



An analysis of participation in a hybrid and asynchronous course

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Abstract

Time- and location-independent teaching helps students to complete their studies independently of external circumstances, such as private ones. Among other things, the use of hybrid and asynchronous teaching scenarios is suitable for this, which is therefore a highly topical but controversial subject in university didactics (even after the coronavirus pandemic). How hybrid teaching can be designed to be effective for learning and systematically developed further has still not been clarified. In the pilot project "TEORy - Try, Explore, Observe and Review hybrid Teaching", a technically and didactically trained person, the so-called e-scout, regularly supports and accompanies a hybrid course. This offers the opportunity to evaluate each individual course in a lecture series and thus provide the lecturer with continuous feedback on the course. In order to address the concerns expressed by lecturers about declining participation in hybrid courses with concrete figures, the development of participation figures on site and online over the semester is examined on the basis of the e-scout protocols. Initial factors influencing the type of participation (online or on-site) in a hybrid teaching scenario are identified. Based on the observations and feedback, it is assumed that the implementation of hybrid and asynchronous courses makes sense under certain conditions and that lecturers should continue to be motivated to offer these teaching formats.

Zeit- und ortsungebundene Lehre unterstützt Studierende dabei, das Studium unabhängig von äußeren, beispielsweise privaten Umständen, zu bewältigen. Hierfür eignet sich u.a. der Einsatz von hybriden und asynchronen Lehrszenarien, welcher dementsprechend (auch nach der Corona-Pandemie) ein hochaktuelles, aber kontrovers diskutiertes Thema in der Hochschuldidaktik ist. Wie hybride Lehre lernwirksam gestaltet und systematisch weiterentwickelt werden kann, ist noch immer nicht geklärt. Im Pilotprojekt „TEORy – Try, Explore, Observe and Review hybrid Teaching“ unterstützt und begleitet daher eine technisch und didaktisch geschulte Person, der sogenannte E-Scout, regelmäßig eine hybride Lehrveranstaltung. Dies bietet die Möglichkeit, jede einzelne Veranstaltung einer Vorlesungsreihe zu evaluieren und so dem Lehrenden ein kontinuierliches Feedback zur Lehrveranstaltung zu geben. Um den von Lehrenden geäußerten Bedenken hinsichtlich einer sinkenden Teilnahme an hybriden Lehrveranstaltungen mit konkreten Zahlen zu begegnen, wird auf Basis der Protokolle des E-Scout die Entwicklung der Teilnahmezahlen vor Ort und online über das Semester hinweg betrachtet. Dabei werden erste Einflussfaktoren auf die Art der Teilnahme (online oder vor Ort) an einem hybriden Lehrszenario herausgearbeitet. Es wird vermutet, dass auf Grundlage der Beobachtungen und Rückmeldungen die Durchführung hybrider und asynchroner Lehrveranstaltungen unter bestimmten Randbedingungen sinnvoll ist und die Lehrenden weiterhin motiviert werden sollten diese Lehrformate anzubieten.

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1. Background

A needs analysis on digital teaching at the Department of Mathematics and Natural Sciences (MN)¹ at TU Dresden revealed that teachers and students consider the possibility of time- and location-independent learning to be the most important goal in connection with the use of digital elements in teaching. The implementation of hybrid and asynchronous teaching scenarios is particularly suitable for achieving this goal [1]. As the term "hybrid" is not clearly defined in teaching [2] we define it below:

Hybrid teaching is a synchronous teaching scenario in which people participate and interact simultaneously on site and virtually.

This type of course poses great challenges for teachers, not only technically but also didactically, as a classroom and online auditorium must be actively involved in the course at the same time. For this reason, in addition to the necessary technical requirements, teachers usually want personnel support in the preparation, implementation and follow-up of hybrid courses [3]. In the literature, for example, the appointment of "student co-moderators and technical assistants" is used [4] who voluntarily take on tasks such as moderating questions from the chat. This approach was viewed

rather critically by some lecturers in the MN area, especially from the mathematics and physics faculties: due to the complexity and abundance of the material covered, students with additional tasks could find it difficult to follow the content. An external person would therefore have to take on these supporting tasks. This is where the "TEORy" pilot project comes in and provides additional staff support for a hybrid course.

