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The Students' Experiences With Live Video-Streamed Teaching Classes

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Abstract: The Bachelor's Degree Programme of Biomedical Laboratory Science at VIA Faculty of Health Sciences offers a combination of live video-streamed and traditional teaching. It is the student's individual choice whether to attend classes on-site or to attend classes from home via live video-stream. Our previous studies revealed that the live-streamed sessions compared to on-site teaching reduced interaction and dialogue between attendants, and that the main reasons were technological issues and the teacher's choice of teaching methods. One of our goals therefore became to develop methods and implement technology to facilitate interaction through increased technological transparency. In this paper, we present and discuss organizational and educational designs as seen from the student's point of view. We do so by investigation of how students experience participation, interaction and technological transparency in the live video-streamed teaching sessions during a 5-year period of continuous development of technological and pedagogical solutions for live-streamed teaching. Data describing student's experiences were gathered in a longitudinal study of four sessions from 2012 to 2017 using a qualitative method inspired from mobile probes (Ørngreen & Jørgensen, n.d.). The research results document a continuous progress in technological transparency, as the live video-streamed classes increasingly support the student's flexibility in ways of attending and interacting in classes. The analysis shows that the students have different needs (as a learning space for individual concentration or a space for highly focused collaboration) and that the technology can meet these different needs. It also shows that there are challenges, similar to many other classrooms. In this live-stream classroom interaction is facilitated through teacher driven support, resulting in classes where students can interact and collaborate equally with on-site students. We therefore argue for a sociocultural understanding of learning as situated, mediated and distributed, which this e-learning-solution support.

Keywords: technological transparency, e-learning, live video-streamed classes, student's flexibility, student's interaction

1. Introduction

At the Bachelor's Degree Programme of Biomedical Laboratory Science (BiomedLS) at VIA Faculty of Health Sciences many students have more than one hour of transportation between home and campus. The programme is organized as a mix of teaching theory and internship, where students with long distance to campus can go through their periods of internship in a local hospital. Offering this education at a distance, results in a well-educated recruitment base for the hospitals in the countryside, as students throughout their studies stay closer to the local hospital; close to where the students already live, but in a distance from campus. The programme have classes 4 days per week, and the establishment of simultaneous live video-streaming in combination with on-campus teaching 1-2 days per week creates a better work-life balance for the students, who can choose whether to join class on campus or to stay at home and join class via Skype for Business, on the so called "net-days".

1.1 History

From 2006 to 2009 a classical setup applying blended learning was offered to these students including asynchronous study activities and two-days seminars every second week. Economy in this setup was not sound and student dropout rates were high. As a reaction to this, we made an informal inquiry about the student's opinion regarding their need for interaction with each other and regarding the time of the day, they were actively studying. This inquiry showed students studied primarily between 8 AM and 3 PM and they appreciated peer-interaction. These findings inspired us to develop a setup consisting of theory classes being live video-streamed to students at home via Skype, the so-called "live video-streamed teaching" (LVST). In 2009, this was established

as the alternative to the asynchronous online education in the classical blended learning format. This means there is a base of experience from offering LVST to nine different classes in the years from 2009 until present.

In this period, there has been an ongoing development regarding the technological setup (V. A. Jelsbak, Ørngreen, Thorsen, & Bendsen, 2015) whereas the basic idea of having one teacher and some students present in a classroom while live video-streaming from the classroom to online students at home is the same. See table 1 for an overview of the development in technological setup and its pedagogical influence.

