Facing the challenges of ‘digital competence’

a Nordic agenda for curriculum development for the 21st century

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Abstract
Digital technology has become increasingly central in curriculum plans during the last decade, but there is hardly any research about the curriculum in the digital age, nor about ‘digital competence’ as a new didactic area that has entered the educational field. In this article, we discuss and analyse two interrelated issues: first, on recent trends in curriculum developments in Norway, Sweden and Finland concerning digital competence; and, second, on related research initiatives of relevance for digital competence as an educational field. The article is based on a theoretically informed review of policy documents during the last decade and research initiatives in this field. The outcome of our study show that digital competence has become an increasingly complex concept, with a key emphasis in recent curricula, and is strongly linked to 21st century education. The article contributes to the ongoing debate about digital competence as part of contemporary educational strategies.

Keywords
digital competence, curriculum development, 21st century skills, computational thinking

Introduction
The term ‘digital competence’ has become a key component in curriculum development, educational policy and research during the last decade (Erstad & Voogt, 2018). However, these developments are embedded with uncertainty and tensions concerning conceptual clarity, how digital competence relates to technological developments, what role research has in defining policy and practice, and the broader implications this new curriculum area might have for school practices. It is of fundamental importance to understand how terms like ‘digital competence’ and ‘digital literacy’ have entered curricula in different countries, and how they are defined as part of transitions of education systems for facing 21st century challenges. Surprisingly, not much has been written about curriculum developments in the digital age (Williamson, 2013). The impact of technological developments on our societies is, however, a major force for redefining the role and function of curricula in education systems, even more so in times of ‘fake news’ and the Covid 19 pandemic.
This article is written as a meta-perspective based on our experiences of working with ‘technology and education’ for a number of years, and how we perceive recent curriculum developments in Norway, Finland and Sweden. At present, these countries are involved in important curriculum developments highlighting challenges and transformations in moving from 20th to 21st century education (Berge, 2017). Our first research question is: how is digital competence conceptualized within recent curricula as an expression of digital technologies in the future of Nordic schooling? Our second research question is: how is the relationship between research and policy related to digital competence in these three Nordic countries? Theoretically, these questions relate historically to three different but interrelated perspectives referring to the complexity of the term ‘digital competence’ in the current state of knowledge in this field. Methodologically this article is a meta-analysis of current curriculum initiatives in three Nordic countries, and a review of relevant research in these countries underpinning curriculum developments.

Towards conceptual complexity
In recent years, several different conceptual frameworks have been developed as expressions of different aspects of digital competence or digital literacies, adding to the confusion about terminology. Still, across many of these diverse frameworks, there are some common components that define basic aspects of digital competence, such as: access, manage, integrate and evaluate information, develop new understandings (create), and communicate with others in order to participate (Ferarri, 2013). As such, a term like ‘digital competence’ has become overly complex and difficult to grasp (Åberg, et al., 2019). We have selected the term ‘digital competence’ instead of other similar terms like ‘digital literacy’, ‘ICT literacy’ or ‘computational thinking’, because it is a common term used in Nordic curricula during the last two decades, and it is broader in conception than the others, including skills, literacies and bildung.

The theoretical positions informing the concept of ‘digital competence’ are also complex, depending on the purposes used by researchers from different fields. We will mention three theoretical perspectives that have been important in informing our contemporary understanding of ‘digital competence’ and how it is expressed in relevant curricula.

New literacy studies: Historicised accounts of literacy show how literacy, both in its material form and as theoretical construct, is deeply embedded in human development and the transformative nature of technological progress. New Literacy Studies (NLS) was developed by researchers interested in the cultural contexts and diversities of literacy within different contexts in everyday life. The emphasis of studying literacy as embedded in specific social practices, in- and out-of-schools, has influenced research on how young people make meaning of and use diverse digital media (Coiro, et al., 2008).

Media cultures: Another influential theoretical position goes back to the ‘cultural studies’ tradition of how cultures and sub-cultures within our societies are formed and develop (Barker & Jane, 2016). The role of media and their diverse content in people’s lives has been a common theme, as consumers and producers of content. This theoretical perspective has been important in understanding what it means for young people to live and grow up in a media culture, and their practices of networking, communicating, sharing, creating, and so forth, that has influenced conceptions of digital competence and how it changes over time.

Learning sciences: An important influence on conceptions of digital competence and research in this area has also been the growth of the learning sciences since the 1990s (Sawyer, 2014). This field of research brought together key insights from research on ‘how people learn’ (National Research Council, 2000), which showed that there is a mismatch
between what research could document about the ways people learn and the ways schools and curricula were organized. These tensions also raised issues about how prepared our education system is for 21st century living and learning (Wells & Claxton, 2002).

