Teachers' experience of the breakdown of infrastructures during the pandemic

Anna-Lena Godhe[1]

Abstract

This article reports on teachers' experience of working during the Covid-19 pandemic. The analysis is based on a thematic analysis of group interviews with 76 teachers working throughout the Swedish school system, i.e., preschools, primary, secondary school, and municipal adult education. The interviews were conducted during autumn 2021. Conceptualizing teaching and working during the pandemic as a breakdown of infrastructures, the article focuses on how teachers talk about changes in institutional, social, technological, and pedagogical aspects of teaching and learning. The results show that changes in institutional aspects mainly concern teachers' communication with colleagues, custodians, and school leadership. Social and pedagogical aspects are emphasized, while technological aspects are not as prominent in the teachers' accounts. Commonly taken-for-granted aspects are brought to the fore, and their importance for teaching and learning has implications for the new normal and for what is of importance when creating future infrastructures for teaching and learning.

Keywords Pandemic · Infrastructures · Emergency remote teaching · Teachers' experience

1 Introduction

Due to the outbreak of the Covid-19 pandemic in 2020, school systems around the world had to take unpreceded measures to protect pupils, students, and the population at large. Sweden, in several aspects, took a different path concerning how to deal with the pandemic. While lower secondary schools closed during shorter periods from

✉ Anna-Lena Godhe
anna-lena.godhe@ju.se

1 Department of Education, School of Education and Communication, Jönköping University, Gjuterigatan 5, 55111 JönköpingBox 1026, Sweden

March 2020 until the beginning of 2022, preschools and primary schools remained open even during times of high infection rates. Upper secondary schools and universities were recommended to practice distance education (Ahlström et al., 2020; Axelsson, 2021). The changes in teaching during the pandemic have been referred to as emergency remote teaching (ERT), rather than online teaching. Bozkurt and Sharma (2020) argue that there is a need to distinguish between ERT and online distance education, as ERT was a temporary alternative delivery mode while distance education has developed into an interdisciplinary field over time. Due to the speed of change during the pandemic, it was not possible to incorporate central aspects of quality found in research on online education, (Hodges et al., 2020).

While most schools remained open in Sweden, recommendations for social distancing were in place until 2022 and affected Swedish citizens at large. All teachers had to follow the government's guidelines regarding social distancing and staying home if they experienced any Covid-19 symptoms. Some concerns were raised about teachers' well-being and the risk of infection, particularly in preschools (Pramling et al., 2020). The decision to keep schools for younger children open was based on less evidence of children getting infected by the virus, but also on the potential harm that closing schools could cause the children (Axelsson, 2021). Since regulations from the Public Health Agency changed with the pandemic, upper secondary schools practiced ERT to varying degrees for two years.

This article presents the findings of a research project on the digitalization and digital competence of preschools and schools in a Swedish municipality. Digital competence was introduced as a foundational concept in the national strategy for the digitalization of education (Government decision I:1, Supplement, 2017) as well as in national curricula throughout the Swedish school system (Swedish National Agency for Education, 2017, 2018). The national strategy stated that due to its changing nature, it is not possible to find a long-lasting definition of digital competence. Both in the strategy and in the changes in curricula, digital competence is related to societal changes. However, a study on the revisions made in curricula for compulsory education found a tendency in the revisions to focus on the digitalization of schooling as a matter of implementing new digital tools, while giving less emphasis to critical awareness and safety issues (Godhe et al., 2020).

The project presented in this article, involved interviews with 76 teachers working in preschools, primary schools, and secondary schools during the fall of 2021. Although the project did not focus on the pandemic, it was conducted at a time when pandemic-related restrictions had been in place in Sweden for over a year, and the teachers had experience living and working under pandemic conditions. Therefore, questions were asked about how, if at all, the pandemic had affected their work as teachers. While the experiences of the interviewed teachers varied, there were also similarities in working with pupils and students of different ages during a pandemic, or what Ahlström et al. (2020) called "business as usual in unusual circumstances" (p. 36). Since the interviews were conducted after more than a year of pandemic-related restrictions, the teachers were able to reflect on their experiences during this time.

Since the outbreak of the pandemic, there has been a surge of studies reporting on the experiences of teachers and students at all levels, as well as on the possible consequences of teaching and learning during Covid-19. Studies of teaching and

learning during the Covid-19 pandemic, both in Sweden and more broadly, tend to focus on teachers' skills and competences (e.g. Perifanou et al., 2021), motivation (e.g. Panisoara et al., 2020; Beardsley et al., 2021), self-perception, and how teachers and students experienced the pandemic (e.g. Niemi and Kousa, 2020). However, few studies take into account how teachers' working environments are affected, including changes in institutional and social aspects related to colleagues and custodians. Both Trust and Whalen (2021) and Ogodo et al. (2021) point out that the pandemic and ERT have exposed a digital divide concerning differences in teachers' preparedness to teach online. In addition to advocating for improved teacher training and increased access to technology, Trust and Whalen (2021) also argue that students and their families need to develop their technological competence.

Many of the studies published so far were conducted at the beginning of the pandemic. Since this article concerns Swedish teachers and the response to the pandemic in Sweden differed from that in most other countries, previous studies in this context are of particular interest. The Swedish National Agency for Education and the Swedish Schools Inspectorate have both reviewed the consequences of the pandemic on the Swedish school system (Swedish school inspectorate, 2021; Swedish National Agency for Education, 2022). They concluded that access to education, in general, has been good and that teachers coped well, considering the circumstances. In a study conducted at the beginning of the pandemic, Bergdahl and Nouri (2021) noted that schools tended to focus on being technologically prepared, while teachers had to put great effort into solving pedagogical aspects pragmatically. In another study conducted at the outbreak of Covid-19 Olofsson et al. (2021) focus on the experiences of upper secondary school teachers and concluded that Swedish schools, in general, were well-equipped with technology, and teachers had good access to support. Olofsson et al. stressed the importance of collegial support and argued that teachers at the schools where their study was done came together when the pandemic broke out to "make it work" and therefore did not experience extra workload as in many other countries (e.g. UNICEF, 2020). Pramling et al. (2020), wrote that policies in Nordic countries reflect the fact that education is considered a right for children and families. However, during the pandemic, these rights sometimes conflicted with the teachers' rights to protect their own health.

