# Digitalization and Digital Competence in Educational Contexts

A Nordic Perspective from Policy to Practice

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## 13 Swedish teachers' digital competence – infrastructures for teaching and working

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## Introduction

This chapter analyzes interviews conducted with primary and lower secondary teachers from a municipality in southern Sweden to examine how they define digital competence (DC) in their work. It also investigates what is required, and at times missing, in the teachers' work environment to support their DC. The conceptualizations of infrastructures used to analyze teachers' digital competence in their work context are based on works by Star and Ruhleder (1996), and Guribye (2015). In Sweden, DC is a foundational concept in curricula and the national strategy for the digitalization of education (Government decision I:1, Supplement, 2017). When comparing how notions related to DC are conceptualized in Nordic curriculum, Godhe (2019) concluded that while the concepts used varied, all were influenced by the notion of *Bildung*, which emphasizes societal issues and a critical approach. Erstad et al. (2021) further expand on this analysis and state that DC has become a key term in curriculum development in the studied countries. Although the importance of teachers' DC is emphasized, there is a lack of consistency in how to develop it.

The first national strategy for digitalization in education ran from 2018 to 2022, and a proposal for a new strategy covering the period 2023–2027 is currently being reviewed by various stakeholders (Swedish National Agency for Education, 2022). The first national strategy aimed to achieve three goals in 2022: digital competence for all in the school system, equal access and use, and research and evaluation of the possibilities of digitalization (Government decision I:1, Supplement, 2017). The development of knowledge, improved student achievement, and equity is connected to digitalization in the overarching goal of the strategy and potential outcomes of a digitalized school system (Government decision I:1, Supplement, 2017, p. 4).

The first national strategy emphasized the changing nature of DC by referring to *adequate* digital competence (ADC), thereby highlighting that what DC entails will change with time. It is not possible to create a lasting definition of DC since the need for developing DC is related to societal changes and the needs of children and students (Government decision I:1, Supplement, 2017, pp. 6–7). The strategy also notes that revisions are needed in the curriculum to

clarify what DC entails at different levels of education. To strengthen students' DC, revisions were made to the national curriculum for compulsory schools in 2018 (Swedish National Agency for Education, 2018). A study on these revisions reveals a tendency to view the digitalization of education as a matter of implementing new digital tools at the operational level, while downplaying aspects such as critical awareness, risk-taking, and safety (Godhe et al., 2020). This leads to a narrow conceptualization of students' DC as mainly concerning operational aspects and the implementation and increased use of a tool.

In the proposal for a new national strategy, the concept of lifelong learning is used to describe the DC that children and students are expected to develop, rather than ADC (Swedish National Agency for Education, 2022). The descriptions of DC in the proposal largely paraphrase statements from the curriculum, suggesting that the revised curriculum is seen as providing sufficient clarification of DC. However, as Olofsson et al. (2020) have pointed out, it is reasonable to expect that teachers also need ADC, even though the term is not explicitly in relation to teachers. I argue that replacing ADC with lifelong learning does not clarify the DC teachers' need to support their students' development of DC. Such a clarification had been welcomed but since it has not been given, I will refer to teachers' DC in this chapter. In my understanding of teachers' DC, I include the changing nature of the concept as well as DC in relation to teaching and teachers' work. This chapter aims to illuminate how Swedish teachers' DC can be understood in relation to infrastructures for teaching and working that support teachers in a digitalized school system.

## Digital competence

DC is a complex and multidisciplinary concept (cf. Godhe, 2019; Erstad et al., 2021) that has diverse connotations in different educational contexts (Spante et al., 2018). Defining DC is demanding, partly due to rapid societal and technological changes. Several frameworks attempt to conceptualize and define DC for teachers, such as the European Framework for the Digital Competence of Educators (Redecker, 2017). However, these frameworks serve more as an instrument for measuring DC rather than investigating it. Krumsvik (2008, 2011) has developed a model for teachers' DC, in which it develops in relation to the practical handling of technical tools and teachers' awareness of how these tools affect their teaching. In a study by Olofsson et al. (2020), Swedish teachers' ADC is explored. They argue that teachers' ADC is "flexible in meaning, is determined by the local, contextual conditions, and is enacted in various activities, understandings, and decisions based on teachers' own framework of values" (p. 740) and conclude that teachers' ADC relates to technological and technological-pedagogical challenges, professional development, communication in a digital context, and digital administrative tasks.

