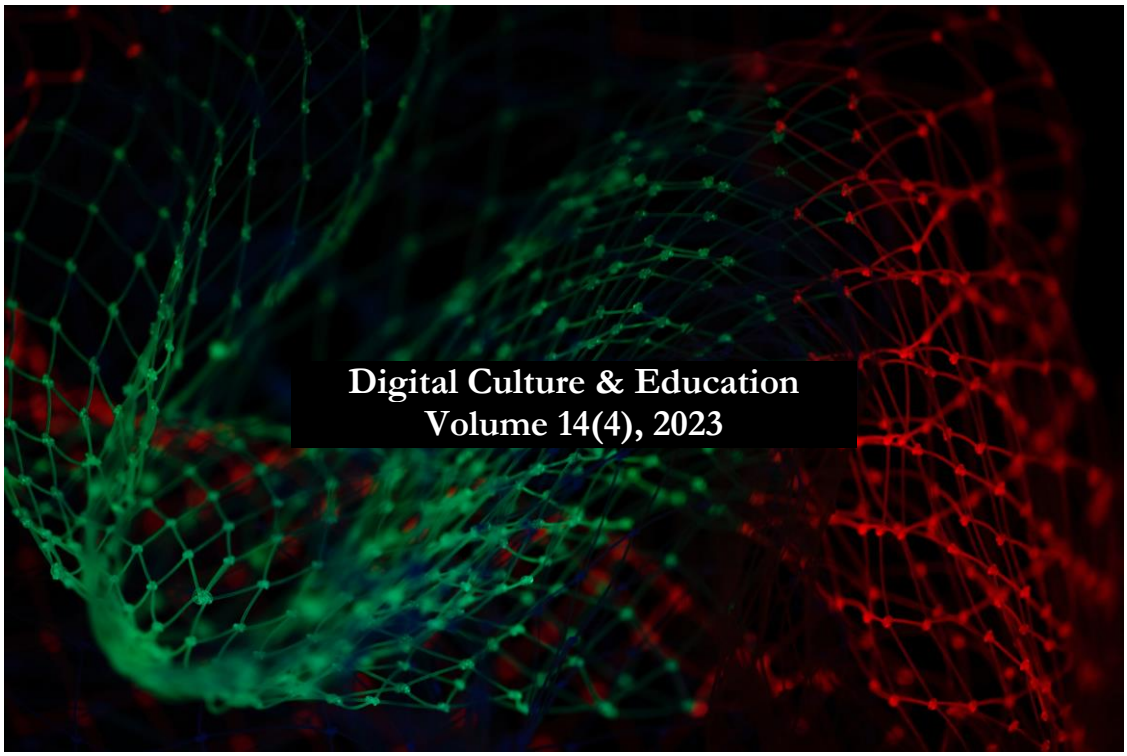

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Online Publication Date: 21 March 2023

To cite this Article: Valasmo, V., Paakkari, A., Sahlström, F., Backholm-Nyberg, Y., Majors, J., Invisible Participation: A Sociomaterial Analysis of a Synchronous Distance Lesson during Emergency Remote Teaching. *Digital Culture & Education*, 14(4), 112-132 Available at: https://www.digitalcultureandeducation.com/volume-14-4

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Invisible Participation: A Sociomaterial Analysis of a Synchronous Distance Lesson during Emergency Remote Teaching

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Abstract: *This research examines the day-to-day sociomaterial practices adopted during a Zoom distance lesson, enquiring into how student participation is enacted in a video lesson assemblage. The research is based on video data recorded by three students and one teacher during the Covid-19 pandemic on an upper secondary school mathematics lesson and interviews with said participants. We approach the distance lesson as a sociomaterial assemblage, applying Actor–Network Theory as a sensitising device. The results highlight the role of four non-human agencies that emerge in the assemblage—the application interface, webcam, microphone and internet connection—which all significantly reconfigure what is understood as participation. Even though the students visibly seek to participate in the lesson, their attempts often go unnoticed because they are not registered by the webcams and microphones or displayed by the interface.*

Keywords*: Zoom video conferencing, distance classroom, emergency remote teaching, participation, sociomaterial assemblage*

1. Emergency Remote Teaching and the Introduction of Videoconferencing Tools Into Everyday School Practices

The Covid-19 (2019 coronavirus disease) pandemic caused the reassembly of educational practices on a global scale, driving a move from classrooms to the homes of students and teachers and causing a shift from classroom teaching to digitally mediated distance instruction. Video conferencing solutions, such as Zoom and Teams, have played a central role in enabling the continuation of school life without encounters that would potentially pose a threat of contagion. In this respect, distance teaching has functioned as a 'digital mask' that shields participants (Gourlay, 2022). It has also emphasised the centrality of applications offered by large technology companies and has given rise to new teaching practices that have introduced a range of technological actors into schools (Williamson et al., 2020).

In this research, we take an in-depth look at how student participation is enacted (Fenwick & Edwards, 2010) in a distance lesson and what implications arise from these emerging participation practices. We draw from a research project that investigated distance teaching practices in an upper secondary school through student- and teacher-operated video recordings and interviews. What initially led us to the problem of participation was the way the students talked about distance teaching. In one of the interviews, Majsa, an 18-year-old upper secondary school student and a participant in the aforementioned research project, discussed the lecture-like quality of distance teaching and how their school days consisted of sitting and listening. She spoke of how teacher talk dominated the lessons and the few opportunities for discussion and participation.

