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GENERATION Z AND THEIR USE OF LEARNING MANAGEMENT SYSTEM IN PROGRAMMING

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ABSTRACT

Generation Z students have grown up with ICT (information and communication technology) and are therefore used to being online more or less simultaneously on different types of media. Universities have different kinds of Learning Management Systems (LMS) with different possibilities for engagement. In the Electrical Engineering B. Eng. program at the Technical University of Denmark (DTU) we use a system called Learn. It has features for setting up individual study plans as well as common plans. Features such as surveys, quizzes, peer reviews are built in. We are interested in the students' use of the LMS, their engagement and the relation to their achievement in the examination. The research questions we would like to answer are: How much do the students use Learn? What kind of materials do the students prefer? Is there any correlation between the use of materials on Learn and the grade? Is there any correlation between the score in quizzes and the grade? In this paper, we would like to describe and compare how much students use the materials in two different courses on the 2nd semester Digital Electronics and Programming (id 62734) and on the 4th semester Digital Design (id 62711). To answer these questions, we use data from Learn. And we conduct two qualitative surveys, one about students' motivation, (Sekala, A et. al, 2023) and the other one as a part of the final course-evaluations in spring 2023.

1. INTRODUCTION

In daily teaching, some of us wonder about students asking questions which could be answered if they had been visiting Learn with the content for the given lecture. Some students do not use the materials on Learn very often, and more or less the same students have trouble with group-work and in completing the assignments to be handed in. This leads to this research to figure out the kind of materials used and

correlations to exam. For two decades or more, we have used learning management platforms at DTU. For the last 6 years we have been using a system called Learn from the company Brightspace. The system has different features such as file-sharing, assignment, survey, quiz, peer grade, self-assessment. The content is organized in learning-modules used as a Lecture container with slides, quizzes and/or surveys, videos and links to external sources. Below in the paragraph 1.1 we describe the students' general background belonging to generation-Z (gen Z). And in paragraph 1.2 we describe teaching method and content in two courses used as case for this study.

1.1 Generation Z and learning

In this section, we present findings from literature about Gen Z and how they prefer to learn. Gen Z is defined in the literature as being born the earliest in 1995 and up to now. The generation overlaps with the millennials (Dolot A. 2018). Gen Z are practical, self-learning, engaging, active learners, prefer short lectures (Mosca J. B. et.al. 2019), (Cook V. S. 2019). The gen Z's are used to having 24/7 access to resources. They prefer to learn just in time. Teachers should guide the students how to use the different devices in a learning context (Cook V. S. 2019). The students have high expectations of their learning environment (Cook V. S. 2019). Research shows the students retention is short 8-10 seconds or else they shift focus to different input of information (Nicholas, A. J.2020). Students expect teachers to help them make sense of overwhelming amounts of information rather than transferring knowledge. Teaching is moving from the authoritative to the more facilitative way, for helping students connect their knowledge to applicable situations (Cook V. S. 2019). Gen Z likes the intrapersonal learning pre class homework and then have the social learning approach in the class with discussions and activities. A hybrid learning opportunity with online modules where they can asynchronously study when they like will also fit the Gen Z preferences (Seemiller C., & Grace, M. 2016). Therefore, the classical pedagogical approach with lectures and exercises afterwards could be changed to flip classroom teaching principle. This could confirm it's appropriate using this teaching principle in the two courses used as case in this article. In the next paragraph we describe the flipped classroom principle in the two courses.

1.2 Courses used in this research

Here we briefly describe the pedagogical method used in the two courses. The courses are: Programming and Digital Electronics (DEP) on the 2nd semester and Digital Design (DD) on the 4th semester. We will here short introduce the uses of teaching materials and the performed teaching method. In both courses we use flipped classroom, which means students need to prepare by reading text-book, watching a video and answering a quiz related to the topic for the coming lesson.

In DEP: The course book for DEP is bought as an e-book. For Program development the students use programming-IDE from Microchip studio installed on their own laptop. Students undertake programming assignments for configuring microcontroller registers and solve different data interface problems. Besides this, they are taught in

general digital interfaces. The lecture typically starts out with a student discussion based upon questions about the lecture topic and then the quiz answers in Learn are opened up and discussed. Thereafter, we briefly explain the slides with code snippets among other things. The students work on assignments in groups of 2 to 3. They hand-in 4 compulsory assignment reports. And the exam is oral based upon questions and the last assignment.