Concerns are raised regarding the lower quality of teaching during the pandemic and greater inequality for students (Grönlund, 2020; Swedish school inspectorate, 2021; Swedish National Agency for Education, 2022). Assessment and awarding grades have been a challenge since teachers found it difficult to collect reliable material as a basis for grading when teaching remotely (Swedish school inspectorate, 2021). Effects on quality are connected to higher absence for both students and teachers, particularly at preschools, which in turn affected the workload of primary school teachers (Grönlund, 2020; Swedish School Inspectorante, 2021; Swedish National Agency for Education, 2022).

Stenliden et al. (2021) argue that changes in spatial arrangements and communicative practices affect teaching because teachers find it more difficult to adapt online teaching to their students' needs. In an online environment, teachers find it hard to "read" students' reactions and feelings through gaze, bodily movements, and facial expressions (Godhe & Wennås Brante, 2022).

This article explores how an analysis using the theoretical framework of infrastructures (Star & Ruhleder, 1996; Guribye, 2015) could contribute to shedding light on how changes in teachers' work environment during the pandemic can be understood more broadly. Other researchers have argued that studies on the digitalization of education tend to focus on how digital resources are used in the classroom by teachers and students and have called for a broader focus to incorporate institutional aspects (e.g., Pettersson, 2018). Conceptualizing teaching during the pandemic as a breakdown of infrastructures highlights aspects that have not been extensively addressed in previous studies, aspects which are also of importance for a future perspective on a new normal for teaching and learning. The research questions addressed in this article are:

- What aspects become visible and important when analyzing what is expressed in the interviews as the breakdown of the infrastructures for teaching and learning?
- How can these aspects inform a "new normal" for education?

The article explores and discusses the implications of the breakdown and lessons to be learned in formulating a new normal for education.

2 Theoretical framework

In this article, the outbreak of the Covid-19 virus is regarded as a breakdown in the infrastructures of education and teaching. The word infrastructure usually brings up images of pipes and roads which supports contemporary societies. However, Star and Ruhleder (1996) define infrastructures as ecological and relational to organized practices. Studying infrastructures then becomes an issue of what is needed for them to support practice, rather than what they consist of. This definition considers the relational aspects among technological entities, the people who use them, and the environment in which they are used, i.e., institutional, social, and technological aspects. The analysis of the interviews in this article aims to illuminate how the pandemic affected institutional, social, technological, and pedagogical aspects of this infrastructure. Karasti and Blomberg (2018) suggest investigating moments of breakdown as a strategy to visualize the invisible dimensions of infrastructure.

According to Star and Ruhleder (1996), an infrastructure is open in the sense that there are no limits to the number of users, technological components, or application areas. This also means that it is heterogeneous as it includes other infrastructures and different ways of putting together various components (Hanseth, 2000). Star and Ruhleder (1996) describe some dimensions that characterize the occurrence of an infrastructure: embeddedness, transparency, reach or scope, learned as part of practice, links with conventions of practice, embodiment of standards, built on an installed base, and becomes visible on breakdown. Embeddedness refers to the infrastructure being emerged in other structures, social arrangements, or technologies. Infrastructures are transparent since they invisibly support a task without having to be reinvented each time the task is carried out. Another dimension is that infrastructures have a reach or scope that goes beyond a single event or practice. An infrastructure

enables and supports a wide range of activities, and it is shared in the sense that a larger community uses the same infrastructure, though it may appear differently for different users. Infrastructures are therefore learned as part of membership so that the infrastructure becomes an object to be learned in order to participate in practice (Lave & Wenger, 1992). Conventions of practice both shape and are shaped by infrastructure, and infrastructures often plug into other infrastructures to become embodiment of standards (Guribye, 2015). The notion of installed base means that infrastructures are always built upon what already exists so that new and old infrastructures always interconnect with each other. Hanseth (2000, p. 60) defines infrastructure as an evolving shared, open, and heterogeneous installed base. Infrastructures evolve by extending and improving an installed base and the concept of installed base can therefore capture historical aspects of transformations and innovative practices (Igira & Aanestad, 2009, p. 214).

Guribye and Lindström (2009) argue that a pedagogical aspect needs to be added when studying education and infrastructures for teaching and learning. They define an infrastructure for learning as;

> … a set of resources and arrangements – social, institutional, technical – that are designed to and/or assigned to support a learning practice (p. 154).

Guribye (2015) writes that since the object of these practices relates to some sort of learning activity, a pedagogical approach is present, even though it may not be explicit. Similarly, mediational means regularly have some underlying theoretical notion of learning inscribed in the design, which then also becomes embedded in the infrastructure (Koschmann et al., 1996).

Star and Ruhleder's (1996) conceptualization of infrastructures has primarily been used when studying information infrastructures and the implementation of technological devices, systems, or applications, as well as in designing such technologies (e.g., Guribye, 2005; Monteiro & Hanseth, 1996). In this article, particular attention is given to infrastructuring, which refers to the process of creating and enacting infrastructures, and the users' experience of a breakdown of the infrastructures they employ when working. The way the teachers talk about their experience of the breakdown concerns changes in the different aspects of the infrastructures when working during the pandemic. The analysis gives particular attention to how the installed base is extended and transformed, as it highlights emerging and innovative practices that can be built upon in the future.

3 Methods

Interviews were conducted in autumn 2021 with 76 teachers working in preschools, primary, and secondary schools in the same municipality situated in the south of Sweden and being one of the largest towns in the country. These interviews were part of a larger research project that focused on the digitalization of preschools and schools, as well as the significance of digital competence in practice in this municipality. The interviews aimed to understand the teachers' opinions and views regarding the digi-

talization of education and teaching practices, as well as their reflections on how the pandemic had impacted their working conditions and their role as teachers. Although the pandemic was ongoing, most teachers felt that the worst was over but remained somewhat cautious about the future. Precautionary measures needed to be taken once again at the start of 2022 due to another surge in infection rates.