Table 1: Overview of the technological progression of LVST-classes

	2009-2011	2011-2015	2015-2016	2017-
Technological setup	<p>Classroom to Student <i>Video</i> showing teacher and blackboard/projector (controlled by technical assistant (TA)) <i>Sound</i> from classroom: Clear sound from teacher, but not from other students. Student to Classroom <i>Chat</i>, mediated to classroom by TA</p>	<p>Classroom to Student <i>Video</i> showing teacher and panoramic view of classroom (controlled automatically) <i>Sound</i> from classroom: Clear sound from teacher, but not from students. <i>Desktop</i> from teacher PC visible for home-students Student to Classroom <i>Sound</i> via loudspeaker <i>Chat</i> (usually not seen by teacher)</p>	<p>Classroom to Student <i>Video</i> showing whiteboard or teacher (controlled by teacher) <i>Sound</i> (high quality from entire classroom) <i>Desktop</i> from teacher PC Student to Classroom <i>Video</i> from up to 5 students at a time <i>Sound</i> via loudspeaker <i>Chat</i> (usually not seen by teacher, but often by other students at home or in classroom)</p>	<p>Same as 2015-2016, Plus: Student to Classroom Possibility to indicate that the student wants to speak. An iPad hanging on the wall combined with Padlet-freeware through homemade programming by BiomedLS staff member.</p>
Cost	<p>One class and two teachers (one as TA) results in increased costs for teaching live video-streamed classes.</p>	<p>One class, one teacher. Supporting TA available on call if technological problems. Slightly increased costs compared to "brick and mortar"-classes.</p>	<p>Same operating economy as "brick and mortar"-classes, but expensive to establish the room.</p>	<p>Same as 2015-2016 and the added Ipad technology and program is an inexpensive technological expansion.</p>
Teachers perception	<p><i>No inquiry</i></p>	<p>Impaired communication between teacher and students at home. Reduced visibility of teachers' drawings and handwritings on whiteboard (V. A. Jelsbak et al., 2015; Ørngreen, Levinsen, Jelsbak, Møller, & Bendsen, 2015)</p>	<p>Teaching experience made easier because of improved audio, whiteboard and less technological skills necessary in order to start teaching (V. A. Jelsbak et al., 2015)</p>	<p><i>Students in 2017-dataset have tried it once during data collection weeks</i></p>

Teachers' perception of teaching live video-streamed classes was examined through focus group interviews. Findings show that teachers find themselves challenged when they are obligated to administer both academic content and the live video-streaming technology in classes. Changes made in 2015 by dedicating a room to live video-streaming improved teacher's perception significantly, as they now have access to sketching on whiteboard, they have video signal from students at home (although only five at a time) and improved audio from classroom to students at home (V. Jelsbak & Buus, n.d.).

1.2 Participation

The perspective of investigating learning through different participation structures can cover many different pedagogical perspectives and modes of participation. Having a sociocultural understanding of learning as an approach for the pedagogical setup, active participation becomes important pedagogical issues and something, which the developed learning design should aim at. This is for example seen in the learning landscape of networked learning (Jones, Ferreday, & Hodgson, 2008). In this paper, we explore the idea of weak ties in networked learning. We go back to the original conception of the strength of weak ties and relate this to Bakhtin and a dialogic understanding of networked learning. These theoretical ideas are applied to the examination of two networked settings in which educational leaders exchange ideas and have the potential to create

knowledge. We examine these networks from the point of view of the overall pattern of interaction and from an interest in the kinds of dialogues engaged in by participants in the network. We identify an area for further research in a comparison of the dimensions of links that appear to be weaker in these networks, those concerning affective aspects of the relationship, with those concerned with the sharing of knowledge, which appear to be relatively well developed. We suggest that presence and proximity become forms of telepresence and tele-proximity and rely more heavily on interactional means to achieve identity formation. Finally we note that knowledge is negotiated and the marks of its personal and situated origin are essential parts of the exchange through dialogue, active learning in PBL (Kolmos & Holgaard, 2012) and communities of practice (Wenger, 1998). In this context of LVST, we see the importance in participation as construction of learning that takes place in situated connections, and that learning emerge from critical dialogue, participation and investigation. Learning is therefore not limited the mind of the individual learner but is to be seen as participation in social interactions and practices aligned with sociocultural learning theories - though being active can also here relate to listening-in-actively and observing-actively in some situations. Taking part is thus both a physical and mental process, and further relates to being actively involved in interaction among each other. Students have different reasons to participate in class or via live-stream, and they need in both settings to be active. Physical participation relates for example to actively communicating verbally and showing visually, whether one as a student is present in the classroom or online via webcam. Mental participation is understood as the students' active choices regarding their way of participating, whether it is choosing to communicate actively or it is the student, which actively switch off sound from the class to work undisturbed and actively in silence. This means that each student have different trajectories and patterns of participation based on their various situations (in everyday work, student and family life, their personal aspirations, and preferred study modes – see e.g. Dreier (2003).