> *It can be a bit annoying, just sitting in Zoom all day every day. I think it's nice when there's variation, but I don't know if I have a favourite way that I would prefer. But I like it when you can get the students to engage. So not like when the teacher just talks to themselves the whole lesson because when you sit by the computer, it can be pretty hard to concentrate for the whole lesson. I like when I myself can participate as a student. Then you can keep following for the whole lesson much easier.* (Interview 1, Maisa)

The excerpt above introduces some commonly discussed themes related to distance teaching during the Covid-19 pandemic: Students were distracted, it was difficult to engage and teachers ended up delivering involuntary monologues. Above all, participating and feeling part of a group were challenging. In spite of these problems, the students that we interviewed saw Zoom as a

reasonably functional way of arranging distance teaching and could understand the difficulties that the pandemic posed to schools. They also spoke of well-functioning participatory distance teaching practices, with group discussions in Zoom breakout rooms mentioned as an example. In this article we go behind these initial shared experiences with a detailed analysis of the sociomaterial practices emerging during the distance education lesson, focusing especially on how student participation is enacted.

Although considerable research on distance education has been conducted since the beginning of the pandemic, there remains a need for an up-close analysis that brings forward the concrete day-to-day practices of distance teaching and the agency of educational technologies that are part of these practices. As previously stated, this examination is undertaken from a sociomaterial point of view (Decuypere, 2019a; Gourlay, 2021; Fenwick et al., 2011), with the enquiry directed towards how student participation is enacted in the sociomaterial assemblage of synchronous distance teaching. The analysis is based on video materials produced in early 2021 during a mathematics lesson by three volunteer students and a teacher from a small town in western Finland, as well as interviews with the said participants. In the analysis, we examined how the distance teaching assemblage produced participation practices, in which a significant part of student engagement was invisible and inaudible to other students and the teacher. The analysis uncovered the central role of the Zoom application and some of the central technological 'actors' that it is composed of, such as webcams, microphones and internet connections, in the enactment of distance lesson participation practices.

2. Technologies as Performative Agents in Sociomaterial Assemblages of Education

We approach the distance teaching practices of interest using actor–network theory (ANT) (Latour 2005) as a sensitising device (Decuypere, 2019a). ANT is not a single or stable theoretical framework (Fenwick & Edwards 2010). It could be described as "- - *tools, sensibilities and methods of analysis that treat everything in the social and natural worlds as a continuously generated effect of the webs of relations within which they are located. It assumes that nothing has reality or form outside the enactment of those relations*" (Law 2007, p. 2). In accordance with our starting point, we explore the distance lesson as an assemblage wherein a heterogeneous group of human and non-human actors come together and take part in enacting the distance teaching practices. The concept of enactment presupposes an understanding of the emergent nature of practices and their being in 'constant making' (Decuypere

& Simons, 2014; Fenwick & Edwards, 2010). Practices are never pre-given but always shaped through relations among heterogeneous actors (Decuypere, 2019b).

We use the concept of *actor* to refer not only to the students and the teacher but also to the various material objects and technologies involved in the enactment of the teaching practices (Decuypere & Simons, 2014; Latour, 2005). ANT oriented analyses rely on the principle of generalized symmetry. According to Fenwick & Edwards (2010, p. 9) "*The insistence upon treating human and non-human entities the same way, looking at their performances and linkages rather than distinguishing them according to some a priori essentialized features, forms the generalized symmetry that is characteristic of ANT."* In line with this principle, different actors, whether humans or non-humans, should be treated equally in analysis (Sørensen, 2009), and researchers should avoid preconceived interpretations about which actors are central in the enactment of a given practice (Latour, 2005). ANT guides researchers to pay attention to relationality and the relations and interactions between different actors (Decuypere, 2019a). The actors are not separate entities, and following this agency is not an individual attribute. Agency is not inherent to a given human or technological actor but distributed and emerging in relationships (Decuypere & Simons, 2014).

A relational analysis of technological actors presents a challenge. Both distance teaching and all actors taking part in it are assemblages themselves that are made up of different actors. For example, the version of Zoom that we analyse as a 'participant' in the distance teaching practices explored in this work consists of algorithms that define its functionalities, the computer, the webcam, the microphone, data transmitting microwaves, cables and data centres, the minerals used for components and the business models of the company. Each of these assemblage components can then be further taken apart and seen as a group of entangled actors. Such fragmentation presents a challenge for a detailed analysis of technologies. Nevertheless, when investigating the agency of various applications in educational practices, it is not necessary to exhaustively list all their sociotechnical components or what applications are made of exactly. Rather, we should ask what applications do as components of localised assemblages (Decuypere, 2019b).

Regarding technologies as assemblages also means refraining from viewing them as static objects. As Sørensen (2009, p. 59) put it, 'technologies do not simply exist; they *become*'. Instead of seeing technology as a product, it is viewed as a process. When technologies move into new connections, they gain new and sometimes surprising properties (see, e.g., MacLeod et al., 2019). This property renders the provision of universal accounts of technologies impossible. Correspondingly, the aim

of our analysis is not to formulate a definitive description of what Zoom is but to study the participation practices emerging when the application is entangled with other actors of distance teaching.

2.1. Distance Education during the Covid-19 Pandemic

During the pandemic, the importance of various technology companies and their software has increased dramatically for education institutions. Many technology giants, such as Google, Microsoft, Amazon and Zoom, put added emphasis on their educational services (Williamson et al., 2020). Videoconferencing applications are not an entirely new phenomenon in schools, but they have become central during the global crisis, as they have enabled the continuation of synchronic teaching while also preventing potentially virus-spreading encounters. The pandemic and the central role of videoconferencing technologies have profoundly changed everyday teaching practices in, for example, university education (Gourlay, 2022; Pischetola et al., 2022). These developments indicate that there is all the more need for research on how various digital technologies become part of everyday educational practices (Williamson et al., 2020; Paakkari et al. 2019; Paakkari 2020; Paakkari et al. Forthcoming). Research on distance education has markedly increased, but less investigations have been directed to everyday practices of distance education, especially from a sociomaterial viewpoint.

