

Student Perceptions of Online Learning During the Pandemic: A Change in Social Dynamics at a Swedish University

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Abstract—This Research Full Paper presents findings on Swedish computer science students' perception of learning online during the Covid-19 pandemic at a mid-sized Swedish university. Due to the pandemic, classes in Swedish universities moved abruptly to an online format during the spring of 2020. Content analysis was used to analyze 10 interviews with third-year bachelor students. The results were discussed in the light of the community of inquiry theoretical framework. We found that when learning online, students communicated and collaborated via a class-wide Discord server, an online communication platform originally developed for the gaming community. The use of Discord was seen to change the students' expectations of student-instructor interaction. The students' frequency of questions to the instructor decreased drastically when learning in the online environment compared to the on-campus environment, both during live-lectures and outside of class. The students perceived instructor engagement and presence in both live and recorded lectures as more important for their learning online than in the on-campus setting and wanted more interaction during lectures. Discord created a community for the students. However, the social aspects of learning were still missed. Many interviewees found it hard to keep focus and struggled with self-discipline and identifying a work structure. Clear benefits given for online learning were flexibility and convenience of time and place. Students also experienced group work to be more efficient online.

Index Terms—online learning, pandemic, student perception, computer science, content analysis

I. INTRODUCTION

Online learning in higher education has been developed and discussed for several decades [1], [2]. Due to the accessibility and convenience of online learning, it can reach a new group of students. Advances in technology are also a contributing factor to the fast development of online learning. These reasons make online learning increasingly relevant in higher education. Almost all courses in higher education today have some digital component, such as a web-based way of delivering information, submitting assignments or in-class interactions. There are also a variety of courses that are offered only in the online setting.

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During the Covid-19 pandemic, many universities had to take measures to reduce the spread of infection. In Sweden, nearly all university education was moved online from the spring of 2020 to the autumn of 2021 with little notice. This rapid move to the online platform is defined by Hodges et al [3] as emergency remote teaching. Since the online setting was a result of an emergency transition, it can not be directly compared to pre-pandemic online courses. However, we believe there is still valuable information to be gained from exploring students' experiences.

Our hope with the study was to gain greater insight into how computer science (CS) students in a mid-sized Swedish University of approximately 20,000 students perceive their learning in the online environment, as well as to gain knowledge in what online learning activities the students felt would be beneficial for their learning in an on-campus course. We interviewed 10 students that were part of a 43 student cohort in their third year of a computer science bachelor's degree about their online experience. This knowledge and understanding is helpful to improve classrooms and develop courses that will enhance students' learning. The research questions for this study were:

- RQ1: How do computer science students in a mid-sized Swedish university perceive their learning in an online environment?
- RQ2: What aspects of online learning do the students think would be beneficial for their learning in an on-campus course?

In this paper, we define an online course as a course in which all of the instructions, materials, assessments, and interactions are carried out online. The environment in which the learning takes place is referred to as the setting or environment.

II. RELATED WORK

The advantages and disadvantages of learning in the online environment have been discussed in related papers [4]–[6]. Benefits of online learning include the convenience of time and place for study and the flexibility and accessibility of the online setting [7]–[10]. But the online setting has its challenges.

Some students feel a sense of isolation and lack of community and the pandemic has added its own challenges. Many studies, both before and during the pandemic, are discussing different factors that are important for online learning and the struggles the students face [2], [5], [6], [9]–[11].

A. Factors for success in online learning

Student self-management [5], [6], [12], [13], which include time management, self-discipline, motivation, concentration and other self-regulating aspects of learning in the online environment, is found to affect how online learning will work for the individual student. The student's attitude and level of anxiety towards online learning, as well as their self-awareness of their own limitations, also affects how successful the learning will be.

The design of the online course is an important factor for successful learning in the online environment [5], [6], [8], [14]–[17]. However, even though information must be easily accessible, a high volume of information is experienced negatively by the students [8]. A literature review of factors for students' success and satisfaction with online learning made by Kauffman [2] summarized that it comes down to instructional and course design for a course to facilitate student satisfaction. The course needs to have a sound and clear structure and there needs to be alignment between learning objectives, activities, and assessment.

