Analysis of analytics - videoclip watching activity in introductory physics

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Conference Topic: Physics in EE

INTRODUCTION

New method to study introductory physics in engineering education was presented by authors in SEFI2014 conference [1]. The key idea of the method is to engage students to study actively during the lectures and also outside classroom. The courses have continuous assessment with weekly measurement tasks or week exams. To save the valuable classroom time to week exams and active engagement activities, such as Peer Instruction [2] and interactive lecture demonstrations [3], the routine-like tasks like checking homework problems is implemented using video solutions to the homework problems. The video solutions are distributed using YouTube via course's e-learning environment.

1 SOME REPORTED IMPLEMENTATIONS OF VIDEO-ASSISTED LEARNING

Video and movie material have been used in supporting traditional teaching for decades [4]. On the last decade, the video streaming technology and the development of mobile technology have made it possible to tailor online videos for any use, also for educational purposes. This has inducted a number of new ideas for educational implementations such as Flipped classroom [5]. In flipped classroom, the students prepare themselves to the lectures with the help of pre-lecture assignments using video-lectures and other materials. In the lectures teaches use their pedagogical expertise to make meaning of the information student gathered before the lecture using the materials available. Video streaming technology has also made possible to do minor and major improvements for all types of lecture implementations. It is reported to increase the student activity and the amount of students passing the course [6]. Pre-lecture activities can be implemented using video tutorials [7]. Common idea of the most of the video implementations is to push the routine-like tasks in the video-assisted material, which is available 24/7 online, and to use the lecture time in more valuable way.

2 THE AIM OF THE STUDY AND BACKGROUND INFORMATION

In this study, the educational video watching activity of bachelor's level engineering students is analyzed. The study was carried out among elementary engineering physics course, "Mechanics, 3 ects" (ects = European Credit Transfer System) at Tampere University of applied sciences. The aim is

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to find out when the students watch videos, to which extend and whether it has positive effects in their study performance. *Table 1* shows the student groups included in this study together with background information.

Table 1: Summary of the student groups.

Group	Students	Average Grade	Videos	Videos Wached	Pass
A	36	2,72	33	58 %	92 %
B	37	1,95	38	41 %	73 %
C	48	2,17	26	32 %	88 %
D	53	2,43	33	39 %	98 %

The video clips showed solutions to algebra-based homework exercises and they were showed in YouTube as “unlisted” videos. The exercises were given to students once a week and the solution videos were opened for viewing after the week using links in Moodle. Therefore, it was possible to monitor the video watching activity of each student individually using Moodle’s logs. On the other hand, viewing activity and average watching times were accessible also in Google analytics. No points were given based on the homework activity and the exercises weren’t compulsory, but the topics covered were tested in week exams every other week.

The students felt that video clips are an excellent way to present results to homework problems and most of them reported that they had benefitted from watching the videos. The students also think that it is easier to follow the reasoning and the steps in solving the problem watching a video, instead of a written solution. This is due to the simultaneous oral explanation the teacher gives and the stepwise progression of the solution in video.

3 RESULTS

3.1 Amount of watched videos

The student groups included in this study had 26-38 videos available depending on the group (*Table 1*).The total number of students was 174. The average percentage of videos watched varied between 32-58 %, including also multiple views of some students. The distribution of viewing times is presented in *fig.* 1. Almost one hundred students had watched only a few videos and of them 39 students haven’t watched any video at all. On the other hand, a couple of students had more than hundred viewing times, which means approximately three views of each video on the average. The highest view count of a single video for a single person was nine times. Based on the data, it seems that the same persons tend to view the videos many times.

