

The use of Video in a Mixed Classroom Approach

Full version with appendix

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ABSTRACT

This paper reports about an introductory programming course in which we have introduced 67 small videos. With use of the videos we have transformed the course from a traditional classroom approach to a mixed classroom approach. These terms are used as a contrast to “flipped classroom” which has become popular during the last few years. The results brought forward in the paper are, to a large degree, based on the student’s answers to a questionnaire about the use of videos during the course. It is concluded that most students evaluate the use of videos in a positive way, but that quite a few students do not watch all the available video material. In addition, it is concluded that the conditions for creating video lectures on a larger scale must be carefully analyzed, in order to find sustainable models that also fits the working conditions of the teachers.

1. INTRODUCTION

In 2014 I wrote a paper about the use of short videos in an introductory programming course at Aalborg University [4]. The paper was based on feedback from two questionnaires, both of which were answered by the students who attended the course in 2013 and 2012 respectively. Based on a situation where only a limited number of videos were produced, the students expressed a substantial interest in short, supplementary course videos.

During the fall of 2014 more videos were produced (see Figure 2 for an overview). In addition, the course model was adjusted. In this paper we discuss our experiences from the new course model. As in the first paper, the current paper is (in part) based on the student’s answers to a questionnaire.

In the remaining parts of this paper we will first introduce the course and the new course model. Following that, in Section 3, we briefly give some facts about the videos, as used in the fall of 2014, supplemented by experience from their use in the course (in Section 4). The mixed classroom

approach is discussed in Section 5, and the conclusions are drawn in Section 6.

2. ABOUT THE COURSE - AND COURSE MODELS

The course is about imperative programming in C. The course is attended by first semester students of the bachelor programmes in computer science and software engineering at Aalborg University. In the 2014 edition of the course, approximately 170 attended the course in the beginning, and 145 attended just before the exam. Additional course details can be found in the first paper that we published about the use of video in the course [4].

Until the fall of 2014, the course followed a model with approximately two hours of plenum lecturing (105 minutes) and approximately two hours of exercises (in the subjects just lectured). We will refer to this model as a *traditional classroom* approach.

In the fall of 2014 we introduced a *mixed classroom* approach, which organizes the course as follows:

1. Repetition of key insight from the previous lecture, feedback on program submissions [3], and introduction to the forthcoming exercises, all together lasting 30 minutes.
2. Exercises in group rooms for about two hours.
3. Lecture in plenum that provides an overview of new material, lasting 75 minutes.
4. Video lectures (at home) that supplies details about selected topics from the lecture (in item 3).

In this course model, the students will have preparation time in between the lecture (where new material is presented) and the exercise slots. The shorter lecturing time (compared with the traditional classroom model) is compensated for by the availability of a number of short videos (see Section 3). During the plenum lectures the students obtain an overview of the course curriculum. In addition, key areas of the course material is presented. Course details are available as video lectures. The students are requested to study these videos as part of their preparation before the next course exercise session.

The third alternative course model is the *flipped classroom* [2]. In recent years this model has attracted a lot of interest. The main idea in a flipped classroom model is to spend the time at the university for *active learning*, and to receive the *instructional content* outside the classroom (watching instructional videos, and reading appropriate literature as it fits the need of the course as well as the learning preferences of the individual student). In the flipped classroom model there is no time devoted to lectures in plenum. We use the terms “traditional classroom” and “mixed classroom” as natural counterparts to the buzzword “flipped classroom”.

It may be asked why we chose a course model in between the traditional and the flipped model. We feel strongly that it is important for the teacher and the students to be together - in space and time - at least occasionally. There is a century long tradition for this organization, crosscutting the levels of the educational systems. Without this anchor point the course will diffuse for some students. In some sense, the plenum lectures *constitute* the course.

3. ABOUT THE VIDEOS

The videos used on the course have been developed over three years.

The total playing time of the 67 course videos is 11 hours and 31 minutes (corresponding to 691 minutes). In the course period (from September 1, 2014 to January 31, 2015) the videos in “Imperative Programming” have been played approximately 6.000 times, for a total for approximately 25.000 minutes. In case all 145 students would have seen all videos (once) in their total lengths the playing time would have been 100.269 minutes. Thus, an “average student” managed to see 1/4 of the video contents which was made available for the course. The average length of a video lecture is 10:19 minutes, whereas the average, actual playing time of a video lecture is 4:09 minutes.

