Experiences after Covid-19 and digital teaching: IT students ask for streaming and recordings, but say they learn best on campus!

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Abstract. In this paper, we investigate experiences among IT bachelor students one year after the lifting of the last Covid-19 restrictions. We conducted an online survey among Norwegian IT students enrolled in a bachelor program (n=420), seeking to answer the following question: To what extent and why do students want streaming and recordings of physical lectures after the pandemic? The results of the statistical analysis show that most of the respondents prefer physical teaching and say that although their motivation for learning is best on campus, they also want the option to follow a stream or watch a recording. Third-year students are more positive about digital teaching, as are those who work a lot alongside studies. We conclude that the use of technology during the Covid-19 pandemic has led students to have new expectations and requirements that need to be taken into account.

Keywords: Higher education · Post Covid-19 · Digital teaching

1 Introduction

In spring 2022, the health authorities of Norway declared an end to all Covid-19-related restrictions [13]. Now, most of the world has returned to normal. This change was not as abrupt as the lockdown; the world opened up gradually. We, the authors, think that this is a good time to look at how the experience has shaped student expectations. Digital teaching as a result of the lockdown period differs from other digital teaching, due to the limited time available for preparation and how lectures and students had to adapt to online learning platforms at short notice [19]. Technology came to the fore and good digital solutions had to be implemented quickly to maintain the progression of teaching and educational courses. Higher education students were one of the groups in our society that was greatly affected by this pandemic. Students and staff had to stay home, which caused a sudden transition to online teaching [4]. Although technological possibilities in teaching had been used to a great extent before the pandemic, the pandemic still brought major changes; students could not meet physically on campus, but had to attend lectures from home. They did not have to think about traveling to school, the costs of traveling, settling somewhere near campus, etc. As a result of this, students could, among other things, manage their

own time to a greater extent. Within higher education institutions, many courses were streamed and recorded during lockdown. Students could choose to watch the recordings when they wanted and could, if needed, watch the recording of lectures several times. They were also free to choose where to sit and, in many cases, recordings were available at any time. But there were also some challenges related to this, and life turned out to be more different for many students in a very short time.

Going from a social life with friends you meet on a daily basis to sitting alone at home, with no or limited social interaction, is something many felt challenging [1]. After at least two years with various levels of restrictions, the students have acquired habits and expectations for teaching activities based on that experience. The authors, as lecturers in higher education in Norway with many years of experience, rarely or never received questions like this before the pandemic. Will the lecture be streamed? Will it be recorded? How long is the recording available to students? Could you record the lecture so that we can watch it as we prepare for the exam? Negative answers to these questions are generally not well received, despite the fact that our participants had signed up for physical campus education rather than an online course.

After the pandemic, there are some habits and expectations that are hard to change because there are still technological possibilities. Our experiences before, during and after the pandemic and the new demands from students have piqued our curiosity about how this pandemic may continue to influence teaching and expectations in the future. In this paper, we investigate the perspectives and experiences of students after the pandemic. The following research question is addressed: *To what extent and why do students want streaming and recordings of physical lectures after the pandemic?* To provide an answer, we draw on empirical data collected through an online survey (n=420) among Bachelor's students in Information Technology (IT) in Norway.

2 Related work

We see that online courses and digital learning have been a topic that has received attention in the last decade, especially after the Covid-19 pandemic. Although digital teaching is nothing new, based on our experience, there are many interesting questions that arise in the aftermath of the pandemic. Most of the work published so far has focused on what happened during the pandemic; some researchers have begun to look forward to the post-pandemic world. Guppy et al. [8] started while some pandemic-related restrictions were still in place, but asked their respondents to look ahead and assess how education is changed by the pandemic. The authors asked the respondents, including students, educators, and administrators, what they expect the trajectory of online education to be. Most of their respondents in all groups foresee a growth of blended and online learning. They concluded quite strongly that there is no way back to "pre-Covid-19 normality" and urged educators to reflect and learn from the experiences gained.

Some studies have found that almost every lecturer in the field of Computer Science (CS) experienced a positive change with the lockdowns [9], although there were some pedagogical concerns. Consistent with this, [12] found that educators are mostly content with digital tools and how they handle them. However, they see challenges in how to actively involve students and in the creation of a two-way dialogue. In addition, different forms of stress were also mentioned.