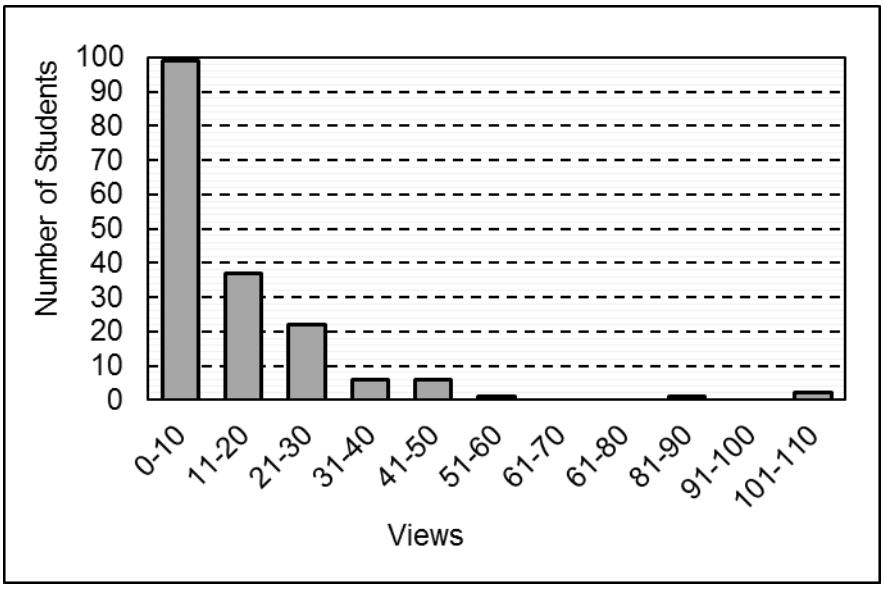

Fig. 1. Distribution of views.

In the feedback, almost all students reported that they considered the videos as a useful method to support learning. In this context, it would have been plausible to assume that they had watched almost all videos. However, majority of the students had watched only a few clips. One possible explanation is that the students have watched only those solutions, with which they had difficulties. Therefore, they considered videos as beneficial for their learning, in spite of the low view counts. This explanation is supported by the fact that many students scoring the highest grade didn't watch videos at all, as explained in the next chapter.

3.2 Relation between final grade and watching activity

Fig. 2 shows the average video view count of different groups diagrammed as a function of final grade. In the figure, the videos are categorized as "exercises" or "examples" depending on the availability and intended use of the video. To exercises, the solution videos are opened for viewing only after the students were asked to do them, whereas examples are available all the time to support studying.

Firstly, the watching activity seems to vary heavily among the groups and among grade categories. Secondly, in groups C and D those students who have failed to pass the course have no video watching activity at all. In general, the biggest differences in average watching counts are approximately tenfold. In *table 1*, the average grade and watching activity doesn't seem to have a clear correlation and therefore, no further conclusions can be made based on the group data.

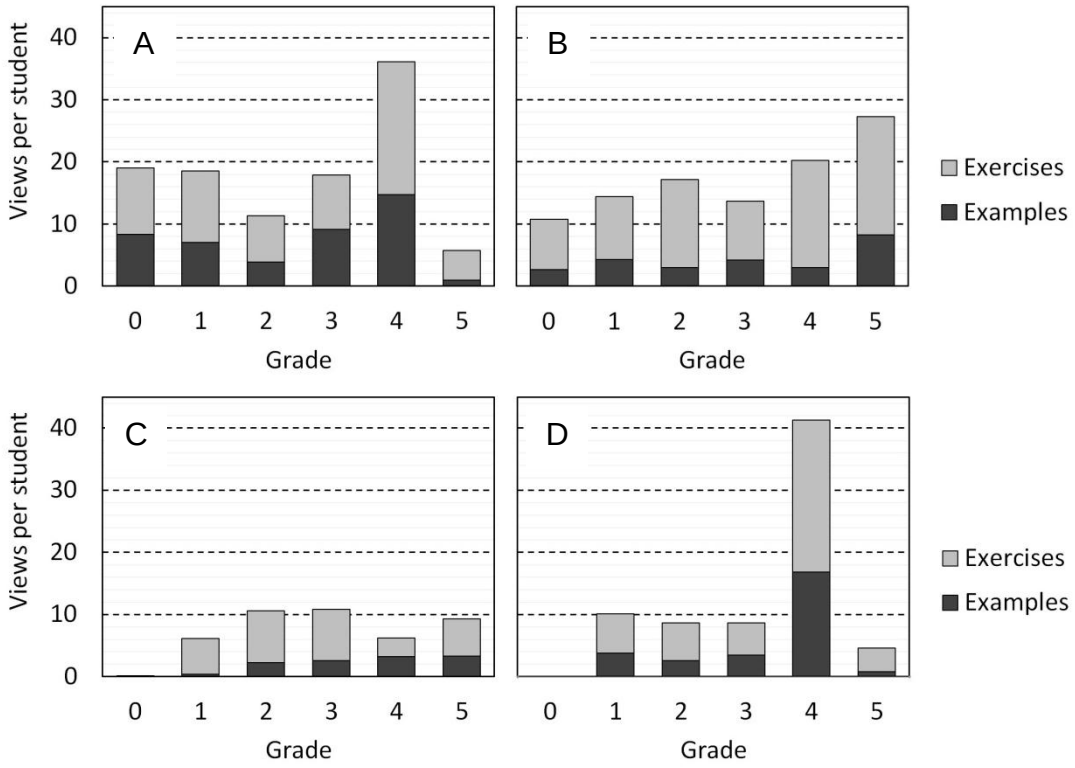

Fig. 2. Average video view count of different groups as a function of final grade.