It is clear from these statistics that many (most) videos are not watched from the beginning to the end. Some students get bored and stops, some skip selected parts of a video, many watch the video at 125% or 150% speed (as recommended during the course), and some just clicks the video link and stops again after a few seconds. Also, some videos are targeted at students with special interests or needs. Nevertheless, it will be a future goal to reach a higher playing ratio of the course videos, primarily because the knowledge gained from the videos is necessary for successful participation in forthcoming exercise sessions. It is interesting to discuss how this may be obtained (see Section 5).

The graph in Figure 1 shows the distribution of the plays during the course period. The peak in the beginning of the semester stems from the videos that instruct in tool setup and tool usage. The even more significant peak at the end of the semester is (in part) attributed to the videos about terminology, which were popular as part of the student’s exam preparation efforts.

4. THIRD RUN EXPERIENCE

In this section we will summarize the most important and most interesting *qualitative feedback* from the questionnaire, as submitted to the students in the 2014 class. The quan-

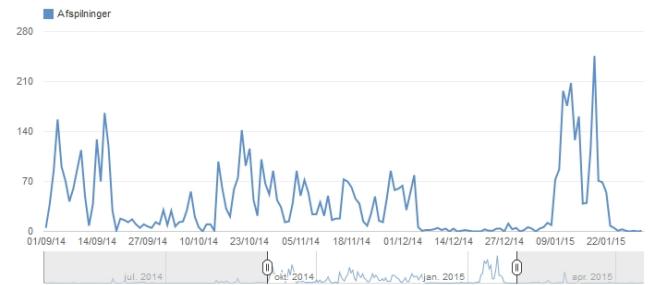


Figure 1: The distribution of video plays during the course period, as reported by YouTube analytics.

titative feedback is reflected in Appendix A. As already mentioned, this is the third time we conduct a study of the use of video in this particular programming course. Experience from the first and second run appears in the original paper [4].

Most trends, as reported in the first paper, are also reflected in the student’s answers to the latest questionnaire.

More than 75% of the students (who submitted answers the questionnaire) like the slightly shorter lectures, as practiced in the mixed classroom approach (see Section 2). Several students emphasize that the time devoted to actual programming during the exercise sessions (guided by the teacher and by teaching assistants) is the most important part of the course. The mixed class room model gives a bit more time for exercises, and we use time (just before the lecture) to introduce the exercises such that most student can get started working on the exercises without too many frustrations.

One respondent states that *it is important that the lectures are not too long or too heavy*. Another writes that *it is better that difficult topics are explained in videos, rather than wasting time on these in lectures*. Difficult topics may give rise to questions from weaker students, which takes time and concentration from the other students.

When asked about “flipped classroom” versus “mixed classroom”, only 15.5% of the respondents prefer a more radical flip of the classroom. A total of 76% are not in favor of a flipped classroom in this particular course.

One student admits that *I suspect myself for not being able to cope with the total responsibility to see the videos* (instead of going to the lectures). Another states that *the university is already very impersonal. Removing the lectures [...] makes this even worse*. In case the classroom is flipped, a couple of respondents point out that it is important to provide an open forum for questions, dialogue and feedback. This can be interpreted as a need for a computer mediated forum, or for live question and answering sessions. A student thinks that a flipped classroom mode will be an *excuse for not showing up*. In addition this student states that *I think we miss something by not being able to ask question during the lectures*.

	Number of videos in category	Average number of plays per video in the category	Average total play time (minutes) per video in the category
Overall topics about programming	3	107	461
Software installation and use of tools	9	95	269
C operators	17	75	266
Types and data structures	10	99	470
Input and output	2	111	642
Control structures	6	73	305
Functions and parameters	5	110	535
Other programming topics	3	34	168
Exercises and solutions to exercises	6	49	260
Terminology	5	185	717

Figure 2: A tabular presentation of the video categories (by rows), the number of videos in each category, the number of times each video (in the category) has been played in average, and the number of minutes each video has been played in average. At course start there were 170 students, and at the end of the course (just before the exam) there were 145. All data in the table are collected from September 1, 2014 to January 31, 2015.

5. DISCUSSION

The mixed classroom approach blends traditional auditorium lectures and video lectures. The main idea is to keep the best from the traditional approach (the class meets regularly) and to introduce new possibilities with video lectures (give room for more active learning at university, just-in-time video lectures). In this section we will discuss the idea of the mixed classroom approach - in general, and in the context of the introductory programming course.