In DD: The students buy the course book as a paper book. For hardware description the students use Xilinx IDE Vivado running on a server students access. In the DD, students describe a Central Processing Unit (CPU) in a hardware description language (VHDL) and implement it in a Field Programmable Array (FPGA) from Xilinx. Besides this, they are taught in general digital design of CPU'es. Each lecture is short with points from the book about the digital design of CPU and small snippets of the VHDL's constructions. Thereafter, the students work in groups of 4 to 5 on three compulsory assignments, each with a report, leading to a complete CPU-design, which in last course week (week 13) can process small programs. The exam is a written multiple choice test and a final report covering all assignment is evaluated.

METHODOLOGY

To understand the students general background we as mentioned in the introduction conducted literature studies to find descriptions of generation Z (Gen-Z) as learners and their preferences for learning. And as empirical data we use quantitative data from the courses described above in paragraph 1.2. The data reveals students' engagement with the slides, quizzes, video, and video-demos about different aspect of programming in the Learn system. For getting qualitative data about the preferred leaning materials we use two questions in a survey in another study (Sekala, A et. Al, 2023). Lastly the final course-evaluation qualitative data are used for eventually finding explanations about why students use materials on Learn as the data reveals. Data selection is further described in 2.1.

2.1 Data selection

From Learn we can extract different reports. A top-level report can tell us about how many students have accessed the different learning modules and how long they have been doing it in total. We collect data (for year 2021, 2022, 2023) about how many students use the preparation materials which consist of slides, video, quiz and the lecture slides and video-demos. Video-demos are practical hints for using different, programming constructs, simulations and settings in the IDE (programming editor) and explaining behavior of the code. In addition, quiz scores are extracted as well for answering the research questions about the eventual correlation between quiz-score and exams-grades. We also present data showing the completion of the course, which means if a student has accessed all materials, then the score is 100%. To know more about students' preferences for learning-materials we use data from one question: "Do you use any other sources apart from class notes to supplement your knowledge?" in another survey (Sekala, A et. al, 2023). And we have this semester added extra questions to the final course-evaluation about the uses of materials. In next section 3 Results, we present the findings founded on the data described above.

3. RESULTS

Here, quantitative data extracted from Learn and qualitative data from questions used in surveys are presented. In part 3.1 we present the quantitative data extracted about the uses of slides, videos, quizzes and video-demos. In part 3.2 we present the grades achieved and the score in quizzes to study if there is a correlation between grades and quiz score. Lastly, in part 3.3 and 3.4 we present from surveys the qualitative data about preferences for learning materials.

3.1 Data from Learn

From Learn, we extracted data about how many students accessed to the different kinds of materials. Figure 1 shows the box-plots for students' relative access to materials. The number of enrolled students in course DEP on the 2nd semester during the three years is 55, 52, and 49 respectively. And enrolled in DD on the 4th semester during the three years are 62, 67, and 57 respectively.