In a review of research on the impact of professional development on teachers' DC, Fernández-Batanero et al. (2020) state that few studies relate to digital teaching competence and that pedagogical aspects need to be in focus

rather than technological. In another review, Pettersson (2018) writes about the sparseness of studies on organizational issues and strategic leadership in connection to the digitalization of education. Studies tend to focus on specific competencies needed by teachers, thereby overlooking contextual factors from a wider perspective. That the development of DC is an organizational question, both driven and affected by contextual factors, is a conclusion drawn by Pettersson. Similarly, Krumsvik (2011) points out that school leaders' and teachers' DC are complex since they are part of complex organizational systems and are affected by strong traditions. In their review of the conceptualization of teacher's professional digital competence (TPDC), Skantz-Åberg et al. (2022) conclude by highlighting that teachers' individual basic skills to handle digital tools need to be considered a collective responsibility accountable to school leaders and school systems.

To summarize, previous research has highlighted that teachers' DC is often narrowly defined as an individual responsibility, which fails to sufficiently address contextual, organizational, and collective aspects. In this chapter, such aspects are addressed by exploring under which circumstances organizational, social, technological, and pedagogical aspects of infrastructures support teachers' DC. By outlining what the interviewed teachers highlight as important in relation to the four aspects of infrastructure, which will be described in the next section, insight can be gained into how these infrastructures support teachers' DC.

## Theoretical framework

Star and Ruhleder (1996) conceptualized infrastructure as ecological and relational to organized practices, thereby considering the relational aspects among technological entities, the people who use them, and the context in which they are used. Examining infrastructures from this perspective shifts the focus to *when* they support practice and what is required for them to do so, rather than what infrastructures consist of.

According to Star and Ruhleder (1996), 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 even though it may appear differently for different users. To be able to participate in practice, it is important to learn and cope with infrastructures in that environment. Infrastructures are therefore an object to be learned to participate in practice. The notion of the installed base means that infrastructures are always built upon what already exists and evolve by extending and improving an installed base.

Star and Ruhleder's (1996) conceptualization of infrastructures has primarily been used in studies of information infrastructures and the implementation of technological devices, systems, or applications, as well as when designing such technologies. However, Guribye and Lindström (2009) extended Star and Ruhleder's concept of infrastructure when defining 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).

Moreover, Guribye (2015) notes that since the object of teaching practices relates to some sort of learning activity, a pedagogical approach is present even though it may not be explicit.

In this chapter, I analyze how teachers talk about what DC entails for them in their work using the three aspects outlined by Star and Ruhleder (1996) – institutional, technical, and social – as well as the pedagogical aspects pointed out by Guribye (2015). The way the teachers talk about their experience of working in a digitalized school system illuminates both what is lacking and what is needed for the infrastructure to support their work. Rather than determining what teachers' DC is, the analysis will shed light on what the teachers see as crucial to support the development of their DC in a digitalized school system.

## Methodology

As part of a larger research project on the digitalization of education and the meaning of DC in practice, interviews were conducted with 76 teachers working in preschools, primary schools, and secondary schools in the same municipality in Sweden during the autumn of 2021. The analysis in this chapter focuses on the answers given by teachers working in primary and lower secondary schools since they share the same curriculum. Six group interviews with 19 teachers were conducted with primary and lower secondary teachers at their respective schools. The focus of the group interviews was on the concept of DC and the teachers' opinions and views on the digitalization of education and teaching practices.

The schools where the teachers worked were selected for the larger research project based on their classification as advanced in their work with digitalization, as indicated by surveys conducted by the municipality. The classification was primarily based on self-reported questionnaires completed by teachers and school leaders – which teachers to interview and how many were decided by the school leadership (see Table 13.1).

The teachers were interviewed in small groups (two to four persons) by one researcher. The reason why teachers were interviewed in groups was that teachers could talk to and be inspired by each other during the interviews, and a larger number of teachers could be interviewed. The interviews were

*Table 13.1* Number of interviews, participants, and selection criteria for the interviews

|  | *Number of interviews* | *Number of interviewees* | *Selection Criteria* |
|---|---|---|---|
| Compulsory school 1 | 3 | 9 | One group for each age group of students (low, middle, high) |
| Compulsory school 2 | 3 | 10 | One representative from each age group of students (low, middle, high) |

semi-structured with broad and open questions, such as "How would you define digital competence?", inviting the teachers to share their thoughts and talk to each other about them. Recordings of the interviews have been transcribed, and answers from the teachers working at primary and lower secondary schools have been extracted from the larger dataset. The interviews, as well as the teachers, have been given codes to anonymize the material. In this chapter, the excerpts have been translated from Swedish and are not verbatim but have been adapted to increase readability.