A Nordic agenda for 21st century curricula

Since 2000, some international frameworks and initiatives have used the term ‘future competences’ and others have used ‘21st century skills’, with implications for curriculum development at the national level, such as the ‘Definition and Selection of Key Competencies’ (DeSeCo) by the OECD, the ‘Key Competences Framework’ by the EU, and the international ‘Computer and Information Literacy Study’ by the IEA. However, research has shown that many countries struggle in their efforts to implement so-called future competences into school curricula (Arjomand, et al., 2013). Curriculum developers and schools tend to focus on competences that are familiar, like STEM, while the more unfamiliar and complex competences, like creativity, collaborative problem solving and digital competence, are not implemented. This tension between competence areas creates challenges in the way curricula represent a connection between past, present and future perspectives on the competences provided by learning activities in schools.

Within a Nordic context, research on ‘digital competence’ and curricula developments has been initiated during the last decades. In one systematic review article, of 107 publications between 1997 and 2017 on the concepts ‘digital competence’ and ‘digital literacy’, Spante et al. (2018) document that there is a range of definitions used in higher education research. Definitions vary depending on the concepts being defined by policy and research, and whether they focus on technical skills or social practices.

Godhe’s (2019) meta-evaluation of curriculum developments in the Nordic countries is related to our argumentation on the role and importance of ‘digital competence’. In her evaluation Godhe compared curricula in Sweden, Denmark, Finland and Norway, and clarified similarities and differences in how the concepts of ‘digital competence’ and ‘digital literacies’ are interpreted. In summing up her analysis, she states that “…the terms used in connection to students’ digital literacy or competence, are in the Nordic curricula conceptualized in a broad sense where societal issues and a critical approach are emphasized… influenced by the notion of bildung” (Godhe, 2019, p. 33). As such, digital competence in Nordic curricula concerns more than developing student’s skills in using technologies. We expand, in this article, on Godhe’s analysis, by providing knowledge of historical developments in three countries, while she only provides that for one country, Sweden, which she identifies as a limitation in her own analysis (p. 33). Our analysis also expands on her study by linking curriculum developments with research initiatives in three countries over time. In addition, our analysis is updated with more recent developments and how these express conceptions of the future of Nordic schooling.

Aim and methodology

In this theoretically informed review of policy documents and relevant research, we focus on the concept of ‘digital competence’ in connection to compulsory education in Norway, Finland and Sweden. The criteria for choosing these three countries and not all the Nordic countries are: first, a need for in-depth knowledge about policies and research developments over time, which we do not have for Denmark and Iceland; and, second, a diversity among countries that can show both similarities and differences within a Nordic context, which Finland, Sweden and Norway represent.
In collecting central documents and defining relevant research, we have not used a systematic review approach, but a meta-analytical perspective where we critically reflect on developments concerning the link between research and curriculum developments, or the lack of such. The process consisted of collecting both the general curricula and subject specific ones of relevance during the last two decades, comparing them to relevant research and analysing them to see how digital competence has become part of educational agendas at the national level.

Developments in three Nordic countries

The education systems in the Nordic countries are firmly rooted in social-democratic educational policies proclaiming equal opportunities for all within public schools, with less alternative private schools than in many other countries. The Nordic countries are characterized by high access to digital technologies. Within this framework of public schools and national curricula, we evaluate how ‘digital competence’, as a new didactic area, has entered the educational field, and consider both similarities and differences among the Nordic countries.

Norway

A key point of departure in Norway is the national curriculum reform in 2006, which built on both the PISA and the DeSeCo projects of the OECD. A key feature of this reform is five basic skills transversing all subjects and levels (Ministry of Education 2005), one of them being ‘to be able to use digital tools’, also referred to as ‘digital competence’ in some documents (the others being reading, writing, numeracy and oral skills). Norway was among the first countries in the world where digital competence/skills were included as core elements of a national curriculum.

Research on technology in teaching and learning in Norway has been going on for a long time. Since digital competence became a key component of the national curriculum in 2006, many research initiatives have been studying this area specifically. Of great importance during the last decade has been the national centre for ICT (IKT-senteret), established in 2010 until it became part of the Directorate of Education in 2018. The centre played an important role in coordinating initiatives between policy, research and practice. Through conferences, building networks, and developing digital resources for teachers, this centre set the agenda for attention towards digital competence in Norwegian education from preschool to teacher education. One important research initiative was the longitudinal Monitor study, done every second year since 2003, documenting the implementation and use of digital technologies in Norwegian schools (Egeberg, et al., 2017). This study showed how technologies became more and more accessible at different levels of schooling, and to what extent digital resources were used in subject domains, but also diversity among municipalities and regions of Norway. The main result over several years was that access was not defined as a challenge, rather the extent to which digital resources were used for learning activities in school subjects was less than expected by policy makers and too dependent on where you lived and the competence of teachers.

