Routledge Research in Digital Education and Educational Technology

DIGITALIZATION AND DIGITAL COMPETENCE IN EDUCATIONAL CONTEXTS

A NORDIC PERSPECTIVE FROM POLICY TO PRACTICE

Edited by
Sara Willermark, Anders D. Olofsson and
J. Ola Lindberg

ROUTLEDGE

Digitalization and Digital Competence in Educational Contexts

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Ultimately, this book's reach far exceeds that of its Nordic contexts and will be of use to postgraduate students, researchers, and scholars across the globe involved with digital education, teacher education, and educational policy and politics more broadly.

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Preface

New digital practices in education: talking about the (r)evolution

Context

There is a perception that the state of education, in response to new technologies, is perpetually on the verge of a 'revolution'. In 1922, Thomas Edison predicted that television would largely replace textbooks. In 1932, Benjamin Darrow suggested that radio would challenge the role of teachers (Darrow, 1932). In 1984, Seymour Papert (Papert, 1984) envisioned that the computer would emerge as the key instructional tool. In 2019, the global COVID-19 pandemic, also labeled as the Great Online Transition (Howard et al., 2022), would catalyze a significant 'shift to digital' in teaching and learning. And today, we are rethinking education in a world with artificial intelligence (Markauskaite et al., 2022). These predictions of revolution and mass change to education have not yet materialized, but teaching and learning have indeed changed and integrated new technologies over the last century.

A state of expected change is the context in which this book is written. As part of this, the book aims to explore how the resulting dimensions of digitalization and associated digital competences have entered the educational field as part of change processes. Here we ask, how can the history of educational technology and change tell us about this goal and for the five themes of the book addressing digitization and digital competence in educational work: (1) policy; (2) digital leadership and organization; (3) digital ecosystem and digital environment; (4) subject, tools and teaching in flux; and (5) digital competence for teachers. Looking back at the history of technology in schools, there have been many success stories when used properly (see, e.g., Liao et al., 2021), but at the same time, it has also been observed that educators only slowly adopt technologies. This adoption is often designed to fit with the existing social organization of schooling or conceptions of learning and teaching. Given that technologies have integrated within existing school structures, values and beliefs about quality learning, the expected revolution of significant change has not yet appeared.

Quality instruction and learning require knowledgeable and engaged teachers and good resources, among other things. However, in regard to resources, education has not benefitted from the use of digital technologies as much as other industries, such as improved experience, productivity and outcomes.

Rather, education has been on the verge of various revolutions instigated by new digital technologies, but changes have been more subtle than 'revolution'. Schools have not taken up the opportunities of technological innovations for teaching and learning in ways that were expected or at the rate desired by the public. Digital technologies have been adopted, generally, where they match existing practice and beliefs (for an overview see Tondeur et al., 2017). The rate of adoption in schools has often been slower than expected, given that change requires three to five years but government funding works on shorter cycles (Howard et al., 2018). Even where integration of digital technologies has been successful, to sustain technology use, new policies are often needed, more money is needed for future upgrading software and hardware, and more appropriate support needs to be provided to both teachers and students. These changes depend on strong leadership (Niederhauser et al., 2018).

Yet, some of these rules are changing. In the past, digital technologies (most technologies) were actively and explicitly adopted and integrated into the classroom by teachers. At the time of writing this book, a different kind of digital technology is rapidly drawing the focus of education and promoting new ideas about an educational revolution. This technology is artificial intelligence and other automated tools. These programs and digital tools are integrated into the digital technologies we are already using. They are working implicitly, without teachers fully knowing what they are doing in the classroom and for whom (Ayanwale et al., 2022). This shift from explicit adoption to implicit use suggests the need for new policy questions and frameworks to guide their use and to understand how these fit with existing practices and values, and how they may disrupt and even dramatically change education.