The digital technologies used in remote work do not free university staff or students from materiality and corporeality, as Gourlay (2020) shows in her study on academic work during the pandemic. Instead, material artefacts, spaces and bodies are key in the messy assemblages of new digital practices. The world of online learning—often seen as disembodied—is always sociomaterially situated (Gourlay 2022, 2021; Paakkari & Rautio 2019). Adding to these insights, Pischetola et al. (2021) asserts that new distance teaching assemblages bring the agency of digital technologies to the foreground. In their sociomaterial analysis of a graduate course during emergency remote teaching in a Brazilian university, the authors discuss how bodies, material things and pedagogic time-spaces entangle in multiple ways. They show how the novel and atypical format of synchronous online classes introduces new limitations and challenges, even as they ensure the continuation of lectures and academic encounters. The authors describe how remote classes that are held over a videoconferencing platform with a specific layout in which student images are displayed on a grid 'brought out a feeling of intimidation, stress, physical pain, outreach expectations, and a perception of continuous focus and surveillance' (2021, p. 9). They also explain

how unstable internet connections drive some students to turn their webcams off and how this causes difficulties for active participation in ongoing discussions. Finally, the authors defined internet connection as an object with power that brings profound inequalities in Brazilian society to the fore.

MacLeod et al.'s (2019) pre-pandemic study probe into videoconferencing in medical education as a sociomaterial practice, with the authors directing their attention to two campuses' lecture halls that are connected through a videoconferencing system. They describe how buttons, screens, cameras and microphones become central actors in the studied practices and how, in addition to connecting the lecture halls, videoconferencing technologies accomplish unintended work in the form of 'exposures'. The three types of exposure identified in the studied practices are visual, curricular and auditory exposures. For example, unintended visual exposure occurs when students sometimes mistakenly hit a button that activates a camera, causing the image of a student to appear on the large screens of lecture halls. Similarly, accidental audio elements, such as sounds of breathing and discussions that are intended to be private, are transmitted through microphones that are mistakenly activated.

3. Materials and methods

The data analysed in this research were produced in the spring of 2021 in an upper secondary school mathematics lesson as part of a project called *HIPPO – Hybrid learning paths*. The aim of the project was to study the changes that the distance teaching implemented during the Covid-19 pandemic had for teaching and learning practices in upper secondary schools. The research was conducted in a school with which we had prior collaboration. The school was approached to find a voluntary teacher that would like to participate in the study. The teacher that volunteered was a mathematics teacher. The classes that were asked to participate in the study and the lessons that were to be recorded were chosen according to the teacher's timetables.

The data analysed in this article consists of video recordings made by three volunteer students and their teacher during a lesson in mathematics. The students were 17 years old and second-year students in upper secondary school, which is a voluntary secondary level education chosen by approximately fifty percent of the student population. Because of the local Covid-19 situation at the time, the lesson took place as the distance teaching with the help of Zoom. Most of the distance teaching in the school had been organised using Zoom, which became the established practice for

the students and the teacher during the emergency remote teaching period. The students and the teacher were also interviewed with regard to their experiences in emergency remote teaching and some technical details of the Zoom lesson. The interviews were then examined using thematic content analysis, with special attention paid to the ways in which the students spoke of participation and the significance of technological actors (Atkinson & Coffey 2001). The interviews were also conducted on Zoom. All the participants were informed about their right to withdraw from the study in any phase of it, and to ask researchers to erase the data if they wished so.

Video recording distance lessons

The three students participating in this work have been assigned the pseudonyms Åsa, Annika and Joel. A fourth student, Majsa, also participated in the data production, but her video recordings failed because of technical problems. The students attended the lesson from their homes and recorded the session with portable GoPro video cameras. Each of them was given a GoPro camera and a head strap for attaching the camera to the forehead during the lesson. The resulting student videos showed simultaneous views of the computer screen and the surrounding environment fronting the student. The spaces that students were located in differed from each other. Åsa attended the lesson from the living room of her parent's home, Joel from the one-room flat where he was alone, and Annika from her own room in her parents' house. During the recorded lesson no other persons or pets were visibly present in these spaces. The teacher delivered instruction in a classroom empty of students and recorded the data with wearable eye-tracking glasses (Tobii Pro Glasses 2). Together with the teacher in the classroom was one of the researchers who assisted with the eye-tracking glasses and the microphones. With the exception of one moment during which voices of people discussing in the school corridor was carried into classroom, no other persons or voices were recorded. The fact that the participants did the recording themselves enabled data production during the pandemic when all encounters were to be avoided. This was also important from an ethical point of view, as this arrangement gave students control over the recordings made in the private spaces of their homes.

The data provides us an opportunity to investigate the entanglement of students, on-screen actors and the objects in the vicinity of the students and the teacher, such as books, mobile phones, notebooks and pencils. This opportunity opens the door for analysing the sociomaterial details of

the unfolding teaching practice and the entanglements between the various actors taking part in it. Video recordings can be paused and slowed down, thereby allowing for the observation of issues that would otherwise have been missed had they occurred in the classroom (Valasmo et al. 2022; Paakkari & Valasmo submitted). With several students and the teacher recording simultaneously, the material clears the way for scrutinising how the video and audio landscapes of the students and the teacher differ and converge. The possibility of analysing the unfolding of a distance education lesson from four viewpoints help illuminate the manner by which the lesson emerges in specific ways in different parts of the distance teaching assemblage.

