

TESTS IN MOODLE IN ENGINEERING EDUCATION - A PRE-STUDY IN THE FIELD OF LEARNING ANALYTICS

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ABSTRACT

Learning Analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs [1]. One of the sub-objectives in this research area is to make teaching and learning behaviour more individualized [2]. Students who complete test assignments in the Learning Management System Moodle [3] leave behind a data set or "digital fingerprint." These data sets provide a basis for a variety of investigations. Discussing analyses and results of a study of Moodle tests is the content of this paper. Online semester means that lectures and exercises were held live via videoconference during the Covid-19 pandemic. Classroom means that lectures and exercises were delivered live in the lecture hall. Mixed forms of the lecture, e.g., that part of the students participate in the lecture hall and part in the video conference, are not considered. The main questions investigated are:

- What is the participation rate of students in Moodle tests and in the exam?
- Are there differences between male and female students?
- Are there differences between students in the first or second semester?
- What are the differences between classroom and online semesters?

Keywords: Learning analytics, digitalization of teaching, face-to-face and online teaching, tests in Moodle, gender in engineering education

1 INTRODUCTION

What is Moodle? Moodle is a platform independent open source learning management system that offers many features, for example, support for group work, various exercise scenarios, discussion forums and chats. With Moodle, educators can provide students with both instructional materials and activities that support the learning process in the virtual classroom.

Why use Moodle? Access to a virtual classroom is an extension of the virtual world in which students operate today. Since today's students are very intuitive with digital media (communication via tools like WhatsApp, Facebook and Email, use of eBooks instead of hardcovers, lecture notes on the laptop, ...) Moodle usage is not an obstacle. The virtual classroom can be designed by the teacher to complement his lectures and exercises in the lecture hall. Collaboration among students can be intensified through the use of Moodle.

What contribution can the study provide for other lecturers?

The study shows that by using exercises in a learning management system, information about the learning progress of the students can be obtained, both activities in the self-study between the lectures, as well as the learning progress becomes more transparent. It also provides information about the usage behaviour of different student groups in Moodle, e.g., female and male students.

2 THE LECTURE AND THE MOODLE PLATFORM

In a lecture "Engineering Mathematics 1" for freshers in the industrial engineering and management bachelor programme at the "Hochschule München, University of Applied Sciences" the learning platform Moodle has been used for several semesters. For students attending the course, there was the possibility to register in Moodle and to complete four tests in Moodle (working time approximately one hour) during the course of the semester that accompanied the lecture. Participation was voluntary and one could not earn bonus points for the exam by taking the tests. Each of these tests included several tasks to apply the content from the lecture.

What students will find when they log into Moodle in our maths course in a classroom semester:

- a) the lecture notes as a pdf document (for download).
- b) the assignments for the exercises (pdf), which will be worked on in the following week.
- c) recommendations for self-study tasks (pdf).
- d) the tests that we examine in this paper.

In the online-semesters, the Moodle platform was used more intensively for student support, communication and interaction. In addition to the materials a) to d) mentioned above, the following content was provided:

- e) some video tutorials on selected theory topics created by the author.
- f) a question and answer forum which was set up for students to interact with each other.
- g) hyperlinks to learning videos and mathematical animations (example sine oscillation) on the internet.
- h) three times the lecture was recorded during the course of the semester and made available in Moodle because some students could not attend the lecture in terms of time.

As part of a written survey using a questionnaire, course participants were asked the question: Do the tests on Moodle provide a benefit to your learning? 78 out of 101 student (77%) gave a positive answer to this question [4]. The following reasons describe the main benefit students perceive by working on the Moodle tests regarding their learning progress. The quick feedback on their own knowledge level and the additional practice opportunities are main arguments to participate in the tests in Moodle.

One example of a benefit for the instructors is that they are able to identify which tasks students are having difficulty with and discuss them again in the practice sessions [5].