The question is how do we know when these changes are needed, are happening, disrupting or revolutionizing education? As we have highlighted, history has suggested digital technologies have not significantly changed education, but is that true? Have we been looking in the right place, to be able to see the revolution? Even if all the necessary conditions are in place, it is still difficult to judge the success of technology implementation as there is still a lack of specific goals or models to emulate. Currently, there are a range of conceptual models that have been developed and used in research and practice (Sosa & Manzuoli, 2019). Some models have stimulated international research initiatives such as the Technological Pedagogical Content Knowledge (TPACK) Model (Koehler & Mishra, 2009) or pedagogical adaptations of generic Technology Acceptance Models (Venkatesh et al., 2003). Other conceptual models have been applied to practice such as the Substitution Augmentation Modification Redefinition Model (Puentedura, 2012) or the Four in Balance Model (Kennisnet, 2014). However, most of these models were developed and tested in the 1990s. It seems that the older models that we use in educational technology research are perhaps no longer appropriate.

Clearly, in order to see the effects of new digital technology use, to even use digital technologies effectively in education, new appropriate conceptual understandings are needed. This will be crucial to guide the integration process

or understand what is happening in educational spaces. We further argue that a holistic approach is needed to understand the complexity of embracing new digital technologies in an adequate way. As stated earlier, the book captures this complexity by addressing five key themes. First, what are the implications for policymakers? As stated in the introduction, teachers are expected to digitalize their educational practice, but also in Scandinavian countries, the implementation of digital technologies is often left to the individual teacher (see, e.g., Grönlund, 2014). Therefore, strong leadership, a second key theme in the book, is important in order to realize these policies. What is a competent leader in the context of the digital (r)evolution? And how does he/she create the conditions to change the educational environment (key theme 3)? Are decisions evidence-based or is there a tendency to either exaggerate the risks connected to the use of the new technologies or to overemphasize their positive effects (Willermark et al., 2023). And how does it affect our view of teaching, tools and subjects (key theme 4)? This brings us to key theme 5, the importance of teacher training and how to develop teachers' professional digital competencies (cf. Tondeur et al., 2023). And finally, what type of research do we need in order to understand these dimensions of digitalization that have entered the educational field as part of the rapid change processes?

This deep dive into digitization and digital competence from the Nordic perspective provides a rich view of the ecosystems and flux of digital technology-related change in education. How do Nordic countries respond to digital technologies in policy and curriculum? What are the new digital ecosystems and related practices? What are the new competencies needed for teachers and learners to navigate these spaces? These changes, while not earth-shattering, are dramatic and important to understand if we are in fact moving into a revolution or if it has already occurred, as part of an ongoing evolution.

Jo Tondeur
Sarah Howard

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Introduction

Sara Willermark, Anders D. Olofsson, and J. Ola Lindberg

Hardly any organization remains unaffected by the digitalization of society. When digital technology is brought into professional practice, it means that the practice of the profession develops, changes, or even transforms (Constantinides, 2012; Karanasios & Allen, 2014; Vial, 2019) in both subtle and subversive ways. In the public debate, the light has often been directed toward an educational context (Aagaard & Lund, 2019; Ott, 2017). The digitalization of education is high on the agenda for politicians, researchers, and the public is not hard to understand, given the central role of education in modern societies (Selwyn, 2023). Educational institutions are the pillars of modern society, and teaching has been described as the 'mother of all professions', as building the foundations for all professions (Ulferts, 2019). Therefore, teachers are part of shaping tomorrow's citizens and leaders, and the teacher's central role can hardly be exaggerated. At the same time, the development of society challenges traditional educational assumptions and puts traditional practices under pressure.

