Tiili, J. & Suhonen, S. (2021) Analysis of Analytics 2 – Students' Online Activity in Introductory Physics Course. Teoksessa Heiß, H-U., Järvinen, H-M., Mayer, A. & Schulz, A. (toim.) Blended Learning in Engineering Education: challenging, enlightening – and lasting? Proceedings of the SEFI 49th Annual Conference. Technical University of Berlin, s. 1341-1347.

URL: https://www.sefi.be/wp-content/uploads/2021/12/SEFI-Annual-Conference-2021-Blended-Learning-in-Engineering-Education.pdf

# ANALYSIS OF ANALYTICS 2 – STUDENTS' ONLINE ACTIVITY IN INTRODUCTORY PHYSICS COURSE

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***Conference Key Areas***: *Physics in engineering, Methods, formats and essential elements for online/blended learning*
***Keywords***: *Continuous assessment, Student activity, Learning analytics*

## ABSTRACT

The global pandemic forced universities globally to rapidly change their way of teaching. All possible learning activities had to convert to online off-campus activities. These activities can be synchronous live events or implemented in a way that students can participate asynchronously, for example with the help of videos. Online courses and blended courses have been running for years, so the situation was not completely new one. But how well do we know what students are really doing during the course? In the paper we present students' studying habits concerning asynchronous introductory physics online course on electricity and magnetism. In the course, assessment is based partially on week exams and partially on final exam at the end. The studying in the course is based mainly on video material delivered in Moodle. The data used in this research is based on the log files on Moodle and the assessment data of the course. Similar research has been implemented in the same University in 2014 in a blended course. The interesting questions rising are:

1. How did the students' activity change during the course overall?
2. How does the video watching activity vary according to the course timeline?
3. How does students' final grade correspond to video watching activity?
4. Has the activity changed compared to previous blended course?

Results show that watching activity is concentrated close to assessed week exams. There is also a strong relation between watching activity and students' final grades.

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# 1 INTRODUCTION

The global pandemic situation forced the whole higher education to transfer into distance learning during 2020. However, there were a lot of experience for implementing successful online teaching and learning beforehand. Experience from online pioneers were very important when all possible teaching was forced to transfer into online mode. There was no time to prepare a well-manuscripted video arsenal for every course in an emergency situation. A typical solution was, for example, transferring the lectures to a virtual environment as synchronous online teaching. If necessary video material was available or made during the course, asynchronous online learning was also possible.

In Tampere University of Applied Sciences, introductory physics theory courses have been delivered on both, blended and online since 2014. Course outlines and study methods have been presented in SEFI conference in 2014 [1]. Online courses are asynchronous but scheduled in weekly level rhythmed by week-exams and measurement assignments that have 50 % weight in the final assessment. In this kind of asynchronous learning we are not able to observe students' activity directly like in lectures. It can be observed indirectly with using LMS's (Moodle) log data or students' voluntary weekly announcements of their activity. [2]

Compared to traditional f2f courses, online students study isolated from other students, if the pedagogical manuscript doesn't allow them to work in groups. In this way, students may feel disengaged and the dropout rate may rise higher than in traditional courses. Experiences from MOOCs show that the dropout rate in online courses may rise even up to 90 % [3]. On the other hand, a study by Doggett shows that students prefer more individual assignments than group work [4]. However, activating methods and working with peers have a positive impact on students learning.[5]

# 2 METHODOLOGY

The data used in this article is based on the learning outcomes and student activity data of two similar implementations, (later "A" and "B"), of engineering physics course "Electrostatics and Electric Circuits, Magnetism". Both implementations were fully online and lasted 10 weeks including the re-examinations after the final exams. The total number of students in this study is 90.

The course contents and assignments were delivered in Moodle. Course structure is described in Fig. 1. The study material included 42 short theory video clips and 58 problem solution videos. All assignments were in Moodle and they served as the basis for continuous, weekly assessment of the course. The short weekly exams and measurement assignments had 50 % weight in the final assessment, whereas final exam had the rest 50 %.  Because the contents were largely delivered in video format, the average number of video watches per student and its relation to learning outcomes is an interesting aspect of the data.