A thematic analysis has been conducted on the relevant interview data, following the method outlined by Braun and Clarke (2006). In their article, Braun and Clarke (2006) proposed two distinct approaches for identifying patterns in thematic analysis: an inductive and a deductive approach. An inductive approach does not utilize pre-defined codes, but instead 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 meaning. The latent level starts with the identification of underlying ideas and assumptions and how they shape the data.

In this chapter, deductive coding with a semantic approach to the data was made using the four aspects of infrastructures outlined in the theoretical framework: institutional, social, technological, and pedagogical. The findings will be organized so that excerpts exemplify patterns in the data relating to each aspect. Following the descriptive presentation of the analysis, implications, and broader meanings will be outlined and discussed.

## Aspects of infrastructures for teaching and working

In this section, the analysis of data will be presented as four aspects of infrastructures for teaching and working. The analysis focuses on how infrastructures can support teachers' work and connect to both the work in the classroom and to teachers' work in a wider context, such as administrative chores, preparing for teaching, evaluation and assessment, collaboration with colleagues, and contacts with custodians. In the following section, the main findings for each aspect will be summarized, and conclusions will be drawn concerning the relation between ADC and the aspects of infrastructure.

### Institutional aspects

Institutional aspects concern the organization of teachers' work and how both the school they work in and other school authorities may affect the work context.

The teachers talk about the need to find a balance between teachers' autonomous decisions and organizational aspects, such as directions from leadership and authorities that frame and influence their work. A positive aspect of working in a digitalized organization, as expressed by the teachers, is the flexibility of being able to have meetings both online and in person. This facilitates cooperation with colleagues and communication with custodians and students. A negative aspect is that regulations like GDPR restrict the way teachers can act autonomously, such as when choosing which digital devices and applications to use.

F4c3:    we used tablets a lot but now they are just lying there because I find apps and went to the IT-pedagogue and asked if I can download them but we are not allowed to and that was even before this with GDPR.

The teacher in this excerpt explains why tablets are no longer used in her teaching practice and refers to the fact that this was also an issue before GDPR. The school's learning management system (LMS) is talked about as a hub in teachers' work but is also said to restrict the teachers' actions at times, especially concerning how to communicate with their students and when assessing students' work.

When it comes to their professional development, the teachers stress the importance of developing teaching practices together with colleagues. However, they recognize the dilemmas in organizing professional development aiming to develop teachers' DC since there are great differences amongst colleagues. Because of this, the way professional development is organized has been changed in one of the schools and is now more diversified and targeted toward smaller groups of teachers. At the other school, a digitalization group had been created, and the teachers in this group were responsible for organizing workshops for their colleagues, aiming to raise their DC.

The teachers regard it as problematic that developing students' DC in the current curricula is expressed as every teacher's and school leader's responsibility.

F3c2:    think that the problem is that we have devices, and we use teaching materials but we have no subject like computer science where you start with how you use Word and write in there.
F3c1:    yes something like that. I don't know if I liked computer science myself really but for it to really become equivalent and equal someone needs to have that responsibility.

The teachers express a need for an explicit structure that clarifies who is responsible for what, relating to both basic skills and ensuring students' progression in digital aspects across different subjects. This is relevant to issues of equity since students' prerequisites vary.

*Technological issues*

Technological issues were not prominent in the interviews. All in all, the teachers express that they possess the necessary technology and basic technological competence. However, they would like to further develop their didactic DC in relation to the subjects they teach and the specific student group they are working with.

The teachers point out that schools have diverse economic resources at their disposal, which creates inequality between schools. Whether the school leadership is interested in allocating resources to investments in technology is another aspect that may contribute to differences between schools.

The teachers talk about the challenge of keeping up to date with new devices, programs, learning resources, and applications. The constant evolution of "new digital things" is challenging since it makes it harder for teachers to choose what resources to use and to feel confident that the tools they use are beneficial for their students' development of knowledge.

When it comes to the network of technologies they are expected to use in their work, the teachers say that it is hard for them to understand, for example, how applications and the LMS they use are connected to each other. These issues relate to the wider technological infrastructure and how applications may be connected to and intertwined in an LMS. The municipality where these teachers work uses the cloud-based Google platform for teachers to interact with students. Most teachers also use Google Classrooms as a place to collect students' assignments and to gather resources for learning, such as presentations and links to teaching material.

F4c2:   Google classroom is like a hub when you work digitally. You notice that new applications often are connected to Classroom or other platforms, so digital competence is about knowing how to navigate them. Often, I think you have a sense of how things are connected and how they operate, and you have experience.