The results presented in this text are based on the lecture of the module "Discrete Structures" in the winter semester (WiSe) 2022/23, an export course of the Faculty of Mathematics for the 1st Bachelor semester of Computer Science. The lectures took place twice a week in a hybrid and asynchronous format. This means that, in addition to the introduced definition of hybrid teaching, the lecture was recorded and then made available to students on the video platform Videocampus Sachsen. This course was supported and accompanied by an e-scout (cf. Fig. 1). The term "e-scout" originates from the "Digital Teaching Hand in Hand" project of CODIP and ZiLL at TU Dresden. It refers to a student assistant (SHK) who is trained in media didactics and technology and then works to support digital teaching at various chairs [5]. From the surveys marked in green of the Fig. 1 marked in green show that the e-scout, in addition to his

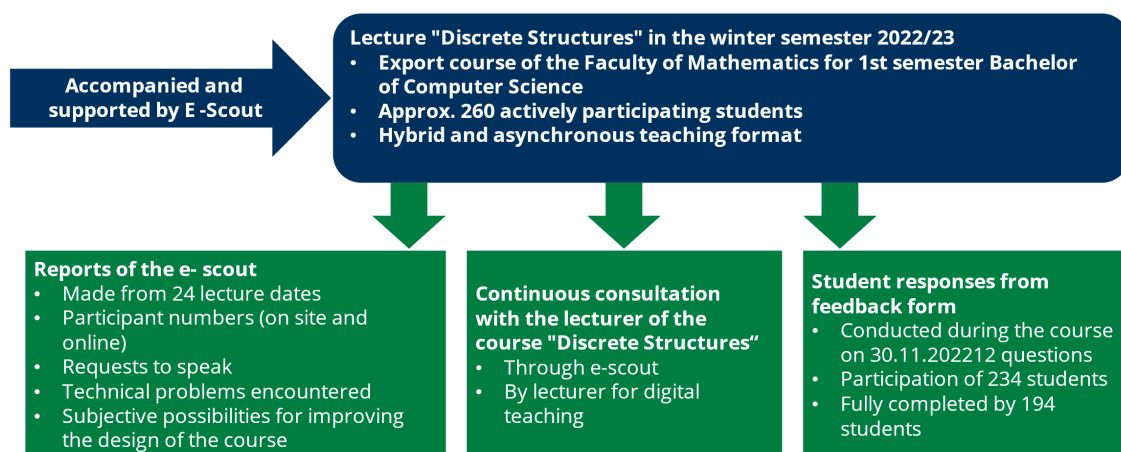


Fig. 1 : Overview of data collection

¹ At TU Dresden, faculties are assigned to a department. The MN area includes the faculties of Mathematics,

Physics, Biology, Chemistry and Food Chemistry, as well as Psychology.

supporting activities in the course, also recorded participant numbers, requests to speak, problems encountered during implementation in the hybrid format and subjective opportunities for improvement. In addition

In addition, a student survey was conducted in the form of a feedback form during a course in the middle of the semester (course on 30.11.2022). Of the approximately 260 students actively participating in the course, 234 took part in the survey. All 12 questions from the feedback form were completed by 194 students (green box on the right in Fig. 1). Overall, the response rate of approx. 75% for fully completed feedback forms is very satisfactory for the authors. The lecturer's perspective was obtained by means of continuous discussions with the e-scout or the lecturer for digital teaching in the MN department throughout the semester (green in Fig. 1). These surveys (protocols of the e-scout, information from students in the feedback form, discussions with lecturers) form the data basis for the results presented here.