Others have found that the change to digital learning had positive effects on students' lives [7]. First, the students had more time to study since they did not have to travel to their study site and had much fewer options for other activities. Second, the studies became more flexible through recorded lectures, which could be reviewed repeatedly and at any time, and more time to pose questions. Some drawbacks were also mentioned, namely, more distractions, lack of structure, and perceived invasion of privacy when asked to turn on their cameras. Students were generally not comfortable sharing their faces and surroundings with the lecturer and fellow students during digital lectures. Others [3] found that most students, 90% do not turn on their cameras during synchronous lectures at a university that had a policy of making it optional; however, they encouraged students to turn on their camera. Various reasons for not using cameras were given: concerns about their appearance, people in the house, physical surroundings being seen behind them, weak internet connection, and they felt that people were looking at them.

Different forms of teaching can also help structure a student's daily life, but research shows that conditions at home affect e-learning behavior [15]. It is important to have surroundings that allow concentration to study and acquire new knowledge. Furthermore, the results of a study by Gonzalez et al. [6] found that students experience live lectures as important, giving them a regular event around which to organize their studies. Having scheduled activities motivates them to get out of bed and start studying. In online education [17], lecturers and students missed physical interaction and experienced difficulty engaging with the use of technology in this context. However, the technologies were found to be useful. Among the benefits, the lectures point out that the recorded lectures can be viewed later for repetition and further learning. Moreover, digital teaching also gave lecturers more flexibility, for example, when they needed to travel for conference participation, since they did not have to give a physical lecture at the school. The advantages for the students were, among others, that the students had access to lecture recordings, flexibility in terms of when they should watch the lecture recording, and that the students could work on their studies at their own pace.

The recording of lectures is a frequently mentioned topic in these papers. It is not logically related to remote teaching because we can record sessions and lectures in a classroom or auditorium. However, lecture recordings are much easier and more prevalent when lecturing online, and the two concepts have become linked in the minds of many students and lecturers. The recording of lectures has been independently investigated. Zhang et al. [20] compared the results of students who watched the recordings with those who did not, finding great benefit in

watching the recordings. These results have the clear limitation that the groups are self-selected. Therefore, students who are more motivated may choose to watch videos. Another study [14], concluded that while providing recordings decreases attendance somewhat, it does improve outcomes for students. However, academic staff are more cautious and concerned about increased absenteeism and reduced interaction in class. This strengthens the view that students benefit from recordings but that lecturers, on the other hand, see some disadvantages with this, such as absences from physical lectures and less interaction with and among students.

According to [10], it is hard to truly understand the effects of the pandemic on education, and more research is needed. Therefore, we feel that there is a need to look more deeply into perceptions and expectations after the pandemic.

3 Method

This paper describes a study drawing on data from an online survey. We focus on the quantitative findings, while the qualitative findings are communicated in another paper.

3.1 Survey design

We use Nettskjema[1], a tool developed by the University of Oslo (Norway) to collect data. It is a web-based survey tool that gives the opportunity to create, save, and manage surveys and data collection. Additionally, the tool is designed to make it easier to comply with various privacy and data protection regulations primarily by anonymizing data from the respondents.

This is an exploratory study, and since no or a limited amount of prior research has investigated this topic, we have not employed a concrete theoretical framework or theory in the development of the survey. The online survey conducted consisted of 13 questions, where several of the questions had subquestions. These were the topics covered in the survey: Background questions, the experience of digital and physical lectures, the experience related to recording and streaming of lectures, and how schoolwork and interaction/communication with lecturers and fellow students are experienced in the two different contexts. For more information on the questions asked in the survey, see Section 4.

3.2 Data collection

We have chosen to collect data only among IT students enrolled in a bachelor's program. Respondents represent first-, second-, and third-year students at a university in Norway. By only focusing on one discipline, IT in this study, we have the opportunity to replicate the same survey among other student groups. The survey was conducted in December 2022-February 2023 and closed with 420

[1] https://nettskjema.no/

respondents. It is important to note that at the time the data were collected, the last restrictions in Norway due to the pandemic had ended almost a year ago, 12 February 2022 [13]. To contact the students, we presented our study during a lecture and then provided them with a link to the online survey questionnaire. We do not have numbers on how many students were present in the various lectures, so we cannot calculate the response rate. The students were told that participation was voluntary and that the responses were completely anonymous.