In light of the global COVID-19 pandemic, the digitalization of education has become more relevant than ever (Bonk, 2020). There has been a stream of research that addresses education in light of the pandemic from different Nordic perspectives (e.g., Iivari et al., 2020; Lien et al., 2022; Olofsson, Lindberg, & Fransson, 2021; Willermark & Gellerstedt, 2022). Still, digitalization has brought an increasingly complex school environment for quite some time (Hatlevik & Christophersen, 2013). The emergence of a new digital landscape has come to be characterized by platforms and digital services for administration, communication, and teaching and learning activities (Islind et al., 2021). In a Nordic context, more and more schools have chosen to provide students with a personal digital device, which means that more and more students have access to a personal computer or tablet (Blikstad-Balas, 2012; Håkansson Lindqvist, 2019; Meyer et al., 2021; Norqvist, 2016; Tallvid, 2015). At an aggregate level, an increasingly digitalized teaching and learning environment entails coordinating effects. Students, pupils, and parents can access information, documentation, and teaching materials in the event of absence (Gu, 2017). Other consequences mean an increased expectation of teachers' accessibility via e-mail and messaging functions that are built into

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the platforms (Mårell-Olsson, 2012), which calls for teaching and interacting with the students both in the classroom and online (Jääskelä et al., 2017). Furthermore, platforms shape teachers' work by supporting norms about how teachers should work, as they contain standardized templates and can define how teachers understand planning, teaching, and assessment (Gullberg & Svensson, 2020; Sandén, 2021).

Due to technological and pedagogical advancements, artificial intelligence (AI), as well as virtual reality (VR), has gained momentum in research and education (Humble & Mozelius, 2019; Luckin & Cukurova, 2019). Similarly, learning analytics and educational data mining have arisen as important research fields in the last decades to enhance education at all levels (Deeva et al., 2021). Moreover, robots are gradually being studied for use in education (Ekström, 2023) aiming at facilitating teaching and learning in different areas such as mathematics (Serholt et al., 2020), geography (Alves-Oliveira et al., 2019), and language learning (van den Berghe et al., 2019). Furthermore, learning analytics and educational data mining have arisen as important research fields in the last decades, intending to enhance education at all levels (Deeva et al., 2021). It centers around personalization, adaptive learning, predictive analysis, and user behavior profiling. The application of learning analytics is often presented as offering unbounded possibilities. Yet, suppose data-driven decision-making should have a real impact in practice, there is a need to enhance the understanding of educators' overall practice, their needs, and how to support them in developing appropriate skills and strategies to enable the data-informed process of digitalization of education (Viberg & Gronlund, 2021). It also raises questions about students' autonomy and integrity. For example, it stresses the risk of viewing students as sources of data and passive recipients of tuition and the risks in implementing decision-making structures increasingly bound to the algorithms without necessarily understanding how they work (Murchan & Siddiq, 2021; Pargman & McGrath, 2019).

Digital social media platforms have also become a place for teachers' professional conversations via Facebook (Lundin et al., 2020) and Twitter (Sandén, 2021). Teachers can interact with 'extended colleges' on social media and bring about professional discussions, knowledge sharing, practical problem-solving, social relations, and support (Sandén, 2021). A darker side of an increasingly digitalized society includes cyberbullying of children and young people (Arnarsson et al., 2020; Kaiser et al., 2020). Furthermore, there are reports of teachers becoming vulnerable in the digital environment. For example, Kauppi and Pörhölä (2015) conducted a study among primary and lower secondary school teachers in Finland, which showed that 7.6% of the teachers experienced cyberbullying from pupils at least occasionally. A Swedish study shows how digitalization, in different ways, creates work environment problems for teachers, where, for example, confrontational and recurring emails from parents have become a work environment problem (Josefsson & Willermark, 2022). It testifies to how digitalization permeates educational work in various ways and raises questions about how preventive work can be conducted and how sharp situations can be handled.

When digitalization enters educational contexts, it can lead to both expected and unexpected consequences. This can bring about both desired and undesired outcomes, including new challenges and advancements (Willermark & Pareto, 2020). Thus, from our point of departure, digitalization does not only support (or, in worse cases, inhibit) educational work (Islam & Grönlund, 2016). It changes the role of educational professions (Willermark, 2018), the educational system (Olofsson & Lindberg, 2021), and the school as an organization (Agélii Genlott, 2020). In the following, we elaborate on several aspects of how digitalization is reflected in varying levels of education.