The analysis of the video materials started with the mapping of different actors, such as applications, devices, tools and the people present in each student and teacher assemblage. We then focused on how student participation practices are enacted in the distance lesson and what roles are played by the actors taking part in the enactment. This stage motivated us to pay particular attention to Zoom audio and video practices and their connections with student participation. As research equipment is introduced into a studied practice, it becomes an actor in it (Sørenssen et al., 2019). In this work, the presence of research equipment influenced how the lesson unfolded and how the students took part in it. Annika joined the Zoom with her webcam off, but then activated it only at the request of the teacher, who wanted to see how the GoPro cameras looked. Joel told us that he normally always had his webcam on during distance teaching but then decided to keep it off this time because he felt that the GoPro was a bit awkward. The sight of GoPro cameras strapped in with headbands caused smiles and laughter as the lessons started. Because of the cameras, some of the actors that may have otherwise played different roles stayed aside. One such actor appeared to be mobile phones. Each of the three students had a mobile phone on their desk on the right side of the laptop, but nobody used it as the lesson was taught. We wondered how mobile phones were used minimally during the lesson—a matter clarified during the interviews by the students, who told us that they consciously reduced phone usage because of being recorded. They described that they normally engaged much more with the devices but did not want to do so when recorded.

Overview of the Zoom lesson

During the lesson, the students began with independent study for 40 minutes, watching the teacher's pre-recorded video on prime numbers. After this, they joined the teacher's personal meeting room in Zoom and participated in a 30-minute lesson on the same topic. This last

synchronous part of the lesson is the focal target of our analysis.

Despite the apparent newness of the technologies, the lesson in question appears very traditional in a pedagogic sense. It is dominated by teacher talk connected to lesson content, the sounds of tools and devices used by the teacher and the visual content that he draws on the whiteboard and communicates via screen sharing on Zoom. The roles of the students are to look, listen, answer questions and take notes. They interact relatively minimally with the teacher. Seven of the 17 students attending to lesson take speaking turns during the lesson. With one exception, the student turns take place in response to a question raised by the teacher. No conversations in Zoom took place between the students. In the interview, the teacher pointed out that Zoom distance teaching tends to render lessons similar to lectures. He contrasts this with the classroom, which produces a more 'natural response'.

> *I'd like to have more interactivity with it; now, you really end up 'teaching' more than you do in school. Here [in the classroom], you see a natural response all the time; they raise their hands and ask questions. That's something I'd like to develop.* (Interview 5, teacher)

In the interviews the students said that the distance teaching sessions during emergency remote teaching period involved long stretches of sitting and listening and that participation was often difficult and occurred less often than in the classroom. We can see many of the issues mentioned in the interviews in the analysed lesson. During the lesson, Åsa, Annika and Joel spend the entire session sitting at their desks. They mostly watch and listen to the teacher, with Åsa being the only one to answer some of the questions raised by the teacher shortly. Upon closer analysis, however, we find that although the students have few speaking turns, they do many other things that can be interpreted as active participation equivalent to that occurring in teacher-led classroom instruction. The students nod, show an intention to answer the teacher's questions, smile, laugh at the teacher's jokes and take notes. What is remarkable is that these ways of expressing participation typically become invisible and inaudible to other students or the teacher.

4. Analysis

Next, we delve into participation in this particular distance teaching lesson, delineating how certain technological actors in the distance teaching assemblage take part in the enactment of student participation and render a significant part of the aforementioned ways of student activity invisible

to the teacher and the other students. The analysis highlights how the students' entanglements with internet connection, the Zoom interface, microphones and video images significantly influence how student participation emerged during the lesson.

4.1. Agency of the Zoom Interface in the Enactment of Student Participation

To understand the participation practices, we first scrutinise the interface of the Zoom application as an actor. The manner by which Zoom displays user thumbnails on the laptops of the students and the teacher during screen sharing have a central influence on how student participation emerges in the analysed lesson. Applications always contain a pre-programmed idea of a user (Decuypere, 2019b), and Zoom is no exception. The program interface displays a grid showing thumbnail images of the participants. During screen sharing, the Zoom interface only has room to display a limited number of student thumbnails, and prioritizes these seemingly on the basis of verbal participation, as evidenced by the fact that the interface highlights thumbnails of participants who activate their microphones. Although it seems logical to assume that Zoom is designed to give room to users who take speaking turns, the focus on minutiae practices shows how the software also pulls up user thumbnails on the basis of accidentally produced sounds. The following excerpt from the lesson illustrates the unexpected effects of this feature on participation practices.