3 ANALYSES OF THE DATA AND LIMITATIONS

When we examine Moodle data of students, anonymity is very important. It must not be possible to draw conclusions about individuals or specific semesters. This is ensured by coding all personal data immediately after collection. Consent was obtained from students to make their data available for anonymous analyses.

The analyses presented here are not part of a funded research project with multiple collaborators, but a lecture-based pre-study by the author for a future research project. The results relate to the author's course "Engineering Mathematics 1" and the Moodle tests used there. They should not be generalized. The processing of the tests by the students represents only a small area of self-study. We do not know the conditions under which students work on the tests. Possibly some work in quiet environments, others with lots of distractions. The main goal of the study is to win ideas for a research project.

4 OVERVIEWS OF THE STUDENT POPULATION

The population for our study groups is 212 (in classroom semester) and 185 students (in online semester) from several consecutive semesters, all of whom attended the same lecture Engineering Mathematics 1 and registered for the exam. All percentages in the following evaluations refer to the number of students registered for the examination, which is set as a reference value of 100%. The students could voluntarily register in the Learning Management System Moodle and complete tests in Moodle during the semester. The same tests were used on the classroom and online semesters. The students are distinguished in the coding into:

- Students registered or not registered on Moodle.
- Test takers or non-test takers in Moodle.
- Female and male students.
- Students in their first or second semester.
- Exam participants respectively non-exam participants.

Since the individual semesters had very similar histograms to the analyses below, the individual participants from several semesters were combined into one data pool, overview Table 1. These 212 (185) students can be divided into female and male students, In the figures below, these are abbreviated F and M respectively. In addition, the data pool can be broken down into participants who are studying in the first or second semester. In the following illustrations these are abbreviated SEM1 and SEM2 respectively. Students in the second semester either failed the exam once or deferred the exam, i.e., did not take it in the first semester. There is an average percentage of 20.4% female students in the total population of our study. In following Table 1 the 73.1 % of students who registered in Moodle are not the same students who took the exam. The number match is a coincidence.

Table 1. Distribution of students in the study

	classroom semester		online semester
	n=212		n=185
students who are registered for the exam in %	100.0		100.0
registered in Moodle in %	73.1		100.0
participated in the exam in %	73.1		51.9
participated in Moodle tests in %	49.1		34.1
female F / male students M %	23.1 / 76.9		17.3 / 82.7
SEM1 / SEM2 students in %	50.0 / 50.0		42.2 / 57.8

5 RESULTS OF THE CLASSROOM SEMESTER

5.1 Registration in Moodle

In our first analysis, we examine registrations on the Moodle learning platform in average during the classroom semester. 155 students out of 212, that is 73.1% sign in on Moodle. 94.3% of the SEM1 students register on Moodle, of the SEM2 students only 51.9% register. The registration rate of female students in Moodle is 79.2% in average (see Figure 1), while that of male students is 71.3%. The percentage of female SEM1 students logging in is the highest at 95.5%, while of the group SEM2 male students log in only 47.5% on Moodle.