In this particular course we have implemented the mixed classroom model by keeping the number lectures constant (relative to the traditional approach), but making each of the lectures shorter. The use of videos gave time for the half hour of initial repetition, feedback about program submissions, and for introductions to exercises. As such, the use of videos improved the conditions for successful accomplishment of the exercise sessions. It did not reduce the total time spend in the auditorium. Rather, the auditorium time was cut into two parts: Repetition etc. in the first part and a short traditional lecture in the second part (with exercises in between).

As an alternative implementation of the mixed classroom approach, it may be considered to simply replace a number of traditional lectures with video lectures. As an example, every second traditional lecture could be given as a video lecture; or the second part (the second hour) of each traditional lecture could be transformed to a video lecture. If auditoriums are scarce resources, one of these implementations of the mixed classroom approach may turn out to be attractive, seen from a university point of view. From a student point of view, however, it is most likely a bad idea to reduce the teaching time at university (and to prolong the preparation time at home). It is far more attractive for the students to keep the teaching time at university constant, shortening traditional lectures (compensated for by video to be watched at home) and lengthening the exercise time at university.

The use of video lectures may be connected with staff cost

reductions. True enough, most videos can be used a number of times (3-5 years in a row, perhaps), and thereby it may save teaching hours. On the other hand, the production cost behind the videos may be high - depending on the way the videos are captured, shared, processed, and disseminated. The production of videos will be felt as a major shift in course preparation work of the teachers. Most teachers will be mentally affected if/when traditional lectures are recorded in the auditorium (it puts strain on the teachers that everything said during the lecture can be recalled from the video). If the videos are captured "in a studio setting" this places most teachers in a new teaching situation. In cases where the teacher must control both the contents of the lectures and the video capturing/editing of these, even more challenges must be dealt with. On top of this a number of legal issues may show up, such as copy right details.

As noticed in Section 2, not all students watched all the videos in the imperative programming course. In the programming course, on which this paper is based, the "average student" only received 1/4 of the total video content. It is not the goal to force all students to see all the videos, from start to end. Some videos address special needs and special topics, which are only relevant for a minor fractions of the students. It is important, however, to ensure that the students are well-prepared for the exercises which depend on the contents of one or more videos. Therefore, it is interesting to consider means to improve the playing ratio of the videos, which are offered for a given course.

It may be possible to introduce activities in association with the videos, which encourage students to study more video material. Quizzes [1] may be one such activity. Quizzes based on multiple choice questions are attractive in this context. By use of quizzes, students may confirm the understanding of the video contents, and teaching staff may be able to check that (or if) the students are prepared before the exercise sessions. Once created, the quiz can be conducted independent of additional teaching resources (because a computer can do the work). However, the creation of good quizzes may be costly. Video production followed

by quiz production is, in particular, a costly combination.

In some teaching regimes (such as the one at Aalborg University) students will typically be encouraged to take the quizzes by motivation. In the traditional US teaching regime, the students will typically be forced to take the quizzes, because they are graded (and part of the course exam).

6. CONCLUSIONS

Three years in a row we have examined the student's reactions to the use of video lectures in the Imperative Programming course at Aalborg University. Almost unanimously, the students react positively towards the use of small videos. The mixed classroom approach, which relies on a mixture old fashioned lectures and video lectures, seems to please most students. More than half of the students prefer to learn about programming from a video instead of reading about programming in a text book. Only a minority of the students wish a more radical flip of the classroom (such that all lecturing takes place via video).

Despite the positive feedback from the students, there are many students who do not watch the videos. Some of these students may not be well-prepared for the exercise sessions, which relies on the video lectures. Therefore it seems attractive to consider additional encouragements for these students, such as a quiz in the slipstream of every video. In the next course offering we plan to introduce such quizzes in the course.

If video lectures are introduced more broadly in the university curriculum the task of creating such videos must be carefully analyzed. It must be decided if additional resources are needed for production of the videos, or if a redistribution of the existing resources will be adequate. It is relatively clear that the introduction of video lectures is an investment. Video lectures can be used over a range of years. In addition, the use of video may lead to greater student satisfaction in the courses (and maybe even better performance/grades of the students).