> *Joel turns off his camera for the whole lesson and mutes his microphone for almost the entire lesson. However, while joining Zoom, his microphone is automatically activated for a few seconds before he turns it off. This brief moment turns out to be significant. Before turning off the microphone, Joel taps his computer's trackpad, producing a sound that the microphone reacts to. While the tap cannot be heard on the data from other students or the teacher, the microphone activation can be seen from the display of a yellow frame to signify a speaker shift to Joel's thumbnail display on all screens. At this stage, the teacher has not started screen sharing but is about to.*
>
> *As the teacher begins screen sharing, nine students are shown onscreen via their webcams. After screen sharing starts, seven of them are bumped out of the central view on the teacher's screen. The teacher's Zoom display is adjusted so that only the thumbnails of five students are displayed. These are selected on the basis of whose microphones have last been activated.[1] Since the tapping sound*

[1] It is important to note that when screen sharing begins, Zoom does not arrange student screens in the same way as a

> *activated Joel's microphone, he appears (via his thumbnail) as one of the five students. In addition to Joel, there is one other student whose thumbnail is shown because of a microphone activation that is unconnected to speaking. Neither this student nor Joel share video images. Three other students that are shown are visible on the teacher's screen because they take part in the discussion before screen sharing starts. Two of them have their video on, whereas one has it switched off.*

In the described case, the technology does not differentiate between accidental microphone activation and intended speaking. Despite the fact that Joel and the other student show no desire to be seen or no intention to participate in the discussion, they appear on Zoom's limited gallery (participation) view while relocating off-screen several other students who are transmitting video. In the interviews, the students said that during distance lessons they keep their video on primarily for the teacher. They said that they wished to participate and signified this desire by keeping the camera on, even though this was often considered arduous. The data reflect how the Zoom interface render the majority of the camera-using students 'invisible' by displaying only a limited number of thumbnails and by prioritising sound in such selection.

Åsa is one of the students who displays a webcam image but is not represented on the teacher screen because her microphone has been inactive. By hiding the students, the interface robs one of the central participation resources in plenary teaching of power: bodily gestures (Kääntä, 2012; Evnitskaya & Berger, 2017). This is exemplified in the following excerpt:

> *Soon after starting screen share, the teacher shows how the SpeedCrunch calculator works and checks in with the students: 'Are you hanging on?' Both Annika and Åsa have their cameras on and nod. Because Annika's microphone was activated earlier when she answered the teacher's request, her image is still shown on the teacher's screen, and the nod is thus transmitted to the teacher. However, Åsa's microphone have not been activated and, therefore, her image is not shown, and her nodding is not transmitted.*

The situation above shows how the bodily gestures of one student are untransmitted to the teacher, whereas those of another student are. In several instances, Åsa and Annika both answer by nodding while simultaneously having their webcams switched on. However, the limited gallery

teacher's. On the teacher's screen, the thumbnail displays are arranged in the order of microphone activation, but the same principle does not apply to students' screens. This leads to different materialisations of participation at different points of assemblage. During screen sharing, microphone activation functions as a principle that pulls up thumbnails on all recorded screens.

(participant) view of the Zoom interface during screen sharing hides the majority of the student images, showing only a few students who either have taken a turn speaking or whose microphone has been activated by other sounds. Whether corporeal gestures, such as nodding, are transmitted to others depends not only on student actions but also the audiovisual operations of a microphone and a camera, as indicated above. Student actions in the participation framework of Zoom are not available to other students and teachers in a manner similar to that in the participation framework of face-to-face classrooms (Sahlström, 2002). In our material, however, the unavailability of bodily participation to the recipient did not seem to affect the carrying out of such actions by the students. This might be attributed to the fact that during screen sharing, it is very difficult for students to assess whether their thumbnail displays are visible to others, as the interface gives no indication of such status.

4.2. Webcam Agency – How Video Feeds Compose Student Bodies

One of the central actors in the enactment of participation practices in distance teaching is the computer webcam. Åsa, Annika and Joel use built-in computer webcams positioned on the upper bezel of their laptop displays. In this position, the camera produces an image that includes the upper body from the chest up with the face positioned at the centre. This version of a student emphasises the participation produced with the face and the upper body. Facial expressions and bodily movements generated with the upper body can be rendered to others, but only if the image is transmitted and shown on others' screens.

However, the visual exclusion of information other than the regions spanning the chest up and the face is considerable. For example, Åsa and Annika frequently take notes. Excluding the physical desktop render the manual note-taking during teaching invisible to the teacher and the other students. Another participatory aspect missing in Zoom is the focus of a gaze and the subsequent shared understanding emerging from its direction. While there is research showing the social norms of gaze shifts in relation to established small groups on shared screens (Hjulstad, 2016), there is no evidence of such established norms in our material. They are also very unlikely to occur in our context because of the dynamic and constantly changing ordering and visibility of participant thumbnail displays.

Other activities that are reformatted in the distance teaching assemblage and are left untransmitted to the other students and the teacher are the actions that signify an intention to answer a question

raised by the teacher. In the analysed Zoom lesson, the intention to answer is produced in co-operation between the student, a computer trackpad and the Zoom interface. At various points during the lesson, Åsa, Annika and Joel intend to answer the teacher's questions, as seen by how, immediately after the teacher pose a question, the students' hands approach their trackpads and move the cursor to the microphone icon in Zoom. However, this subtle corporeal choreography, produced interactively with the computer, is wholly untransmitted to others because of its minimality and the way the video feed register the students' bodies from the chest up. The example below shows how the version of a student composed through the video feed dissolve the intention to answer a question.

> *Åsa is about to answer the question 'What comes after thirty-seven?' Immediately after the question is raised, Åsa turns a page in the notebook in front of her on the table and checks the answer from a table of prime numbers. She then moves her left hand to the trackpad, moving the cursor to the microphone symbol. However, she does not have time to activate the microphone before another student's voice can be heard answering the question. While Åsa's video feed is visible on the teacher's screen, it shows nothing of the activity associated with the answering intention and therefore gives the teacher no clues about it*

The intention to answer a teacher's questions can be considered a central activity of student participation in teacher-led classroom instruction. In a traditional classroom, this intention is expressed and shared to others through various corporeal orientations, involving gaze, hand raising and other bodily actions (Evnitskaya & Berger, 2017; Kääntä, 2012; Sahlström, 2002). In the analysed distance lesson, this intention is reformatted by technological actors, such as the trackpad, the cursor, the microphone icon and the webcam. This new activity, produced interactively by student bodies and technologies, is left untransmitted to the teacher and the other students, thereby losing its shared character and its effectiveness in expressing student participation.