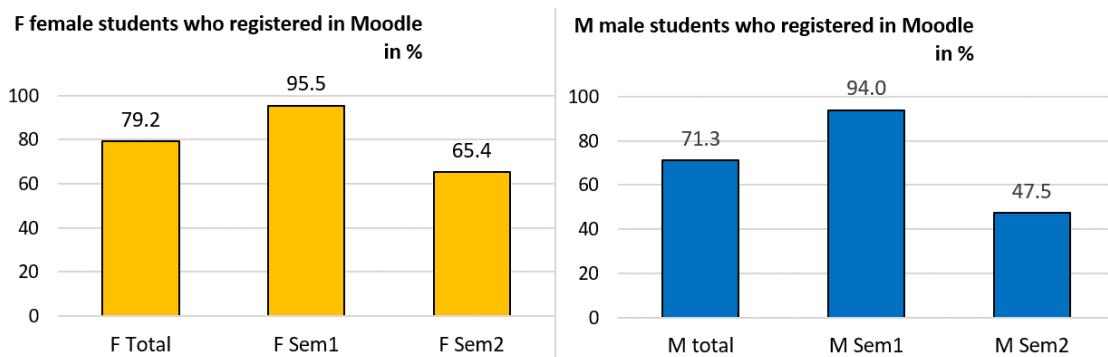


Figure 1. Registration rates in Moodle

We can note that especially first semester students log on to Moodle during the classroom semester and female students log on slightly more often than male students. However, this still does not contain any statement about the use of the tests available on Moodle. We can only guess why 26.9% of students do not log on to Moodle. It is possible that not all students have computer equipment and sufficient internet access.

5.2 Participation in the Moodle tests

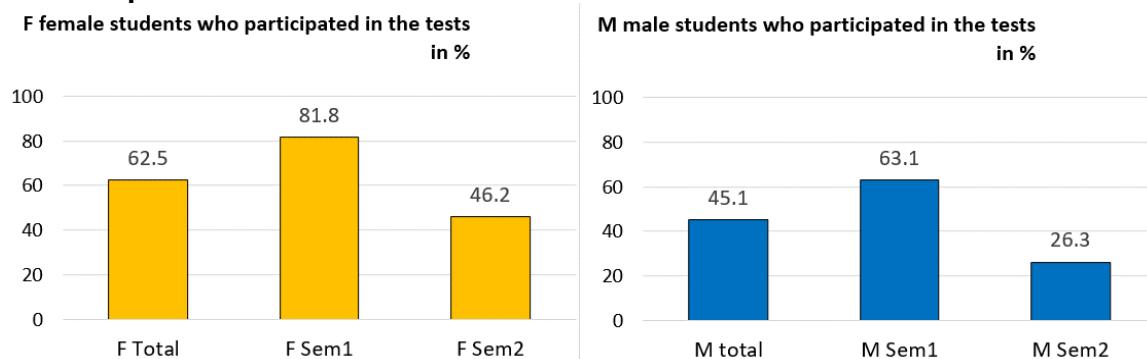


Figure 2. Participation rates in the tests

Of all classroom students, 49.1% participate in the Moodle tests, and of first semester students, 67.0% participate. This is two thirds of the SEM1 students who are the main target group for the course. Figure 2 shows the percentages of test takers in the female and in the male student group, i.e., students who took at least one of the four tests. A particularly high value is shown by the first semester female students with 81.8%. In the male student group, the participation rate averages 45.1%, with 63.1% in the SEM1 group and a particularly low value of 26.3% for male SEM2 students.

5.3 Participation in the exam

Figure 2 depicts the participation rates of students in the exam. Female students (85.4%) participate in the exam with a higher rate than male students (68.9%). SEM1 female students show the highest exam participation (90.9%) among the groups studied. The differences between first semester and second semester are less pronounced but show the same trends as in Figure 1.