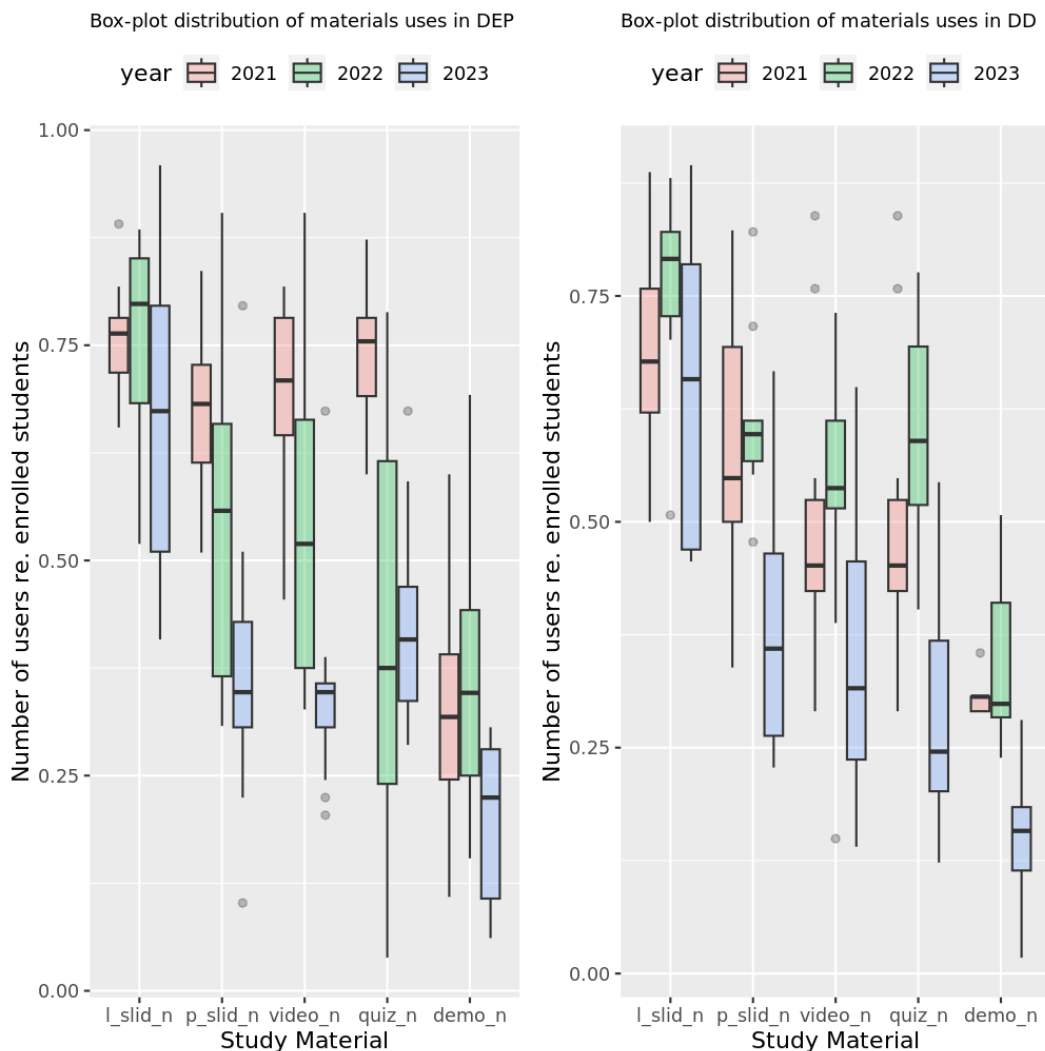


Fig. 1. Relative number of students using study materials in course DEP and DD. On x-axis: l_slid_n slides and video demos (demo_n) used in the lectures. For preparation before lecture: slides (p_slid_n), quiz (quiz_n) and video presentations of

slides (video_n). On Y-axis: the number of actual users divided by the total number of students enrolled.

The Covid pandemic in 2021 closed the face-to-face lectures. Therefore, the students participated in the online lectures using Zoom and received supervision through Discord. The students in DEP 2021 show persistence in the lectures and in the preparation. The access to preparation-materials: videos and quizzes is much higher in 2021 than in 2022 perhaps because everything was online. Whereas DD students show 15 -20% less engagement with the preparation. The students in DEP in 2021 are the same students in DD 2022 and they still are more persistent in preparation compared to students in 2023 and 2021. If we look at the DEP year 2022 and year 2023, they are most active using the slides for the lectures and are not so engaged in being prepared by using the materials. Similarly for the students in DD 2021 and 2023. Perhaps students show lack of interest using online materials as a post Covid reaction. As well as participating in lectures and using slides is also less compared to 2021. In general, the students in the semester 2023 are less active compared to the two previous semesters regarding preparing by using materials provided on the Learn. Lastly, from figure 1 we find fewest access the video-demos (demo_n).

3.2 Degree of completing topics/quizzes on Learn and grades.

Table 1 on next page shows the individual grade and students' overall completion in percentage task/topic by visit in Learn. Available topics for DD from 2021 to 2023: 129,135 and 116 respectively. And for DEP from 2021 to 2023: 142, 169 and 148 respectively. In 2022, for the DEP course the EM(not attending exam) is up to 8 students and one got the grade 0 (not passed) and two students got 02.

In 2021, in the DD course, two students did not enroll for the exam, one completed by 61% course-materials and the other one by only 3% therefore this huge standard deviation of 10.

Moreover, in DEP in 2021, 5 students did not enroll for the exam and with a range of completions from 68% to 0% completions. The reason for getting no exam is that students often fail in group work for social or learning reasons, and therefore do not hand in assignments, which is required for attending the examination for both courses. Especially for the DEP course, up to 30% of the students do not obtain the exam the first time. As one student said by the final evaluation in 2023, "I have this semester prepared before the lectures and it goes quite well". From Table 1 it is seen students with grade 10 (like A) and 12 (like A+) have a mean value of completion of 17% to 25%. The students with grade 4 (like a C) show mean values of completion variates 11% to 16 %. Whilst grade 7 (like B) shows above 22% of completion except in DD 2021, so higher activity than students getting a 4. The lower limit for passing is 02 and there is an interesting observation that they have actually been actively completing tasks from 11% to 22%. In both courses, which is comparable with a grade 12 where the mean value is 17% to 25%. An explanation for that is the way the grade is given - grading is based on evaluation of written report, a program, and an oral exam by 5 minutes presentation of a known question before exam, random chosen. Moreover, in the course DD the grading is based on an evaluation of a digital multiple choice and a report-documentation for the design of a CPU.