3.3 The respondents

The demographic distribution of the respondents is described in Table 1.

Table 1. Demographic overview of the participants.

Gender			
Women	Men	Other/N.A.	
30%	69%	1%	
Age			
18-23 years	24-39 years	30-39 years	40 years or older
45%	36%	17%	2%
Year of study			
1st	2nd	3rd	Other
55%	35%	10%	0%

After the initial demographic questions, we also asked if the students had done paid work alongside their studies. Here, 25% answer that they do not work outside of their studies, 34% work 1-10 hours a week and 31% work 11-20 hours a week. 10% of the participants work more than 20 hours a week. Furthermore, we were interested in the extent to which respondents had experience with digital teaching during the pandemic. The findings show that 59% have experience with digital teaching to a very large extent or to a large extent, 21% have medium experience, and 20% have little or very little experience with digital teaching. In addition to this, we were interested in whether the students had a suitable place to sit when attending digital lectures. The results show that just under 82% always have a suitable place to sit, 16% sometimes, and about 2% never.

3.4 Data analysis

After the survey was closed with 420 respondents, we generated initial plots of responses. The purpose was to get an overall impression of the results and how the responses were distributed on the scale for each of the questions. Then we move on to the next step and perform a more sophisticated analysis. To develop statistical analysis and graphical presentations, we used the HH package in R. Subsequently, we analyzed the data and performed various cross-analyses to find significant differences among the demographic groups: gender, age, level of education, and degree of work in addition to the studies.

4 Results

First we looked at general preferences among respondents and then at differences between demographic groups as described in Section 3.3. Unless otherwise noted, there are no statistically significant differences among the groups, or we have too few respondents within one group to report on each group separately. We have tested to see if there are significant differences between how women and men responded in this survey, but we have not found differences. The results are grouped according to how the questions were presented in the survey.

4.1 General preferences among students

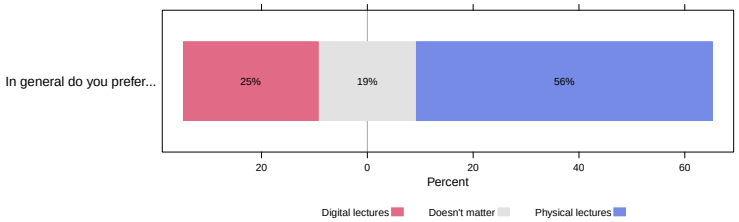

Fig. 1. General preferences for digital versus physical lectures.

First, we present the respondents' general preference for digital or physical lectures as shown in Figure 1. Most of the respondents clearly prefer physical lectures over digital lectures, while some do not.

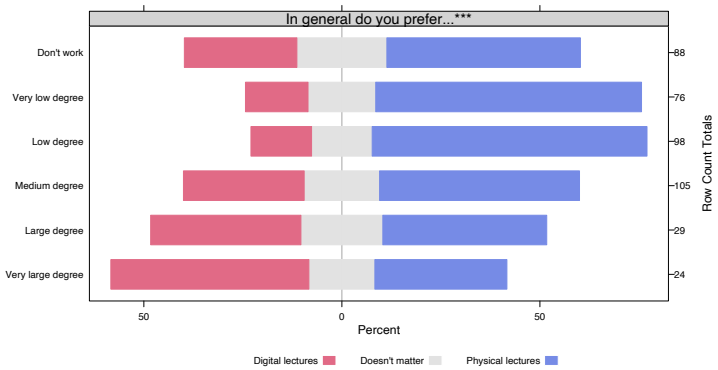

Fig. 2. General preferences for digital versus physical lectures. Here, split by the participants' answer to the questions: "To what degree does paid work affect your ability to participate in teaching activities?" This difference is significant by chi-squared test, $p < 0.001$.