The schools and preschools, where the teachers work were chosen for the larger research project because they had been categorized as advanced in their work with digital aspects of teaching and learning in surveys conducted by the municipality. The categorizations were mainly derived from self-reported questionnaires answered by teachers and school leaders. What it meant to be advanced in digital aspects of teaching and learning varied to some extent depending on the age of the children. Labeling the preschools and schools as advanced did at least mean that they were not new to working with questions relating to digital aspects of teaching and learning. All teachers thereby had experience using digital tools of different kinds for their work and in teaching. The preschools and schools were spread out across the city, representing different parts with populations of higher and lower socio-economic ratings. The school leadership decided which teachers to interview and how many (see Table 1). Selection criteria, decided upon by the school leadership, varied, as shown in Table 1, which also reflects the different school forms. In preschool, importance was given to that the teachers being interviewed together also worked together. In compulsory school, getting a mixture of teachers teaching different age groups was important, while in upper secondary and adult education the groups in each interview taught the same subjects. The decision to interview a wide range of teachers, from preschool to adult education, was based on the wider research project, as digital competence is part of the Swedish national curricula from preschool to adult education. For this particular article, the differences in experiences of working as teachers during the pandemic at the different levels were considered important in relation to the new

Table 1 Number of interviews, participants, and selection criteria for the interviews

	Number of interviews	Number of interviewees	Selection Criteria
Preschool 1	4	11	Working together, being able to participate at that time
Preschool 2	4	14	Working together, being able to participate at that time
Compulsory school 1	3	9	The age group they teach (low, middle, high)
Compulsory school 2	3	9	One representative from each age group of students (low, middle, high)
Upper secondary school	3	10	The subjects they teach
Adult education	5	23	The subjects they teach

normal for education, regardless of the school level and also regardless of personal characteristics of the teachers, such as gender, age and years teaching.,

The empirical data on which this article is based consist of what the teachers said in interviews about how Covid-19 had affected their work as teachers from early 2020 up until the time of the interviews. The teachers were interviewed in groups of 2 to 6 people. They were interviewed in groups so that they could talk to and be inspired by each other during the interviews. Since the purpose of the study was to find out important aspects that become visible during the pandemic and the breakdown of infrastructures for teaching and learning, the participants were able to build on each other's arguments and experiences in the interviews. Additionally, since the interviews were the first part of a study that also included observations of classrooms, group interviews were less time-consuming and made it possible to interview a larger number of teachers. The interviews were semi-structured with broad and open questions, such as "What have you experienced as pros and cons when working during the pandemic?", which invited the participants to share their experiences and talk to each other about them (Brinkmann & Kvale, 2009). Most interviews were conducted at the teachers' workplace, but five interviews were done digitally due to the Covid-19 restrictions. The interviews were conducted with teachers working at two preschools, two compulsory schools (primary and lower secondary), one upper secondary school, and one municipal adult education (Komvux). The teachers' interviewed at the school of municipal adult education all taught at the upper secondary level but differed from the upper secondary school teachers in that their students are adults.

All interviews were recorded, and some were filmed. The main reason for filming the interviews was to be able to distinguish who said what since this is difficult in audio recordings with unknown persons. When the interviews only involved two persons, perhaps of different genders, this was not necessary. Another reason why not all interviews were filmed was that all groups were asked if they consented to be filmed and not all teachers did so. Subsequently, transcripts of answers concerning the pandemic were extracted from the larger dataset. The interviews as well as the participating teachers have been given codes to anonymize the material.

A thematic analysis of the relevant data from the interviews has been conducted (Braun & Clarke, 2006). Two different ways of identifying patterns in thematic analysis have been suggested by Braun and Clarke (2006): an inductive and a deductive way. An inductive approach does not use predefined codes but defines themes based on data-driven analysis. A deductive approach is driven by a theoretical or analytical interest where the codes used when analyzing the data derive from theoretical aspects and research questions. Moreover, Braun and Clarke (2006) differentiate between semantic and latent themes. A semantic approach focuses on the surface meanings and involves an analysis that progresses from description to interpretation. Data is first organized and presented to show patterns in content and then interpreted to theorize the patterns and outline implications and broader meanings. The latent level starts with the identification of underlying ideas and assumptions and how they shape the data.

In later writings, Braun and Clarke (2019; Braun et al., 2019) have written that their early article has been misunderstood and have argued for a mix of semantic and latent, inductive and deductive, rather than either or. In this article, I would argue

Table 2 Names and descriptions of themes generated in the data

Name	Description
Institutional aspects	Organizing teachers' work during the pandemic; meetings; professional development
Social aspects	Interacting at a distance, contact with custodians, students, and colleagues during the pandemic
Technological aspects	Changes in the use of digital tools, affordances, and constraints with ERT
Pedagogical aspects	Organizing teaching during the pandemic, losses and gains when changing delivery mode of teaching

that the theoretically driven themes, i.e., the aspects of infrastructures outlined by Star and Ruhleder (1996) and Guribye (2015), serve two purposes. These aspects have been employed to explore how an infrastructure analysis may be used, not only to understand information structures or designing and implementing technological devices and systems, but also to understand infrastructures for teaching learning. Moreover, aspects of infrastructures are in this analysis used to understand teachers' work during the pandemic to illuminate contextual factors of importance to understand digitalized teaching and learning, which is of relevance when addressing a new normal for teaching and learning. The results will be organized so that excerpts from the data exemplify patterns in the data in relation to the four aspects of infrastructures outlined in the theoretical framework: institutional, social, technological, and pedagogical (see Table 2). Following this descriptive presentation, implications, and broader meanings will be outlined and discussed in relation to the future and how the pandemic may affect the establishment of a new normal.

All interviewed teachers have been given information about the larger research project and agreed to take part in the study. An ethical review has been approved by the Swedish Ethical Review Authority.

4 Results

In this section, excerpts will exemplify prominent issues in each of the four aspects of infrastructures for teaching and learning. Star and Ruhleder (1996) outline institutional, social, and technological aspects as important when regarding infrastructures as ecological and relational. Guribye (2015) adds pedagogical arrangements as essential when analyzing infrastructures for learning (Guribye & Lindström, 2009).

4.1 Institutional aspects

All the interviewed teachers discussed changes in how meetings were held during the pandemic, and they identified both positive and negative aspects of these changes. One positive aspect of online meetings that many teachers pointed out was the reduction in travel time and the need to move from one place to another. This applied to meetings with custodians, authorities, and colleagues. While they recognized the efficiency of this approach, they also experienced it as tiring in the long run. Some

preschool teachers expressed that they had spent more time working with the children during the pandemic because of this.