The teacher in this excerpt can see connections between the LMS and apps but, though s/he claims to have a sense of how things are connected, s/he does not appear to be sure how these connections work.

Most teachers talk about Google as supporting their everyday work with their students and few express any critical views of the LMS. However, there is a push from the municipality for teachers to become certified by Google and some teachers question why they should spend time and effort on learning about the LMS in ways that they do not see as beneficial to their teaching.

F4b3:   I am happy that I did it (*become certified*) in a way because I can support my colleagues in another way now, but it took a lot of time, and I did not really get that time but had to do it in my spare time which was negative. But I did learn a lot, absolutely. And I became more confident in all parts of the Google environment. I only use some parts, but I became aware of what is there.

The teacher in this excerpt expresses that the certification has helped when supporting colleagues but it has also meant spending time learning about applications that are not relevant to teaching and working with students.

### Social aspects

Social aspects of DC to a large extent concern broader issues such as the digitalization of societies, democratic issues, and students' use of technology in their spare time. For both the teachers and their students, the blurred boundaries between work and spare time are challenging. For the teachers, the challenge mainly concerns issues of always being available.

The teachers talk about how the custodians need to be able to assess and use digital tools and systems to communicate with the school and get relevant information.

F3a3:   We have a lot of difficulty in getting everyone (*custodians*) to go in and read in platforms, so it almost becomes excluding, discriminating since you need to know the language really well.

This teacher discusses the disadvantage of communication platforms for custodians, particularly for those who do not have Swedish as their first language.

While the teachers recognize the importance of connecting to the digitalization of society, they also find it challenging to discuss with students when digital devices can be helpful and when they may become a distraction. They emphasize the importance of students understanding their role in the digital world and how digitalization may affect democratic society. However, some teachers point out that students' ability to choose relevant and trustworthy information is often lacking, which affects the students' possibilities to reach the goals for different subjects in the curricula. Some teachers discuss the relationship between higher goal attainment and highlight the importance of teaching students how to use digital tools and programs.

In the following excerpt, the teachers discuss equity issues and their relation to their work as teachers.

F3a3:   we perhaps work in an area where I feel that our students mainly use different chat forums in different ways, they use Snapchat and Google Hangouts and that is perhaps a rather limited use. We really have quite a big democratic responsibility to connect digitalization to equity issues more than we do.

F3a1:   if you should relate to the curriculum and how that is structured, we should also make them ready for life, also outside of school and there is a big debate right now about many feeling alienated because they don't have access to things like digital ID, for example, older people. But if we have a generation who are not digitally competent more than in certain ways they may end up in another kind of alienation.

When the teachers here talk about equity in relation to digitalization, they paint a more nuanced picture than the one given in policy documents and can also see their own importance in preparing their students to become active citizens.

### Pedagogical aspects

Many of the teachers stress their use of several digital teaching resources as beneficial to their teaching since it enables them to create variation in their teaching and to adapt to their students' needs. They also consider variation important in relation to the issue of equity.

F4c1:   I had one pupil who had great difficulties writing texts with their fingers on the keyboard but when we sat and talked, he was able to tell me and then he could use the function on the computer to talk and the program could write. That is a big thing, and I could assess his ability to build a cohesive story. Yes, he can do that and then there is no need to write if that is an obstacle for him to show his knowledge. I think that is really positive.

The multiplicity of resources available online is often regarded as beneficial for most students, but essential for some. The teachers give examples of how students' understanding benefits from multimodal media resources such as films and podcasts. At the same time, some teachers emphasize the importance of written language for students' success in the school system and express concern about the extent to which the next generation is learning to read and write alphabetic texts.

F3a3:   It is also easy that it becomes negative, I think, and that was a problem when we had tablets at my last school because it was easy for the students to do completely different things during lessons. So sometimes I chose not to use digital resources at all and only used books so that nothing would distract the pupils. So, it is a bit double.

F3a4:   that the pupils should lose this bit with writing by hand, and we need to balance it somehow to be able to write on the computer and also by hand.

These excerpts reveal an ambivalence concerning the use of a multiplicity of ways of receiving information and expressing knowledge that is discernible in the teacher's answers. The teachers regard the variation in teaching as a positive outcome of the digitalization of their teaching. On the one hand, the teachers can see that the different resources give them increased possibilities of adjusting the teaching to students' needs. Moreover, they can see that being able to access information in different formats (films, speech, writing, images) is beneficial for students in many subjects. On the other hand, some teachers

are worried about the students not being able to express their knowledge in the mode that is most highly evaluated in an educational context, that is, in writing.