However, there is a clear difference based on one of our background questions: "To what extent does paid work affect your ability to participate in teaching

activities?" Generally, the more respondents work, the more positive they are about digital lectures, as shown in Figure 2. This clear trend has a curious exception for those who do not have paid work at all. Therefore, the findings show that those who work little prefer physical lectures at school, while those who work much prefer digital lectures to a greater extent. There are also some respondents who responded that it does not matter whether the lectures are digital or physical.

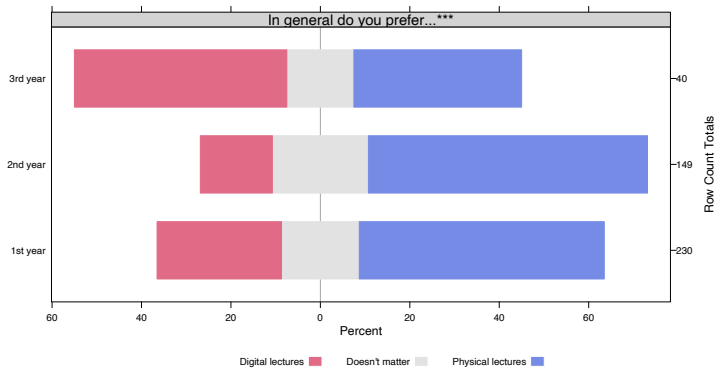

Fig. 3. General preferences for digital versus physical lectures. Here, split by the participants' year of study. This difference is significant by chi-squared test, $p < 0.001$.

Consequently, the findings give a clear signal that paid work alongside studies affects student life and students' preferences in terms of how the teaching takes place. If you do not have to physically meet on campus, life is easier for those who work a lot. Differences are tested and are significant using the chi-square test $p < 0.001$. We also see a clear difference in the responses by study year, as shown in Figure 3. In particular, third-year students are much more positive towards digital lectures. This group of students also has the longest experience with digital teaching, at least at the educational institution where they are now completing their final year of their bachelor's degree.

4.2 Qualities of online versus physical lectures

Furthermore, we asked respondents to rate some qualities of teaching to determine whether it works best in digital or physical teaching, as shown in Figure 4.

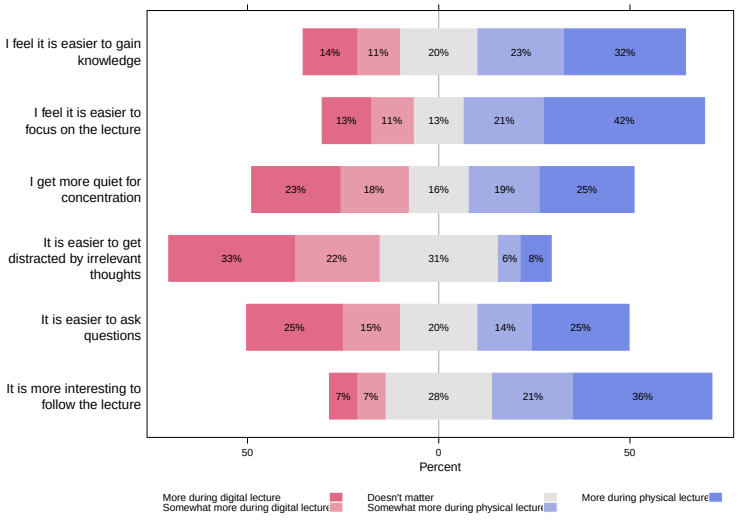

Fig. 4. Perceived qualities of digital and physical teaching.

Most of the respondents rate most of the positive qualities better for physical teaching. The ability to acquire knowledge, focus on the content of the lecture, and it is more interesting to follow the lecture are qualities that are rated highest for physical teaching on campus. Distractions, a negative quality, are more pronounced in digital teaching. Therefore, students find it easier to follow what the lecturer is talking about when they are physically present.

The positive aspects of digital teaching are that our students think it is easier to ask questions in digital lectures. Here, it is important to note that we often have a text chat available to students during digital teaching. Opinions are more divided as to which situation is the most conducive to concentration. To all the questions, some of the respondents also answered that it does not matter if it is a physical or a digital lecture. Therefore, they do not take a position on perceived qualities in the two different teaching contexts.