Teachers at all levels pointed out that meeting in large groups and having workshops or teacher development online, does not work as well as when they are held physically. Sitting in front of the screen alone, you tend to "zoom out" after a while during large group meetings, and online professional development quickly becomes tedious since it often lacks practical engagement. Workshops to try out applications and new technology have been difficult because it is not possible to explore, try out, and use them practically.

Teachers at all levels emphasize the importance of communicating with their colleagues through various online channels during the pandemic, but they miss the spontaneity of face-to-face conversations in the corridors. These brief encounters often spark ideas and create a sense of unity within the school. Although the primary teachers have largely been physically present in the school, they had to maintain physical distance. As the teacher in the following excerpt notes, this has altered the overall atmosphere among the teachers at that school.

> F4c3 – We sat in different classrooms, one for each teaching team and I thought that that actually created a bad feeling in the school as a whole because you discussed things in your own little group, and discussions online with other groups did not really work. There has always been a really nice and warm feeling amongst the staff here but that is built on meeting each other and socializing and that was not possible to obtain. (F4c)

The teachers who had to practice ERT supported each other through online chat groups, where they could discuss how to manage technological issues and share what worked and didn't work while teaching online. They also discussed changes in their workload during ERT, with many expressing that preparing digital lessons was time-consuming. In the following excerpt, an upper-secondary teacher reflects on changes in lesson preparation and the role of the teacher during lessons.

> F5b2 – To get some action you had to prepare lessons meticulously. When the lesson had started you were quite passive since you were not really in contact with the students so you mainly made sure that you followed the lesson plan. Give out assignments, check who was there, who disappeared, who came back, and if anyone had a question. The time during the lesson was really ineffective, so much time was put into preparations instead. It did not feel like I time-wise could use my competence on the right things. (F5b)

Teachers in adult education have been teaching remote courses for years and note differences in how courses are organized, such as synchronous online teaching. Some teachers in adult education are concerned that ERT will result in changes to how teaching is organized in the future. They are mainly concerned with possible expectations of teaching on and offline after the pandemic as well as an increase in students choosing to study at a distance and how this affects their work.

4.2 Social aspects

The most prominent social aspect identified when interviewing preschool and primary teachers was the changed interaction patterns with custodians. Generally, teachers missed out on the small talk that usually takes place when parents drop off and pick up their children, which has led to a loss of trust. Small talk and observing their children's activities are the main ways custodians build trust with teachers.

> F2Aa2 – The parents didn't get information, they became dissatisfied, and then greater pressure was put on us to send more text messages, phone more, and send more e-mails. It is hard to find time to do this. I felt that custodians were more irritated. There is a sock missing or where is that piece of clothing? We know and we try as best we can. The year that parents have not been allowed to come inside, we have lost their trust. Just because our doors are closed does not mean that we don't do our work, we do exactly the same work, but parents are not let in. They feel that they are on the outside looking in and have no idea what is going on. (F2Aa)

The inability to communicate with custodians in person was seen as the primary challenge, but a few advantages were also identified. One primary school teacher considered the increased distance to parents to be "nice in a way". Some pointed to the benefits of online communication with custodians, as it is easier to find time for meetings when neither party must travel or take time off work. Generally, more parents attend meetings online than when they were held at the preschool or school.

The move to online communication has also highlighted issues with some custodians' digital competence and language barriers.

> F1e2 – We have tried to have conversations over the phone, but we had to give it up since those parents who don't understand so much Swedish or can express themselves in Swedish, to them, body language is really important. So we sat far away from each other in a room otherwise they would have missed out totally. (F1e)

Teachers at one school emphasized the difficulties some parents face communicating online. To improve parents' digital competence, the school has offered workshops and considered creating instructional videos on how to log in to applications, enabling parents to help their children and communicate with the school. However, videos may also be challenging for parents with limited proficiency in Swedish.

Using Instagram to communicate with parents has become a common strategy in preschools. While it was appreciated during the pandemic, teachers also highlight difficulties, particularly regarding equity, as not all parents have access to Instagram. Due to security and ethical reasons, children cannot be shown on Instagram, therefore the photos shared there only show activities at the preschool, for example at the playground.

Many preschools and primary schools have created videos to show parents what the inside of the preschool looks like. This was particularly important for children who changed groups or who were new to the preschool or school.

> F1b1 – We have presented each section of the preschool in films so that the parents can see their child's preschool environment. We have also used Instagram more. We had an account earlier but have not been so active, but now each section publishes photos almost every day on Instagram since you can't show the documentation we do as easily. (F1b)

Teachers at the secondary or adult level hardly mention custodians but instead, discuss their students' well-being and changes in the roles of students and teachers during the pandemic. Several teachers noted a difference in students, with stronger students benefiting from working from home, while weaker students did not.

> F4d2 – What was positive was that some students worked better at home because they were in their room in their bubble, students who perhaps are easily disturbed in the classroom. There were still some students who thought it was better to be at home and who even wished to be able to be more at home now when we came back, but for the majority, you could see in their results and grades that students who before just reached the level to pass they are below that level now. Many of my students, they cannot motivate themselves. They need someone who is there and helps them: here, do this, write here (shows). Otherwise, they have YouTube, films, and Netflix which is so much easier to attend to. (F4d)

According to teachers, both the way they interact with the students during the lessons and the degree to which students actively participate by asking questions and showing their involvement have changed.

While several upper secondary school teachers report that their students had difficulties staying motivated when spending most of the day at home, teachers in adult education found that working from home was positive for many students. These are adults who may have families and work while studying, and more students have attended online lectures when studying from home.

> F6a1 – I think about the positive effect since students who otherwise would not have been able to attend the lesson since their children are sick or something. They could attend the online meeting and at least listen to what you say. Being able to record lessons that can be watched afterward means that more are able to follow the teaching. Many of our students work, and not having to travel to school increases the accessibility since they can attend a meeting for a while before going to work. (F6a)

Another difference between upper secondary and adult education is the support that classmates may provide in classrooms. Due to not being together in a classroom, upper secondary students had less support from peers and relied more on teacher

support. The lack of in-person classroom interaction also affected the communication between students. An upper secondary teacher notes how students have become less inclined to cooperate after the pandemic and how this affects the classroom climate.