4.3. Microphone Agency – Highlighted Teacher and Silenced Students

The computer microphone is another central actor in the enactment of student participation. Earlier, we described how Zoom prioritises users on the basis of microphone activation. Next, we will ascertain how the default switching on of the teacher's microphone while the students' microphones are muted further cements the centrality of the lecturing teacher. In conjunction with this phenomenon, the students keep their microphones off whenever they have no intention to

speak, which inescapably leaves out sounds that denote student participation. Again, this is in stark contrast to the situation in face-to-face classrooms prior to digitalisation, where the shared sound space is a core aspect of classroom constraints and affordances for participation (for an extended discussion, cf. Sahlström et al., 2019).

Åsa, Annika and Joel join the Zoom meeting with their microphones turned on. Only a few moments after joining, all of them turn their microphones off. With the exception of the beginning of the lesson when students join Zoom or later when they take speaking turns, student microphones are always muted. In the interviews, the students confirmed that having microphones muted was the norm in distance teaching. In contrast, during the recorded lesson, the teacher's microphone is constantly on. Throughout the lesson, teacher talk and the sounds of his desktop equipment dominate the audio landscape in all the points of the assemblage that are visible from the video data. Sounds such as the clacking of the teacher's keyboard or noises that accompany drawing on the whiteboard are transmitted to the students through the teacher's microphone. At the same time, because the students' microphones are muted, all the sounds that they produce (e.g. turning pages or writing notes) are untransmitted to others. This sharply contrasts with in-person instruction and learning, during which student sounds can be relied upon as an index of student participation. Audially, therefore, the analysed distance teaching assemblage emphasises teacher activity while simultaneously silencing the sounds of student participation. The upshot of all this is a further accentuation of the power position occupied by the lecturing teacher.

From a participatory point of view, the microphone and the practices associated with it often results in a failure to convey student participation in teaching. This is supported by the situation below.

> *The teacher makes a joke about Euclid. Joel laughs. Because his microphone is muted, the laugh is not transmitted to others. This effect is underlined by the fact that his video is turned off and his face is not visible.*

Video data from Joel, Annika and Åsa shows how all of them use their voices in relation to teaching. For us, these sounds express students' orientation towards teaching. This can be seen in situations wherein Annika audibly whispers her answers to the teacher's questions, Åsa says 'mm-hmm' to signify that she understands what the teacher meant and Joel laughing out loud at the teacher's joke. When microphones are consciously turned off, the interactional character of these

sounds is questioned. Still, it is clear that the sounds are produced in relation to the teaching and express student participation in it. The analysed distance lesson assemblage enacts the sounds produced by the students in a manner that strips them of their interactional meaning. The sounds of laughter, agreement and work, which can express participation in a face-to-face classroom, are stripped of this capacity and are translated into non-interactional actions.

4.4. Agency of Unstable Internet Connection – Breakdowns that Accentuate the Agency of the Internet

As long as internet connection functions without interruption, it seems to be a self-evident infrastructure that silently operates in the backstage of distance teaching practices. When *breakdowns* occur, however, the agency of internet connection is highlighted (Alirezabeigi et al., 2020; Pischetola et al., 2021). Our data shows how the unstable internet connection of one student and the ensuing momentary *breakdowns* affect distance lesson participation practices by conveying multiple simultaneous versions of students' speaking turns. The instability of Annika's internet connection becomes apparent more than once and each time influences how participation materialises differently at different points of the distance teaching assemblage. This observation is corroborated by the following excerpt:

> *At the beginning of the lesson, the teacher asks Annika to turn on her camera because he wants to see what the GoPro cameras of the students taking part in the research look like. The request is met with laughter and jokes, after which Annika turns on her web camera. While responding to the teacher's request, Annika jokes about how even her dog gets scared seeing the GoPro on her face. However, the teacher does not react to the joke in any way. When we watch the situation from teacher's perspective, we notice that only words that can be heard are 'also my dog'. Annika's joke does not reach the teacher and, therefore, she gets no response to it. As Zoom soon after her joke warns Annika that her internet connection is unstable, it is most likeable that the reason for why Annika's talk is not fully transmitted is the momentary breakdown of her internet connection.*

Later in the lesson, the unstable connection affects the forms by which the other students' speeches were presented in Annika's space. In the following, a student answers a question from the teacher:

> *Teacher: What should we look at next?*

Student: All prime numbers up to 44.

In the situation, the student's response is transmitted clearly to the teacher, Åsa and Joel. Only in Annika's space is it incomprehensible. A few moments later, a Zoom notification on her screen reports that her "internet connection is unstable".

Both the situations discussed above highlight the centrality of internet connection in the enactment of student participation. In the first case, connection instability advance the enactment of Annika's turn in such a way that only part of what she says is transmitted. This results in the teacher disregarding the joke that she makes. Although the Zoom interface notifies Annika of the instability, it is difficult for her to assess how this affects the speech that she wants transmit to others as in this case she has no means to assess how her speech materialises in the spaces of other students and the teacher. From the perspective of teacher–student interaction, the loss of information caused by connection instability is problematic.