## Conclusion

In this last section of the chapter, the findings of the analysis of the infrastructures are first summarized (see Table 13.2) and then related to teachers' DC.

The main findings for each aspect can be seen on a continuum from an individual level to a structural level, where the individual level often connects to work in classrooms with students, that is, an infrastructure for teaching, and the structural level relates to work outside the classroom, that is, an infrastructure for working. For example, Finding H concerns the individual level and classroom practices, whereas Finding D concern the structural level and teachers' work outside the classroom. Some findings concern both the individual and the structural levels, such as Finding B.

The empirically grounded findings shed light on contextual factors that affect Swedish teachers' DC and contribute to an understanding of how they

*Table 13.2* Overview of findings related to each aspect of infrastructures for learning and working

| Aspect | Main findings |
| --- | --- |
| Institutional | A – Finding a balance between autonomy and directions from leadership and authorities. |
| | B – Professional development together with colleagues, examples of local initiatives to cater for differences amongst colleagues. |
| | C – Structure to clarify who is responsible for what in relation to students' DC, possibly a specific subject. |
| Technological | D – Diversity of technology at schools because of economic resources and local school leadership. |
| | E – Challenge to keep up with constant technological changes as well as understand how platforms connect and are intertwined. |
| | F – Certification in particular platforms are not always connected to teaching. |
| | G – Wider issues of DC in society connected to custodians' ability to assess and use digital systems to partake in their children's education. |
| | H – Teaching students how to use digital resources is essential, particularly the ability to critically evaluate searches and sources. |
| | I – Broader equity issues in society affect students' DC, education is important to narrow the gap. |
| | J – Digital resources facilitate variation in teaching and in adapting to students' needs. |
| | K – Using different digital resources is connected to equity since more students can participate in teaching and show their knowledge in diverse ways. |
| | L – Tension between seeing the benefits of using multimodal resources and concerns about students' ability to, for example, write by hand. |

relate to infrastructures for teaching and working, which previous research has been pointed out as lacking (Krumsvik, 2011; Pettersson, 2018; Olofsson et al., 2020; Fernández-Batanero et al., 2020). Furthermore, the analysis addresses the relationship between individual and collective responsibility (Skantz-Åberg et al., 2022). In their work, teachers use various digital tools and platforms, not only to carry out their teaching but also to communicate with students, colleagues, custodians, and authorities, and to complete administrative tasks as part of their work. Therefore, a network of platforms plays a significant role in the infrastructures for teaching and working in education today (Pangrazio et al., 2022).

The opportunities and challenges teachers face in developing DC are largely framed by the institutional prerequisites of their workplace. A prominent concern regarding technological aspects is the need to continuously develop DC so that teachers can use technology in teaching and understand the technology they use (cf. Pangrazio et al., 2022). However, the primary concern of teachers is not the technological aspects, but rather how organizational, social, and pedagogical factors need to be considered for infrastructures to support teachers' work and teaching. Notably, teachers attach great importance to equity issues related to DC, in relation to technological, social, and pedagogical aspects. Additionally, the influence of *Bildung* on DC is highlighted in teachers' discussions about how ADC connects to societal issues and the development of students' critical approach. A tension is discernible regarding pedagogical aspects, where the positive factors of DC, such as facilitating variations in teaching and how knowledge can be expressed, also raise concerns about what to prioritize to enable students to become active citizens.

## Implications

Overall, the analysis shows that teachers' DC in the Swedish educational system is linked to the increased complexities of infrastructures for teaching and working. The aspects that teachers express as important points toward what is needed for infrastructures to support teaching and working (Star & Ruhleder, 1996; Guribye, 2015). As stated in the introduction of this chapter, a new strategy for the digitalization of education in Sweden is currently under review. At this point in time, we do not know what the result of the review process will be. However, the term ADC has been replaced with *lifelong learning* to signal the ever-changing nature of DC for students, while little is said about what teachers' DC entails. Neglecting to address the complexity of teachers' DC may undermine the high expectations set forth in policy regarding the digitalization of education by failing to lead to higher goal attainment for students and resulting in increased inequity rather than equity.

This study is a small-scale study where 19 teachers have been interviewed, which is a limitation if aiming to generalize the findings. However, when comparing the answers of these 19 primary and lower secondary teachers to the larger dataset of 76 teachers working in other stages in the Swedish

educational system their answers are similar. To validate the findings, further studies on a broader population are needed. Future research into our understanding of teachers' DC is needed, and the analysis based on the four aspects of infrastructures could be a stepping stone in that direction, pointing out the continuum between individual and structural levels on the one hand, and teachers working practices in and out of classrooms, on the other.

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