1.3 Interaction

The sociocultural understanding of learning entails facilitation of interaction and active learning are important when designing learning activities. Students actively construct knowledge by intervene in social constructions and interacting with others. Vygotsky (Vygotsky, 1978) defined the zone of proximal development (ZPD), as an optimum zone to be in / or meet the learner in. A lot of literature cover this in more detail than we can do here, but from a pedagogical approach, Vygotsky (ibid.) focused at the interrelations between people and the sociocultural context in which people build shared experiences by acting and interacting, supporting being in the ZPD and make learning taking place. From this perspective, students' interaction and teacher interaction become important. When teaching in a live video-streamed setup, it is a challenge to initiate interaction between students that are present in class and students participating via live video-streamed (Ørngreen et al., 2015). Don Ihde (Ihde, 2002) investigate various perspectives on how we can experience and participate in something through technology. The live video-streamed setup becomes a part of the students 'being in the class', as it is not possible to interact without the technology. Tele-presence is a much discussed issue and Levinsen, Ørngreen and Buhl (2013) found describing the interaction in a form of "being there", may not cover the situation and enlighten the factors at play. For the student at home, the teacher and students in class would then be experienced as "being here". Both participants at home and in class, are in these setups aware of their physical location, and instead the concept of the third teaching room is used, which acknowledges that people in LVST today, are neither tele-transported to a here or there, but that all meet in a new socially constructed third room (Levinsen et al., 2013). In this context of BiomedLS students, we investigate factors affecting the students' experience of interaction and the students' possibility of interacting with each other and with the teacher. Some organizational and physical issues may intervene in the students' interaction and some structural issues support students' interaction. The term "interaction" is here defined as two (or several) persons that are in contact, interact and have influence on each other through this technological-mediated interaction.

1.4 Technological transparency

How we interact and participate in non-mediated and mediated situations are newer the same. Ihde (Ihde, 2002) describes humans' perception of the surrounding world as affected by technology, the perception is transformed into a human-technology-relation and thereby the technology is non-neutral. This however, does not imply that mediated interaction and participation is better or worse than, just that it denote a difference. Peter-Paul Verbeek (2012) discuss mediation theory and technological transparency of use (with inspiration from among other Ihde and Heidegges technological views and in his dialogue on Van de Eede – e.g. in his discussion of technological transparency of use and opacity in context (Levinsen et al., 2013; Verbeek, 2012)). Throughout its history, the LVST setup in the BiomedLS context has established different ways of interacting and participating,

and the level of transparency as experienced by teachers and students is possibly affected as a result of that. Factors that influence relate to the contextual and everyday-in-use situations, as well as to the breakdown situations, i.e. when the technology does not work and cannot mediate as it “usually do” (in a vor-handen and zu-handen sein in a Heidegger sense). In this research, we work with transparency in the sense of non-distraction of the technological part in mediated communication and sharing of content (but not necessarily experience of disappearing technology). That is, we are interested in understanding the situations where technology doesn’t attract attention, but is solely facilitating the mediated communication, and the situations where it does attract attention, when it fails to facilitate the mediated communication. As such we, without here going in deep with the concept of agency, we find that students perceived transparency and opacity of the LVST relates to how well the technology support students’ ability to act in a way that helps interaction to be perceived as natural as a result of technology acting as expected.

1.5 Research focus

We are interested in exploring how to procure the experience of transparency in live video-streamed teaching. As outlined above we see that creating a space for learning connects to students’ ability to participate in various modes of their choice and to interact with co-students and teachers. Also, that this space for learning is related to technological transparency and its role in students’ ability to act. In this research, we therefore worked with the research question: *How is the development of technological transparency perceived by students in live video-streamed teaching based on an investigation into the students’ experience of participation and student’s interaction.* Through identifying factors related to students’ participation and interaction, we expect to be able to comment on transparency and the role of ICT in supporting learning processes and students’ ability to act in a LVST-setup.