2. Problem definition

Although the combination of hybrid and asynchronous teaching formats enables students to learn independently of time and place [1] the return to unrestricted face-to-face teaching from winter semester

2022/23 at TU Dresden as a whole, especially in the MN department, meant that fewer lectures were offered in hybrid formats or lecture recordings were made available. This can be seen from a comparison of the data on TU Dresden's course offerings from the winter semester 2021/22 with the winter semester 2022/23 and the current planning status 2023/24.² In addition to various technical and didactic challenges, the lecturers in the MN department at TU Dresden expressed concerns that the number of in-person participants would drop sharply over the course of the semester in a hybrid lecture course (cf. [6] and [7]). In the underlying surveys and interviews, only subjective

perceptions and estimates of lecturers with regard to participation in hybrid courses have been recorded to date. Accordingly, the numbers of participants documented on site and online in the course of the pilot project are evaluated below and initial factors influencing the type of participation in hybrid courses are highlighted.

The analysis of the number of participants and the data presented in section 1 can be used to derive arguments that support the thesis that the implementation of hybrid and asynchronous courses makes sense under certain conditions and that teachers should continue to be motivated to offer these teaching formats.

3. Type of participation in hybrid courses

In the following section, the number of participants in a hybrid course is analyzed over the course of the semester and initial factors influencing the type of participation are identified on this basis.

Total number of participants over the course of the semester

As described in section 1 the e-scout recorded the number of participants on site and online over the course of the semester. The documented values are shown in Fig. 2 shown. It can be seen that the total number of participants decreased by around 150 students over the semester. This decline should not be attributed to the hybrid, asynchronous format of the course. Studies show that the amount of time students spend attending a course depends on numerous factors, such as compulsory attendance, course size or the type and scope of examinations ([8, p. 38]). With approximately 260 participating students, the underlying course is comparatively large. Empirical findings support the thesis that "anonymity in large lectures encourages students to stay away" [8, p. 39]. It should also be noted that when considering a first-semester course in computer science, influencing factors such as course changes and dropout rates can have a negative impact on the total number of participants over the course of the semester

² Last system access on 14.07.2023

(cf. dropout rates in [9], cf. change of degree program in [10]).

Development by type of participation over the course of the semester

The in Fig. 2 shows the development of the number of participants by type of participation over the course of the semester and shows that, with two exceptions, more students took part in the courses in person than online. Over the course of the semester, the numbers of on-site and online participants converge, with the number of students participating online fluctuating constantly around 50. The numbers of on-site and total participants tend to develop similarly over the course of the semester.

There was a real slump in the number of participants in December. This is the course before the mid-term exam. The week before the midterm exam (corresponding to the 2nd and 3rd course in December) has two special features: Firstly, it was the first course in which more students participated online than in the lecture hall; and it was the course with the lowest total number of participants (directly before the midterm exam). It may be a coincidence, but it is remarkable that this phenomenon is repeated in the last two lectures before the examination period. The question arises as to whether students focus on self-study and repetition when preparing

Tab. 1 Evaluation of participant numbers

	Regardless of the day		
	Presence	Online	Total
Mean value	135	49	184
Percentage share Mean value	73%	27%	100%
Median	130	43	176
	Wednesday		
	Presence	Online	Total
Mean value	125	71	196
Percentage share Mean value	64%	36%	100%
Median	110	71	181
	Friday		
	Presence	Online	Total
Mean value	143	30	173
Percentage share Mean value	83%	17%	100%
Median	140	31	171

for exams instead of using the opportunity of the course to clarify any existing questions or gaps in understanding in an active exchange with the lecturer. However, this is not the question to be answered in this paper.

