Leading the digitalization in K–12 education at the municipality level

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ABSTRACT
This study aims to explore the practice for leading the expansion of the access to and application of digital technologies in K–12 education at the municipality level. Participant observations were used to collect the data in a network with three Swedish municipalities. The study drew on the theory of practice architecture as an analytical tool to understand the practice. The findings indicate that leadership in digitalizing K–12 education should involve collaboration and a comprehensive viewpoint that facilitates the expansion of access to and application of digital technologies and a mutual understanding of the challenges and opportunities digital technologies present in K–12 education. Understanding the significance of digital technologies in K–12 education holds great importance for how digital technologies are prioritized in schools. Further, the findings show how school organizers’ support of teachers and school leaders affects how digital technologies are expanded in K–12 education and how digital technologies are applied in teaching, affecting equality within schools and the quality of teaching. Therefore, school organizers’ digital competence is important.

Introduction
Digital technologies offer opportunities to deliver inclusive and high-quality education for all. These promises are emphasized in digitalization policies. Such policies prescribe school organizers as responsible for organizing digitalization of K–12 education. These policies often come from the government (Swedish Government, 2017) or transnational policy, such as the Organization for Economic Collaboration and Development (OECD, 2019). However, as highlighted by Reis-Andersson (2024), the realization of these policies hinges significantly on effective leadership at various levels within the education system. Therefore, school organizers are perceived as a driving force that allows ideas for these policy documents to be realized in schools. School organizers are responsible for ensuring that school leaders and teachers receive the required support and assistance to provide all students the education they are entitled to regardless of students’ individual needs or conditions.

Furthermore, Stoll and Kools (2017) underscore the necessity for schools to prepare students for an ever-evolving digital landscape, where emerging technologies shape future professions and societal functions. Amidst these imperatives, leadership for the digitalization of K–12 education may be challenging because school organizers lead the expansion of digital technologies in activities in which they are not involved.
Measuring the effects of digital technologies on students’ outcomes presents challenges, as the results may depend on various elements and influences. One reason for expanding digital technologies in education is to prepare students to gain experience using digital technologies from a lifelong-learning perspective (Jaldemark, 2021). Another reason is to increase equality within and among schools by giving schools opportunities to access and apply digital technologies in teaching, thereby enhancing teaching quality (Swedish Schools Inspectorate, 2023). Policy makers are urged to develop and implement policies that aim to promote digital equality in education (Gottschalk & Weise, 2023).

The expansion of digital technologies in K–12 education is nothing new. However, in the last few decades, it has played a central role in creating a society and preparing young people for an uncertain future regarding which new digital technologies will emerge (Stoll & Kools, 2017; Willermark, 2018). At the same time, the expansion of the access to and application of digital technologies in K–12 education creates changes in, for example, the schools’ systematic quality work, long-term work with prioritization and financing, sufficient organizational capacity, access to educational and technological support, and resources for professional development (Bottino, 2020; Cortellazzo et al., 2019; Lawrence & Tar, 2018). In the realm of education, digital technologies are acknowledged as pivotal tools that not only enhance teaching quality but also advance equity within and across schools. This recognition underscores a fundamental shift in the learning process (Reis-Andersson, 2024). Effective leadership in education necessitates the capability to strategize, oversee, and tackle the challenges posed by digital technologies.

Leadership is essential in digitalizing K–12 education (Håkansson Lindqvist & Pettersson, 2019; Uzorka & Olaniyan, 2023) and ‘important to describe and understand’ (Lund, 2022, p. 2). The expansion of the access to and application of digital technologies is often not apparent; technology is a secondary element and usually something that ‘individual staff could take a personal lead on if they so wished’ (Selwyn et al., 2018, p. 54). Haelermans (2017) pointed out that how digital technologies are implemented and used influences their effectiveness in learning situations, requiring priority and an attitude toward expanding digital technologies from leaders’ perspective. It is important for students to have access to digital technologies in schools, especially when they do not have access at home (Håkansson Lindqvist & Pettersson, 2019). Ifenthaler and Schweinbenz (2016) investigated tablet personal computers (TPCs) in schools and emphasized that ‘a better understanding of key factors influencing the acceptance of TPCs in the classroom might support a sustained and successful integration of this technology (p. 306). However, the application of digital technologies in K–12 education is challenging. Implementing digital technologies in teaching requires the right technology for the purpose and digital competence for teachers. The application of digital technologies may also necessitate changes in teaching methods, for which teachers may need time and digital competence. Teachers’ opportunities to apply the right digital technologies and digital competence are crucial for how digital technologies are applied in teaching practices, influencing students’ outcomes (Denoël et al., 2017). School organizers need to comprehend the key aspects that influence the acceptance of digital technologies in K–12 education. Also, teachers’ and leaders’ attitudes toward digital technologies are important, and the human factor’s role should not be underestimated (Haelermans, 2017; Sing Yun, 2023). Understanding how school organizers support school leaders in creating conditions for technology-enhanced learning is crucial for advancing innovative teaching and learning through the use of digital technologies (Håkansson Lindqvist, 2019). However, further research on leadership for expanding digital technologies in K–12 education is needed (Cortellazzo et al., 2019). This study aims to explore and contribute knowledge about leading the expansion of the access to and application of digital technologies in K–12 education at the municipality level. The following research questions are put forward:

- How can the practice for leading the expansion of the access to and application of digital technologies in K–12 education at the municipality level be described?
- What enables and constrains the practice for leading the expansion of the access to and application of digital technologies in K–12 education?