> F5b3 – I have a group of students who were fantastic at helping each other before the pandemic. They have lost that now. The pandemic has ruined their way of working together, unfortunately. (F5b)

In adult education, peer support is not as common since students seldom study together with the same group of people to any large extent. Even so, the teacher in the following excerpt, points out relational aspects as missing and hard to replace in ERT.

> F6e4 – In the beginning we were all on our toes, eager to make it work but when you enter into some sort of routine, with digital teaching again and again, then you are left with a feeling of mental exhaustion, which prevents you from being 100% present and you rarely feel WOW that went so well! (F6e)

4.3 Technological aspects

Teachers at all levels have mentioned how they became familiar with using online tools for meetings and communication during the pandemic. They had no other option but to use technology during this time, and this has resulted in raising the level of competence among teachers in general. Some teachers also mention that they and their colleagues have become aware of the usefulness of technology and reflect on the fact that living through the pandemic without technology would have been much more difficult. The use of technology has enabled them to continue their work and the students to continue their education.

While all primary and secondary teachers had personal laptops before the pandemic, some teachers at preschools received personal devices for work during the pandemic. Many preschool teachers say that they have learned to use digital tools such as Zoom and Teams during the pandemic. An upper secondary teacher talks about how meeting online has become a tool to use with colleagues and students.

> F5c1 – When working with colleagues at school we still say but let's just have a quick Meet to go through this. Also, with students who have been away, we meet quickly online. You have learned Meet as a tool which we did not do at all before. Now it is a tool to use when needed. (F5c)

Teachers at the lower secondary level, who had to teach online for shorter periods of time, talk about how some students did not have sufficient broadband at home and how the schools equipped them with technology so that they could partake in the online lessons. For some students, the problem with online teaching was not technological but rather not having space at home to work undisturbed or having problems focusing on schoolwork at home on their own.

F3b1 – We had that problem here that all students don't have access to the internet at home. Some students came to the school and worked here.

F3b3 - Some parents or adults came here and collected assignments on paper and then the students had to solve them as best as they could at home, and they could phone and ask questions. So, we solved it in one way or another, but it is not the same. (F3b)

A negative aspect related to technical issues that some teachers talk about is that there has been less time to introduce new applications. In preschools, this is often talked about in connection to higher absence among staff.

F2Ab4 – Introducing new things has become less common since many are off sick and we have no substitute teachers. It has not been possible to spend time introducing new things or to get to know new material in smaller groups. Instead, you use what you already know or what is available. Less development than if you had the time to properly introduce new stuff. (F2Ab)

At the adult education school, teachers distinguish between regular courses, distance courses, and ERT. They point out the difference between asynchronous teaching in courses that have been taught online for some time and the synchronous lessons that some students have become accustomed to during the pandemic. They had a structure for delivering courses online where they shared learning resources such as presentations, links to films and sites, and assignments. However, they were not used to synchronous teaching as was expected in ERT. Although some teachers have started holding synchronous meetings in distance courses, they still consider these courses to be based on the student studying individually. They prefer to deliver lectures in a classroom rather than digitally.

4.4　Pedagogical aspects

Pedagogical aspects of teaching during the pandemic have been mostly discussed by teachers who have had to teach online, as well as preschool teachers. However, while teachers at upper secondary and adult education talk about changes related to teaching their subject, teaching quality, and assessment both in the classroom and online, preschool teachers talk about spending more time outside and about how Covid-19 has become part of their teaching content during the pandemic.

　Several preschool teachers have noticed that children have had a lot of questions about Covid-19, particularly at the start of the pandemic, but gradually, things like washing hands and keeping their distance have become part of their everyday life. While the youngest children did not have much to compare with, slightly older children divided their lives into before and after Covid, and they missed not being able to do the things they were used to.

F2Aa2 – The children in my group have noticed what they cannot do, they cannot go to birthday parties, and they cannot see their grandparents. Maybe

it mirrors what parents say and do and their worries which they talk about at home. Older children understand in another way and do not like the fact that they must stay at home more and cannot do things they are used to. We talked about and googled a lot in 2020 on Corona. (F2Aa)

When it comes to their work with the children, the preschool teachers point out the positive aspects of spending more time outside with the children. Some say that talking to the children about source criticism has become more important during the pandemic since there has been more misinformation in society at large. However, some preschool teachers talk about preschools being isolated during the pandemic.

F1e2 -We have felt isolated, not being able to meet anyone, no theatre, nothing. The children who were small when the pandemic started have lost quite a lot of what you usually do in preschool and that cannot be substituted by the digital. We have had digital theatre and it was exciting, but not really the same thing.

Teachers at the lower secondary level, who had to teach online for shorter periods of time, say that the quality of teaching has suffered, especially in practical subjects such as music and physical education. A primary-level teacher talks about the long-lasting effects that are noticeable in mathematics:

F4d1 – The method we use there (maths) means that we had to take a break since too many had lost out when being absent from the classroom. We repeated other things instead. But it left us behind and still in year 3, this was in year 1, but we can still feel that we are behind also because pupils have been at home for longer periods of time, and I have been off sick more than usual because I had to stay at home if I had any symptoms and that also slows done the process. So yes, it has affected us. (F4d)

Tests and assessments are aspects that several teachers in the later years talk about as problematic during the pandemic. They do not see online tests as reliable since their control is limited and it is easier for students to cheat. However, some teachers also mention that certain kinds of tests where students need to present something or discuss issues, for example in language subjects and mathematics, work better digitally than in the classroom.

Several teachers talk about changes in the dynamic of the classroom and how they affect both their teaching and them as teachers.

F6d1 – What you miss online is the spontaneity that you may have in the classroom. You get many more questions; it is much easier for the students to connect to something. It is a bigger step for them to ask a question in a digital classroom. And since you have another overview in a classroom, you can easier pick up on signs. You notice if a student has not really understood something in another way, I think. But the students have become better at handling this, no doubt about it, and many prefer to be at home, but it is obvious, at least in language education, that some teaching is needed in a classroom. (F6d)

Teachers in upper secondary and adult education express concern about long-lasting changes in how they teach, involving more online teaching. However, their concerns differ slightly. Upper secondary teachers show concern regarding the expectation to teach both in the classroom and online, while teachers in adult education are mainly concerned with their students choosing to study online without realizing how much time and discipline is needed to pass these courses. In the interviews, the teachers reflect on why students choose distance education and the implications for their teaching. Since many students are older and combine their studies with work and family life, it is not surprising that courses run at a distance are popular. Students who study at a distance with few or no synchronous lessons need to be motivated and structured in their studies to succeed. One teacher talks about a change in the student population, where previously mainly motivated students with quite a high level of knowledge chose courses at a distance. Nowadays, also students who are not as motivated and with less previous knowledge in the subject choose distant courses.