Analysis of the number of participants by day

A closer look at the number of online participants in Fig. 3 it is noticeable that it

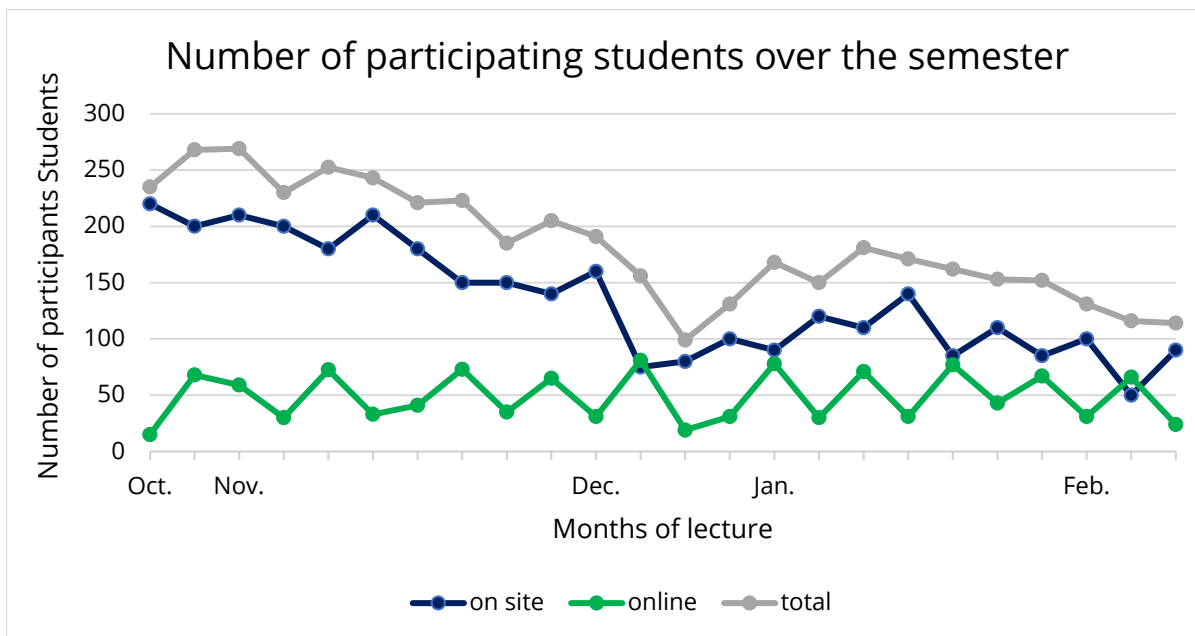


Fig. 2 : Recorded number of participants in the Discrete Structures lecture in winter semester 2022/23