Digitalization is reflected in policy. Digitalization contributes to writings in international, national, and local policy documents. The digitalization of society constitutes a significant force for redefining the role and function of curricula in education systems (Erstad et al., 2021). The visions for education concerning digitalization have been expressed through curricular demands in categories like 21st-century skills and lifelong learning (Siddiq, 2018) or in terms of literacy and digital competence (Olofsson, Lindberg, Young Pedersen, et al., 2021). Curricula in Nordic countries have undergone recent changes due to the digitalization of society and education (Godhe, 2019). The policy is characterized by ambitious goals linked to digitalization in schools, such as using digital technology throughout the educational system, that digitalization should be permeating all subjects (Arstorp, 2021), and has an objective to be the best in the world at utilizing the opportunities created by digitalization. Based on policy, teachers are in their educational work expected to digitalize teaching practice; however, it is not specified *how* this development will proceed. The Nordic teaching profession is characterized by a relatively high degree of autonomy (Uljens et al., 2013) and the practical implementation of digitalizing teaching is primarily left to the individual teacher (Grönlund, 2014; Lipponen & Kumpulainen, 2011). There is a recent call for additional systematic approaches to strengthen research on digital competence and how it is developed in teacher education and schools, of relevance for both policies and practice (Brevik et al., 2019; Erstad et al., 2021).

Digitalization puts new demands on educational leadership. Educational leadership is crucial in the digitalization of education. School leaders are stressed as crucial to concretize policies on digitalization into realistic goals as well as provide concrete support actions at local schools (Hatlevik & Arnseth, 2012) to find the balance between leadership and joint participation (Petko et al., 2015) and the importance of school leaders by setting direction through their actions (Lindqvist & Pettersson, 2019). To achieve sustainable improvement, school leadership carefully orchestrates teaching technological and cultural resources (Hauge et al., 2014). Thus, leading the digitalization of schools is a much more delicate issue than purchasing and maintaining technology and infrastructure (Reis-Andersson, 2023). Recently, researchers highlighted the importance of leadership that focuses on school development as an organizational project and building school culture rather than pursuing the professional development of individual teachers (Grönlund, 2014; Hatlevik et al., 2015). Furthermore, a digitalized education system can collect,

measure, process, and act upon the educational data, thus realizing data-driven decision-making strategies to support school leadership and inform improvement (Sergis et al., 2018). Although the importance of digital leadership is demonstrated within research, recent literature reviews show that research on strategic leadership in school is sparse, not least in a Nordic context (Pettersson, 2018; Willermark, 2021), and further research that addresses competent digital leadership is requested.

Digitalization changes the educational environment. Introducing new technologies in educational settings is generally associated with expectations of how they will change education and issues about their appropriateness. There is a tendency to either exaggerate the risks connected to the use of new technologies or to overemphasize their positive effects (Godhe, 2014). However, using a laptop, a tablet, or a smartphone is not equivalent to an activity in its own right, such as reading a book or writing an essay, since it is a standard part of many activities and is, as such, a prerequisite for these activities (Lindroth, 2015). Instead, there is a need to "unpack" the activities in the technology-mediated teaching and learning environment (Agélii Genlott, 2020; Hattie, 2008). New operating models, increased competence, and changed working methods are necessary but demanding (Bass & Eynon, 2017; Islam & Grönlund, 2016). The quest to adapt learning based on the individual student's particular needs is perhaps more relevant than ever and has come to take on new and technically more advanced expressions. Still, intelligent tutoring systems can create contradictions for the teachers concerning, for example, predictability, individual versus collective learning, and accountability (Utterberg Modén, 2021). Virtual realities have also entered the educational context, for instance, via virtual labs, which represent interactive environments with an interface design that mimics a physical school laboratory (Edstrand, 2016). Virtual labs offer many opportunities in areas such as physics, chemistry, and biology, for example, by allowing students to conduct an experiment that may be dangerous, difficult, or impossible to carry out in situations. Still, there are also new challenges since virtual labs often communicate a simplified view of scientific inquiry, which in the worst case may hinder students' understanding of scientifically relevant ways of conducting research (Edstrand, 2016).

