evaluation were derived from the survey conducted in the end of the summer term 2010 which can be found in [5]. In this survey we asked students about desired improvements of the videos of the recorded lectures. Out of the results we identified the following functional requirements which the software for producing the lecture videos should fulfill.

- *Slide + audio + text*: Besides the slides and the audio narration, the lecture video shall also display the spoken text for students with another mother tongue than German or students with disabilities.
- *Printable version with spoken text*: A printable version of the slides including the whole spoken text for each slide shall be producible.
- *Video download*: The downloading of the videos shall be possible in order to enable the offline watching of the lecture videos.
- *Navigation*: The navigation through the slides according to their chapter structure shall be possible.
- *Searching*: The search for phrases shall be possible in the text of the slides themselves, as well as in the spoken text.

Additionally to these requirements derived from the OOM students' feedback, we identified the following functional and non-functional requirements.

- *Integration of existing videos*: The software for producing the lecture videos shall enable the integration

of existing videos, such as videos recorded with the document camera.

- *Easy changes*: Another requirement was that it shall be easily possible to make changes in the slides, audio narrations, and the transcription independently of each other, such as re-recording the audio narration of single slides or correcting typing errors on affected slides.
- *Usability*: The software shall be easy to use in order to enable the audio narration, pre-, and post-processing of the videos without high training efforts.
- *Costs*: Due to limited budget available for producing the lecture videos, the software shall be available at low cost.

The software evaluation was again carried out by the two student assistants. For this purpose, they conducted an Internet research for available tools that enable the production of lecture videos. 11 applications were selected for further evaluation according to the aforementioned requirements. In this evaluation the applications were tested by creating small lecture videos comprising all the needed requirements. Additionally the license costs as well as the supported video formats were collected for each application. The results of this evaluation are depicted in Table 2. Of the 11 evaluated applications, 5 fulfilled all the requirements – Adobe Captivate 5, iSpring Pro 5.5, articulate Presenter 09, authorPoint Lite 3.5, and Adobe Presenter 7 –, whereas 6 only fulfilled them partly – Microsoft Power Point 2007, Wondershare Power Point 2 Flash Professional 5.6, Lecturnity 4, authorPoint 3.9, Camtasia Studio 7, and AllCapture Enterprise 3. Adobe Captivate was the most comfortable tool and licenses were already available, so this software was chosen for producing the lecture videos.
The selection and evaluation of the applications took about 95 working hours.

Video creation. The video production itself was conducted in the following six steps. (1) Preparation of the videos, (2) Recording of the audio narration, (3) Post-processing of the audio narration, (4) Definition of a chapter structure for navigation, (5) Creation of animations for supporting the audio narration, (6) Publication of the videos.

1. Preparation of the videos
For preparing the lecture videos, the only step needed when using Adobe Captivate is to create a new project and import the respective Power Point slides. However, due to incompatible image formats used in the slides, some graphics had to be adapted in addition. One noteworthy feature of Adobe Captivate is that it also imports the text included in the slide notes. Thus the transcribed speaker text for each slide was also automatically imported. Adobe Captivate enabled therewith to not only search for phrases in the slide texts, but also in the speaker texts.

2. Recording of audio narration
As stated before, the recording of the audio narration was done by the lecturers themselves. For that purpose, a 15 minute tutorial on how to record the audio was given to the lecturers by the student assistants.
For enhancing the lecture slides with one hour of audio narration, 10 hours of work were necessary for the lecturer on average. However, a learning curve was observable. Whereas the recording of the audio narration of the first lecture (which is the most extensive one) lasted for about 20 hours, only 8 hours were needed in order to record the last one.

3. Post-processing of audio narration
Some post-processing of the audio narration was necessary, such as erasing silent parts of the recordings and ensuring an equal sound volume through all slides of one lecture.

4. Definition of navigation
To enable an easy navigation through the lecture videos, a chapter structure was defined and the corresponding slides were assigned to them accordingly.