2. Method

2.1 Data collection

Data describing student’s experience were gathered in a longitudinal study of four sessions from 2012 to 2017 using a qualitative method inspired from “mobile probes” (Ørngreen & Jørgensen, 2016). The probes were designed as 11 open questions to the students about their experiences, figure 1: “Why do I choose to stay at home/to come to campus on netdays?”, “What do I remember most clearly from the latest netday?” and “Mention something regarding organization of the netdays, that does or does not work for you”. Questions were posed every second day in a period of two weeks, during which the students had both traditional and live video-streamed classes. The data were gathered in 2012 (49 students), 2015 (73 students), 2016 (23 students) and in 2017 (29 students). Students’ answers were assembled in Excel, answers from the four datasets placed in four parallel columns. One sheet for every question, example shown in figure 1. From a critical data gathering perspective, it is noteworthy (though not surprisingly) that students answered less intensively to the last questions than the first.

	A	B	C	D	E
1	Spm 6 - Nævn noget ved den tilrettelagte undervisning på netdage der fungerer godt for dig, hvad end du deltager som fremmøde eller hjemmefra.				
2	2012	F2015	E2016	F2017	
3	Jeg bliver ikke sådan forstyret når jeg sidder hjemme, og jeg synes det er meget nemmere at koncentrere mig fx opgave regning. Dog synes jeg let jeg kommer til at mangle det sociale når jeg bare sidder der hjemme.	Det fungerer meget godt når læren virkelig har sat sig ind i det der skal ske på dagen, så det kan forløbe nogenlunde problemfrit og uden afbrydelser fordi, de ikke lige havde tænkt over at det er netdag og når de ikke bare sætter os til at læse noget på en netdag.	Synes det fungerer rigtig godt at man kan følge en præsentation på skærmen, hvor underviserne bruger "pennen" når de underviser (dog ikke alle der gør dette og så har det den modsatte effekt).	Det fungerer godt at vi skal gå i grupper og arbejde sammen på den måde. Det er godt at vi kan høre alle. Skærmdeling fungerer især når den aktive tavle bliver i "tegne" samtidig.	
4	Hej. Det ved jeg helt ærligt hvordan jeg skal svare på det. Dorte	jeg synes at jeg får mest ud af netdagen, når der er oplæg, eller gennemgang af opgaver.	Ved netdag fungerer det rigtig godt, at de er et webcam, hvor man kan se underviseren, samtidig med at underviserens skærm kan ses. Dette gør sig blandt andet gældende ved fremlæggelse ved powerpoints. Det er generelt rart, at kunne blive hjemme når jeg er pendler. Ved fremmøde fungerer det godt, at	Opgaveløsning i studiegrupper	
	Karen Louise har lavet et par gange med først oplæg og så skulle vi i grupper diskutere nogen opgaver - det fungerer godt på lync, man bliver lige aktiveret og er på igen hvis man har siddet		Det er rigtig godt at være fri for 4 timers rejse. Ved selvstudie eller opg. regning kan man bare slukke for lyden å arbejde i ro. Man har altid	At der er skærmdeling på, så man kan se at følge med hjemmefra	

Figure 1: Answers from four datasets, question no. 6 (in Danish: spm 6) shown in this sheet

2.2 Analysis of data

Analysis was carried out following the six phases of thematic analysis (Braun & Clarke, 2006). Students' statements were analyzed and subtopics were identified through describing initial codes. Codes were subsequently sorted in sub-themes and related to one of the three themes in focus for this inquiry: participation, interaction or technological transparency, table 2.