Digitalization affects our view of teaching, tools, and subjects. The fast-paced changes in both the workforce and society emphasize the importance of a type of education that prioritizes transformation and innovation, rather than just repetition. This education should also foster social learning, rather than just individual learning (Tynjälä, 2013). Digitalization has the potential to transform how we learn and how we come to interpret teaching and learning, including which digital competencies are considered particularly important and which might be dated (Säljö, 2010). The view of digital technology as an "access point" to complex knowledge has recently emerged. The term "access points" refers to gaining access to complex knowledge as the use of digital technology opens up new ways of presenting and processing information that

differs from traditional text-based materials (Edstrand, 2016; Säljö, 2010). For example, students can calculate their climate impact by entering information about their way of life without mastering the algorithms behind the calculation. Thus, one can be part of complex contexts and learn what one's way of life means for climate impact (Edstrand, 2016). This can be seen as an illustration of how the user, together with digital technology, can perform more advanced tasks, redefining what is possible and what knowledge and abilities are essential to master (Edstrand, 2016; Säljö, 2010). In mathematics education, there was an early recognition of the interrelationship between the subject and digital technology, including teaching machines, intelligent torturing systems, and programming (Utterberg Modén, 2021). When the calculator became everyone's property, it instigated a discussion about what was considered necessary and relevant mathematical knowledge (Tallvid, 2015).

In the same way, questions are addressed about what it means to be knowledgeable in the subject of social studies in a globalized and increasingly interconnected world. In language education, the written text is challenged as the norm as it is not enough to master skills in reading and writing but also to evaluate and analyze texts as well as to handle audio and image-based texts (Aarsand, 2019; Godhe, 2019; Kress, 2005; Kumpulainen et al., 2020). In science, the importance of scientific literacy is emphasized as the expansion and exposure of new knowledge makes it even more important to understand the logic of scientific work and how to code the world in scientifically relevant ways (Edstrand, 2016). Digital technology makes it possible to create music in new ways, for example, by using sampling and loop-based programs to make electronic music. The music-creating process loosens past boundaries between composers, artists, musicians, sound engineers, and listeners (Ideland, 2020). However, this only constitutes a few examples of how digitalization transforms disciplines, subjects, and contents.

Digitalization puts new demands on teachers' digital competence. Digitalization changes the role of teachers (Mishra & Koehler, 2006) and brings increased complexity to the teaching profession (Erstad & Hauge, 2011; Willermark, 2018). It demands more than basic technological skills; it is about integrating them into an educational setting as a pedagogical resource (Kivunja, 2013). The development of teacher education has brought increased interest in matching twenty-first-century skills (Näykki et al., 2021). While aspects of digital competence must be adequately addressed in teacher education, teacher educators face challenges in preparing pre-service teachers for a digitalized teaching and working life (Gudmundsdottir & Hatlevik, 2018). The complexity of such a task consists of educating pre-service teachers to develop digital competencies for teaching both in the present and the future (Lipponen & Kumpulainen, 2011; Roumbanis Viberg et al., 2023). Here the role of teacher education in making it possible for student teachers to develop the professional digital competence (PDC) needed to perform their future profession in a highly digital school context is crucial (Lindfors et al., 2021; Uerz et al., 2018).