Understanding the dynamics of digital technologies in K–12 education is crucial in today’s rapidly changing society. The following chapter will explore the background of digitalization in K–12 education, with a particular focus on the role of school leadership in shaping digitalization in K–12 education.
Background

Digitalization creates changes in our society, and these changes require new skills that individuals should incorporate into their lives. Schools have an important mission in these changes, and effective school leadership is vital in guiding these changes. They must prepare students for the challenges digitalization brings. There is a potential to apply digital technologies in education if the choice of digital technology and application is right. However, digitalization is also about changing working methods and processes to increase teaching quality in schools. School leadership plays a pivotal role because such changes embrace that organizing digital technologies in K–12 education entails challenges. Among others, it requires infrastructures that involve organizational knowledge (Bottino, 2020). Learning organizations and digital technologies in schools are interconnected at various K–12 education levels, creating a need for network interaction (Cousin, 2019; de Mello & Ter-Minassian, 2020; Ottestad, 2008).

The effective utilization of digital technologies for pedagogical purposes in schools is closely linked to school leadership (Ottestad, 2008). School leadership is crucial for expanding access to and applying digital technologies in K–12 education (Dexter & Richardson, 2020; Håkansson Lindqvist & Pettersson, 2019; Harris et al., 2021). Open-mindedness and a desire to learn from others are important for successful school leadership (Leithwood et al., 2008, 2020), which is important to lead the digitalization in K–12 education.

School organizers have an important target in creating conditions for school leaders, teachers, and students to provide access to digital technologies and opportunities to use digital technologies in their practice (Gustafsson, 2021; Lindfors et al., 2021). Expanding access to digital technologies in K–12 education implies providing access to the right type of digital technologies based on every school’s needs and conditions, requiring digital competence. School organizers and school leaders should develop strategies for increasing teachers’ digital competence, thereby enhancing the quality of teaching (Pettersson, 2018). School organizers support school leaders’ practices in establishing favorable conditions for technology-enhanced learning plays a crucial role in enabling school leaders to effectively promote the expansion of access to and application of digital technologies in K–12 education (Håkansson Lindqvist, 2019). However, economical aspects enable and constrain what municipalities can do (Henning Loeb et al., 2019). For example, if a municipality has poor finances, it may be difficult to provide each student with a computer. Opportunities for teaching with the support of computers are constrained, and students’ learning in terms of digital technologies is hindered, reflecting a material–economic arrangement within a social space in the theory of practice architecture.

The expansion of digital technologies in K–12 education provides opportunities and challenges (AlAjmi, 2022; Salavati, 2016). One of the challenges is that it requires support in the act of leading and teaching (A’mar & Eleyan 2022; Willermark, 2018). In their work, the school organizer should help the school leaders lead the expansion of the application of digital technologies in K–12 education. A successful aspect of creating opportunities for access to and application of digital technologies in K–12 education is how leaders lead this process (A’mar & Eleyan 2022; Håkansson Lindqvist & Pettersson, 2019). Leadership is important in the organization of digital technologies in K–12 education (AlAjmi, 2022; Berkovich & Hassan, 2023; Håkansson Lindqvist, 2019) because many challenges in schools are related to digital technologies (Christopoulos & Sprangers, 2021; Masters, 2018). Leadership is crucial, but even the availability of time and other resources plays a crucial role in facilitating the change process. Theories of practice can make leadership practices more understandable. Actors and structures must be considered because they both contribute to practice in a mutually influential manner (Kemmis et al., 2014; Kemmis & Grootenboer, 2008). This contribution concerns arrangements in semantic, physical, and social spaces influence and are influenced by what happens in the practice (Kemmis et al., 2014) for leading the expansion of digital technologies in K–12 education.

Digitalization in K–12 education requires not only leadership; it also involves collaboration between school organizers and school leaders. The access to and application of digital technologies in K–12 education continues to increase, and it is the school leader’s responsibility to create conditions for teachers to remain up to date with the development (Håkansson Lindqvist, 2019). At the same time, the school organizers need to support the school leaders. Therefore, the expansion of digital technologies in K–12 education is connected to how digital technologies are prioritized by the school organizers. Moreover,
how school organizers lead digital technologies in K–12 education varies, and it impacts the results in practice. For example, some school organizers take a more proactive approach by directly engaging with the expansion of digital technologies, while others may opt for a more decentralized strategy, delegating responsibilities to digital technology coordinators. Reis-Andersson (2024) emphasized the significance of considering leadership dynamics, particularly in the context of municipality-level initiatives.

Digital technology coordinators are often centrally placed and belong to the strategic part of K–12 education. They can act as a link between school organizers and school leaders, advising the latter on fostering a culture that embraces digital technologies in K–12 education (Avidov-Ungar & Shamir-Inbal, 2017). These scholars pointed out that ‘there is a gap between the maturity of personal use of digital technology in daily life and the use of digital technology as a pedagogical tool at school’ (Avidov-Ungar & Shamir-Inbal, 2017, p. 171). However, ‘a successful digital technology coordinator must be independent and proactive, be able to offer current resources and plan and apply strategies for computer integration into teaching and learning’ (Avidov-Ungar & Shamir-Inbal, 2017, p. 172). In this paper, the digital technology coordinators are called IT strategists, which is the name used in the municipalities.