Table 2. Themes and subthemes selected for analysis in students' statements

Themes	Sub-themes
1 Participation	Time and flexibility Concentration and the feeling of surplus in the everyday life The surroundings regarding table space (both in class and at home) Number of lectures and difficulty of subjects
2 Interaction	The social element and the class sense of unity The student-teacher interaction The student-student interaction including students who choose to shut off sound to be able to work at home in peace and quiet The hurdle affecting whether students interact or choose to be by themselves in class
3 Transparency	Sound issues affecting interaction Video issues affecting interaction Software issues Problems arising from the classroom technology

The student statements were condensed per each of the twelve subthemes, and subsequently described regarding differences through the dataset. The analysis process is described in figure 2 and is demonstrated for one of the twelve sub-themes.

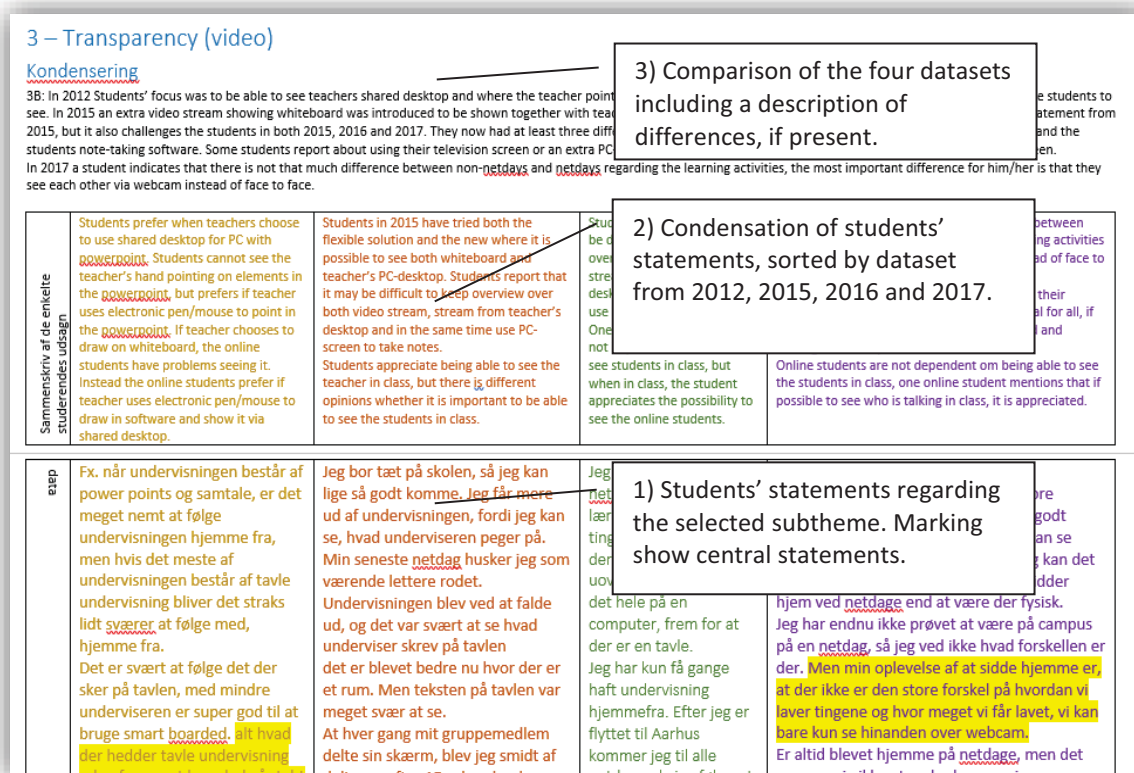


Figure 2: Steps of analysis starting from sorted students' statements to the text describing differences between datasets in a sub-theme

3. Findings and discussion

Findings are presented as the result of merging the four different sets of data from 2012, 2015, 2016 and 2017. Subsequently differences between datasets in students' experience regarding the themes and subthemes has been described.

3.1 Participation

Time and flexibility are the two most used argument for staying at home on netdays. Students appreciate the time given in breaks to do practical stuff at home. Students appreciate the flexibility regarding place to be when participating in LVST-classes. Students in 2015 and in 2017 mention the possibility to continue doing homework immediately after class ends, because both computer, books and notes are already in front of them on the desk.