4.3 Streaming and recording of physical lectures

Almost all of our respondents find recordings from lectures useful, as shown in Figure 5. This clearly shows that experiences and the way technology was used during the pandemic have led to wishes and needs that were rarely considered before the pandemic. Furthermore, we also see that students generally do not find it harder to be physically present during streaming or that it is harder to ask questions during a lecture that is being streamed or recorded. We see that they show a sense of confidence in being able to ask questions about things that they wonder about or that are unclear. Regarding the need and desire for a physical lecture to also be streamed, the respondents do not agree that it is unnecessary. On the contrary, they want all physical lectures at school to be streamed. They

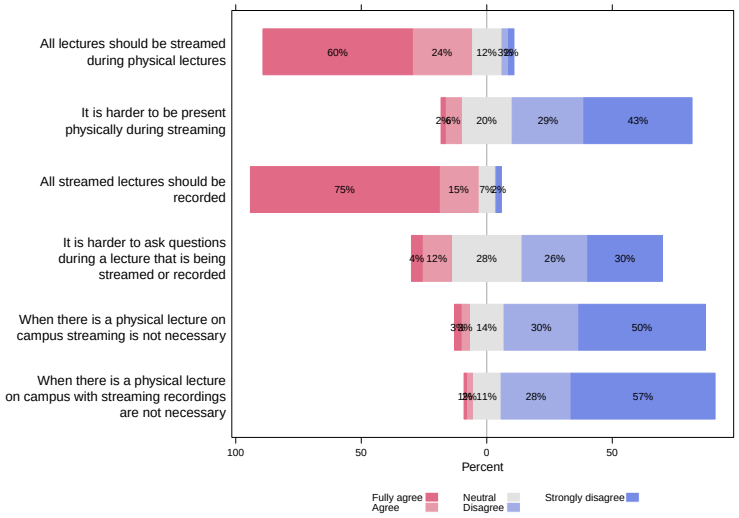

Fig. 5. Perception of the need for streaming and recording and some concerns about either.

also believe that it is necessary to record lectures so they can watch lectures several times if necessary. Overall, these findings show that from the students' point of view, it is highly desirable to both stream and record physical lectures.

4.4 What works best on campus and what works best online

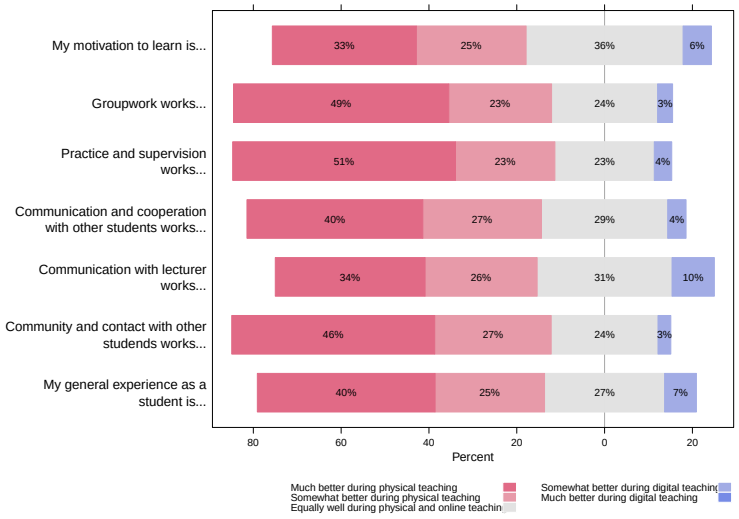

Fig. 6. What aspects work better online and on campus.

In Figure 6 we see that, in general, motivation is higher during physical lectures, but there are also some who feel it does not matter. Other things they find best in physical teaching are group work and supervision. Communication and cooperation with other students also work best with physical presence, in addition to communication with lecturers.

Contact with other students and having an interaction with fellow students also work best at school. In relation to the overall experience of being a student, physical education is clearly preferable. After the pandemic, there has been a great desire to get students back on campus. Not only because it gives perceived benefits to learning, but also because it improves social interaction, networking, collaboration, and contact with fellow students and lecturers.