Bottino (2020) stated that the quality of the expansion of digital technologies in K–12 education is a problem. It is not just an issue of what digital technologies are used but also how digital technologies are applied in teaching practice. In effect, school organizers’ expansion of digital technologies in schools requires organizational and pedagogical change (Pettersson, 2021). Digital technologies, for instance, facilitate learning and communication at any moment in time and from any location, enabling collaboration across different times and locations (Grönlund et al., 2018). According to Glover et al. (2016), the focus should be on teaching practices to enhance learning methods with the help of digital technologies. Among others, the application and expansion of digital technologies in teaching require an organization that supports their application in daily practice (Agéli Genlott, 2020; Vanderlinde & van Braak, 2010). Moreover, it is also a complex process that requires strategic planning and a commitment to succeed (Hopkins, 2017). Another issue is that access to digital technologies in education and the reality that digital technologies are developing rapidly create a need to understand why a specific digital technology should be applied in teaching (Agéli Genlott, 2020). School organizer’s responsibility is to help school leaders support teachers and provide access to proper digital technologies and digital competence.

School organizers’ and school leaders’ ability to lead digitalization in K–12 education and offer appropriate support structures, technological and pedagogical, and proper infrastructure is crucial. This ability is essential for successfully expanding access to and application of digital technologies in K–12 education (Fransson et al., 2018). School organizers are responsible for giving school leaders sufficient support for digitalization. Schools that successfully expand the access to and application of digital technologies in education are usually better at handling change. This ability is defined as school organizing competence (Larsson & Löwstedt, 2020). However, digitalization in K–12 education demands courage and requires school organizers and leaders’ engagement. Digital technologies in education have not been applied systematically in most schools, and only a few can be characterized as learning organizations with a collective dedication to digital technologies in education (Lim et al., 2013; Sackstein et al., 2023; Tondeur et al., 2017).

It is the school organizers’ responsibility to create the right conditions for schools through dialogue and by understanding the school’s needs and prerequisites, distributing resources, and following up on the schools’ development. The practice of leading involves orchestrating terms and conditions influencing other practices. Three important keys to embedding technological innovation into teaching are presented (Conrads et al., 2017). Two of these keys are teachers’ confidence in applying digital technologies in an educational context that is meaningful and aligned with pedagogical principles and teachers’ eagerness to embrace innovation by leveraging the technologies. The third essential key is strong leaders in education, such as school organizers, who are responsible for creating the necessary conditions in schools, facilitating the optimal growth and development of the first two keys (Conrads et al., 2017). How digital technologies are expanded in K–12 education influences how teachers apply digital technologies in teaching.
**Methodology**

This study intends to contribute knowledge about digitalization in K–12 education regarding, for example, opportunities, challenges, and changes digital technologies bring and what enables and constrains the expansion of the access to and application of digital technologies in schools.

**Research design**

For this study, a qualitative research approach was employed to facilitate the extraction of meaningful insights from the data (Cohen et al., 2017). Qualitative methods were chosen for their suitability in exploring complex phenomena within real-world contexts, such as the integration of digital technologies in educational settings. This methodological choice enables a deep understanding of the nuances and complexities of digitalization in K–12 education.

**Research settings**

The research was conducted within a network comprising three municipalities, denoted Municipalities A, B, and C. This network served as a catalyst for these municipalities to expand digital technologies in their schools, facilitating knowledge exchange and ideas. This enabled the municipalities to overcome similar challenges and grasp opportunities to develop digitalization in K–12 education. The network constitutes the practice for leading the access to and application of digital technologies in K–12 education. This practice is founded at the municipality level, with collaborative efforts among school organizers aimed at expanding digital technologies in K–12 education.

The network is a purposive practice (Ifenthaler & Schweinbenz, 2016) where the practice is used as an analytical tool, and the purposive approach united the three municipalities around discussions on leading the expansion of digital technologies in K–12 education. This methodology is important because it allows discussions on digital technologies provided to those who will apply them, which is important for the final adoption of these digital technologies (Rogers, 2003). The theory used to analyze the collected data in this paper was the theory of practice architecture (Kemmis et al., 2014).

**Research participants**

The participants in this study comprised representatives from the three municipalities in the network, including school organizers, school managers, IT strategists, and school leaders. These representatives engaged in discussions regarding what municipalities have been doing, are doing, and what they play to do regarding expanding the access to and application of digital technologies in their schools, as well as the challenges and opportunities associated with this. Approximately 12 individuals participated in each meeting, with varying representation from each municipality. The discussions’ statements have been attributed to Municipalities A, B, and C. Table 1 illustrates the distinctions among the three municipalities.

**Data collection**

Data were collected through participant observation during meetings where discussions on leading the expansion of digital technologies in K–12 education took place. Participant observation (Cohen et al.,...
2017) was chosen to provide in-depth insights into the dynamics of the meetings and the decision-making processes surrounding digital technology initiatives. Furthermore, participant observation ensured the collection of sufficient data by allowing the researcher to observe events as they naturally unfolded when these municipalities discussed their digitalization initiatives, challenges, and opportunities. Researchers can take on various types of roles in observations, actively engaging in note-taking and careful description (Bryman, 2016). This approach to collecting data calls for a participant as an observer and emphasizes that the researcher is ‘part of the social life of participants, documenting and recording what is happening for research purposes’ (Cohen et al., 2017, p. 552). In this research, the researcher acted as a member of the group, and the other participants were aware of the researcher’s presence. Nine participant observations were conducted between November 2018 and February 2022 and lasted about 3 hours each. Due to the pandemic, six of the meetings were conducted via video conferencing, ensuring continuity in data collection while prioritizing participant safety and accessibility. In total, 339 pages of transcriptions, meeting protocols, and notes were collected.

**Data analysis**

The collected data were analyzed using the theory of practice architecture (Kemmis et al., 2014). This theoretical framework facilitated an examination of the practice involved in leading the expansion of digital technologies in education at the municipality level. The analysis focused on identifying cultural-discursive, material-economic, and social-political arrangements influencing digitalization in K–12 education.