To further analyze this possible relation between activity and grade, data of all students are presented in *fig. 3*. The average percentage of watched videos includes also multiple views as explained earlier. The bubble size corresponds the number of students at that grade category. Especially, the grade category 4 had two students, who had viewed the videos much more times than others in general. Their average view count for a video was three and the maximum was nine times. Since these two persons seem to differ from the rest of the students, the data is presented excluding their contribution (dark bubbles). The light bubble at grade 4 contains data of all students including the aforementioned two individuals.

Up to grade 4 there seems to be a relation that video watching activity has a positive impact what comes to the grade. The average amount of watched videos at grade category zero was 23 %, whereas in grade category four the percentage was 49 %, respectively. Assuming that the students haven't viewed the videos just for fun but rather in relation to homework, the explanation is quite simple: the more effort you put into an algebra-based exercise, the better you understand and get familiar with the physics and mathematics behind the exercise. The average activity in grade category five, is the lowest in all passed categories (grades 1-4). In this study, the students are bachelor's level freshmen, who have very heterogeneous background. Some have taken and passed all physics courses in high school, whereas some have studied almost no physics ever. Therefore, it is likely that participants included also those persons who had a strong background in physics. They needed no or very little practice to pass and even to score grade five and, obviously, lower the average count of videos watched in grade 5 category.

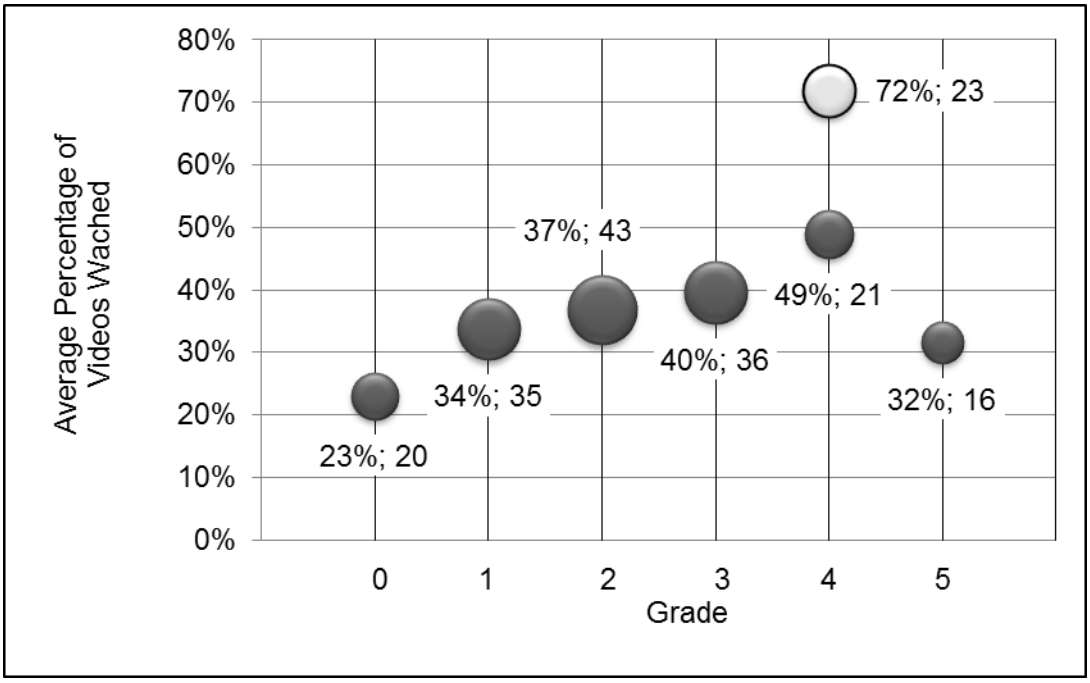

Fig. 3. Average percentage of videos watched in different final exam grade categories. The bubble size presents number of students at that category. Data labels contain the viewing percentage and amount of students.