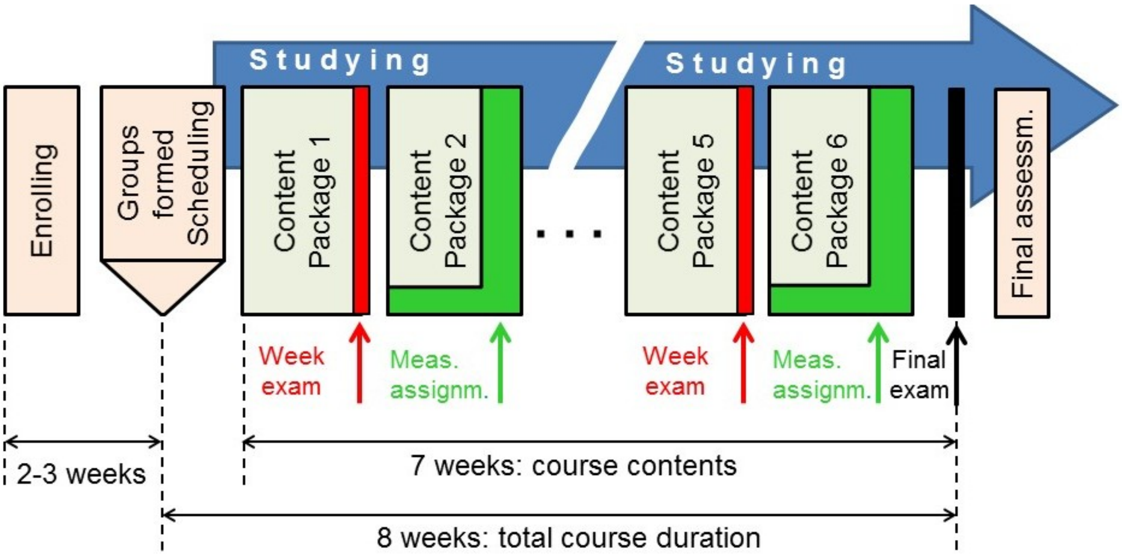


*Fig. 1. Online course structure.*

Moodle log file stores the learner activity that takes place at the main page level in Moodle. Therefore, the course was constructed in such a way that time-stamp data was stored of all meaningful student actions in Moodle, such as opening a video or reading an assignment. The log file was analysed after the course implementations.

Students' success in the course is described with the final grades after the assessment.  The distribution of final grades is shown in Table 1.

*Table 1. Students' final grades*

| | Implementation "A" | Implementation "B" |
|---|---|---|
| Dropped out | 12 | 10 |
| Fail | 5 | 6 |
| Pass, grade 1 (lowest) | 8 | 3 |
| Pass, grade 2 | 10 | 7 |
| Pass, grade 3 | 7 | 6 |
| Pass, grade 4 | 4 | 5 |
| Pass, grade 5 (highest) | 4 | 3 |

# 3 RESULTS

## 3.1 Temporal distribution of student activity

The daily distribution of students' activity on both course implementations are presented in figure 2. Both distributions have similar structure: the spikes represent days of some assessed assignment, either a week exam or a measurement assignment. On the "B" implementation the activity is somewhat more spread out in comparison to the implementation "A", which distribution is spikier. However, there are no statistically significant differences in the learning outcomes of the two groups and therefore this difference is not discussed further. The highest peak at the end of the course is the final exam. Seemingly, the assessment has a very strong effect on students' time usage and therefore we recommend a continuous assessment method, which helps the students to distribute their workload more evenly throughout of the course.