APPENDIX

A. THE 2014 QUESTIONNAIRE

In this section we reproduce the questions of the 2014 questionnaire (translated from Danish to English), and we show the number of responses in each category. A total of 71 students submitted answers the questionnaire. The questionnaire was submitted to a total of 179 students. It was enforced that a given student can only submit his/her answers once. Question 7 allows the students to select more than one answer; The other questions forces the student to pick a single answer. An additional comment text box was provided for each question, and at the end of the questionnaire. The most interesting qualitative answers - from these text boxes - are addressed in Section 4 of this paper.

QUESTION 1:

The Imperative Programming course in the fall of 2014 made use of a number of videos in the most important areas of the course. To which extent have you seen these videos?

I have not seen any of them, and I don't remember that they were available	0	0%
I have not seen any of them, but I remember that they were available	0	0%
I have seen a few of these videos	21	29.6%
I have seen most of these videos	39	54.9%
I have seen all the videos	11	15.5%

QUESTION 2:

How do you evaluate your professional outcome from watching the videos?

Very Good	27	38.0%
Good	40	56.3%
Not so good	2	2.8%
Bad	1	1.4%
I don't know/not relevant for me	1	1.4%

QUESTION 3:

Will it be useful to support more subjects in Imperative Programming with short, focused videos - as supplements to the lectures? You may propose subjects in the comment field.

Yes - to a high degree	30	42.3%
Yes - to some degree	22	31.0%
No	11	15.5%
Don't know	8	11.3%

QUESTION 4:

How do you consider 'learning to program' from a video, compared with 'learning to program' from a textbook?

I prefer to read a book instead of watching a video	6	8.5%
I prefer to watch a video instead of reading a book	51	71.8%
No difference between video and book	13	18.3%
Don't know	1	1.4%

QUESTION 5:

Will it affect your participation in the lectures if there exist a number of videos on the topics exposed during the lecture?

Not at all	41	57.7%
To some degree	24	33.8%
To a high degree	6	8.5%

QUESTION 6:

As an alternative to short, focused videos one can imagine that an entire lecture is recorded on video. How do you consider this option?

A video of the entire lecture is more useful than a number of short videos	4	5.6%
I prefer a number of short videos on selected topics instead of a video of the entire lecture	36	50.7%
I would prefer both short videos and a video of the entire lecture	26	36.6%
For me it makes no difference which kind of video is being offered	5	7.0%

QUESTION 7:

How did you make use of the short videos in Imperative Program?

I watch them before the lecture, as a preparation	12	16.9%
I watch them after the lecture to re-capture subjects that I did not understand	42	59.2%
I watch them during exercise sessions in order to understand topics that are necessary for the problem solving	33	46.5%
I watch them as a preparation for the oral exam	55	77.5%
I watch them 'just in time' when I face a programming problem	37	52.1%
Other applications - describe it in the comment field	1	1.4%

QUESTION 8:

In the fall of 2014 a lecture typically lasted 75 minutes. Some subjects were only covered at an overall level, and the details were available in videos. What do you think about the idea of primarily covering selected course topics in short video lectures?

I think it is really good that some topics primarily are covered in videos	18	25.4%
I think it is OK that some topics primarily are covered in videos	39	54.9%
I think it is a bad idea that some topics primarily are covered in videos	3	4.2%
I think it is a very bad idea that some topics primarily are covered in videos	3	4.2%
I don't know	5	7.0%

QUESTION 9:

There exists a wealth of videos, for instance on YouTube about subjects that are relevant for the first year of studies. How often do you watch such videos?

At least once a day	0	0%
At least once a week	19	26.8%
At least once a month	26	36.6%
More rarely - or never	24	33.8%

QUESTION 10

The concept of 'flipped classroom' means that the traditional lectures are supported by video, and that the time spent at university is devoted to exercises and similar activities. Will you prefer a change of the course such that all lectures will be offered via video (in small parts), and such that the university teaching time is used for exercises, quizzes, repetition, feedback, workshops, etc.

No	26	36.6%
To some degree	28	39.4%
To a high degree	11	15.5%
Don't know	4	5.6%

QUESTION 11

You have now studied slightly more than half a year in either the Computer Science programme or the Software Engineering programme. Will it be useful for your outcome of the studies if video communication becomes more widespread in the courses?

No	2	2.8%
To some degree	24	33.8%
To a high degree	37	52.1%
Don't know	6	8.5%

B. REFERENCES

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