3.3 Temporal distribution of watching activity

In traditional course implementation learning outcomes are tested at the end of the course using final examination. When using this type of summative assessment, the studying activity tends to be highest just before the final examination. To encourage the students to spread their activity throughout the course, continuous assessment was chosen to be used. All the course implementations in this study had a week exam every other week. In general, temporal distribution of students' activity can be surveyed for example using log books and questionnaires. However, in this study, the video watching activity is likely to be proportional to the amount of homework the students have done. The amount of views and watching times are easily accessible using Google Analytics, which offers a large variety of options (time, traffic sources, percentages watched, location, device, etc.) for analyzing the activity.

Fig. 4 shows the daily number of views (left axis, solid line) and cumulative watching time (right axis, dashed line) of all the videos offered to students in this study. Triangles indicate when week exams were arranged. Based on *fig.4*, it is quite clear that the students have mostly watched the videos 1-2 days before the exam, or even on the same day. This raises the question, that if there hadn't been week exams, could the video watching activity be concentrated to few days preceding final exams.

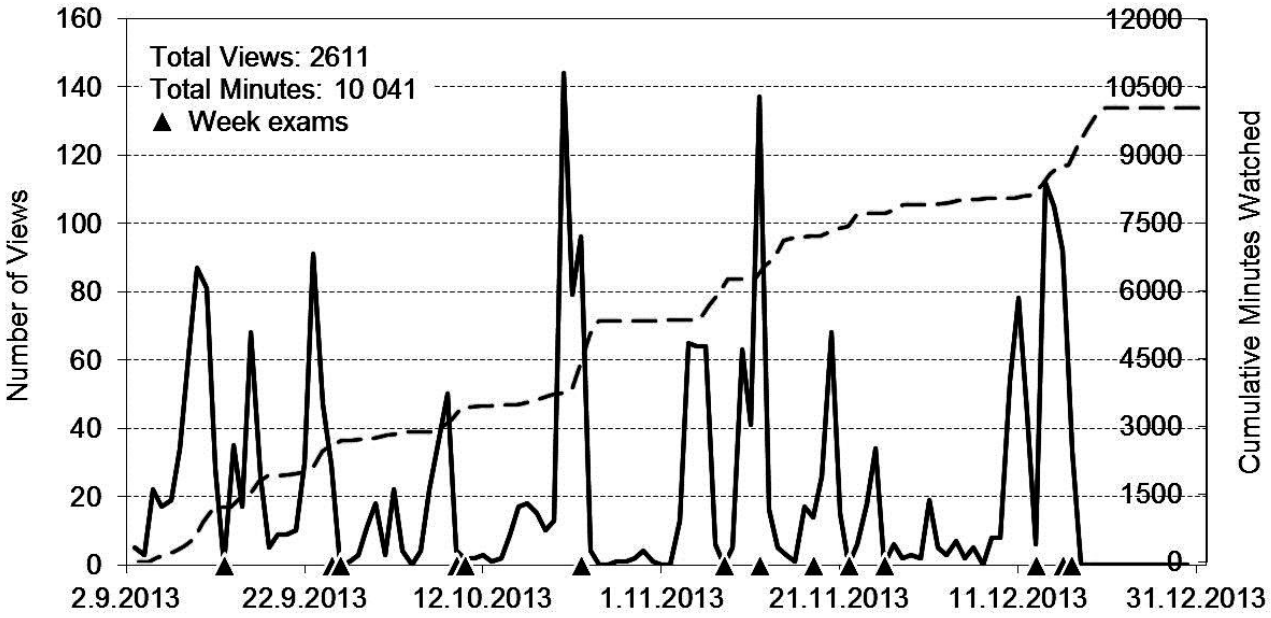

Fig 4. Daily number of views (left axis, solid line) and cumulative watching time (right axis, dashed line) of all the videos offered to students in this study.

3.4 Video length vs watching activity

Depending on the topic and the exercise itself, the video clips had different lengths varying from 3 minutes to almost 14 minutes. The exercises were of different topics and had different levels of difficulty. Therefore, the student's need to watch a certain solution varies from video to video. However, an interesting question is whether the video length itself affects the average watching time and to what extent.