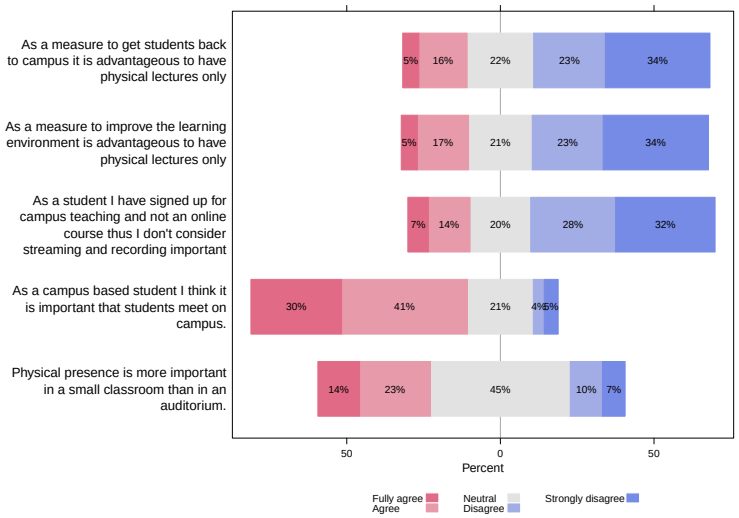

Fig. 7. Views about campus only teaching as a measure to motivate students coming back to campus.

In Figure 7 the findings show that students are generally not completely convinced that to get students back on campus, it is beneficial to offer only physical lectures or that only physical lectures improve the learning environment.

Respondents who participated in the survey complete an education designed for location-based teaching, but the findings show that they perceive streaming and recording lectures as important. Additionally, respondents feel that it is important to show up on campus. It seems that the students participating did not accept any of our arguments against streaming and recording, nor did they like us withholding this as a means to get students back to campus.

5 Discussion

After the introduction of digital teaching during the pandemic, streaming and recording of lectures have been a topic of discussion, among other things. To

some extent, students have become used to the flexibility it provides in the form of lectures that can be viewed again at any time. This has some clear advantages, but also some disadvantages that it is important to be aware of. Our findings show that almost every respondent finds lecture recordings useful, either for repeating difficult topics or as a tool to prepare for the exam. Previous research [18] also reports on the effectiveness and opportunities students have seen in tools such as Zoom. Most of the students were not used to having such additional learning materials prior to the pandemic, but it has clearly led to new needs and expectations. If a lecture is streamed, the students also expect a recording to be made, which is published after the lecture. From our experience, the result of this is that students to a lesser extent attend lectures in person but rather follow the lecture digitally or watch recordings afterwards. This means, among other things, that they lose the opportunity to ask questions, either verbally in physical attendance or via chat, if they only watch the recordings. Students who do not attend physical lectures also get less social interaction with the lecturer and fellow students, which in turn greatly reduces the opportunities for collaboration and knowledge sharing.

Most of our respondents believe that all physical lectures should be streamed. We see that the students do not find it difficult to be present at a lecture, even it is streamed. One could imagine that it would be more difficult to raise the hand and ask questions if a lecture was streamed or recorded, but that does not appear to affect the students. Moreover, the majority also believe that all lectures that are streamed should also be recorded and subsequently published for the students. Although students really want lectures to be both streamed and recorded, they generally prefer physical lectures to digital lectures. Streaming or recording seems to be considered an added value and gives students the opportunity to choose if they want to follow a lecture in physical or digital surroundings. In this, there is a difference between those who work outside of their studies and those who do not. When we compare the degree of how much they work alongside their studies, we see a clear trend: The more students work, the more they prefer digital lectures. Consequently, working alongside studies has a clear influence on students' preferences and needs. Furthermore, previous research found that balancing online studies and other activities can be challenging [5], and this probably also appears in location-based studies. Among the respondent group who do not work at all and who you would think were the most flexible, we also see that they want digital teaching at roughly the same level as those who have paid work to some degree. This is somewhat surprising. In general, the more students work, the more positive they are toward streaming and recording. This is also in line with [7] and the flexibility that streaming and recording provide, and [4], which also found that students prefer flexibility and the opportunity to study when they have time and energy.

Among other things, the sudden transition to digital teaching during lockdown resulted in some pedagogical concerns, although there were also some positive experiences among the lectures [9]. Because students want access to lec-

tures streaming and recordings, it is reasonable to assume that they generally have positive experiences.