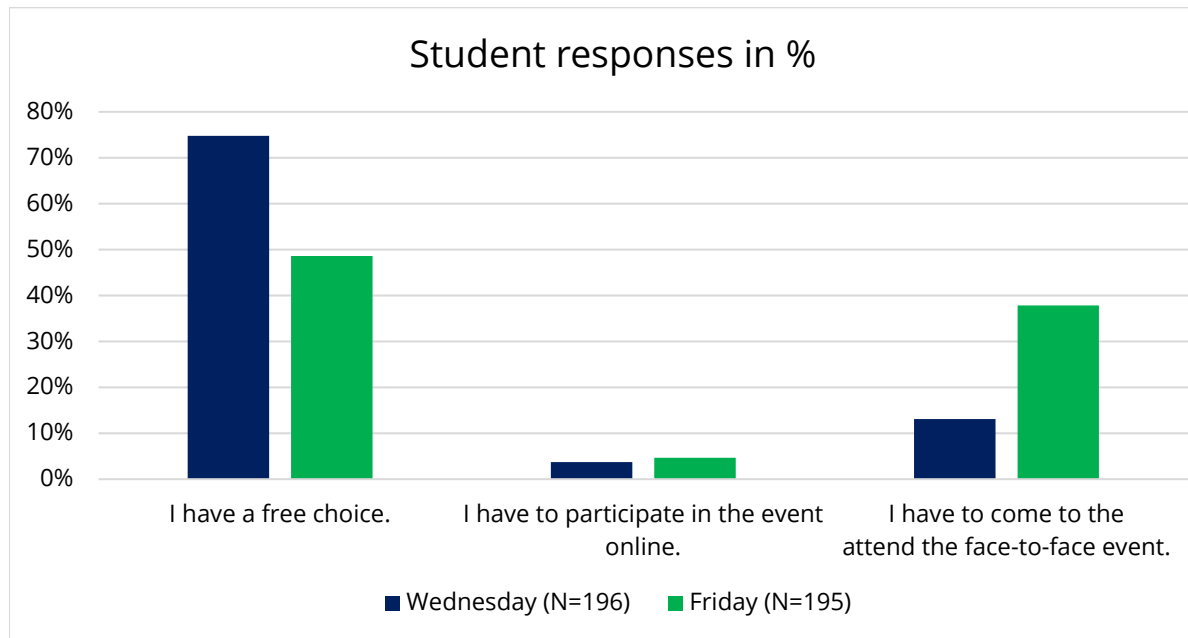


Fig. 4 : Student responses in the feedback form to the question "Do you have to attend the lecture online/live due to a course before/after?"

oscillates between two values at a relatively constant rate throughout the semester. Lectures with fewer than 50 online participants are often followed by lectures with between 50 and 100 online participants. To take a closer look at this phenomenon Tab. 1 shows the mean and median values of the number of participants by day and type of participation, so that readers can better interpret the mean value in relation to outliers. The values from Tab. 1 show that not only the average total number of participants varies depending on the day (on average 20 fewer students on Friday than on Wednesday). The proportion of students participating on site also changes depending on the day of the course. For example, an average of 64% of participating students are present on site on Wednesday and 83% on Friday. The median and mean value of online participants on Wednesday and Friday are (almost) identical. This leads to the conclusion that the number of students participating online is symmetrically distributed over the semester on both days of the week, while the distribution of attendance on Wednesdays is skewed to the right.

Identification of initial factors influencing the type of participation

In the needs analysis for digital teaching in the MN department [7] some of the students surveyed stated in the free text field that

attendance in hybrid formats depends on the semester timetable, among other things. For example, the fact that courses may overlap, that it is not possible to change locations during breaks and that other courses are offered exclusively online or as face-to-face events on the same day all play a role. Based on the results of the needs analysis, the students were asked to provide feedback on the Discrete Structures course in the feedback form (see green box on the right in Fig. 1): "Do you have to attend the lecture online/live on Wednesday/Friday due to an event before/after?" For this question, depending on the day, it was possible to indicate whether the lecture had to be attended in person or online or whether the students were free to decide how to attend the lecture. The answers of the students surveyed are shown in Fig. 3 shown. In addition, a free text field was available in the feedback form for this question, in which the answers given could be commented on or justified.

Looking at the data shown in Fig. 3 it is noticeable that the proportion of students who have to attend the lecture on site due to an event before/after is higher on both days than the proportion of students who have to attend online as a result. On Wednesday, the proportion of students who are free to choose which format they attend is significantly higher than the proportion of students who have to choose a lecture format due to other (private

or university) events in order to be able to attend the course at all. On Fridays, this ratio is relatively balanced. Furthermore, the data set shows that 48% of students are free to choose whether to attend the course online or in person on both Wednesday and Friday. Only two people (approx. 1%) stated that they had to attend the lecture online on both days. According to the information provided, 24 (approx. 11%) of the students were required to attend the course on site on both days. In addition, three comments were made in the free text field, the content of which is reproduced here³:

- I only take part online on Wednesdays because I have a part-time job.
- On Wednesday, I would have to drive to the university for the lecture, which is why I use the online alternative. It's perfect for me.
- Although I have the choice of how I attend the event, I would always prefer the on-site event. I am simply more attentive and stay on the ball. The videos available help me to look at certain things again afterwards.

The comments show initial influencing factors, such as timetable and having a part-time job,

on the type of participation in hybrid courses. Unfortunately, the responses to the feedback form are not suitable for showing a broader spectrum of influencing factors. In future surveys, a selection of predefined influencing factors would be useful instead of a free comment field.