There is a slight development towards larger fraction of students reporting to be more concentrated at home in 2017 in opposition to previous years. All four datasets have statements regarding students gaining a surplus, more energy to overcome the non-netdays and less stress in general.

We interpret this, as the students perceive netdays as providing a good mixture, and not as them wanting to have solely LVST classes. The mixture enables them to participate in different modes, which they report to do in using different trajectories and appreciate the possibility of being able to do so. Students at home settle down surrounded with computer, extra computer screen, books. In 2017 most students describe their surroundings as comfortable and several students mention access to food and drinks and uses a cozier rhetoric tone in their statements compared to previous years. We interpret the use of a cozier tone as a result of the students being more relaxed and less alert regarding the risk of technology posing a challenge.

3.2 Interaction

In 2017, a student report that netdays have no influence on the social element in class although this was expected. Students use terms as "I feel like everybody participates, a bit like they are attending physically" and "it creates a sense of community that "those at home" hang on the wall behind". But at the same time some students also do report about the feeling of less social interaction because of less people being around.

Students at home describe that they feel more like a part of class, when teachers actively involve them in the dialogue.

The student-teacher interaction: All four datasets hold students' description of challenges regarding the contact to teacher from home. Students attending class has easier access to help from the teachers for instance if they are working on assignments. Teachers have very different capabilities when it comes to strategies for giving attention to students at home. This has an important influence on the students' experience of much they feel included in class. However, in opposition to this, students from 2015, 2016 and 2017 mention positively the possibility to reduce sound from class and to work on their own. They find that it helps them concentrate. Nevertheless, students from 2012 and 2015 use rhetoric showing that they sometimes feel forgotten by the teacher and no such formulations are present in data from 2017. The fact that they don't report about being forgotten may be because the students trust the teacher's attitude, whereas it only is the mediating technology that challenges or reduces communication parameters (not being able to see body language f.i.).

The student-student interaction: All four dataset holds statements about online students working more on individual activities on netdays compared to non-netdays. In 2012, 2015 and 2016 students report about choosing to come to class when group work is on schedule. This is not mentioned in students' answers from 2017. Instead, they report about working in study groups, while being at home. In general, all students find it is easier to work in study groups in non-netdays, all though all datasets similarly contain statements showing that they are engaging in study group interaction, working together, on netdays. In 2012 one student describes a successful study group experience on a netday, one student in 2015 and one in 2016 mentions working with assignments in an online study group. In 2017, many students report to have contact with each other via the chat function in the software or via study groups' online room, and they do so in positive terms. In 2015 and in 2017 students report that the LCD-screen on the rear wall in class has a positive effect regarding the in-class students feeling of being together with the online students. Student-student interaction in general seems to be less affected by technology than student-teacher-interaction.

The hurdle affecting students' interaction: All four datasets indicate that online-students feel there is a hurdle for them to overcome to be able to take part in class discussion. The hurdle is described as harder to overcome in datasets from 2012 and 2015 than in 2016 and 2017. In 2017 there is no statements about whether netdays has less activity in class in opposition to the previous years, where netdays are reported to be quieter. Data from 2016 (where online students were used to be shown as photos and no live stream) holds, that online-students are aware about being one of the five shown if they talk, so it may prevent their active participation, and they state they would prefer if all online students were shown instead. In 2017, some students mention, that the fact that they are "on display" has a negative effect regarding their spontaneous and immediate response to questions, the mediated communication is stated as the most important feature causing negative effect on students' interaction. Another fraction of the students is not affected by being "on display". For them, it is probably the mediated communication being reduced compared to face-to-face communication that holds the reason for less interaction on netdays. One student mentions in 2017, that it would be positive, if all students uses the new function implemented in the data gathering period where marking to enter discussion is electronic and equally available to all students – from home and in class. Full implementation of using this, it will reduce differences between online students and in-class students regarding initiation of interaction with the teacher.