**The theory of practice architecture as an analytical tool**

The theory of practice architecture (Kemmis et al., 2014) was used to examine the practice for leading the expansion of the access to and application of K–12 education at the municipality level. This theory permitted asking what happens in the practice and considering the arrangements that shape the practice. A practice is defined as a set of sayings, doings, and relatings that hang together in a project or aim and can only be separated in analysis (Kemmis et al., 2014). The project of a practice is encapsulated by individuals’ responses to the question, ‘What are you doing?’ (Kemmis et al., 2014, p. 31). In this study, the project is leading the expansion of the access to and application of digital technologies in K–12 education, as illustrated in Figure 1.

Figure 1 shows that the sayings, doings, and relatings in practice architecture have three dimensions: cultural–discursive arrangements in the semantic space, material–economic arrangements in the physical space, and social–political arrangements in the social space. The cultural–discursive arrangements concern language, ideas, and reflections. An example of this is how school organizers discuss digitalization in K–12 education, reflecting their attitudes toward digital technologies in teaching. The material–economic arrangements are, for example, artifacts of digital technologies and digital competence. Finally, the social–political arrangements concern rules, roles in the organization, and steering documents such as the curriculum and the digitalization policy. By analyzing the practice and the arrangements in the dimensions, knowledge about what happens in the practice for leading the expansion of the access to and application of digital technologies in municipality schools and what enables and constrains digitalization in K–12 education from a leadership perspective has been gathered. For example, financing may enable access to and application of digital technologies in teaching, but the lack of financing may constrain the opportunity to purchase digital technology or participate in continuing education.

**Procedure of analysis**

The processing of qualitative data analysis means that the data are organized into categories that are later brought together in various themes or connections between the categories (Cohen et al., 2017), which was the first phase after the data transcription. The theory of practice architecture was used analytically to interpret data. First, the school organizers’ sayings, doings, and relatings have been analyzed. Focusing was on leading the expansion of the access to and application of digital technologies in K–12 education at the municipality level. Second, cultural–discursive, material–economic, and social–political
arrangements that enable or constrain digitalization in K–12 education in the semantic, physical, and social spaces have been analyzed.

**Findings**

This section presents the findings of this study, focusing on the analysis of the sayings, doings, and relatings that compose the practice for leading the expansion of the access to and application of digital technologies in K–12 education at the municipality level. It examines both the elements identified within the practice and those that enable and constrain it.

**Practice for leading the expansion of digital technologies in K–12 education**

In the practice for leading the expansion of digital technologies in K–12 education, four elements have been identified though sayings, doings, and relatings. These elements are collaboration, digital competence, infrastructure, and leadership.

**Collaboration in practice**

The discourse surrounding the expansion of digital technologies in K–12 education emphasizes the necessity of a strong relationship, open dialogue, and collaboration between the strategic and operational levels in K–12 education as well as the IT department: ‘We have to collaborate with the IT department and involve them in the process [the digitalization process in municipality schools]’ (C, September 3, 2021). Collaboration in the educational system concerning digitalization issues is lacking: ‘There is no structure made for how we should collaborate on digital technologies with other municipalities. Generally speaking, Swedish schools have more exchanges with other schools in Europe than IT exchanges within Sweden’ (A, February 17, 2021). This lack might be attributed to Sweden’s considerable resources, yet the entire educational system stands to benefit considerably through enhanced collaboration.

Collaboration is manifested through the dissemination of ideas, experiences, and good examples among leaders and teachers in K–12 education. This occurs through networks among schools and municipalities, as well as workshops and collegial learning. Collaboration is a way to share ideas, experiences, and good examples. It is a means to develop professionally: ‘To have someone who can work with the collegial learning on the school’ (A, December 7, 2020). Collegial learning is a way of working with digitalization collaboratively: ‘You actually create the knowledge in your school based on what happens there and then; that is what has proven to be the most effective’ (B, February 17, 2021). Another reason for collegial learning is that it ‘is also the cheapest solution’ (B, February 17, 2021). Collaboration
in K–12 education also becomes visible in the action of mapping the municipality schools’ needs for digital technologies and digital competence between school leaders and teachers.

The understanding of the effects of digital technologies in K–12 education, particularly in relation to digitalization efforts, is linked to the expansion of the access to and application of digital technologies in K–12 education. Understanding this impact is related to digital competence, making it possible for leaders to understand the opportunities and challenges technologies bring to teaching. For example, in municipality schools, teachers who are enthusiasts of digital technologies in teaching are an engine for the digitalization of education, and they should be involved in the expansion of digital technologies in schools. This emphasizes the significance of strategically placing digital technology knowledge where it is most needed. The relation of IT strategists who work centrally and support school leaders and teachers indicates collaboration in expanding access to and application of digital technologies in K–12 education. Collaboration is emphasized in decision-making processes, where data regarding the infrastructure available in schools and each school’s specific needs are considered. This collaborative approach ensures that decisions are made with input from school leaders and teachers.

**Digital competence in practice**

The importance of increasing digital competence among teachers has been a topic for discussion. Teachers’ digital competence is crucial for effectively integrating digital technologies into daily teaching practices. However, teachers need time to enhance their digital competence and effectively integrate digital technologies into their daily practice, thereby enhancing the quality of teaching, which has been described as an essential prerequisite: ‘Digital technologies add quality in teaching if they are used correctly’ (A, September 3, 2021).