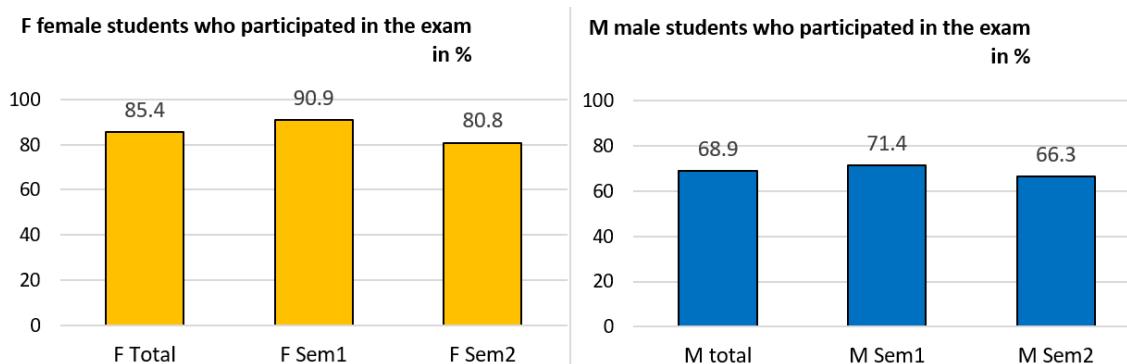


Figure 3. Participation rates in the exam in percent

6 DIFFERENCES BETWEEN CLASSROOM AND ONLINE SEMESTER

In the face-to-face semester 73.1% of the students had registered in Moodle, in the online semester this was number was 100% (see Table 1). The 100% population again consists of all students who had registered for the exam. The reason for this is that content was provided on the Moodle platform without which one could not participate in the course at all, e.g., the internet links to the video lectures or exercises.

If we look at the face-to-face semester, 73.1% of the students had registered in Moodle, while in the online semester this percentage was only 51.9% (see Table 1). The online-end-of-Semester exam was a written exam under video observation, calculation had to be documented on paper and results had to be entered into Moodle. Free navigation between tasks was not possible. Each task had to be completed in a given time, then the next task followed. The restriction of free navigation is necessary to minimize digital cheating by third party support. After the working time, the students had to scan their calculation sheets with their smartphone and upload them to Moodle. In the face-to-face semester 49% had participated in the tests in Moodle, in the online semester only 34%. This is a low number especially considering the high registration rate in Moodle of 100%. It can be assumed that the tests in Moodle are less noticeable and less used in the context of the diverse materials which was available on Moodle in the online semester - see Section 1: material a) to g). Overall, the instructor and his colleagues had the experience that the number of active participants in the online courses was lower than in the face-to-face courses / Aktivität in Online Vorlesungen und Übungen.

More SEM2 students are registered for the exam in the online semester (41% SEM1 to 58% SEM2). Only 50% of the SEM1 and 55% of the SEM2 students participated in the exam (compared to 74.5% in classroom SEM1 resp. 69.8% in classroom SEM2). How can this be explained? The lecturer has interviewed some students about the low rate of participation in the exams. Several effects may account for this. Some students explained that they were unsure of their own level of performance and then preferred not to take the exam. In the covid-19 Semesters, students in the first semester in particular lacked the opportunity to get to know each other personally, form study groups, and engage in joint activities. In addition, students perceived the exams in the online semesters as more difficult. This is consistent with results by other researchers [8] those technical problems with access to the Moodle platform, as well as in the unstable video connection via the Internet and limited navigation, cause difficulties for students in online exams that do not occur in face-to-face written exams. The Hochschule

München, University of Applied Sciences extended all deadlines in the Corona semesters. This means that the deadlines for examinations in the first semester, for repeat examinations and the maximum permissible duration of study were extended by one semester. Thus, students had no disadvantages if they postponed an exam into the next semester.

6.1 Comparison of female and male students

In the online semester, females taking Moodle tests to males shows a difference of 44.4% to 31.3% in Figure 4 when we compare the total groups. The low participation rate of SEM1 female students is striking. Female students use Moodle tests more intensively in both the classroom semester and the online semester. The change from classroom semester to online semester shows no significant changes in the percentages of female and male students in exam participation. Female students attend the exam significantly higher than the male students.