3.3 Transparency

As seen in 3.1 the utterings from the students in 2017 are much more related to a cozier and more relaxed atmosphere from home, using their participation mode of choice - some very physical active communicating, others more mental active listening by choice. This clearly marks the most predominant form of technological transparency. In these answers, the students do not even relate to the technology in their answers on the questions. We interpret this, as students perceive technology as enabling them to participate and act in ways they see as establishing a space for learning. However, there are issues at play:

Many points of reference: In 2012 students' focus was to be able to see teachers shared desktop and where the teacher points. Drawings on whiteboard was hard for the students to see. In 2015 an extra video stream showing whiteboard was introduced to be shown together with teacher's shared desktop. The doubling of video streams is appreciated in a statement from 2015, but it also challenges the students in both 2015, 2016 and 2017. They now have at least three different elements showing on their computer screen, the two video streams and the students note-taking software. Some students report about using their television screen or an extra PC-screen and maybe an iPad to administer the many elements to be seen. The extra screen creates more technological complexity for the students, but if they succeed it will increase their experience of participation and interaction.

When sound is a deliberate choice: Data shows, that online students of all four datasets are regulating their conduct to get the best audio-experience for themselves, and they describe sound as the most important part of communication with students and teachers in the classroom. As discussed above there are students who sometimes choose to mute the volume, or turn it down. We see the reasoning behind turning sound down, as an intentional shift in participation trajectory, particularly when comparing to other remarks in the answers. In the first years, it seems the soundscape received at home from the class was too chaotic when the students were in dialog or doing assignments, and reaching a teacher was therefore hard. The technology of only being able to draw attention via chat and later also loudspeaker, meant students at home either had to communicate via another student in the chat (as the teacher would be engaged with other students), or by "blasting through" on the loudspeakers, without being seen in the room, as there were no visual representations. This made technology negatively present (as in opposed to transparent). To concentrate and maybe also to reduce the feeling of being forgotten, some chose to turn down the volume, to utilize time better. Today, the reason for turning sound down is primarily a deliberately choice of focusing on an individual activity. As such, the students perceived technology transparency has increased, though we also see that teachers' capabilities to have strategies of how to interact needs to be improved.

Technology as a time consumer: In 2012, 2015 and 2016 students report about technical issues taking time from teaching. In 2017 students still reports on technical problems, but no student mentions time as a factor being affected. One student mentions teaching being affected in one case, where the teacher gave the impression, that the subject raised by the student was of less importance and the teacher thereby and through his/hers acts also gave the impression that the online students were less important. This could be interpreted as when technology fails, both students and teachers feels pressed for time, and that this may continue into the situations where the technology is again working, where teachers must make on-the-spot priorities affecting the students

perceived ability to participate and interact. Data shows that teacher's priorities has an important effect on students' experience and choice of participation whether it is active communication or just listening and notetaking.

4. Critical reflections and conclusion

The findings are all identified on basis of relevance according to the three themes in our research question, regarding how to procure the experience of transparency in live video-streamed teaching to generate a space for learning, enabling students to have different participation and interaction modes. The questions in the probes, that were sent to the student every other day in two weeks, were open and primarily formed to make the students reflect on their experiences regarding netdays. We related the findings, that there is a positive change in the students experience of technological transparency and ability to act, to the development in the technological setup (see table 1). However, besides the technical setup, the programme has also developed their pedagogical approaches, and the 2017-dataset is based on students, who had more group-organized assignments than students represented in the other three datasets. This development in thinking more group-organized can also be a development in teachers' pedagogical mindset of active learning possibilities in LVST-setups, and the 2017-dataset supports this in showing that there is an intense student-student interaction in online group rooms.

Our aim was to explore how to foster transparency in live video-streamed teaching, focusing on how students experience participation and student's interaction. Within this, identification of progression in students' experience is evaluated as a result of a well described technological progression in the setup of LVST-classes.

Identifying progression in students' participation and interaction, we are able to comment on transparency and ICT's role in supporting learning processes in a LVST-setup, as we can see an increased student-student interaction and an increased flexibility in pedagogical designs applicated to LVST-classes due to increase in technological transparency.

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