Table 1: Mean value and standard deviation (sd) for the completions in % grouped by the grade achieved by exam.

course	DEP 2021		DEP 2022		DD 2021		DD 2022	
Grade	mean	sd	mean	sd	mean	sd	mean	sd
NO*	10.00	10.12	3.00	1.00	13.67	5.13	19.50	20.51
EM**	10.67	9.42	10.80	6.37	8.50	10.60	16.25	16.52
0	12.00	5.66	24.25	9.03	No data	No data	29.00	NA
2	21.00	6.75	11.50	7.78	No data	No data	22.50	9.19
4	14.60	8.96	13.00	6.00	12.50	9.81	16.58	8.45
7	22.42	7.30	24.00	9.56	17.45	10.60	22.43	10.81
10	19.62	7.31	18.33	8.87	24.19	9.34	22.45	10.64
12	16.83	4.07	23.75	4.69	25.33	2.08	19.50	6.81

*did not register for the exam, **did not attend the exam.

Students who have not been writing any code very seldom get a grade above 4. In course DD, when we compare with figure 1, the activity in spring 22 is high and therefore the percentage completed becomes higher (Table 1).

An assumption has been that the quiz score for the students and the final grade is related - a high grade means a high score in the quiz. To test the hypothesis, we used a dependent t-test, and we did it for the spring semester 2022 quiz data in both courses: It reveals that there are no dependencies between the score in the quiz and the grade. For DEP t-test shows: $t = -11.489$, $df = 38.317$, $p\text{-value} = 5.593E-14$ as t is negative and $p\text{-value}$ very small, it implies no dependencies.

For DD t-test shows: $t = -19.088$, $df = 61$, $p\text{-value} = 2.2E-16$ as t is negative and $p\text{-value}$ very small, it implies no dependencies.

The hypothesis is that the more active students are in the Learn, the higher the grade. A t-test was using the same data as in table 1 and the grades,

For DEP t-test shows: $t = 12.869$, $df = 59$, $p\text{-value} = 2.2E-16$, as t is 12 and p is close to zero the hypothesis is false. For DD t-test shows: $t = 13.068$, $df = 38$, $p\text{-value} = 1.236E-15$, as t is 13 and p close to zero, it implies no dependencies.

It should be noted here that the number of students enrolled in the courses are between 49 and 67 and the grades is not normal distributed.

3.3 Qualitative data from final course evaluation

In the final course evaluation in 2023 for the two courses (DEP, DD) we asked three questions about the use of the materials:

1. Which material(s) on Learn in DEP/DD most supports your learning and why?
2. What materials on Learn in DEP/DD give you the least learning and why?

3. Which material(s) on Learn in DEP/DD do you use least and why?

In the DEP course, twenty-four students answered the general evaluation and twenty-one answered the first question, sixteen students answered the 2nd question and fourteen students answered the 3rd question. In the first question, ten commented: “the videos are good for preparation” and seven students wrote: quizzes are good. The Datasheet about the microcontroller was mentioned as a source for learning. The least learning comes from the e-book. In general, the answers were very diverse.

In the course DD, twenty-six students answered the general evaluation but only fifteen answered the first question, seven students answered the second question and eight students answered the last question. From the answers to question 1, five students expressed that the videos are helpful. Five students expressed that the project assignments about CPU design give the most learning. One complained about too much material on Learn. The answers to the second question, the lectures, and the quiz give less learning. As answer to the third question, one wrote: “Preparation before lessons - Do not have time”. And three students wrote that the different kinds of guides/demos are used less.

3.4 Qualitative data about use of alternative materials

Figure 2 shows the result for one of the questions used by Sekala, A et. al, 2023: “Do you use any other sources apart from class notes to supplement your knowledge?” . 26 students answered in DD (62711) and 22 students answered in DEP (62734). 60% of the students in DD (62711) and 50% in DEP (62734) try to find alternative materials on their own. Only 46% in DD use the recommended book and 36% in DEP use the e-book. And 71% use the internet in DD and 50% in DEP use the internet.