5. Creation of animations
An important step of the video creation was to add animations to the videos in order to support the explanations given in the audio narration. For instance the explanation of token flows in activity diagrams and similar concepts were animated in the slides to facilitate a better understanding.

The post-processing steps 3-5 were carried out by the student assistants and together took about 230 hours.

6. Publication of videos
The last step comprised the publication of the lecture videos. Adobe Captivate produces Flash videos as output. All videos were made available to the students through our e-learning platform TUWEL[3].

The result of the whole project comprised five lecture videos, one for each of the five mainly taught diagrams (the lecture about the object diagram was included in the class diagram video). The overall duration of the videos is 6 hours. For each video, the students are provided the following resources:

- An online version of the lecture videos (in Flash) which is searchable and structured according to the covered chapters
- A download version of the lecture videos (in Flash)
- A printable version of the slides (in pdf)
- A printable version of the slides including the whole spoken text for each slide (in pdf)

The lecture videos and all corresponding teaching material can be downloaded at the web page of our book [10][4].

5. EVALUATION

From the teachers' point of view, the project was a big success. The grades of the students improved a little bit, although we increased the level of difficulty of the lab exercises and the test exercises compared to the semesters before, because we were expecting better results. We also noticed

[3] `http://tuwel.tuwien.ac.at`
[4] `http://www.uml.ac.at`, section "Unterlagen" (all the material is in German)

Software	*Slide*	*Audio*	*Text*	*Search*	*Navigation*	*Video integration*	*Usability*	*Easy changes*	*Format*	*Costs*
Adobe Captivate 5	✓	✓	✓	✓	✓	✓	~	✓	swf	€ 839 license available
iSpring Pro 5.5.0	✓	✓	✓	✓	✓	✓	✓	✓	swf	€ 200
articulate Presenter 09	✓	✓	✓	✓	✓	✓	✓	✓	swf	€ 570
authorPoint Lite 3.5.13.1	✓	~	✓	✓	✓	✓	~	~	swf	free
Adobe Presenter 7	✓	✓	✓	✓	✓	✓	✓	✓	swf	€ 532
Microsoft Power Point 2007	✓	~	~	×	~	✓	✓	✓	ppt, pps,htm	license available
Wondershare PowerPoint 2 Flash Professionell 5.6.0	✓	~	~	×	✓	✓	~	✓	swf	€ 50
Lecturnity 4	✓	✓	×	✓	✓	✓	~	~	mpeg4, swf, flv, WindowsMedia, RealMedia, Lecturnity format	€ 149
authorPoint 3.9	✓	✓	✓	✓	✓	✓	~	×	swf, WindowsMedia	€ 240
Camtasia Studio 7	✓	✓	✓	×	✓	✓	✓	~	mp4/flv/swf, wmv, mov, avi, m4v, mp3, rm, camv, gif	€ 240
AllCapture Enterprise 3.0	✓	✓	×	×	×	✓	✓	~	swf, mpeg, WindowsMedia	€ 249

Table 2: Results of the software evaluation

a significant change during the lab sessions. The students asked as many questions as before we changed the course structure, but their questions were a lot more advanced.
Creating the videos was very time-consuming. Even after the preparation of the script by the student assistants, the lecturer still needed about ten hours to produce one hour of a video, but it was also very interesting and poses a considerable alternative to classroom lectures in other courses as well. Our biggest advantage is the fact that we do not have to teach the theoretical basics every single semester anymore. Teaching the syntax and semantics over and over again got very tiring. Now, in the demo sessions we can concentrate on teaching practical aspects, on pointing out unclear sections in the UML 2 standard resulting in different interpretations in the scientific community and on answering the students' questions as well as discussing probable drawbacks of the UML 2 standard. This is much more fun than simply reciting theoretical concepts.
The videos can be updated with little effort. Small updates that don't require changing the audio files such as correcting spelling mistakes in the slides can be done by a student assistant or even the secretary. The slides have to be updated and new versions of the video and the corresponding resources have to be produced. If the audio narration of a slide has to be updated, the lecturer that originally did the audio narration has to newly record the part that has to be changed. Then anybody with sufficient knowledge about Adobe Captivate can embed the new audio file into the video, thus exchanging a part of the audio file with the new one.
To find out more about the students' point of view, the students were asked to voluntarily take part in a survey covering the teaching methods and materials used in the course. We did surveys at the end of summer terms 2011 and 2012. Due to some major changes in our Computer Science curriculum, the survey of summer term 2012 is not very representative. So we decided to refer to the results of the 2011 survey in this paper. In summer term 2011, 210 students out of a total of 520 course participants took part in the survey which results in a participation rate of 40%. The students showed great motivation in giving feedback to help us improve our course and we learned a lot from the survey. Concerning the lecture videos, the students mainly stated the following advantages:

- *Flexible timing*: They can watch the videos wherever and whenever they want and make breaks adapted to each individual learning style. Especially in courses with a high number of participants, lecture halls tend to get very crowded and the limited space and oxygen as well as a certain noise level hinder concentration. With a video you can choose the location that suits you best.
- *Suits many different backgrounds*: Students with previous knowledge can easily skip certain parts while students that are hearing the topics for the first time can even watch chapters several times. This is also a big advantage for students with a different mother tongue than German.
- *Motivation*: Some students stated that they would have never visited a traditional lecture but could easily motivate themselves to "watch TV". Watching the videos again the evening before the test is a nice repetition.
- *Examples*: The short practical examples in combination with the animations helped understanding the matter, but the students wish for even more examples.

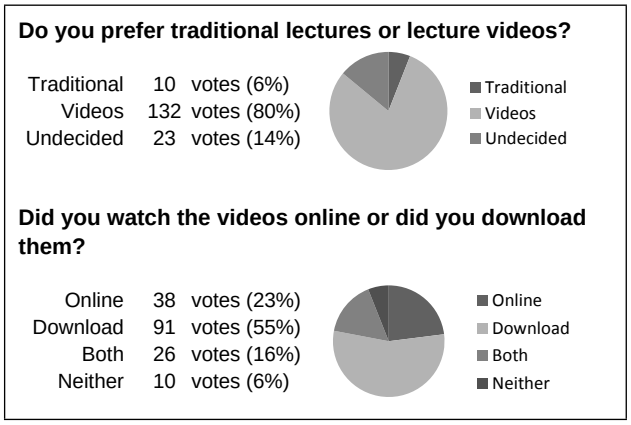

Figure 1: Survey results concerning the lecture videos

The feedback was all in all very positive. When we asked the students if they preferred a traditional lecture or lecture videos, 80% stated that they preferred the videos and about 14% stated that they do not care which of the two, so only 6% preferred traditional lectures (see also Figure 1). As always, doing both – a traditional lecture and lecture videos – would be the perfect option for a lot of students. Then everybody could choose to watch the videos, attend the lectures or do both. This would be preferable but due to budget restrictions this is not possible. In addition to that, usually the number of students that want the possibility to attend a traditional classroom lecture is much higher than the number that actually attends them.
As already mentioned, the students were provided with an online version as well as a download version of the videos. We expected that most of the students would download the videos, but a surprisingly high percentage of students, namely 39%, watched the videos online or used both options (see also Figure 1). Therefore we will also provide the chance of watching the videos online in the future.
We also asked the students for feedback about the demo sessions. 98% stated that they liked the idea of replacing traditional classroom lectures with lecture videos and demo sessions. 77% of the students that actually attended the demo sessions stated that the sessions proved to be helpful to understand the subject and prepare for the lab sessions. The results of the survey questions concerning the demo sessions may be found in Figure 2.
In short, the students stated the following advantages of the new concept:

- *Ask questions*: If you watch the video before the demo session, you can prepare questions – often during traditional lectures the questions come to mind only after the lecture or while re-reading the slides at home when it is too late to ask questions.
- *Practical focus*: The teachers can concentrate on the practical aspects and have more time for discussions than in traditional lectures.
- *Bonus points*: If you are well prepared you can earn some bonus points to improve your grade.
- *Preparation for lab sessions*: The demo sessions help with the preparation of the lab exercises and show how to generate models out of verbal or textual descriptions.