In the second excerpt, a student answers a question raised by the teacher. The video data from four locations shows how a speaking turn materialises differently at various points of the lesson. Whereas the assemblages of Joel, Åsa and the teacher produce comprehensible speeches, that of Annika was disrupted by the participation of her unstable connection in the production of the turn, rendering the reply of the student incomprehensible. There are many situations during the lesson wherein student participation emerges in many simultaneous forms and it is often difficult to assess which technological actors participate in the enactment of these versions. In the two cases described above, however, because Annika's screen shows a Zoom notification immediately after incomprehensible student speaking turns, it seems likely that the unstable connection is central to the enactment of simultaneous different versions of student participation. The analysis shows how weak internet connection affects student speaking turns and thus disadvantages students with regard to participation and puts them in unequal positions (see also Pischetola et al., 2021).

5. Discussion

Our analysis of distance teaching described how the interface, webcam, microphone and internet connection entangle with the students and play crucial roles in the enactment of participation. As we have described, the distance teaching assemblage hides many student activities related to

teaching. However, it is important to point out how the assemblage also conceales many actions that are not explicitly related to teaching. Joel, for instance, could be observed drinking water, listening to music, tapping rhythmically with a pen and stretching. Åsa was seen yawning and checking the student management software Wilma. Annika sneezed and tapped the desk. All these activities remained invisible and inaudible to the teacher and the other students. The assemblage made invisible occupations that could be interpreted as offshoots of participation in teacher-led face-to-face teaching. This reminds us of Gourlay's (2022) analysis of pre-recorded university distance lectures, in which she proposes that the digital screen is an actor in distance teaching that is enrolled in a wider act of symbolic hygiene. She points out how

> *the screen might be compared to the anti-epidemic mask, decontaminating the mess of the non-professional setting, allowing for the creation of a heavily curated performance of elements that may be considered inappropriate to the pre-prepared video, and also elements which would be accepted as normal in a live face-to-face setting.* (Gourlay, 2022, p. 7)

The synchronous distance lesson that we analysed differs from the one in Gourlay's analysis but connects with her suggestion about a 'symbolic hygiene that decontaminates the lecture in a range of ways' (Gourlay, 2022, p. 7). Interestingly in the practice we have analysed, the decontamination does not concern teachers actions but instead students actions. When entangled with webcams and interfaces, their physical bodies are not as visible as before. When entangled with microphones, the sounds produced by their bodies and their interaction with tools are silenced. It is tempting to suggest that as offshoots are cleared away, student presence in the lesson becomes thinner. Participation is 'made efficient' in the sense that sound and image are displayed mostly when they concern the most obvious form of participation: answering a question from the teacher. Among what disappears are many of the aspects that, in face-to-face interaction, hint at the presence of other students, such as the chinks and rustles produced by bodies and tools, sneezes or drumming sounds and the indication of proximity to other students on the basis of the volume of these sounds. At the same time, the actions of the teacher and the sounds produced in the teacher's space become more prevalent than before.

The prevailing normative expectations of classroom participation emphasise active, interactive and visible participation while labelling 'passive' those activities that are incompatible with these norms (Gourlay, 2015). This shows a strong reliance on humanistic thinking, wherein human actors are placed front and centre, devices are seen foremost as tools and spatial and temporal dimensions

are regarded as contexts or backdrops for human activity (Gourlay, 2015). Our data points to the centrality of sitting and listening, lecture-like teaching, the dominance of teacher talk and the minimal interaction between students—characteristics that could be labelled 'passive' from the normative standpoint. A more detailed analysis focusing on the sociomaterial minutiae of the practices reveals active and complex relations among students, artefacts and technologies. Our analysis sheds light on how student participation is not simply about human interactions and activities but is enacted in an assemblage constituted by a heterogeneous group of actors. We described the significant role of some technologies in the enactment of participatory practices in distance teaching. This kind of analysis questions simplified conceptions such as passive or active participation and instead highlights how practice is constituted in the complex associations between technologies and students. Thus, our approach provides an empirical basis for the renegotiation of some of the commonly held binaries in educational discussions, such as students/devices and practice/context (Gourlay, 2015), as it describes how different technologies and materialities that associate with teachers and students have a crucial role in the shaping of educational practices. Further, the analysis contributes to the reformulation of agency in educational practices.

6. Conclusion

We probed into synchronous distance teaching practices from a sociomaterial perspective, with a focus on the materiality and embodiment of the day-to-day practices of distance teaching. In our analysis of the embodied and material entanglements of students and distance teaching technology, we presented how the examined distance teaching assemblage reshapes student participation practices in teacher-led pedagogy. The analysis also brought forward how particular technological actors—the Zoom interface, webcam, microphone and internet connection—played a crucial role in the enactment of student participation. The analysed distance teaching assemblage stripped away certain central characteristics of student participation in teacher-led pedagogy. The students' embodied actions and corporeal orientations, such as gaze directions, nods, smiles and note-taking, which are central resources of participation in a pedagogical framework that imposes many restrictions on verbal student participation, were made, in large part, invisible. As these pivotal participatory activities are rendered largely invisible, what remains shared between the students, and the students and the teacher, is a 'thinner' version of student participation than that occurring in classrooms where the distance teaching format has its origins.

Acknowledgements

The authors sincerely appreciate the contributions of the participating students and teacher. This research was funded by the Media-alan tutkimussäätiö and supported by the Academy of Finland (grant number: 339603).

CONFLICT OF INTEREST

The authors report no conflicts of interest.

PARTICIPANT CONSENT STATEMENT

All the participants in this study consented to the use of the data that they provided in research publications.

ETHICS STATEMENT

The research has been conducted in accordance with the recommendations of the Finnish national board of research ethics.