The information in the feedback form is consistent with the figures collected by the e-scout from the courses. Since, according to the feedback form, 75% of the students surveyed had a free choice between online and face-to-face participation on Wednesdays, it could be concluded from the e-scout's surveys that around half of the students prefer the face-to-face event to the online event. Conversely, however, it is also clear that a not insignificant proportion of students need or prefer the online option.

The comments suggest another factor influencing the type of participation in hybrid courses - personal (learning) preference.

Conclusions

In summary, the results show that a hybrid and asynchronous teaching format does not

Tab. 2 Statistical evaluation of access to the lecture recordings

	before audit period (until 03.02.2023)	in the audit period (03.02.2023-03.03.2023)	Total (until 03.03.2023)
Total number of views	290	542	832
Mean value (views per lecture)	11	20	31
Percentage of the mean value	35%	65%	100%
Median (views per lecture)	8	17	23
Variance	64,51	104,61	275,31
Standard deviation	8,03	10,23	16,59
Min. number of accesses (of a lecture recording)	0	8	12
Max. Number of accesses (of a lecture recording)	31	44	69

³ A qualitative content analysis according to Mayring is only recommended for 10 or more statements. Accordingly, all

comments were reformulated at this point, but their content was not changed.

automatically lead to an empty lecture hall. On average, around 70% of students took part in the course on site. The type of participation is influenced by external factors such as timetable and part-time job. As attendance is not compulsory for students in this module, studies have shown that a decline in the number of participants over the course of the semester can also be expected in purely face-to-face courses (cf. [11], [8], [12]). In connection with the ZeitLast study and the project of the same name, which deals with "Studyability in Bachelor's and Master's degree courses, particularly with regard to the organization of time, learning culture and the use of modern technologies" [12, p. 4] various influencing factors (e.g. having a part-time job) on participation in face-to-face courses have already been identified (cf. [11], [8]). This raises the question of whether and in what form these influencing factors can be transferred to hybrid formats. If, for example, doing a part-time job in purely face-to-face formats leads to students staying away from the course altogether, while in hybrid formats they have the opportunity to take part in the course online, this could, contrary to the assumption made in section 2 a hybrid teaching format could have a positive effect on the total number of participants. The observations raise the question of whether in a hybrid course, compared to a pure face-to-face course, the face-to-face participants switch to the online format or whether an additional group of students is reached through the online offer. In other words, the question arises as to whether the total number of participants in hybrid courses is higher due to the online offering. However, this requires comprehensive studies.

4. Influencing factor lecture notes

As described in section 1 the lectures were recorded and made available online. The following section looks at the views of the lecture recordings and answers the question of whether these correlate with participant numbers. The aim is to investigate the hypothesis that lecture recordings of courses with a lower number of participants record more views for follow-up and exam

preparation than lecture recordings of courses with a higher number of participants. The authors therefore expect a negative linear relationship between the variables.

In Tab. 2 shows a statistical evaluation of access to the lecture recordings. Among other things, the average views of the lecture recordings are shown. The values from Tab. 2 show that almost two thirds of the views are recorded after the lecture period. This is in line with the students' statements in the needs analysis and the associated focus group discussions, in which it was stated that the lecture recordings are primarily used to prepare for exams [7]. It can also be seen that the lecture recordings were used comparatively rarely by the students (approx. 260 participants and an average of 31 views per lecture). As the videos were made available on Videocampus Sachsen, it is unfortunately not possible to make any statements about how long the students watched the individual lecture recordings (e.g. continuously or at certain times). Other video platforms, such as YouTube, are suitable for such evaluations. This data could be used to investigate whether the consumption behavior of students changes before and during the examination period, for example whether the videos are preferably watched continuously during the lecture period and whether they actively skip to certain explanations/topics during the examination period. However, this is not the focus of the present study.