> F6a2 – And then we need to adapt our teachings so that we can also reach those students who are not so strong academically or have a high degree of self-discipline. That is a challenge for us now, to be able to work with all kinds of students. (F6a)

5 Discussion

The implications and broader meanings of how teachers experienced their work during the pandemic will here be discussed and related to the theoretical framework and previous studies. The discussion will also highlight how the analysis contributes to answering the research questions: What aspects become visible and important when analyzing what is expressed in the interviews as the breakdown of the infrastructures for teaching and learning? How can these aspects inform a "new normal" for education?

The theoretically driven themes highlight how the breakdown of the infrastructures for teaching and learning affected the teachers' work. What the teachers talk least about is the technological aspects of the infrastructures. Instead, they emphasize the social and pedagogical aspects thereby bringing oftentimes taken-for-granted aspects to the fore, such as being able to socially connect to students when being in the same room and having face-to-face discussions with larger groups of students. When it comes to the institutional aspects, emphasis is given to changes in communication with different stakeholders.

That the teachers did not talk extensively about technological aspects of the transition to ERT is probably because most teachers and students in Sweden are already used to working with digital tools and schools in general are well-equipped with technology. However, having to do some, or all, of their work online has positively influenced teachers' digital competence in general (cf. Beardsley et al., 2021). A few reluctant colleagues have been forced to start using technology in their work, and most teachers have become better at using tools like Zoom.

The teachers mainly talk about how the transition to ERT affected the other three aspects, institutional, social, and pedagogical. Institutional aspects concerned how meetings and professional development transformed into digital environments. The teachers paint a nuanced picture where they express both positive and negative aspects of having online meetings. Living and working through a pandemic has given them experience with online meetings and when and for what purpose they are preferable to meeting offline.

While the teachers could see both positive and negative aspects of having meetings online, they were more negative towards professional development online. Negative opinions connect to social aspects and differences in communicating online, often individually. These results differ slightly from what Olofsson et al. (2021) found in their study, conducted at the outbreak of the pandemic, where they saw collegial support as a positive aspect of teachers' work during the pandemic. The fact that the interviews in this article were conducted more than a year after the outbreak may be the reason for this difference. When the initial sense of coming together to cope with the situation wore off, the strain of social distancing and not being able to meet in the same physical room for a longer period of time took its toll. However, the teachers also talk about how certain practices have evolved during the pandemic. For example, in discussions in chat forums, teachers build on and expand the installed base when they learn how to communicate with colleagues and students online.

The teachers' experiences have given them an increased awareness of when and how the infrastructures work for them, and this has implications for the institution in which they work and how their work is organized in the future. On one hand, the teachers are more flexible with working online or offline, but on the other hand, they may protest changes in the organization if they see them as inappropriate based on their experience during the pandemic.

Social distancing during the pandemic has had a significant impact on the social aspects of living and working, so it is not surprising that all teachers talk about social aspects. However, the concerns about social aspects differ depending on the age of the teachers' students and are related to custodians when the teachers work with young children and to the students when they work with older students (cf. Trust and Whalen, 2021). This has implications for how infrastructures for learning and teaching need to be improved at different levels of the school system. There is a need for greater emphasis on infrastructures that also work for custodians of young children, and equity issues must be considered.

Equity issues also arise concerning older students, particularly those who have difficulty studying during ERT due to insufficient support from teachers and peers. Similar to Grönlund's study (2020), teachers are concerned with losing the social connection with their students when teaching online and feel that some students have been "lost" while the contact with other students has actually become better when they do not have to be in school. In addition, equity issues related to technology arise when teachers discuss how differences in students' home environments affect their ability to participate in ERT. Students were more dependent on a supportive home environment when studying from home, which affected some groups of students more than others (cf. Swedish National Agency for Education, 2022).

According to Swedish curricula (Swedish National Agency for Education, 2017, 2018), Swedish preschools and schools have a compensatory mission (*kompensatoriskt uppdrag*), which means that they are responsible for ensuring equitable education for all students, regardless of their preconditions. A study carried out in Finland highlights similar statements in the curricula, indicating that equity issues are a concern across borders (Niemi & Kousa, 2020). Equity issues generally point to inequalities in society, which here are highlighted concerning children and students' education. However, teachers found ways to overcome some of these issues by, for example, communicating with custodians through films and social media. Such innovative practices point to adjustments and flexibility needed in infrastructures for teaching and learning for all stakeholders in the new normal.

Pedagogical aspects are brought up by most teachers but there is a difference in focus related to the age of the students. In preschools, the pandemic has become part of the content when teachers have explored and learned about Covid-19 together with the children. Moreover, the boundaries of the preschool have been expanded when more activities were done outside, but also restricted since it was difficult to visit other parts of society. Taking the opportunity to engage in current issues which engage children and students could be a productive path for education in general. How infrastructures can support such emerging practices and engagement is an important aspect of the new normal.

Understanding how infrastructures for learning and teaching were affected by the pandemic highlights what needs to be strengthened to avoid breakdowns in the future. Implications to be drawn from this study in other contexts than the Swedish one is that it is not sufficient to assure access to technology. Social and pedagogical issues connected to teaching are just as important to attend to for the infrastructures of teaching and learning to be robust in times of change. In a previous study, Pettersson (2018) focused on institutional infrastructures, arguing that studies tend to focus on a single actor such as teachers or pupils. Teachers' work is embedded in structures that usually invisibly support tasks, but during the pandemic, transparent and taken-for-granted, aspects of their work came into focus. Teachers largely managed the breakdown by building on the installed base (Star & Ruhleder, 1996) and engaging in emerging and innovative practices to cope with ERT. The downside of this may be that teachers tend to continue using technology in ways that reinforce teacher-centered practices, rather than exploring what may be possible with technology in the particular situation they are in (Trust & Whalen, 2021).