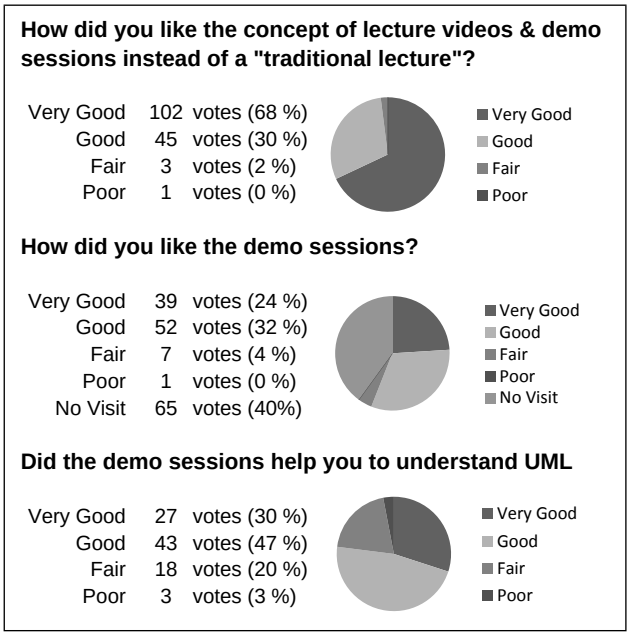

Figure 2: Survey results concerning the demo sessions

Most of the feedback was positive. Some students stated that they did not have the motivation to watch the video before the demo session and therefore the demo session did not help them at all. Others mentioned that they did not need additional practice, they understood the videos and felt prepared good enough to do the lab sessions and ask questions there. These two statements show that the demo sessions are not the overall solution for everybody, but they are an additional chance to practice modeling that at least about half of the students surveyed used.
As already mentioned, to produce the videos we also prepared scripts for each slide of the presentation. We decided that we would also provide a printable version of the slides with the corresponding script to the students as we already had the texts anyway. This "slides with speech as text" version was meant for students that have a different mother tongue than German and for students with disabilities. We did not expect a lot of students to use this version for studying. To our big surprise, 75% of the students that did the corresponding part in the survey stated that they used this version (see also Figure 3). They stated the following main reasons:

- *Easy to read*: The text is a script and not scientifically written, so it is very easy to understand.
- *Quick information finding*: If you look for a specific topic, you can find it in the text more quickly than in the video. You could also only read the slides and use the text as additional information if needed.
- *Supports visual learning*: Some students prefer reading to listening.
- *Easy to carry around*: Printing out a pdf file to read

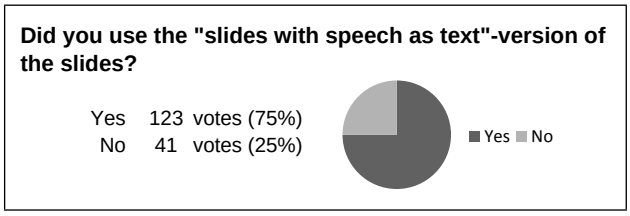

Figure 3: Survey results concerning the "speech as text"-version of the slides

> it in the park or on the bus is still easier and more intuitive than watching a video.

In the survey, the students also offered a lot of suggestions on how to improve the videos. They would like to have even more animations embedded in the videos, some stated that they need "something to move" on each slide otherwise they are bored. There is also still potential to improve the sound quality and the quality of the demonstration of some of the examples. A lot of students asked for the possibility to search the video – this is quite interesting because we already included a search option (see Section 4). Another desired improvement was providing the videos in a format other than flash, preferably in a format that can also be watched on mobile devices such as iPhones. We hope that we can provide other video formats soon.
In our first survey regarding lecture videos in 2010 [5], the survey we derived part of the requirements for our videos from, some students also stated that they would like to see the lecturer picture-in-picture with the video of the slides. This falls in the same category of desired improvements as the aforementioned need for "something to move" on the slides. We decided not to record the lecturer when recording the audio narration for two reasons. First of all, the lecturers often did the recordings from home or late in the evening and not in a professional studio and the recordings were not done all at once. The videos would not look appealing with background and robe changes within one video. Second, during the post-processing of the slides, the audio file was modified, e.g., long periods of silence were erased. This would not have been possible that easily in combination with a video of a lecturer that moves at least a little bit which would show if parts of the video were cut out.