In recent years there are increasing numbers of intervention studies, and studies using design-based research studying digital practices in Norwegian schools, all working closely with teachers and school communities (Rasmussen & Damsa, 2016). These studies are an important addition to the national surveys in the sense that they document how students and teachers use specific applications and tools, and add to the knowledge on digital competence as part of specific learning practices.

With inspiration from the international TEPEC (technological pedagogical content
knowledge) model, several researchers within teacher education have focused on the professional development of teachers in digital competence (Lund, et al., 2014). At a regional level, several important research and development projects have been initiated as part of the Ministry of Education’s strategy for increasing the quality and competences of teachers, both pre-service and in-service. These projects have connected researchers in teacher education with municipalities and networks of schools to increase digital competence among teachers at different levels.

The most important development in Norway during the last couple of years has been a general revision of the national curriculum from 2006 implemented during Fall 2020, called ‘Fagfornyelsen’ (‘Renewal of the Subjects’, White Paper, 2016). Of importance to our analysis is the emphasis on some key future competences closely linked to the 21st century skills agenda (Binkley, et al., 2012) and also the emphasis on deep learning as a main pedagogical challenge for the future school. Digital competence is still defined as one of five basic and transversal competence areas at all levels and subjects. In the White Paper (2016) outlining the curriculum reform, it is recommended that the skills are further developed into competencies and that they are “integrated in all subjects and understood as ways to acquire and treat, to produce and edit, to communicate and [have] digital judgement” (White Paper, 2016: 30, 32). The White Paper also states that “it is more important to assess how technological and digital development influence the content in each subject, instead of emphasizing common traits with digital skills across subjects. … that one should differ between different aspects of digital competence than what is done today” (ibid., p. 30). Two school subjects are of specific importance in relation to digital competence. One is social science, where there is an emphasis on digital interaction and digital citizenship, as well as on students using critical judgement towards information sources, and becoming collaborative, communicative and creative using digital resources. The other subject domain is mathematics, where new elements have entered. Programming and computational thinking have become essential elements in the revised curriculum for mathematics. Research on the revised curriculum and these specific areas of importance concerning digital competence has just begun.

This shows that digital competence has become a key area of importance, with there being several national initiatives to promote digital competence in Norwegian schools and in society as a whole. However, research in this area is fragmented and varying in quality, and at the moment there is a lack of a national agenda for research on digital competence—with no real national research base that could inform policy makers or practitioners.

Finland

In Finnish education, there has been increasing discussion that the challenge of education is no longer about knowledge delivery, but in creating an environment that effectively combines pedagogical, social and digital/technological affordances, in the form of tools and activities for learners to themselves construct knowledge, by engaging and inspiring them to learn. Research on technology-enhanced learning and teaching has been active in Finland (e.g. Lehtinen, et al., 2001; Näykki, et al., 2019), and the results have provided arguments for further development of digitalization in schools. Especially learning scientists have stressed that learning in and for the 21st century requires motivational competence and effective learning strategies in individual and collaborative learning settings. Thus the challenge in schools is to help learners become aware of their strengths and weaknesses in a learning situation, so as to help them develop skills and strategies for continuing to learn throughout their lives (Järvelä & Renniger, 2014). Therefore, in Finnish education a tendency has
been to discuss 21st century learning skills: learning-to-learn skills, collaborative problem solving, use of digital technologies, and the designing of learning environments for creating opportunities for active and interactive learning. A core issue has been “How do we steer digitalization to kindle learning, not to pass on it?”

Action to develop the school system in Finland has recently been taken through the renewed National Core Curriculum, which has been implemented since 2016 (Finnish National Agency for Education, 2016). An argument for Finnish schools to use technologies and digital tools is for enhancing competence building and development of 21st century learning skills among students. The rationale is that because the world around us is changing rapidly, and education, too, must evolve to meet the needs of the future. The objective of these reforms is to raise the level of competence, expertise and education in Finland, making it possible to support the changes in society and enabling equal opportunities.

One implemented idea supporting digitalization in the curriculum is ‘transversal competences’ developed in all subjects. These competences are based on different perspectives: learning-to-learn, interaction and expression skills, and multiliteracy (including digital literacy), which is the ability to produce and interpret a variety of different texts, as well as cultural competence, interaction and self-expression, competence in digital technologies, working life competence and entrepreneurship, participation, involvement and building a sustainable future.