The action for increasing digital competence in schools is concretized with a checklist so teachers know what school leaders expect concerning applying digital technologies in teaching. A checklist clarifies the lowest level of digital competence for a teacher and shows what ‘every teacher should know’ (A, December 7, 2020) and what ‘every teacher should be able to do’ (C, April 28, 2021). Digital technologies in schools are a means to increase the quality of K–12 education. A survey conducted by Municipality A showed that teachers’ digital competence is lacking. Students used tablets as a means to pass the time, and the parents asked why the application of digital technologies in schools was necessary. After the survey, Municipality A made two decisions; they decided first, together with school leaders and teachers, to purchase a digital technology that teachers would apply in teaching. The chosen digital technology was purchased centrally. The decision was based on the teachers’ statement:

> At big conferences, we have attended many fantastic workshops and learned how some software functions. However, when we were back in our schools, we received so much input that it became difficult to sort through it all, and as a result, there was nothing instead. (A, September 3, 2021)

The second decision was made based on the need for digital competence. Two workshops that teachers must attend were created. In the first workshop, all teachers would try applying the purchased digital tool: ‘Everyone was forced—sounds awful—but you had to try the technology. You could not lean against a colleague and simply observe. Everyone was going to make tryouts’ (A, September 3, 2021). After the first workshop, teachers tested the technology in their teaching. By testing the tool in the workshop and teaching, ‘we got rid of a little bit of this fear that many teachers had; it is a kind of step over this wall that they had built’ (A, September 3, 2021). In the second workshop, teachers shared their experiences with applying the tool in teaching.

There is a relationship between teachers’ digital competence and their ability to effectively apply digital technologies in teaching, requiring time. Neglecting to allocate adequate time can lead to a decrease in educational quality rather than the intended improvement. Enhancing teachers’ digital competence is crucial for successful digitalization efforts in K–12 education. Furthermore, leaders’ understanding of the effects of digital technologies is linked to the expansion of access to and application of these technologies in schools. This understanding is closely related to digital competence as it enables the comprehension of the opportunities and challenges associated with technology integration in teaching.
Infrastructure of digital technologies in practice

The discourse concerning the infrastructure of digital technologies in K–12 education revolved around analysis, support, and leadership. The need to map the infrastructure for digital technologies in municipality schools has been described as a first step for the expansion of digital technologies in K–12 education. Even a view of other municipalities’ digitalization processes has been described as significant for knowing how other municipalities are doing and what lessons can be learned from them: ‘With them [the IT strategists], we also could get information about how other municipalities had organized digital technologies in their schools and learned from their successes and failures’ (C, December 7, 2020). Leading the expansion of the access to and application of digital technologies in K–12 education requires leadership: ‘School leaders are also chiefs, which requires leadership skills’ (B, February 17, 2021).

The action of mapping the municipality schools’ need for digital technologies and digital competence took the form of diverse analyzes, such as needs analysis, situation analysis, and surveys, from preschool to upper secondary school. The aim was to map digital technologies in municipality schools: ‘We started with looking at what resources we had in schools’ (C, December 7, 2020). Based on the information about the municipality schools’ needs and conditions concerning access to digital technologies and digital competence, a strategy was made: ‘We needed to do a clear strategy for implementing digital technologies in the schools’ (C, December 7, 2020). Based on the strategy, choices were made regarding the procurement of, for example, Chromebooks, tablets, systems, digital books, and digital competence.

Another way to share ideas, experiences, and good examples is to provide opportunities to participate in continuing education and workshops. Sharing knowledge and experiences has been important for the expansion of digital technologies in municipality schools: ‘We have saved time and energy by avoiding common pitfalls’ (C, February 17, 2021). However: ‘Collaborations of this type of question [digitalization] and in this level [municipality] are very few’ (A, February 17, 2021).

The IT strategists worked centrally, supporting school organizers, school leaders, and teachers: ‘They have both technological and pedagogical competence’ (C, February 21, 2022), linking the strategic and operational levels in K–12 education. When making decisions, the data regarding the infrastructure available in schools for access to and application of digital technologies, as well as each school’s specific needs and conditions, was considered.

The expansion of access to and application of digital technologies in K–12 education is one of many processes in digitalization. These technologies should be integrated into the administrative and pedagogical aspects of the schools, as they are not merely side projects: ‘It is not a side project, the technologies should be integrated with the pedagogical work’ (C, April 28, 2021). A way to integrate digital technologies into the various parts of K–12 education is by increasing digital competence within those schools: ‘We have a competence strategy that is revised every year, and it addresses some focus areas’ (A, February 17, 2021). With the implementation of the digitalization and digital competence strategy, a suitable prerequisite for expanding access to and application of digital technologies has been established. Integrating digital technologies in the activities of K–12 education, which influences the infrastructure and requires digital competence, is important.

The relationship between teaching and the opportunities presented by digital technologies in teaching practices is evident. Digital technologies made it easier for teachers and students to work simultaneously on the same document. However, teachers may require adjustments in their working methods, underscoring the significance of allocating time to do it. Failing to allocate ample time can result in decreased educational quality rather than its intended enhancement. The action of mapping the municipality schools’ needs was related to the need to understand how many digital technologies the schools had as well as what digital competence in schools and the infrastructure of digital technologies looked like as a starting point for the expansion of the access to and application of digital technologies in K–12 education.