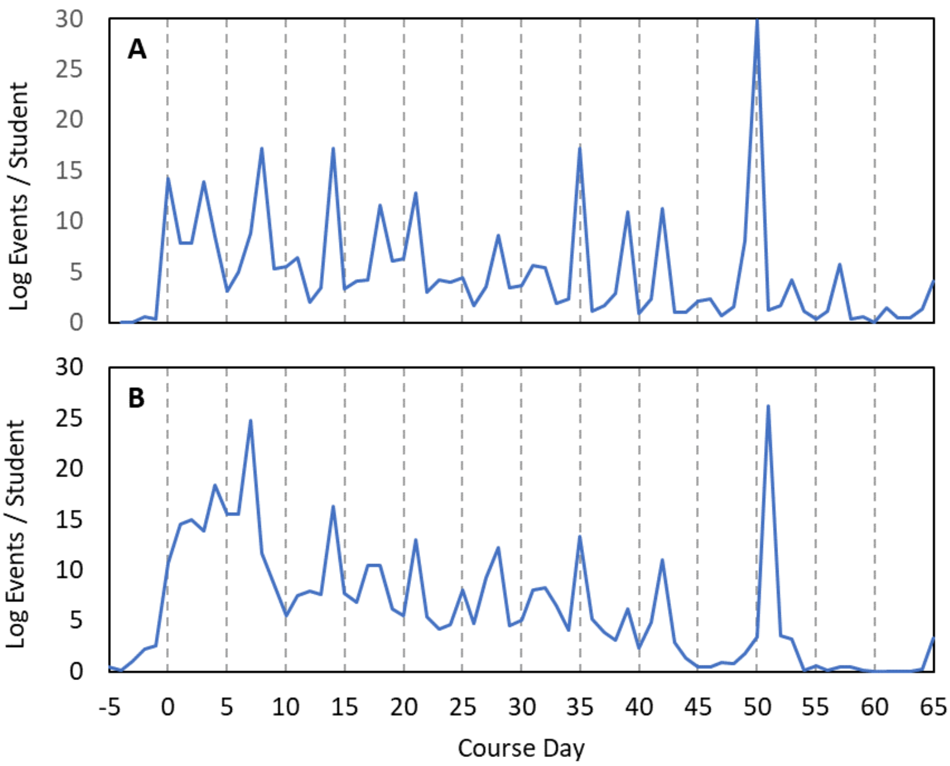


*Fig. 2. Daily sum of log events per student for two different course implementations.*

## 3.2 Activity distributions

Student activity and engagement is naturally essential for learning. The distributions of number of log events (A) and number of video watches (B) are presented for each learning outcome category in Figure 3 for all students of both course implementations. Clearly, there is a positive correlation between activity and final grade up to grade 4. The same applies also to number of video watches and final grade. However, it seems that those students who got the highest grade (5) didn't need to be so active or watch as many videos as those who got grade 4. The best students in the group either learn faster, have a better prior knowledge, or have more confidence in themselves. Whichever is the explanation, this finding is in good correlation with our earlier study [2]. Another interesting observation is that those students who dropped out of the course didn't even start to study. Most of them (77%) have zero or almost zero interaction with the material. Thus, dropping out seems to be caused rather by some other life conditions, not due to too difficult course contents or course arrangements.

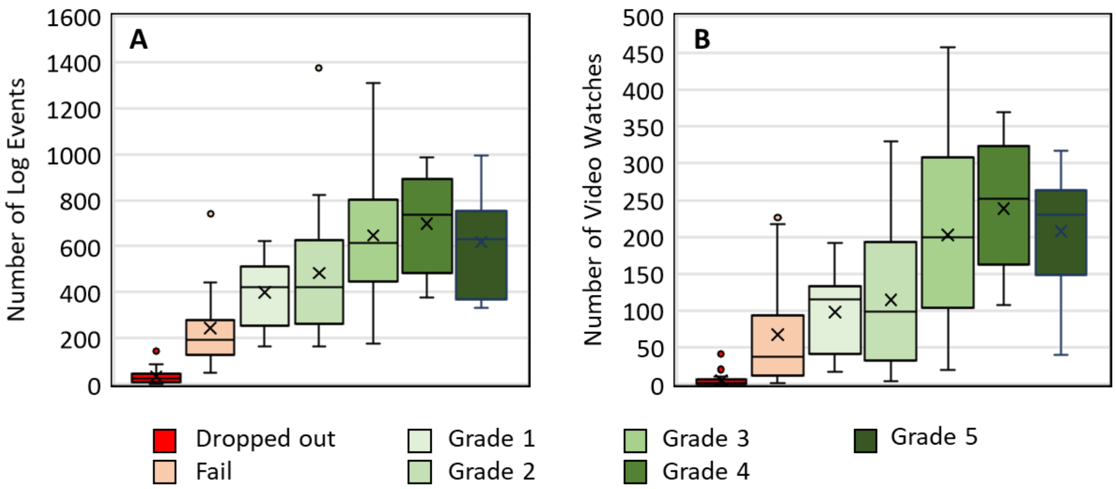


*Fig. 3. Distribution of number of log events (A) and number of video watches (B) per student in different final grade categories.*

To investigate the students studying behaviour further, weekly cumulative sum of log events in different final grade categories was calculated. This is presented in Figure 4. Clearly, those who dropped out, stopped studying after the first or second week. And as mentioned earlier, most of them didn't even start to study. The activity graph shows that studying pays off: the higher the activity the better the final grade. This applies to grades from fail to 2. The higher grades (3-5) all have rather similar activity which is higher than that of those of lower grades. Again, the data shows that the best students succeeded with somewhat lower activity than those who got 3 or 4. This may be a result from students' earlier studies in physics, because the course contents was introductory electricity and magnetism.