Students also need to have a valuable interaction with their instructors [5], [6], [8], [14]–[19]. The quality of students' interaction with the instructor in an online course is a significant contributor to students' learning and satisfaction. In the online learning environment, students are physically separated from their instructors and peers and the natural moments for interaction are fewer, if even existing, than when learning in an on-campus environment. The instructor plays a key role in how students perceive the quality of an online course and can also help students feel included in the learning community and get active engagement from the students. Having an instructor that guides and facilitates the instructions, interacts with class discussions, and provides regular feedback and communication is important for students to be active in online learning.

A recurring reflection on challenges with online learning is not being part of a community and missing interaction with peers [2], [5], [12], [14], [16]–[19]. Social presence will affect how much a student feels motivated to communicate with the online community which affects their sense of belonging and feelings of isolation. Helping students feel included and part of a community as well as providing opportunities for collaboration and facilitating discussion and interaction in the class is valuable in the online environment. Alquarashi [15], however, argues that peer interaction is not as important for satisfaction as course design and student-instructor interaction is.

Technology is another aspect of learning in the online environment that can either hinder or facilitate online learning [5], [8], [19]. Technical difficulties, or concern over technical problems, can be a barrier to learning. How comfortable the

students are with the technology used and how the design of the course uses technology are also aspects that affect how learning in the online environment is perceived. One can argue that how used a student is to technology affects the student's learning outcome. However, Kauffman [2] finds that studies have shown there is no difference in learning outcomes for students with high versus low technology efficacy.

B. Online learning during the pandemic

Just as for online learning pre-pandemic, different factors affect students' perception of their learning and their environment during the pandemic [9]–[11], [20]–[22]. Warfinge et al [20] as well as Riese and Kann [21] could see that students felt less overall satisfaction with the online version of the courses and that they experienced the quality of the on-campus courses as higher than the online courses. Meanwhile, Bogdandy et al [22] on the opposite found that online education was experienced as successful by the students. Things such as social interaction, technical issues, motivation and study discipline were found to be struggling for students while learning online [9]–[11], [21], this is consistent with pre-pandemic studies such as [2], [5], [6], [8], [12], [14].

Stevanovic et al [10] found that one of the biggest shortcomings of learning in the emergency remote environment was the lack of interaction and live communication. Students experienced that they missed out on the social context of learning, which indicates a feeling of isolation and missing a community. Feedback from instructors as well as interaction with instructors is another aspect students experienced a negative change in [9], [11], [20] which correlates to the finding of [5], [6], [8], [16], [19]. However, the change in student-instructor communication can also be a positive change [10] when experienced to be freer than previously. Scalero et al [23] could see that lack of in-person classes and limited interaction with peers made students feel disconnected from their education. Warfinge et al [20] found that the students felt they had more time for understanding but felt more pressure and found it harder to understand expectations. The authors also found, both from students and teachers, that the focus of assessments had shifted towards a more in-depth understanding with a change in question types. Individual skills, such as writing and the ability to plan, had increased while learning teamwork skills had suffered.

Students experience flexibility, accessibility and less commuting to be advantages with learning in the online environment [9], [10], [21]. Students highlight the access to course material and the ability to re-watch video lectures as positives. This accessibility together with the flexibility of making one's own schedule enables students to follow the course at their own pace. These are all positive aspects of online learning found in pre-pandemic studies as well [7], [8].

III. THEORY

The results of this study are discussed in the light of the Community of Inquiry (COI) theoretical framework [24]. COI describes how social, cognitive and teaching presence

facilitate learning to take place for a group of learners, through the educational experience. Social presence is the ability to identify with the community, being able to communicate purposefully in a trusting environment and develop interpersonal relationships. Teaching presence includes designing and developing a course and its educational material, as well as guiding and supporting the students. Teaching presence not only includes the instructor but can also be provided by any of the participants in the community. Cognitive presence is important for developing critical thinking, learning through reflection, discussion and feedback. The three interactions of a COI can either enhance or inhibit the quality of the educational experience and therefore also the quality of the learning outcomes. Presence is a social phenomenon that is visible in interaction [25]. COI is a popular model for active online and blended courses.