Leadership in practice

Leadership has been identified as a prerequisite for engaging with the opportunities and challenges of digitalization in K–12 education. For instance, enhancing collaboration is crucial for the successful
integration of digital technologies in K–12 education. Additionally, it is important to understand that ‘digitalization takes time’ (C, April 28, 2021). Furthermore, well-founded knowledge is necessary when systems are to be procured: ‘We need to be careful and acquire good order skills’ (C, February 21, 2022), when decisions need to be made. Teachers’ digital competence is connected to how teachers may apply digital technologies in teaching, which constitutes a leadership issue. Moreover, it is associated with the amount of time teachers have to increase their digital competence and enhance their teaching methods. The checklist serves as a guiding instrument for leading digitalization efforts in education by concretizing the action for enhancing digital competence in schools. It provides teachers with clear expectations from school leaders regarding the application of digital technologies in teaching.

An action for enhancing leadership and increasing digital competence is the Swedish National Agency for Education’s continuing education module, Lead Digitalization. The module has been used to increase school leaders’ digital competence: ‘We carry out that all [school leaders] are going through Lead Digitalization now’ (C, December 7, 2020). ‘Everyone has been involved, including the school managers, in their own group’ (C, April 28, 2021). However, Lead Digitalization content must be adapted to the schools’ needs, and the right time to continue education must be chosen. This initiative by the Swedish National Agency for Education should be adapted for each school, and the timing of implementation needs to be chosen appropriately.

The relation between collaboration and leadership needs to be considered. Collaboration plays an important role in leadership and expanding the access to and application of digital technologies in K–12 education requires leadership: ‘A leadership that may not really have all the understanding of the parts that digitalization brings with it can mean that the equality is neither improved nor achieved’ (B, February 17, 2021). There is also a connection between leadership and equality within and among schools: ‘If a leadership may not really have all the understanding of the parts that digital technologies bring, it may mean that we will not achieve equality or not even improve equality’ (B, February 17, 2021).

The significance lies in the importance of municipality schools, both within and among them, sharing ideas, experiences, and examples of effective teaching supported by digital technologies. It implies the importance of knowledge of digital technologies in the right place. The staff’s knowledge and the organization’s needs must be better matched. For example, place the staff where their knowledge can best be used.

Table 2 summarizes the elements that constitute the practice for leading the expansion of digital technologies in K–12 education at the municipality level.

Table 2 provides a summary of the practice descriptions for leading the expansion of the access to and application of digital technologies in K–12 education. These descriptions are organized thematically, encompassing the sayings, doings, and relatings.

**Arrangements in three spaces**

The arrangements in the practice for leading the expansion of digital technologies in schools have been identified, increasing our understanding of how the practice is conducted at the site and what enables and constrains this practice in the semantic, physical, and social spaces.

**The semantic space**

In the semantic space, the attitudes of teachers and school leaders toward digital technologies in teaching play a crucial role in encouraging students to utilize digital technologies effectively. These attitudes can serve as either enable or constrain to students’ engagement. Moreover, the attitudes of teachers and school leaders are interconnected with the perspectives of school organizers regarding the digitalization of K–12 education. Notably, Municipality B emphasizes the importance of widespread comprehension of digital technologies in people’s lives, suggesting that such understanding can foster advancements in digitalization (B, April 28, 2021). However, practitioners have highlighted potential constraints on opportunities for school leaders and teachers to share effective teaching examples supported by digital technologies, mentioning that ‘It is a bit tricky in connection with GDPR [General Data Protection Regulation] because then you have to think about what I can and cannot share’ (A,
December 7, 2020). The attitudes of school organizers and school leaders significantly shape the support and priorities of K–12 education, influencing the accessibility and application of digital technologies in education settings. Additionally, time and energy constraints might limit the adoption of new digital practices: ‘You do not have time or the energy to go to do anything more than the work you have to do’ (B, April 28, 2021). Furthermore, initiatives aimed at enhancing digital competence often incur additional expenses, such as hiring substitute teachers during staff training, which can be challenging for schools with limited budgets: ‘I also have to hire a substitute teacher’ (A, February 17, 2021).

**The physical space**

In terms of the physical space, the presence of functional infrastructure emerges as a critical element for accessing and applying digital technologies in municipality schools. Teachers’ concerns regarding the reliability of digital technology and the availability of timely support often prompt them to include analog backups in their lesson planning, reflecting a sense of uncertainty. Moreover, the availability of financing opportunities within municipalities can significantly influence opportunities in schools. A municipality’s financing opportunities can also enable or constrain the expansion of digital technologies in municipality schools. While essential resources such as hardware, software, a stable internet connection, support to schools, and digital competence are costly, it is worth noting that ‘even time is money’ (A, February 17, 2021). However: ‘There has not been money set aside for the digitalization process in the budget’ (A, September 3, 2021). Furthermore, municipality schools face specific constraints when applying digital technologies in teaching practices. For instance, certain devices like Chromebooks may not be suitable for all courses, such as technology courses. Issues with printing, calendar usage, and the need for adapted programs for children with special needs also pose challenges. Additionally, legal restrictions regarding the saving of recorded videos and taking photos further complicate the integration of digital technologies.