The effect of video length can be seen in *fig. 5*, which shows all video clips available to the students, their lengths and percentages viewed on average. The bubble size corresponds to the times viewed, varying from 148 to 9. The same data is then categorized and summarized in *table 2*. The effect of length can easily be seen in the table: the percentage viewed drops form 71% to 40 %, when the video clip length increases. Same effect is also visible in the bubble graph. In addition to that, in *fig. 5* the variation of percentages watched between videos of same length but different topics and levels of difficulty can be seen.

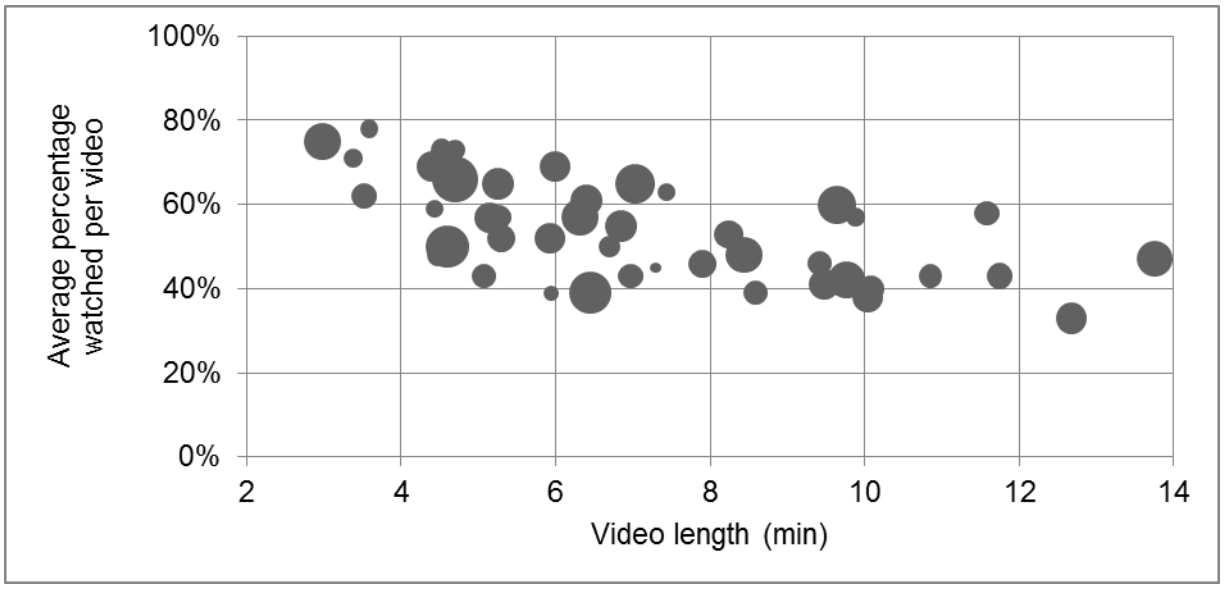

Fig. 5. Average percentage watched as a function of video length for all video clips. The bubble size corresponds to the times viewed,

Table 2. Total viewing time and average percentage watched in different video length categories.

Video Length	Total Time Watched (min)	Sum of Lengths (min)	Watched	Total Views
< 4 min	443	620	71 %	191
4-5 min	1328	2170	61 %	473
5-6 minr	1379	2426	57 %	443
6-7 min	1501	2992	50 %	457
7-8 min	860	1478	58 %	202
8-9 min	783	1652	47 %	196
9-10 min	1624	3305	49 %	343
10-11 min	667	1667	40 %	162
> 11 min	1443	3270	44 %	258

In the *fig. 5* and *table 2* it can be seen that the length of the video does not effect on the amount of views, but strongly effects on the percentage of the video watched. Videos of all lengths are watched, but the shorter videos are watched thoroughly more often.

4 SUMMARY

The results presented show that students' video watching activity is strongly connected to week exams in the course's timeline. This indicates that the assessment strongly guides students' time usage. The amount of watched video per student varies a lot, but overall students feel that videos increase their time usage and motivation to study. The increase in amount of videos watched seems on the average to have positive impact on the final grade up to some level, but the difference between individual students varies a lot. It is sad to find that students failing to pass the course do not even tend to watch the solution videos of the homework problems. The increasing length of the video clip seems to lead to tendency to jump forward in the video.

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