IV. RESEARCH METHOD

To gain insights into the students' experiences and perceptions of learning in the emergency online environment due to the Covid-19 pandemic we conducted semi-structured interviews with 10 third-year computer science bachelor students at Mälardalens University in Sweden. The interviews were recorded and then transcribed using otter.ai and manual processing. Inductive content analysis [26] was applied to the data.

One of the authors is a computer science teacher at Mälardalens University and therefore did not conduct any interviews. Third-year students were chosen because they did the majority of their first year on campus, the entire second year online, due to the Covid-pandemic restrictions, and are now back on campus for their third year. The perceptions of this student group are interesting to explore because they have experienced both on-campus and online learning. All participating students volunteered based on an email asking for participation sent to the entire class. The interviews were conducted in English, since this was the common language between interviewer and interviewees, and were anonymized before analysis. All of the interviews were originally planned to be in person but due to increased Covid-infection rates, three of them were conducted via Zoom, a video communication platform.

All interview transcripts were carefully read through by both authors. Quotes that were not in the scope of this study were removed. Each of the remaining quotes were placed into categories that emerged during the analysis. Quotes that were troublesome to sort into the current categories were thoroughly discussed and if needed new categories were added. If a quote fit into two or more categories it was divided and placed into all of the appropriate categories. When all quotes were placed into categories the different piles were re-evaluated and any quotes that did not fit into that category were moved to a more appropriate one, here as well new categories emerged, making this an iterative process. When all quotes were sorted into descriptive categories, connections between the categories were found and they were merged into themes.

V. RESULTS

We found that the students' responses could be separated into five themes: student self-management, course design, community, technology and instructor presence. We were able to identify how the students' perceptions and experiences related to the themes identified as important to online learning. In addition, the students also identified what would be important for them to bring into an on-campus course, the benefits and challenges of learning in the online environment and how the pandemic affected their education.

The students noted the benefits of the online environment. When giving presentations, several of the students felt less nervous. Many felt that the schedule was more flexible, both since the teacher could more easily make changes to the course schedule and that they did not have to plan their day around the course. Several students appreciated the easier access and availability to information and that they could attend lectures even when sick or injured. Recorded lectures were highlighted as a positive experience and during live online lectures, the ability to ask questions privately was a benefit for some. Some saw benefits in being able to take courses that would otherwise be inaccessible due to location. Many students appreciated not having to go to campus, but for those living further away from campus, being able to study from home had an added benefit of no travel time. One student expressed the benefit of being able to have physical movement, such as standing up during the lecture.

Even though the students found many benefits with learning online, the majority of them preferred the feeling of the physical classroom. The interviewees felt they were more focused and it was more personal learning in the on-campus setting. They were also able to keep better routines. Students experienced that it was easier to have social interactions and the interactions were better, such as talking to classmates. One student missed using the computer rooms and whiteboards available on campus when learning. There were also issues with the learning space itself when the setting was online, such as bad internet or lack of a good location to do schoolwork or attend lectures in their home. The lack of availability with the instructors was also a problem for many of the students when learning in the online environment.

Most of the students commented on the benefits of group work being done online. Most found it was more efficient to collaborate via screen sharing and it was easier to have short impromptu meetings since everyone in the group was more available than they normally were on campus. One student mentioned that it was easier getting people in the group to participate when meeting in person than in a digital format.

A. Student Self-Management

There was a large variation in workspaces. Some students had a one-room apartment and others were living with family and had a location to turn into a dedicated workspace. Some already had an online setup that they transitioned into a workspace. The students that were able to find a separate workspace seemed to enjoy their experience more than those

that had less space to set up. An issue that several students commented on was not being able to destress at home, in that they never quite felt done with school for the day.

Erik: “I think it was like more of a looming presence that you always had in the back of your head. Like, even though I’m at home, I have to think about school.”

Dual tasking and losing focus during lectures was a challenge for almost all of the students. They found it hard to focus on the lectures when studying from home.

William: “I think I realized that after a while, I see that, Okay when I sit with my phone at the end of the lecture, I have no idea what they have talked about.”