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**Table 2. Leading the expansion of digital technologies in K–12 education.**

<table>
<thead>
<tr>
<th>Sayings</th>
<th>Doings</th>
<th>Relatings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Collaboration</strong></td>
<td>Have a strong relationship, open dialogue, and collaboration with the IT department and the educational system</td>
<td>Networks, workshops, collegial learning, collaborations, spreading ideas and experiences.</td>
</tr>
<tr>
<td><strong>Digital competence</strong></td>
<td>Time allocation for enhancing digital competence, digital competence, and integration of digital technologies into administration and pedagogy.</td>
<td>Continuing education for school leaders and teachers; collegial learning and sharing knowledge; addressing digital competence through workshops, testing, and application of digital technologies in teaching.</td>
</tr>
<tr>
<td><strong>Infrastructure of digital technologies</strong></td>
<td>Infrastructure mapping, integration of digital technologies into administration/pedagogy, spreading ideas and experiences, knowledge placement, and utilization.</td>
<td>Needs analysis and mapping, planning for digital technologies, and digital competence.</td>
</tr>
<tr>
<td><strong>Leadership</strong></td>
<td>Leading digital technologies requires leadership, knowledge placement and utilization, and a checklist for digital competence.</td>
<td>Continuing education for school leaders—Lead digitalization.</td>
</tr>
</tbody>
</table>
The social space

Changes in organizational structures emerge as significant arrangements affecting the expansion of digital technologies in K–12 education. For instance, transitions in leadership roles within schools, such as when school organizers and school leaders change positions, can potentially constrain the progress of digitalization initiatives. While IT support was initially provided at the school level, it has now been centralized under the municipality’s IT department, which oversees major digitalization issues, such as system procurement for the entire municipality. Despite this centralization, municipalities pointed out the importance of maintaining a strong relationship with the IT department to support school leaders and teachers in integrating digital technologies into their daily practices. Collaboration with the IT department is deemed essential for effective digitalization efforts: ‘To work closely with them [the IT department]’ (C, December 7, 2020) and reinforce a strong relationship with the IT department.

Table 3 provides an overview of the arrangements in semantic, physical, and social space that surround the practice for leading the expansion of the access to and application of digital technologies in municipality schools. These arrangements maintain, enable, or constrain the practice.

Discussion

The discussion is organized around the research questions posed at the beginning of the study, offering a structured framework for the exploration and interpretation of the findings.

**How can the practice for leading the expansion of the access to and application of digital technologies in K–12 education at the municipality level be described?**

This question yielded information about the practice for leading the expansion of digital technologies in K–12 education. Time emerges as a crucial element, echoing Lindfors et al. (2021) emphasis on the time-related aspect of digitalization. Both school organizers and school leaders need time to conduct analyses to understand the school’s needs and conditions concerning applying digital technologies in teaching. Similarly, teachers need time to acquire digital competence and change their working methods in their daily practice. Digital technologies have streamlined the process, allowing teachers and students to work collaboratively on the same document simultaneously with greater ease, which is in line with Grönlund et al. (2018). The relationship between teachers’ digital competence and their access to and application of digital technologies aligns with the claim that digital competence increases the quality of teaching (A’mar & Eleyan 2022; Larsson & Löwstedt, 2020; Pettersson, 2018).

Furthermore, the findings suggest that digitalization in K–12 education is part of a broader organizational transformation within municipality schools. Digitalization strategies serve to redefine attitudes toward digital technologies among school leaders and teachers, aligning with Pettersson’s (2018) insights into the transformative potential of digital initiatives in education. Effective teaching practices, bolstered by positive attitudes toward digital technologies, are instrumental in driving improved learning

<table>
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<th>Table 3. Enabling or constraining in three spaces.</th>
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<tbody>
<tr>
<td><strong>Space</strong></td>
</tr>
<tr>
<td>Semantic</td>
</tr>
<tr>
<td>Physical</td>
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<tr>
<td>Social</td>
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outcomes (Glover et al., 2016). However, the successful integration of digital technologies goes beyond mere access, emphasizing the need for thoughtful application in teaching, as noted by Bottino (2020).

In line with Pettersson (2021), the study underscores the pivotal role of digital competence as a leadership skill for school organizers and school leaders spearheading digitalization efforts. Understanding the key aspects that influence the acceptance of digital technologies in education is crucial, as highlighted by Ifenthaler and Schweinbenz (2016), which requires digital competence. The school organizers responded to this need by hiring IT strategists to address digitalization issues at the municipality level. This approach to leadership aligns with the traits that a leader should possess. In addition to digital competence, leadership encompasses building infrastructures for digital technologies, listening to the school leaders and teachers, and collaborating and communicating openly with the operative level of the chain of command (Dexter & Richardson, 2020; Fullan, 2007; Harris et al., 2021; Stoll & Kools, 2017).

To increase digital competence, school organizers and school leaders participated in the Swedish National Agency for Education’s Lead Digitalization. They also collaborated with each other, sharing experiences and effective examples, which Cousin (2019), de Mello and Ter-Minassian (2020), and Ottestad (2008) elevated. Sharing experiences and effective examples should permeate all parts of K–12 education. Collaborative learning emerges as an element for enhancing digital competence. To give teachers opportunities to share ideas, experiences, and examples of effective teaching with digital technologies, the school organizers and school leaders organized space for collegial learning, continuing education, and workshops. It is also necessary to build an infrastructure (Bottino, 2020) that enables teachers’ access to digital technologies and competence to apply them in teaching and change their working methods if needed.

The practitioners emphasized the importance of matching knowledge and the organization’s needs, placing the staff’s knowledge where it can be best utilized. It is about leading a learning organization (Lim et al., 2013; Reis-Andersson, 2024) with a lifelong learning perspective (Jaldemark, 2021). However, both the act of leading and teaching are challenging (A’mar & Eleyan, 2022; Willermark, 2018).

What enables and constrains the practice for leading the expansion of the access to and application of digital technologies in K–12 education?

The question revealed what enables and constrains the practice for leading the expansion of the access to and application of digital technologies in K–12 education in the semantic, physical, and social space. Many conditions enable and constrain the digitalization process. Some of them are presented in this paper.