Teachers have had to rethink their teaching methods during ERT. The breakdown of teaching methods and conventions of practice in connection to pedagogical issues has been noticeable, particularly in relation to maintaining the quality of teaching and ensuring accurate assessments, which teachers in primary and secondary schools have brought up as problematic. However, several teachers have adapted their practices so that assessment work in the new environment. It is important to incorporate these emerging and innovative assessment practices in infrastructures for learning and teaching as another aspect of the new normal. These aspects are relevant in other contexts and need to be attended to in the new normal for educational systems to be prepared for future possible disruptions.

In summary, analyzing the interview data with an infrastructural framework sheds light on the social, institutional and pedagogical aspects in particular, since they were accentuated by their absence. This is also evident in the research conducted by Stenliden et al. (2021), and Godhe and Wennås Brante (2022). Similar to Trust and Whalen's conclusion that "educators faced an uphill battle of trying to create equitable learning opportunities for all students in an inequitable society" (p. 19), the connection between the social aspects of infrastructures for teaching and learning and broader issues in society, concerning equity and inclusion, becomes apparent. Ogodo et al. (2021) note that it is in particular students and teachers in low socioeconomic contexts that face challenges related to access to technology and limited use. Social aspects highlight that resources are not equally distributed and that the general level of digital competence in the population is unequal. ERT has raised teachers' awareness of how online environments may be used fruitfully, or not, in the institutions they work. Their experiences of what needs to be strengthened to deliver good quality and equitable education in the future should be incorporated into the new normal for education.

Based on the findings of the infrastructure analysis, particular attention needs to be given to the social and pedagogical aspects of infrastructures in the new normal for education, to strengthen the infrastructures for teaching and learning and to improve both quality and equity. The interviews show that teachers are quite confident in dealing with technological aspects but find the often otherwise taken-for-granted, aspects relating to social and pedagogical issues more challenging. These aspects were also the most affected during the pandemic. In the new normal of education, attention needs to be given to the central role of social and pedagogical aspects, and how they can be dealt with if, or when, there is another breakdown of the infrastructures. Issues of equity and quality, and how they can be, at least, maintained in situations such as the pandemic, need to be given serious attention in the new normal. Trust and Whalen (2021) point to the fact that not only can teachers be ill-prepared for supporting technology-rich education, but so are students' family members as well as students themselves. Equity relates to broader societal aspects that do not concern only education but also other institutions in society, and how issues of equity are considered throughout society. The breakdown has destabilized several aspects of education but also lead to transitions and emerging new practices which has expanded the installed base. In the new normal, it is essential to incorporate these new practices into everyday schooling. Otherwise, practices may retreat to the old and familiar, thereby missing out on building on positive experiences from the pandemic and expanding the installed base of teachers' work. The analysis gives rise to new questions that need addressing in future research, concerning how to develop infrastructures for teaching and learning that work both online and offline, and that contribute to both quality and equity.

Declarations

References

Ahlström, B., Leo, U., Norqvist, L., & Isling, P. P. (2020). School leadership as (un) usual. Insights from principals in Sweden during a pandemic. *International studies in educational administration*, *48*(2), 35–41. ISEA-2020-48-2.pdf (cceam.net).

Axelsson, I. (2021). Schools do not need to close to reduce COVID-19 but other measures are advisable. *Acta Paediatrica*, *110*(8), 2296–2297. https://doi.org/10.1111/apa.15951.

Beardsley, M., Albó, L., Aragón, P., & Hernández-Leo, D. (2021). Emergency education effects on teacher abilities and motivation to use digital technologies. *British Journal of Educational Technology*, *52*(4), 1455–1477. https://doi.org/10.1111/bjet.13101.

Bergdahl, N., & Nouri, J. (2021). Covid-19 and crisis-prompted distance education in Sweden. *Technology Knowledge and Learning*, *26*(3), 443–459. https://doi.org/10.1007/s10758-020-09470-6.

Bozkurt, A., & Sharma, R. C. (2020). Emergency remote teaching in a time of global crisis due to Corona virus pandemic. *Asian Journal of Distance Education*, *15*(1), i–vi. https://doi.org/10.5281/zenodo.3778083.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa.

Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health, 11*(4), 589–597. https://doi.org/10.1080/2159676X.2019.1628806.

Braun, V., Clarke, V., Hayfield, N., & Terry, G. (2019). Thematic analysis. In P. Liamputtong (ed.), *Handbook of research methods in health social sciences*, (pp. 843–859). https://doi.org/10.1007/978-981-10-5251-4_103.

Brinkmann, S., & Kvale, S. (2009). *Interviews: Learning the craft of qualitative research interviewing*. Sage Publications.

Godhe, A. L., & Wennås Brante, E. (2022). Interacting with a screen–the deprivation of the 'teacher body' during the COVID-19 pandemic. *Teachers and Teaching*, 1–16. https://doi.org/10.1080/13540602.2022.2062732.

Godhe, A. L., Magnusson, P., & Sofkova Hashemi, S. (2020). Adequate Digital competence – exploring revisions in the swedish national curriculum. *Educare*, (2), 74–91. https://doi.org/10.24834/educare.2020.2.4.

Government decision I:1, Supplement to Government Decision. (2017). *Nationell digitaliseringsstrategi för skolväsendet [in English: National digitalisation strategy for the school system, supplement to Government decision I:1]. Dnr U2017/04119/S*. Stockholm: The Swedish Ministry of Education.

Grönlund, Å. (2020). Skolans fjärrundervisning under Coronapandemin 2020 – utmaningar, resultat och framtidsutsikter [in English: Distant teaching in schools during the Corona pandemic 2020 – challenges, results and implications for the future]. Retrieved 230617 from http://www.diva-portal.org/smash/get/diva2:1477034/FULLTEXT02.pdf.

Guribye, F. (2005). *Infrastructures for learning – Ethnographic inquiries into the social and technical conditions of education and training* [Doctoral thesis]. University of Bergen. https://core.ac.uk/reader/30895610.

Guribye, F. (2015). From artifacts to infrastructure in studies of Learning Practices. *Mind Culture and Activity*, *22*(2), 184–198. https://doi.org/10.1080/10749039.2015.1021358.