The Pearson correlation coefficient was determined in order to check whether there is a correlation between the number of participants and the number of accesses to the lecture recordings. At $r=0.227$, this indicates a positive, weak linear correlation, which is not statistically significant with a p-value of 0.308.

The high variance and standard deviation of accesses from Tab. 2 indicate a wide spread of accesses, i.e. there are lecture recordings that were clicked on very frequently and others that were rarely clicked on (cf. min. and max. from Tab. 2). A closer look at the lecture with the most accesses before the examination period (lecture from 04.11.2022; 31 accesses until 03.02.2023) confirms the weak positive correlation effect, as 230 students took part in

this course, 200 of them on site and 30 online. This lecture was also accessed comparatively frequently (35 times) during the examination period. These figures indicate that students use lecture recordings primarily for topic-specific follow-up/exam preparation of the material taught.

Contrary to expectations and the initially formulated thesis, there is a weak positive correlation between the views of the lecture recordings and the number of participants. In addition, the numbers of views match the students' statements in the needs analysis and focus group discussions (cf. [7]), which state that

- Lecture recordings are mainly used for exam preparation
- Lecture recordings help to explain "difficult to understand topics" again.

5. Effect on the examination performance

In the following section, the examination performance in winter semester 2022/23 will be briefly discussed and the observation will be put up for discussion.

It should be noted that this is the first time that this course has been offered in a hybrid and asynchronous teaching format. Before the corona pandemic, the course "Discrete Structures" was designed for a purely face-to-face format and was switched to a purely online format due to the circumstances of the pandemic.

In Tab. 3 lists the failure rates for the final exams of the first semester course "Discrete Structures" in the Bachelor of Computer Science from winter semester 2016/17. The figures contained therein come from the responsible examination office. The results of

Tab. 3 Examination statistics of the final exam in the course Discrete Structures

winter semester Year	Average points	Failure rate
2016/17	49	44,73%
2017/18	51	40,35%
2018/19	42	56,98%
2019/20	40	47,47%

the exams in the Corona semesters are not taken into account, as these took place online and therefore in a non-comparable setting.

It is noticeable that the average number of points achieved in the exam in winter semester 2022/23 is higher than in previous years. The failure rate also decreased in the semester that was offered hybrid and asynchronously compared to the purely face-to-face semesters.

Of course, this one-off observation may be purely coincidental and independent of the teaching format offered. However, the results positively surprised the lecturer of the course and encouraged him to offer the lecture in hybrid and asynchronous format in the coming winter semester 2023/24.

It is important to continue to monitor the development of failure rates in the Discrete Structures course and to discuss whether a hybrid and asynchronous course offering in this course (with comparatively large numbers of participants and a heterogeneous student body) helps to reduce failure rates while maintaining the same level of examination demands.

6. Summary

The recorded attendance figures show that more students took part in the course on site than online. The type of participation is influenced by various factors, such as timetable, part-time job or personal learning preferences. Some of the students stated in the feedback form that they had to take part in the course online. It is assumed that hybrid teaching formats can contribute to higher overall participant numbers on average than pure face-to-face courses. This should be investigated in more detail in the future.

Accordingly, the analysis shows that the additional online offer of the hybrid course is used or preferred by a not insignificant proportion of students.

Furthermore, contrary to expectations, the number of views of the lecture recordings and the number of participants in a lecture indicate a weak positive linear correlation. From the click behavior and student surveys, it can be assumed that lecture recordings are primarily

used for lecture follow-up and exam preparation.

In connection with the examination results achieved in winter semester 2022/23, the conversion of the course to a hybrid and asynchronous format is rated positively by the lecturer (and, as can be seen from the feedback form, also by the students) and encourages the lecturer to offer the course hybrid and asynchronous in the coming winter semester as well.

In summary, it can be said that the analysis presented here has highlighted arguments that confirm the thesis that the implementation of hybrid and asynchronous courses makes sense under certain conditions and that teachers should continue to be motivated to offer these teaching formats.

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