In the semantic space, attitudes toward digital technologies in K–12 education enable or constrain the expansion of the access to and application of digital technologies in municipality schools. Teachers’ and school leaders’ attitudes toward digital technologies in education are important for involving students in using digital technologies in various ways. However, teachers’ and school leaders’ attitudes are related to school organizers’ attitudes toward digital technologies in K–12 education. In addition, attitudes toward digital technologies may be related to the support school leaders and teachers get from the school organizers. The importance of attitudes is consistent with the argument by Haelermans (2017) regarding the significance of attitudes in the expansion of digital technologies in K–12 education. Bad experiences with digital technologies and a lack of support may make those school leaders and teachers avoid using digital technologies in their practice, which Håkansson Lindqvist (2019) pointed out as an important school organizer task. Teachers also may feel that they are digitalized because they use, for example, the cloud service and distance teaching. In this case, it may be necessary to work with the understanding of what digitalization in K–12 education entails. Therefore, IT strategists become important change enablers. In addition to acting as a link between school organizers and school leaders, they are responsible for helping teachers apply digital technologies in K–12 education (Agélii Genlott, 2020; Avidov-Ungar & Shamir-Inbal, 2017).

In the physical space, functional infrastructure and financing opportunities enable or constrain the digitalization process in municipality schools. A clear mapping of schools’ situations in relation to access to digital technologies seems important for how school organizers make decisions concerning expanding the access to and application of digital technologies in education, which Hopkins (2017) pointed out
as an important element of a successful digitalization process. Digital technologies, for example, hardware and software, are very expensive. According to Henning Loeb et al. (2019), finances in a municipality may enable or constrain the expansion of the access to and application of digital technologies in K–12 education. However, the practitioners underlined the importance of the right competence in the right place, which Vanderlinde and van Braak (2010) discussed in the form of the capacity to effect change. Finances may also influence equality within and among schools because they affect access to digital technologies in K–12 education and teachers’ opportunities to enhance digital competence.

In the social space, changes in organizations may enable or constrain digital technologies in K–12 education. School organizers’ support of school leaders is crucial to the digitalization process and enables the expansion of digital technologies in K–12 education (AlAjmi, 2022; Fransson et al., 2018; Håkansson Lindqvist & Pettersson, 2019). School organizers would be critical in applying digital technologies in education. Therefore, they should listen to the school’s needs and conditions with open-mindedness (Leithwood et al., 2008, 2020).

In summary, school organizers should encourage teachers and school leaders to develop digital competence concerning applying digital technologies in education, thereby increasing the quality of teaching. The digitalization process involves purchasing digital technologies for municipality schools and how they are used in K–12 education. Digital technologies are not bad or good. They can increase equality or inequality within and among schools. The school organizer needs to understand every school’s needs and not apply a blanket solution.

**Implications**

The implications of this study span theoretical, methodological, and practical dimensions. The study underscores the utility of the theory of practice architecture as an analytical framework to investigate complex interactions and structures in educational practices. It highlights how this framework can be used to investigate the complexities of these practices. Furthermore, from a methodological standpoint, this research underlines the value of participant observations used in this study as a method to collect data. This methodological choice has provided a deep and nuanced understanding of the dynamics within the practice for leading the expansion of digital technologies in K–12 education at the municipality level. In terms of practical implications, the study provides valuable insights for municipalities involved in the digitalization of K–12 education. It emphasizes the importance of leadership and collaboration, supporting teachers and school leaders as they develop digital competence. These insights are especially pertinent in the context of expanding access to and application of digital technologies in K–12 education.

**Conclusion**

In practice, the significance of time for both the strategic and operative levels in K–12 education is highlighted. This underscores the need for time to understand schools’ needs, facilitate teachers’ practice, and enhance digital competence. The relationship between teachers’ digital competence and access to, as well as the application of digital technologies, is emphasized, linking digital competence to improved teaching quality. Digitalization in K–12 education involves strategies to change attitudes toward digital technologies among school leaders and teachers. Digital competence emerges as a crucial leadership skill for school organizers and school leaders, underscoring its role in understanding the impact of digital technologies.

The arrangements that enable and constrain the practice for leading the expansion of digital technologies in K–12 education include attitudes toward digital technologies, the role of IT strategists as change enablers, infrastructure, financing opportunities, placing the right competence in the right place, organizational changes, support, and open-mindedness.

In alignment with the recommendations put forth by Petko et al. (2015), this study underscores the imperative of integrating pedagogy with technology in educational practices. Petko et al. (2015) highlighted the need for educational researchers to explore the reasons behind the slow adoption of digital technologies in schools and the skepticism among teachers regarding its integration. This study directly
addresses these concerns by providing insights into strategies, challenges, opportunities, as well as enablers and constraints for the expansion of digital technologies. This contribution aims to advance the understanding of how to bridge the gap between pedagogy and technology in K–12 education, aligning with the broader goals outlined by Petko et al. (2015).

**Future research**

Future research should incorporate student perspectives in light of the limitations and opportunities identified during this study. While the current study mainly captures the perspective of leaders and teachers, future research could incorporate the viewpoints of students. Researchers can delve into school organizers' and school leaders' experiences, challenges, and perceptions, providing a deeper understanding of how their roles and competencies shape the implementation of digital technologies. For example, understanding how leaders' roles and competencies influence digital technology implementation using case studies involving interviews and observations. Researchers can focus on specific municipalities or schools to gain insights into practices. Future research can also apply long-term research projects that track changes in leadership roles and their impact on digital technology implementation over time. These studies allow researchers to identify trends in leadership practices. Future research needs to explore the perceptions of school organizers regarding digital technology implementation. Researchers can adopt a mixed-methods approach to provide a comprehensive understanding.

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**Data availability statement**

The data that support the findings of this study are available on request from the corresponding author.

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