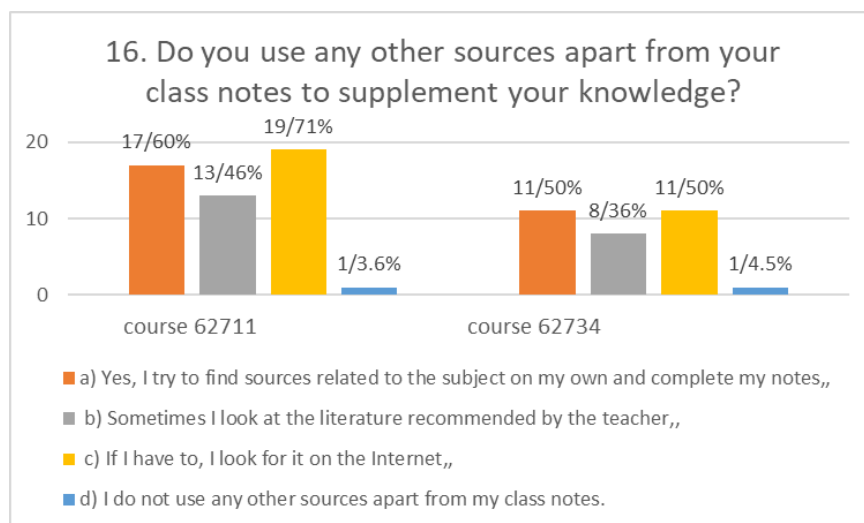


Fig 2. Students use other source in DD (62711) and DEP (62734)

This results can perhaps explain why students don't interact with the materials on Learn. In addition, regarding Gen Z students, who are used to being connected to the internet 24/7, prefer searching on the internet instead of logging on to the Learn and thereafter trying to find the relevant materials in folders. A few students at the midterm evaluation and the final evaluation have remarks such as “too many materials it's very hard to find things”. Perhaps the way the materials are organized also explains the lack of uses. But in addition, in the attitude of self-determined learning it can explain how they find their own materials, which gives meaning. The article by (Bond, M. et al. 2020) has done a literature study about students' engagement in relation to learning

technology. And they describe the engagement in 3 categories, behavioral, cognitive, or affective indicators. Having that in mind, the results shown here could for the remaining group of students who use the Learn very little or not at all be explained by the disengagement factor as frustration. This fits with the students' oral feedback when we discuss course evaluation of the DEP - "It is very hard to understand how programming of registers is done and that it differs much from c-programming in general".

4. DISCUSSION AND CONCLUSION

The answers to the research questions are up to 70 % students accessed most of the lecture slides and secondly, most of the preparation slides. Thereafter, they do the quiz rather than watching the video. Only a few accessed the video-demos. An explanation for not watch the demo videos is as a student said in the final course evaluation "it's hard to know where the demo is we miss a complete list over demos". There is no correlation between the overall students' access to the materials (completions) and the grade at the exam, neither the quiz score nor the grade at the exam. The reason for that is that the work with the assignments does not necessarily depend on the materials in Learn as the students can find answers on the internet and by asking the supervisor for help. Moreover in DEP, the grading at the exam depends on a report and an oral exam and in DD digital exam and the evaluation of the report does not directly depends on the activity in Learn. It is striking that our data shows Gen Z students are not engaged in preparing themselves by using materials on Learn, when they are described in the literature as self-determined and self-directed (Cook V. S. 2019) would rather watch a video than read (Nicholas, A. J.2020). One student, in the final course evaluation for DD, wrote "I find it easier to watch a video and take notes than to read 20 pages of the book, although it is clearly best to do both". Regarding the flipped classroom, only approx. 50% of the students do not do the quiz before the lecture. An explanation for not all students do the quiz, is that the teacher does not enforce that students to do the quiz before lecture. In the next semester we will try to enforce that. Another explanation for students don't use Learn-materials, can be by the programming assignments does not link directly to materials on Learn. And when programming they don't necessarily need to use the materials on Learn. But it is strange that only 10%-30% of the students use the video-demos, as students who have used them responded positively as shown in part 3.3. A reason could be the way the video-demos are embedded in the lecture-folder. In the future the video-demos will be in its own folder. Another explanation for not using materials: The workload is high and this stresses the students so they prioritize their time on the assignments instead of using materials on Learn. In general, students learning programming do not dependent on materials offered in Learn. Maybe the structure and access facility does not faster quick answers compared to "Googling". To conclude, data from LMS give knowledge about students' activity. There is a challenge in using flipped class room when students does not meet prepared which unfortunately the data reveals. That rise the questions about organization of materials and the students workload as well as enforcing the students need of being prepared before lecture.

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