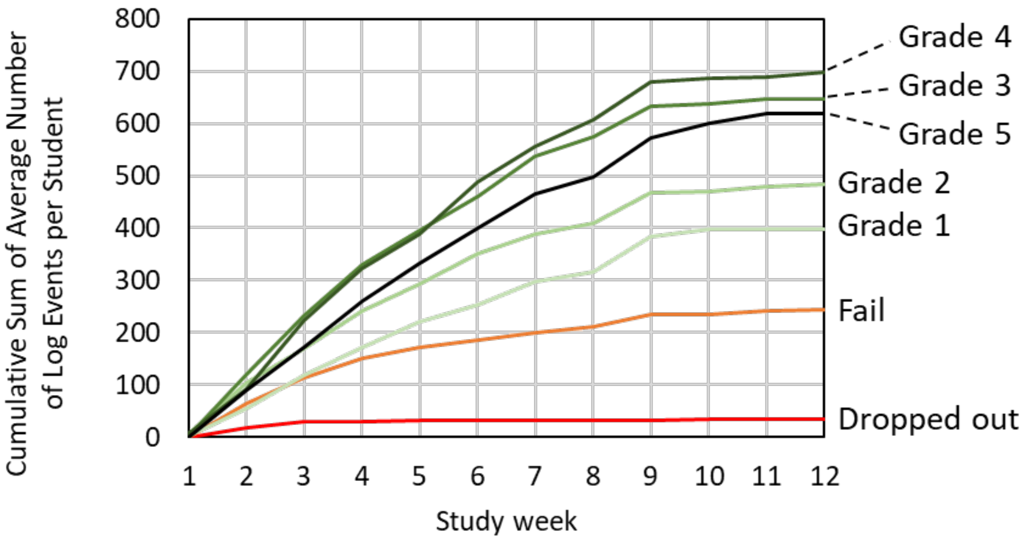


*Fig. 4. Weekly cumulative sum of log events in different final grade categories.*

A similar analysis was made in a blended introductory physics course in the same university of applied sciences in 2014. The results presented are well in line with previous results from blended course [2]. The figure of the video watching activity (largest part of the log events) with different final grades in the earlier blended course (2014) is presented in Fig. 5.

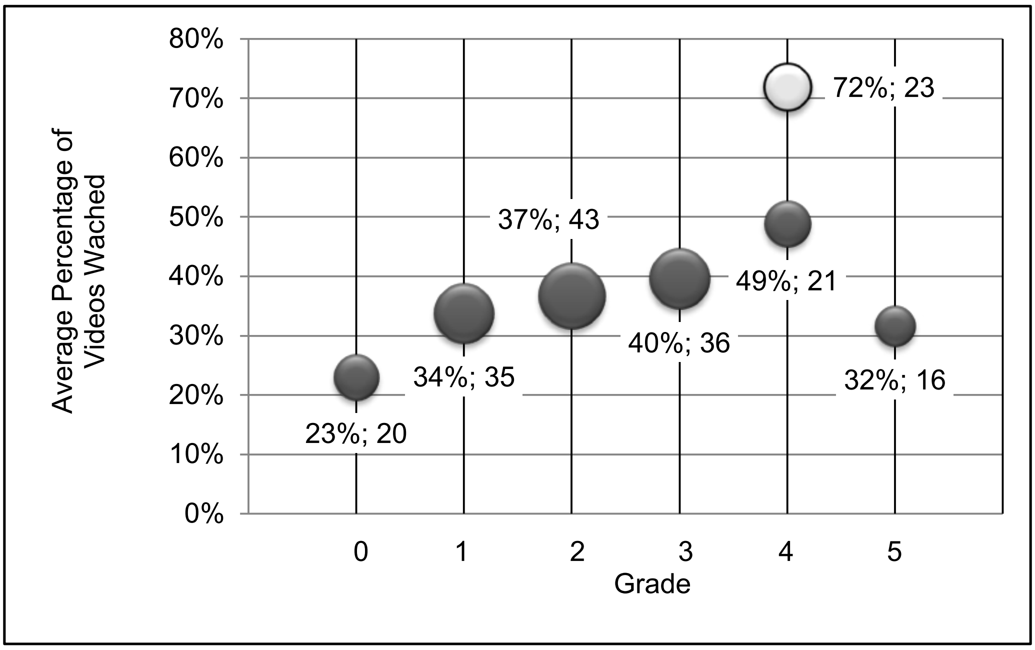


*Fig. 5. Average percentage of videos watched in different final exam grade categories. The bubble size presents number of students at that category. Data labels contain the viewing percentage and number of students [2]*

## 4 SUMMARY

According to study, it can be said that students' activity is a good predictor for success, which is obvious. Even though at higher grades, activity is not the only predictor. One solution to increase students' activity is to use continuous assessment throughout the course, because the assessment strongly directs students' behaviour. Question that remains is how we as teachers manage to attract and activate those students, who drop out the course in the early stage, to start and maintain their interest in active studying.

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