After a time, strategies changed for many of the students. A few students felt it important to set up a schedule. A couple of students noted that a more rigid work schedule worked better and they found ways to limit distractions, for example leaving their phone in another place or deleting entertainment from their computer. Most students found that a set structure and not mixing free time activities with school work benefitted them the most. There were some students that did not change anything.

Almost all the students stated a lack of focus, distractions, motivation, and discipline as issues. It was easier to skip class or leave during a lecture than when they were participating in person.

B. Course Design

Some students felt that the online classes felt like a boring routine, that they knew exactly what to expect at the lecture. The instructors that the students felt more engaged with had students interact during the class. This was done in breakout rooms, calling on random students to answer questions or using polls through Zoom, mentimeter.com, or Google forms. For project courses, small project group meetings with the instructor were also seen as positive for the students’ learning. The common theme is that the students are required to actively participate.

Erik: “[...]So there were like, exercises that [the teacher] would do. So that was like, better because then you actually felt like you were learning.”

Students felt very positive about the availability of recorded lecture materials. For students that had language challenges, subtitles and the ability to rewatch were very helpful. The ability to speed up or slow down lectures made the pace of the video less important. A course structure that students identified as working well was to have recorded lectures and then the lecture time be used for interactive activities.

Changes were made to assessments for the online environment. Some exams were supervised over Zoom which allowed the exam to remain similar to prior exams. Other courses changed the nature of the exam to account for the extra resources the student had available, which felt much more challenging to the students. The exams that were failed by

students due to this were passed at a later time because they then had a better understanding of the exam expectations.

Emma: “[...] I went through all this five stages of like, you know, anger, depression, and all that kind of stuff before I finished it. So yeah, that was—that experience was—I think it was the worst exam that I had actually, like emotionally.”

The most positive experiences with assessment came from courses that changed the proficiency assessment to a project.

Erik: “[...]But for instance, last semester, we had a [CS course]. [...] [the instructor] switched it to a project and that felt better because then you can show off what we had learned during the labs and during the lectures to him.”

C. Community

A student-led initiative for communication was a Discord server, an online communication platform, set up at the beginning of the students’ first year which included the entire cohort. There were no teachers or other school representatives involved in this communication or setup. The Discord group was used by all of the interviewed students. Some students were more likely to just read what was said in the Discord group than actively engage with it, though they all accessed Discord and received support from it.

Filip: “So we can just pretty much go in there and then find the right people we knew and connect in private communication pretty much. So we just go on there and reach out.”

Students were able to do voice and video chats as well as create topic channels in the Discord channel. Discord is where most of the students would utilize their peers to answer questions before going to a teacher. Many of the students had Discord running on their workspace so that they were contactable throughout the day.

Oscar: “[...]so the time I would have been in school I sit in Discord instead. I’m in Discord from when I wake up to when I go to bed, basically.”

Some of the students started utilizing Zoom for social interactions and would set up Zoom calls to interact with friends.

Daniel: “Now I love Zoom. [...]when we’re bored, we send the Zoom link in our Discord server, and then people join and we sometimes play games or drinking beer or talking school or something, eating lunch.”

Zoom was a replacement for social interactions that couldn’t be completed with Discord, however, it still did not have the same feel as an in-person interaction.

D. Technology

All of the students seemed to feel confident with the technology due to their technical background. They did, however, identify challenges when there was an unstable internet connection. A bad connection can cause issues with online

teamwork as well as attending a course. Students occasionally found the instructor wasn't sufficiently proficient with the technology.

Daniel: "Some teachers, it can take 15 minutes for them to get everything to work. So that's a problem sometimes.[...]Yeah, Can you see me? Can you hear me? Can you see the PowerPoint? "

E. Instructor Presence

There was very little student-instructor interaction outside of live online lectures. Some students found the instructors more distant in the online setting. Many of the students did not contact the instructor with their questions about assignments but instead went to their peers with issues first. Breaks and after lectures were common times that students would interact with the instructor in an on-campus class setting but students found that time vanished. Students felt that it was hard to ask the instructor questions in an online setting.

William: "And then since no one else asked questions, personally, I was like, Okay, well, maybe I should not ask questions either[...]"