6. CONCLUSION

In this paper, we reported our experiences on enhancing the course Introduction to Object-Oriented Modeling with lecture videos. We hope that this paper is helpful for lecturers who are organizing similar courses. Despite the vast amount of literature on e-learning technologies and lecture videos in general, we could not identify a paper on the application of lecture videos for teaching Object-Oriented Modeling which provides concrete strategies for setting up a course enhanced with lecture videos.
Overall, lecture videos offer more learning flexibility to the students than traditional lectures. The usage of these lecture videos may be seen as the next step to apply novel technologies to improve learning experience and learning success. In previous work [5], we demonstrated how technologies like document cameras, lecture recordings, and self assessments integrate smoothly in a traditional lecture. The lecture recordings were simply taken during the lectures and were of bad quality. Instead, the lecture videos were based on a prepared script and recorded in a silent environment. With the lecture videos, we drastically changed the organization of the course. An online survey conducted at the end of the semester indicated a high acceptance rate of the lecture videos by the students and that lecture videos are valuable supplemental material. Finally, with the lecture videos we have the chance to target not only our students at the Vienna University of Technology, but we may attract a larger audience over the web. We hope that our lectures may support many people in learning Object-Oriented Modeling on the basis of the UML and we also hope to get much feedback to steadily improve our lecture.

7. REFERENCES

[1] B. Alexander and A. Levine. Web 2.0 storytelling: Emergence of a new genre. *EDUCAUSE review*, 43(6):40–56, 2008.

[2] J. Barokas, M. Ketterl, and C. Brooks. Lecture capture: Student perceptions, expectations, and behaviors. In *World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education*, pages 424–431, 2010.

[3] M. Brandsteidl, M. Seidl, and G. Kappel. Teaching Models @ BIG: On Efficiently Assessing Modeling Concepts. In *Educators' Symposium @ Models 2009*, 2009.

[4] M. Brandsteidl, M. Seidl, M. Wimmer, C. Huemer, and G. Kappel. Teaching Models @ BIG: How to Give 1000 Students an Understanding of the UML. In *Promoting Software Modeling Through Active Education, Educators' Symposium Models'08*, pages 64–68. Warsaw University of Technology, 2008.

[5] M. Brandsteidl, K. Wieland, and C. Huemer. Novel Communication Channels in Software Modeling Education. In *MODELS'10 Proceedings of the 2010 international conference on Models in software engineering*, pages 40–54. Springer, 2010.

[6] J. Foertsch, G. Moses, J. Strikwerda, and M. Litzkow. Reversing the lecture/homework paradigm using eTEACH web-based streaming video software. *Journal of Engineering Education*, 91(3):267–274, 2002.

[7] M. Hitz, G. Kappel, E. Kapsammer, and W. Retschitzegger. *UML@Work, Objektorientierte Modellierung mit UML 2*. dpunkt.verlag, Heidelberg, 2005.

[8] M. Krüger and E. Plaza. Vortragsaufzeichnungen–ein querschnitt über die pädagogischen Forschungsergebnisse. In *Proceedings of the DeLFI Workshop*, 2005.

[9] C. Rupp, S. Queins, and B. Zengler. *UML Glasklar. Praxiswissen für die UML-Modellierung*. Hanser Fachbuch, 2007.

[10] M. Seidl, M. Brandsteidl, C. Huemer, and G. Kappel. *UML @ Classroom: Eine Einführung in die objektorientierte Modellierung*. dpunkt.verlag, Heidelberg, 2012.

[11] B. Zupancic and H. Horz. Lecture recording and its use in a traditional university course. *SIGCSE Bull.*, 34(3):24–28, June 2002.