The lectures in general dealt well with the use of technologies. From previous studies, we also know that the workload for educators increased due to the abrupt transition to technology during the pandemic [11], and for many there was a lot of new knowledge to acquire in a short period of time. It is natural to believe that this has affected skills related to digital lectures and the willingness to share recordings after lectures. More in-depth research studies on this topic would be useful and interesting, especially with regard to lecturers' views on the distribution of recordings after a lecture. Furthermore, our findings show that group work is best when students meet physically and the same applies to supervision. This also includes communication with the lecturer, contact with fellow students, and the general experience of being a student. Research conducted after lockdown reveals that students find collaboration and communication challenging when only using digital tools and not physically attending [16]. This clearly shows the importance of physical presence and human contact, especially when it comes to collaboration related to a specific task. As previous studies [3] show, during digital lectures, most students do not turn on their camera, especially if it is optional to turn it on.

A clear trend in our study is that the students want both: they prefer physical teaching, while they also want streaming and recording. The digital element in teaching that was introduced during the pandemic has created some new views on teaching and the use of digital tools has created in many ways new needs and desires. In the coming years, it is important to distinguish between how students utilize these two different forms of learning and in a process of acquiring new knowledge. Many prefer to be present during physical teaching at school, to meet fellow students and communicate with them and the lecturer. But, as a supplement to this, it is good to have recordings to be able to repeat the syllabus, especially where there is something difficult.

Although students believe it is important to meet physically on campus, they appreciate the opportunities that exist through the use of technology. Previous studies [2] show that student engagement is important to achieve satisfaction with education, while at the same time, it also has a positive influence on students that the lecturer shows engagement [5]. This can be demonstrated in various ways, including by academic weight and knowledge, communication skills, and the preparation of study material for students (for example, by publishing a recording of a lecture). In higher education, where attendance at classes is voluntary in most cases, we can imagine that many students choose not to attend physically, but rather follow digital teaching. The reasons for this can be many, but among other things, the students prefer to work to earn money, sleep late in the morning, it is more comfortable to sit at home, etc. We know that students experience the best learning at school, but halting streaming and recording may not be the best initiative to get students back on campus. This is something that can affect the students' satisfaction with the course, precisely because they have now seen the advantages that this can create.

6 Conclusion

Our results make it abundantly clear that students after Covid-19 have some new needs and requirements. In addition to attending physical lectures, students expect to be able to watch lectures at any time and any place. Consequently, students expect lecture streaming and recording as an option. However, it is equally clear that students actually strongly prefer physical teaching and claim to learn best on campus. Beyond this, they see a clear value in being able to have social interaction, especially with their fellow students. This means that as an incentive to bring students back to school, refusing to stream or record is a very unpopular alternative among students. Note that the views of the students should not be the only factor determining this choice. We should, however, look for other ways to encourage students to physically appear on campus.

Future research in this area may focus on how student needs and expectations are balanced with pedagogical elements, in line with what provides students with the best learning. Furthermore, future studies could incorporate qualitative data, such as interviews and focus groups, to explore in depth what students need as additional learning materials in a learning process. Moreover, it would be useful to investigate to what extent students actually use the recordings and how it possibly contributes to increased learning. It could also be valuable to research the experiences and views on digital teaching, including streaming and recordings, from lecturers' point of view.

References

1. Almendingen, K., Morseth, M.S., Gjølstad, E., Brevik, A., Tørris, C.: Student's experiences with online teaching following covid-19 lockdown: A mixed methods explorative study. PLOS ONE **16**(8), 1–16 (08 2021). https://doi.org/10.1371/journal.pone.0250378
2. Baloran, E.T., Hernan, J.T., Taoy, J.S.: Course Satisfaction and Student Engagement in Online Learning Amid Covid-19 Pandemic: a Structural Equation Model. Turkish Online Journal of Distance Education **22**(4), 1–12 (2021). https://doi.org/10.17718/tojde.1002721
3. Castelli, F., Sarvary, M.: Why students do not turn on their video cameras during online classes and an equitable and inclusive plan to encourage them to do so. Ecology and Evolution (01 2021). https://doi.org/10.1002/ece3.7123
4. Dinu, L.M., Baykoca, A., Dommett, E.J., Mehta, K.J., Everett, S., Foster, J.L.H., Byrom, N.C.: Student perceptions of online education during covid-19 lockdowns: Direct and indirect effects on learning. Education Sciences **12**(11) (2022). https://doi.org/10.3390/educsci12110813
5. Farrell, O., Brunton, J.: A balancing act: a window into online student engagement experiences. International Journal of Educational Technology in Higher Education **17**(1), 25 (2020). https://doi.org/10.1186/s41239-020-00199-x
6. Gonzalez, R., Sandnes, T., Fagernes, S.: Student perspectives on the digital learning experience during COVID-19 lockdown . ECEL - 20st European Conference on e-Learning pp. 203–209 (2021)