Most students found the instructor's response time to be too slow to be helpful. Positive interactions with instructors involved a booked, weekly planning meeting and asking questions via email and the instructor setting up an online meeting to help the student if the question couldn't be answered simply. Some students felt positive about classes that felt like a conversation with their instructor, as one student described it.

Several students perceived the engagement of the instructor and their tone affected their feelings towards the course. The negative effect of low instructor presence in a course can be seen by the following student experience:

Erik: "And the lectures were—it was so impersonal because [the instructor] just posted a two and a half hours clip of a lecture and said, Hey watch this and read these pages.[...]when you say you can't hear colors, I heard black and white when [the instructor] was talking. [The instructor] was just like so monotone and impersonal you just felt like, Do I even want to watch this or do I use Google online trying to find answers to everything that I try to solve?"

VI. DISCUSSION

Variables important for online learning can change [14]. This is also clear in the interviews conducted in this study. Students entered the online environment with little to no prior online education experience. It has been very interesting to look at how the students see themselves evolving and adapting in this setting and how they have met different challenges and benefits over time.

Having the Discord group created a community for the students. Belonging to a community and not feeling isolated is an important factor for social presence within online education

as stated by for example [5], [8], [10], [14], [19], [23]. However, it seems the students in this study felt they missed their community more than they felt that they didn't belong to one. This is a clear distinction as they had ways of reaching out to each other and finding support amongst themselves. Many students felt this connection because they had already spent time with each other during their first year of study before going online and because they had the Discord group. The majority of the students seemed to have access to Discord at all times, which gave them a quicker response time than email or other forms of asynchronous communication. It is much easier to ask a question casually in a Discord channel than to email an instructor. This changed group project dynamics and interactions with instructors as well as with their peers. In contrast to [15], we could see that the students perceived their peer interaction as a vital factor for their learning in the online environment. Using Discord in online education as a means to facilitate social presence has been successfully described in recent studies [27]–[29]. An interesting finding in this study was that it was the students themselves who saw a need for and created this platform for social presence and cognitive communication.

The decrease in teacher interaction may have created a higher need for Discord for students to find answers to their questions. However, perhaps the ability to ask questions to peers was two-fold in that they were able to engage with their classmates, giving them the social interactions that were limited. This also created a positive peer-to-peer learning environment for the students. Asking questions to the instructor was no longer perceived by the students as an important reason for interaction with the instructor. Communication with the instructor outside of lectures was mostly for logistical reasons, and not about the educational concepts in the course.

There is a strong connection between teacher presence and the class structure. The students experienced the instructor's engagement and presence in live online lectures and videos to be important for their learning. Students were more engaged with teachers that had a positive demeanor and had space built into the course for interactions. Our study shows that the quality of student-instructor interaction is highly important, which confirms the results of [6], [9], [16], [17], [19]. Being included and engaged in lectures enhances students' feeling of learning and also helps them focus and maintain interest and motivation in the subject. We also found that a smaller class size can facilitate the students to feel more comfortable in the online lecture environment and therefore help them to interact.

All but one of the students' feelings towards online learning changed as they got used to it. Many developed strategies and understood the expectations of the courses. Initially, almost all of the interviewed students had the idea that it would be nice to work from home but they didn't realize until later the mental pressure this would add. Mental pressure is something all interviewed students worked on during their year of at-home study. There were many different home strategies, such as setting work hours, minimizing distractions, and working

in specific locations that were set up by the students that enabled them to have better focus and productivity. Almost all of the students seemed to realize that this was needed at the beginning of learning in the online environment or came to this conclusion during their online experience. This correlates with the results of [5], [6], [12], [13] that motivation, discipline, and time management are highly important for satisfaction in online learning.

The online setting due to the pandemic cannot be fairly compared to online learning in courses that from the beginning were planned to be online since they don't have the same conditions [3]. However, we can still learn from the students' experiences. We found that flexibility and accessibility are benefits of online learning, as seen by [7], [8], [21]. However, we did not see the same struggles with social integrations and technical issues as [9], [21]. Students' teamwork skills were in related studies found to suffer during the emergency online learning [20]. We, however, saw the opposite. The students felt teamwork was more efficient and collaboration was easier online. Thus it's important to mention that the students in this study in majority worked with peers they had already met during their first months at the campus and worked with before. Students being less active in the online setting [21] is somewhat the case in our study. Several students stated that they would ask questions during lectures on campus but that they wouldn't during the online equivalent. However, they were more active with their peers on Discord and preferred when live online lectures included interactive activities such as questions or small group discussions.