Guribye, F., & Lindström, B. (2009). Infrastructures for learning and networked tools – The introduction of a new tool in an inter-organisational network. In L. Dircknick-Holmfeldt, C. Jones, & B. Lindström (Eds.), *Analysing networked learning practices in higher education and continuing professional development* (p. 103–115). Sense Publishers. https://doi.org/10.1163/9789460910074_007.

Hanseth, O. (2000). The economics of Standards. In C. U. Ciborra, K. Braa, A. Cordella, B. Dahlbom, A. Failla, O. Hanseth, V. Hepso, J. Ljungberg, E. Monteiro, & K. A. Simon (Eds.), *From control to drift. The Dynamics of corporate information infrastructures* (pp. 56–70). Oxford University Press.

Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, M. A. (2020). The difference between emergency remote teaching and online learning. *EDUCAUSE Review*. https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning.

Igira, F., & Aanestad, M. (2009). Living with contradictions: Complementing activity theory with the notion of "Installed Base" to address the historical dimension of Transformation. *Mind Culture and Activity*, *16*(3), 209–233. https://doi.org/10.1080/10749030802546269.

Karasti, H., & Blomberg, J. (2018). Studying Infrastructuring Ethnographically. *Computer Supported Cooperative Work*, *27*, 233–265. https://doi.org/10.1007/s10606-017-9296-7.

Koschmann, T., Kelson, A. C., Feltovich, P. J., & Barrows, H. S. (1996). Computer-supported problem-based learning: A principled approach to the use of computers in collaborative learning. In T. Koschmann (Ed.), *CSCL: Theory and practice of an emerging paradigm* (pp. 83–124). Erlbaum.

Lave, J., & Wenger, E. (1992). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Monteiro, E., & Hanseth, O. (1996). Social shaping of information infrastructure: On being specific about the technology. In *Information technology and changes in organizational work: Proceedings of the IFIP WG8. 2 working conference on information technology and changes in organizational work*, December 1995 (pp. 325–343). Springer US. https://doi.org/10.1007/978-0-387-34872-8_20.

Niemi, H. M., & Kousa, P. (2020). A case study of students' and teachers' perception in a finnish high school during the COVID pandemic. *International Journal of Technology in Education and Science (IJTES)*, *4*(4), 352–369. https://doi.org/10.46328/ijtes.v4i4.167.

Ogodo, J. A., Simon, M., Morris, D., & Akubo, M. (2021). Examining K-12 Teachers' Digital Competency and Technology Self-Efficacy During COVID-19 Pandemic. *Journal of Higher Education Theory & Practice*, *21*(11). https://www.proquest.com/docview/2586553057?pq-origsite=gscholar&fromopenview=true

Olofsson, A. D., Lindberg, J. O., & Fransson, G. (2021). Swedish upper secondary school teachers' experiences with coping with emergency remote teaching (ERT) – emerging pedagogical issues in pandemic times. *Education in the North*, *28*(3), 85–99. https://doi.org/10.26203/v1s1-ty08.

Panisoara, I. O., Lazar, I., Panisoara, G., Chirca, R., & Ursu, A. S. (2020). Motivation and continuance intention towards online instruction among teachers during the COVID-19 pandemic: The mediating effect of burnout and technostress. *International Journal of Environmental Research and Public Health*, *17*(21), 8002. https://doi.org/10.3390/ijerph17218002.

Perifanou, M., Economides, A. A., & Tzafilkou, K. (2021). Teachers' Digital Skills Readiness during COVID-19 pandemic. *International Journal of Emerging Technologies in Learning (Online)*, *16*(8), 238. https://doi.org/10.3991/ijet.v16i08.21011.

Pettersson, F. (2018). On the issues of digital competence in educational contexts–a review of literature. *Education and Information Technologies, 23*(3), 1005–1021. https://doi.org/10.1007/s10639-017-9649-3.

Pramling Samuelsson, I., Wagner, J. T., & Eriksen Ødegaard, E. (2020). The coronavirus pandemic and lessons learned in preschools in Norway, Sweden and the United States: OMEP Policy forum. *International Journal of early childhood*, *52*(2), 129–144. https://doi.org/10.1007/s13158-020-00267-3.

Star, S. L., & Ruhleder, K. (1996). Steps towards an ecology of infrastructure: Design and access for large information spaces. *Information Systems Research*, *7*, 111–134. https://doi.org/10.1287/isre.7.1.111.

Stenliden, L., Martín Bylund, A., Landkvist, L., Ekström Lind, L., Kellgren Lundberg, S., Stenmark, H., & Wilhelmsson, C. (2021). Lärares (digitala) kompetens före, under och efter covid-19: Skärvor av förståelse från skolor i sverige. *Utbildning och Lärande/Education and Learning*, *15*(1), 9–28. https://doi.org/10.58714/ul.v15i1.11221.

Swedish National Agency for Education [Skolverket] (2017). *Swedish curriculum for the compulsory school, preschool classes, and recreation centers 2011, revised 2017.* https://www.skolverket.se/publikationer?id=3813.

Swedish National Agency for Education [Skolverket] (2018). *Swedish curriculum for preschool.* https://www.skolverket.se/publikationer?id=4001.

Swedish National Agency for Education [Skolverket] (2022). *Covid-19-pandemins konsekvenser för skolväsendet – slutredovisning* [In English: Consequences of the Covid-19 pandemic for the school system – final report]. https://www.skolverket.se/publikationer?id=10589.

Swedish school inspectorate [Skolinspektionen] (2021). *The consequences of remote teaching. A review of how remote teaching during the Covid-19 pandemic has affected students' chances of reaching set goals as well as their health.* https://skolinspektionen.se/the-consequences-of-remote-teaching-Swedish-schools-inspectorate-2021.pdf(skolinspektionen.se).

Trust, T., & Whalen, J. (2021). K-12 teachers' experiences and challenges with using technology for emergency remote teaching during the Covid-19 pandemic. *Italian Journal of Educational Technology*, *29*(2), 10–25. https://doi.org/10.17471/2499-4324/1192.

UNICEF. (2020). *Innocenti research brief. Promising practices for equitable remote learning. Emerging lessons from COVID-19 education responses in 127 countries.* Available: https://www.unicef-irc.org/publications/pdf/IRB%202020-10.pdf.