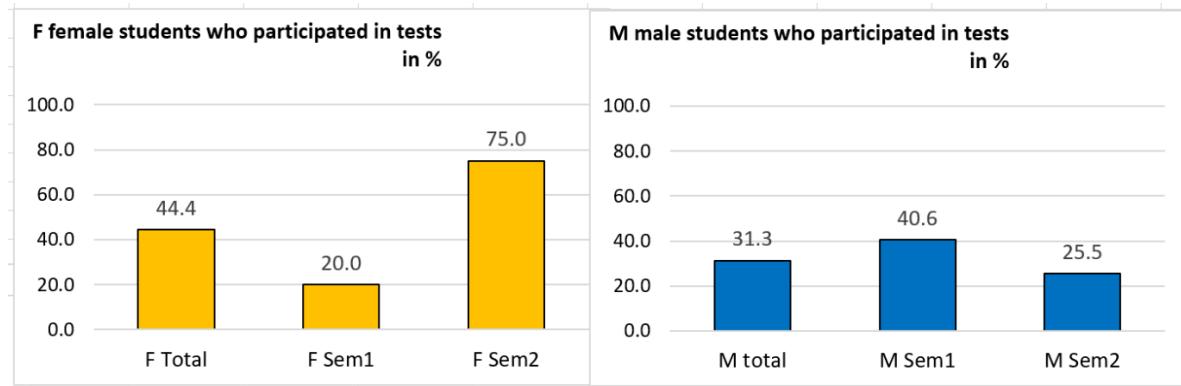


Figure 4. Participation in the Moodle tests in the online Semesters

7 DISCUSSIONS OF THE RESULTS

Statistics should not be the main focus of our investigation. Nevertheless, some results, e.g., the correlation between gender and test participation, were tested for stochastic independence using the chi-square test. When the calculated p-values are below the error level of 0.05, 0.01, or 0.001, we refer to significant (*), very significant (**), or highly significant (***). The statistics help us to give more weight to some results and hypotheses in the following discussion.

94.3% of first semester students register on Moodle and 67.0% take the tests in a classroom semester. These are high participation rates that encourage continued use of the Moodle Learning Management System and tests in future teaching. We can derive the following hypotheses from our study:

First semester students are more likely to register on Moodle than second semester students (***) and are more likely to participate in the Moodle tests offered than second semester students (***).

The low registration rate of second semester students on Moodle of 51.9% (and the low test participation 30.8%) is surprising. Actually, these students should be particularly interested in good learning material and also in passing the exam in order to progress in their studies.

Female students are more likely to log on to Moodle than their male counterparts (79.2% to 71.3%, and they are more likely to take Moodle tests than male students (62.5% to 45.1%, **). These data support the hypothesis that female students are more active in using the Moodle platform and taking the tests.

Price [9] found in a study that female students prefer online assignments. Arrenberg and Kowalski [10] reasoned that those female students are not in direct competition with others there. Keller and Köhler [11] also documented that those women favour new teaching methods where they do not compete directly with male fellow students. Female students who are registered for the exam are more likely to take the exam than male students (85.4% vs. 68.9% see Figure 3, **). The high exam participation rate of female students can be interpreted as an indication of a clear study organization with the personal requirement to take exams in the planned time schedule. According to [10] female students take their studies more seriously than male students, and they take a more formal approach.

The change from classroom to online semester significantly increased the registration in Moodle to 100% of the students registered for the exam, but the participation rates in the tests and the exam dropped sharply. This means that participation rates in the exams will increase sharply after the Corona pandemic, when courses and exams will be held in the classroom again.

8 IDEAS FOR A RESEARCH PROJECT

It would be interesting to investigate the reasons why students, especially in the second semester, do not use the Moodle offerings and tests (availability of internet access, digital literacy, fear of surveillance...). Students' motivations for registering for exams and then not taking them are also worth investigating, as this behaviour directly leads to longer study times. Sociologists and psychologists should be involved in these studies.

Plans for the research project are to revise and expand the scope of our Moodle tests, which have now not been changed for several semesters. One idea would be to use uniform tests on Moodle in lectures taught by different instructors. For a comprehensive research project, it would be very helpful to use entrance and exit tests to record students' competencies in order to be able to measure the increase in competencies due to digital learning support.

In addition, it would be very interesting to identify further teaching and learning formats that address women and men differently in order to be able to support the learning process of female and male students through suitable teaching methods.

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