A. Limitations

It is hard to take away how much of the loneliness and stress the students felt during their online course was due to the pandemic. Therefore, the pandemic could have affected some of these results in ways that were not realized.

The students all volunteered to do the interviews and were active third-year students. Students who perhaps struggled more may not have been willing to participate in the interview, this we don't know. It is therefore not possible to say whether the interviewed student group is representative of the class as a whole. All interviews were completed in English which is not the students' first language. Though all students were fluent and were able to have a natural conversation, it can't be said if this affected the conversation. Three of the interviews were completed using Zoom. We asked the Zoom interviewees if they felt the interview would have gone differently in person and they all stated it would be the same due to the 1:1 interaction. The interviewer agreed and felt that the students seemed relaxed and open with their responses.

VII. CONCLUSIONS

The relationships between students, school and teachers changed significantly during the pandemic. The students gained many new experiences and a lot can be learned from them. The fact that the students had met during their first year at the program and that they had a class-wide Discord channel

was a big reason for them not feeling isolated and actually being able to communicate with peers. However, they still missed socializing with their community physically. Discord was frequently used for questions, changing the focus of what types of interactions the students' perceived as important to have with their instructors. Many students did not seem to miss the interaction with the instructors involving asking questions. However, many students were wanting instructor interactions added into the lectures. Actively planning for more interaction to take place during lectures and other types of joint sessions is an opportunity for the instructor to set the climate, bringing social and teaching presence together.

The students perceived recorded lectures, the efficiency of group work, easy access to information and teacher-facilitated interaction and engagement during lectures as positive for them learning online. The flexibility and convenience of where and when to study are highlighted as positive aspects of the online environment. Students struggled with focus and finding a structure to their workday. Many students felt the need to have a dedicated workplace.

We have found that there are certain things in the online class that the students found effective for their learning, that increased engagement and focus in the online classroom, and in the online course itself. Aspects and activities we think can be helpful for enhancing students' learning in an on-campus course are the following:

- Recorded lectures, particularly with subtitles, so students can watch the lecture several times, change the speed, or just re-watch specific sections. This is particularly beneficial for students when the lecture is not in their first language.
- Possibility for individuals or small groups to book short meetings with the teacher online.
- Interaction during the lectures with tools like mentimeter.com, teacher questions or discussions in small groups. Lectures where the student watches a recorded lecture beforehand and the classes are activity-based were also more engaging for the students.
- Have a way for students to move around or stand up during the lectures without distracting the rest of the class.
- Allow the option for group work to be done online.

How students perceive learning and the learning environment has big implications for the learning process and quality. It is important to study this to try and get an understanding of how these aspects are experienced by the student. We could clearly see that both social presence and teaching presence was perceived as highly important for the interviewed students' perception of both their learning environment and learning itself. We, therefore, see a high need for these different kinds of interaction to be facilitated and supported in future courses that are planned to be conducted online, both in part and as a whole. We also see a need for teachers who want to continue using online elements even after the pandemic to understand how the students' need for interaction might change and how

to adapt to this as well as how to support them in this transfer.

A. Future Work

It would be interesting to further look into different years and how they dealt with communication. This group of students relied on the Discord server which filled a missing need very well. How did the fact that they spent their first months on-campus have an effect on this aspect?

One interesting thing that came from the interviews was the students' practical experience with the hybrid classroom where the students could choose to attend the lecture physically or digitally. An option that many of the students would like is the availability to attend a lecture at home, especially if they were unable to come to school because of injury or sickness. However, other students have had experiences with such a hybrid lecture, both from taking it online as well as from sitting in the classroom on campus. Their experiences were that the teacher tended to forget about the online students and therefore missed questions from them, that it was hard to hear clearly when attending online and that the students online could hear private conversations from students in the classroom. Looking at if, and if so, how a hybrid setup could work would be an interesting topic to look at further.

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