7. Gonzalez, R., Sørum, H., Raaen, K.: Emergency digital teaching during the covid-19 lockdown: Students' perspectives. Education Sciences **12**(3) (2022). https://doi.org/10.3390/educsci12030152
8. Guppy, N., Verpoorten, D., Boud, D., Lin, L., Tai, J., Bartolic, S.: The post-covid-19 future of digital learning in higher education: Views from educators, students, and other professionals in six countries. British Journal of Educational Technology **53**(6), 1750–1765 (2022). https://doi.org/10.1111/bjet.13212
9. Hjelsvold, R., Nykvist, S., Lorås, M., Bahmani, A., Krokan, A.: Educators' Experiences Online: How COVID-19 Encouraged Pedagogical Change in CS Education. Norwegian Conference on Didactics in IT education (2020)
10. Kerres, M., Buchner, J.: Education after the pandemic: What we have (not) learned about learning. Education Sciences **12**(5) (2022). https://doi.org/10.3390/educsci12050315
11. Lepp, L., Aaviku, T., Leijen, Ä., Pedaste, M., Saks, K.: Teaching during covid-19: The decisions made in teaching. Education Sciences **11**(2) (2021). https://doi.org/10.3390/educsci11020047
12. Løkeland, L.S., Ekren, K., Brynestad, E.K.: Desktop Video Conferencing Tools in Higher Education : Understanding Lecturers ' Experience. UDIT Norsk konferanse for utdanning og didaktikk i IT-fagene (2021)
13. Ministry of Health and Care Services, Norway: Tidslinje: Myndighetenes håndtering av koronasituasjonen, https://www.regjeringen.no/no/tema/Koronasituasjonen/tidslinje-koronaviruset/id2692402/, accessed: 2010-09-30
14. Morris, N.P., Swinnerton, B., Coop, T.: Lecture recordings to support learning: A contested space between students and teachers. Computers and Education **140** (10 2019). https://doi.org/10.1016/j.compedu.2019.103604
15. Prasetyanto, D., Rizki, M., Sunitiyoso, Y.: Online learning participation intention after covid-19 pandemic in indonesia: Do students still make trips for online class? Sustainability **14**(4) (2022). https://doi.org/10.3390/su14041982
16. Raaen, K., Sørum, H., Gonzalez, R.: IT bachelor capstone project during lockdown: Student experiences . Norwegian Conference on Didactics in IT education (2020)
17. Radmehr, F., Goodchild, S.: A transition to online teaching and learning of mathematics in Norwegian higher education institutions: the perspectives of lecturers and students. Teaching Mathematics and its Applications: An International Journal of the IMA (09 2022). https://doi.org/10.1093/teamat/hrac014
18. Salvi, M.M., Achar, C.: A study on effectiveness of zoom in online classes. International Research Journal of Modernization in Engineering Technology and Science **07** (07 2022)
19. Tsang, J., So, M., Chong, A., Lam, B., Chu, A.: Higher education during the pandemic: The predictive factors of learning effectiveness in covid-19 online learning. Education Sciences **11**(8), 446 (Aug 2021). https://doi.org/10.3390/educsci11080446
20. Zhang, J., Leung, P., Tan, C.I., Xian, A.: Assessing the impact of recorded lectures on learning effectiveness. vol. 2022-June, pp. 199–206. Universidad Politecnica de Valencia. (2022). https://doi.org/10.4995/HEAd22.2022.14543