References

Alirezabeigi, S., Masschelein, J. & Decuypere M. (2020). Investigating digital doings through breakdowns: A sociomaterial ethnography of a bring your own device school. *Learning, Media and Technology*, *45*(2), 193–207. doi:10.1080/17439884.2020.1727501

Atkinson, P. & Coffey, A. (2001). Revisiting the relationship between participant observation and interviewing. In J. F. Gubrium & J. A. Holstein (Eds.) *Handbook of Interview Research.* London: Sage, 801–815.

Decuypere, M. (2019a). STS in/as education: Where do we stand and what is there (still) to gain? Some outlines for a future research agenda. *Discourse: Studies in the Cultural Politics of Education*, *40*(1), 136–145. doi:10.1080/01596306.2018.1549709

Decuypere, M. (2019b). Researching educational apps: Ecologies, technologies, subjectivities and learning regimes. *Learning, Media and Technology*, *44*(4): 414–429. doi:10.1080/17439884.2019.1667824

Decuypere, M., & Simmons, M. (2014). On the composition of academic work in digital times. *European Educational Research Journal*, *13*(1), 89–106.

Evnitskaya, N., & Berger, M. (2017). Learners' multimodal displays of willingness to participate in classroom interaction in the L2 and CLIL contexts. *Classroom Discourse*, *8*(1), 71–94. doi:10.1080/19463014.2016.1272062

Fenwick, T., Edwards, R. & Sawchuk, P. (2011). *Emerging approaches to educational research.* Routledge.

Fenwick, T. & Edwards, R. (2010). *Actor-Network Theory in Education.* Routledge.

Gourlay, L. (2022). Digital masks: Screens, selves and symbolic hygiene in online higher education. *Learning, Media and Technology*. doi:10.1080/17439884.2022.2039940

Gourlay, L. (2021). There is no 'virtual learning': The materiality of digital education. *Journal of New Approaches in Educational Research*, *10*(1), 57–66. doi: https://doi.org/10.7821

Gourlay, L. (2020b). Quarantined, sequestered, closed: Theorising academic bodies under Covid-19 lockdown. *Postdigital Science and Education*, *2*, 791–811. https://doi.org/10.1007/s42438-020-00193-6

Gourlay, L. (2015). Student engagement and the tyranny of participation. *Teaching in Higher Education*, *20*(4), 402–411. doi: 10.1080/13562517.2015.1020784

Hjulstad, J. (2016). Practices of organizing built space in videoconference-mediated interactions. *Research on Language and Social Interaction*, *49*(4), 325–341. doi:10.1080/08351813.2016.1199087

Latour, B. (2005). *Reassembling the social.* Oxford University Press.

Law, J. 2007. "Actor Network Theory and Material Semiotics." Accessed 2 March 2023. http://www.heterogeneities.net/publications/Law2007ANTandMaterialSemiotics.pdf.

MacLeod, A., Cameron, P., Kits, O. & Tummons, J. (2019). Technologies of exposure: Videoconferenced distributed medical education as a sociomaterial practice. *Academic Medicine*, *93*(3), 412–418. doi:10.1097/ACM.0000000000002536

Paakkari, A. (2020). *Entangled Devices: An ethnographic study of students, mobile phones and capitalism.*Helsinki studies in education. Doctoral dissertation. University of Helsinki.

Paakkari, A. & Rautio, P. (2019). 'What is puberty, then?' Smartphones and Tumblr images as de/re-territorialisations in an upper secondary school classroom. *Discourse: Studies in the cultural politics of education*. https://doi.org/10.1080/01596306.2018.1451304

Paakkari, A., Rautio, P. & Valasmo, V. (2019) Digital labour in school. Smartphones and their consequences in classrooms. *Learning, Culture and Social Interaction* 21(2019), 161-169.

Paakkari, A. & Paananen, M. & Grieshaber, S. (Forthcoming) Activity-tracking Assemblages in Finnish Early Childhood Education and Care. *Childhood.*

Paakkari, A. & Valasmo, V. Cracks in the sidewalk. Looking behind the seamless surfaces of digital schooling. In process.

Pischetola, M., Thédiga de Miranda, L. V. & Albuquerque, P. (2021). The invisible made visible through technologies' agency: A sociomaterial inquiry on emergency remote teaching in higher education. *Learning, Media and Technology*, *46*(4), 390–403. doi:10.1080/17439884.2021.1936547

Sahlström, F. (2002). The international organization of hand raising in classroom interaction. *Journal of Classroom Interaction*, *3*7(2), 47–57.

Sahlström, F., Tanner, M. & Valasmo, V. (2019). Connected youth, connected classrooms: Smartphone use and student and teacher participation during plenary teaching. L*earning, Culture and Social Interaction*, *2*1, 311–331. doi:10.1016/j.lcsi.2019.03.008

Sørensen, E. (2009). *The materiality of learning: Technology and knowledge in educational practice (Learning in doing: Social, cognitive and computational perspectives)*. Cambridge University Press.

Sørenssen, I., Aarsand, P. & Hoveid, M. (2019). Beyond binaries – Enacting agency in video observation in ECEC. *Video Journal of Education and Pedagogy*, *4*(2019), 1–18.

Valasmo, V., Paakkari, A. & Sahlströ̈m, F. (2022): The device on the desk – a sociomaterial analysis of how Snapchat adapts to and participates in the classroom, Learning, Media and Technology, DOI: 10.1080/17439884.2022.2067176

Williamson, B., Eynon, R. & Potter, J. (2020). Pandemic politics, pedagogies and practices: Digital technologies and distance education during the coronavirus emergency. *Learning, Media and Technology*, *45*(2), 107-114. doi:10.1080/17439884.2020.1761641