A holistic approach to digitalization in the educational context

In this brief introduction, we aim to demonstrate how digitalization affects the entire educational system. It constitutes a complex process that cannot be fully understood using a single research approach, theoretical perspective, or empirical case. In this book, we explore how digitalization and digital competence have entered the educational field. Through a multidisciplinary and holistic approach, we address the consequences of digitalization from various perspectives, actors, and authors. Prominent researchers from the Nordic countries contribute with theoretical perspectives and empirical examples to shed light on this complex issue. However, capturing digitalization and digital competence in educational work might be like hitting a moving target. As technology continually changes, digitalization takes new paths, and the meaning of digital competence must also change. In the center, there are teaching and learning activities, but these are surrounded by policy, leadership, administration, and infrastructure. In light of digitalization, urgent questions arise about the meaning of digital competence, learning outcomes, and equivalence, as well as how to prepare the future generation of teachers and how to pursue professional development for in-service teachers (Roumbanis Viberg et al., 2023). This book centers around five themes that address digitalization and digital competence in educational work, including (1) policy; (2) digital leadership and organization; (3) digital ecosystem and digital environment; (4) subject, tools, and teaching in flux; and (5) digital competence for teachers (see Figure 0.1). In short, the book captures the central aspects of how digitalization permeates educational work.

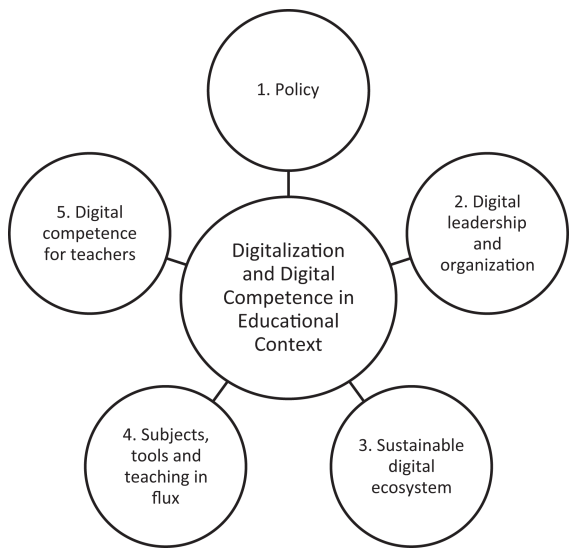

Figure 0.1 Illustration of the book's different themes.

A Nordic perspective on digitalization in the educational contexts

As the title suggests, this book is based on a Nordic perspective. The rationale for this is twofold. Firstly, it is a matter of digitalization being prominent in the Nordic region. Secondly, it is a matter of the countries being similar to the extent that it is possible to identify currents and transfer results and reasoning (Olofsson & Lindberg, 2021), such as offering "theoretical generalization" (Mitchell, 1983) and "analytical generalization" (Yin, 2009). Nordic countries are frequently positioned as digital front-runners both in a European and a global context (Drotner, 2010; Randall & Berlina, 2019). Recurrently, the Nordic countries top different lists that measure nations' digital maturity. For example, *The Network Readiness Index (NRI)* evaluates countries' ability to take advantage of the opportunities of digitalization. Sweden and Denmark top the list, and Norway, Finland, and Iceland receive high rankings (Dutta & Lanvin, 2020). The digitalization of Nordic societies is reflected in the educational systems through policy reforms (Olofsson, Lindberg, Young Pedersen, et al., 2021) as well as in educational initiatives and research projects, see Einum (2020), and Willermark and Pareto (2020). The educational systems in the Nordic countries are described in various ways that differ from those in other parts of the world. For example, there has been a more robust tradition in the educational work of project-based learning, proclaiming equal opportunities for all and high access to digital technology (Erstad et al., 2021).

This book provides a significant contribution to the intensified discussions concerning digitalization and digital competence in the educational context from a Nordic viewpoint. It does not mean that the ambition is to compare the different Nordic countries. Instead, we want to shed light on issues of digitalization and digital competence from a Nordic perspective. Taken together, the insights described, lessons learned, and implications provided through this book are therefore of value for both researchers and practitioners that are in different ways engaged and occupied with educational work and digitalization, not only in the Nordic countries but in the world at large.

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‘This Is How We Do It!’ – rural resilience in local translation work on national school digitalization policy

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Conclusion – knowing in a digital world

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