The new curriculum also has a recommendation that students will have at least one multidisciplinary learning module every year, which gives opportunities for using technologies and digital tools in projects, inquiries and topics students are working on (e.g. Riikonen et al., 2020). During a school year, every school has at least one clearly defined theme, project or course that combines the content of different subjects and deals with the selected theme from the perspective of several subjects. These entities are called multidisciplinary learning modules, and active use of technologies for planning, conducting and presenting the learning modules are encouraged. In order to support digital transformation in Finnish schools, evaluation of its progress in comprehensive schools is ongoing, reporting about the areas which have progressed and stressing needs to develop in everyday school activities (See e.g. summary Comprehensive Schools in the Digital age, 2020).

One of the support actions is to focus on pre- and in-service teacher education, which is undergoing reform and integration. The introduction of digital materials and new learning environments will be facilitated through digital-pedagogic training (e.g. Näykki et al., 2019). Every Finnish teacher will be offered access to online learning, starting from one’s own level. For example, university research centres, in-service teacher training and school networks will be bridged for spreading evidence-based ideas for digitalization in schools, but also for helping researchers to gather data about the actual use of digital tools in teaching and learning. Ultimately, the aim is to disseminate the best evidence-based practices in pedagogy, digital learning and new learning environments.

There is a strong consensus that pre-service teachers play an important role in transferring 21st century skills into school practice, and increasing research evidence to support this is available. For example, there is a current large-scale study on pre-service teachers’ 21st century skills and the development of these skills in teacher education (Häkkinen, et al., 2017). The study has focused on the following three areas of 21st century skills. First, learning strategies, which are crucially important for the future workforce who have to be able to quickly react and adapt to changing situations, which involves skills for self-regulated and collaborative learning. Second, collaboration and teamwork, which are increasingly important in today’s global economy. For example, teachers’ collaboration between their
peer teachers is important for developing schools’ practices and culture (Ertmer & Ottenbreit-Leftwich, 2010). A third area is knowledge and attitudes towards the use of technology and digital tools (digital competence) in education, since technology serves as a hub of 21st century skills and students need skills to use technology as a tool in other areas of 21st century skills (Voogt et al. 2013). In order to do this, pre-service teachers need to be provided with competences to take advantage of technology in pedagogically meaningful ways. Findings from this study point out that Finnish teacher students are optimistic about their strategic learning skills, but these strategic learning skills are not supported by their collaborative learning skills and attitudes. Instead, teacher students are less optimistic about their skills and their attitude towards the use of technology in teaching and learning, which varies a lot (Valtonen, et al., 2017). In conclusion, more effort is needed to invest in teacher education and preparing student teachers’ digital competences. In all, digital competence is a key area in the new Finnish curriculum, but it is also integrated into broader issues of curriculum reform and teacher education programmes, moving these curricula and programmes, towards implementing 21st century skills and developing student-centred learning environments.

**Sweden**

In 2015, the Swedish National Agency for Education was given the mission from parliament to suggest reinforcements and clarifications in the curriculum to strengthen children’s digital competence. Another aim was to strengthen children’s innovative skills. Four priorities are emphasized by this Agency (2020) for adequate digital competence: Understand the impact of digitalisation on society; Use and understand digital tools and media; Have critical and responsible approaches; and, Solve problems and translate ideas into action.

The aim with the update of the national curriculum was that children should develop an understanding of how digitalization can impact upon society, but also how it could impact upon the individual. Children’s ability to use and understand digital systems and services are highlighted as well as their ability to relate to information and media in critical and responsible ways. There is also an emphasis on the creative side of digitalization, children’s problem-solving skills and their ability to make ideas real with digital resources. One of the milestones in the government’s digital strategy is that all students should develop their digital skills, as all children should be familiar with digital resources and services as well as being able to follow and participate in digital development depending on their own prerequisites. Also digital competences of teachers and principals are included as a prerequisite for children to develop digital competence.

According to the Swedish government (Government Offices of Sweden, 2017), digitization means changes in life and society. These changes lead to demands as well as expectations of schools’ ability to give all children digital competence. An emphasis is on equity which underpins the national digitization strategy for education. According to the government, the changes can be summarized in the following six points: 1) programming is introduced as a prominent feature in several different subjects in primary education, especially in technical science and mathematics, 2) students will be strengthened in their critical evaluation of sources, 3) students can solve problems and translate ideas into practice in a creative way with the use of digital technologies, 4) students shall work with digital texts, media and tools, 5) students should use and understand digital systems and services, and 6) students should develop an understanding of the impact of digitization on the individual and on society.

In Sweden, digital competence is highlighted also in preschool, with the aim of fulfilling education’s democratic mission and to counteract digital gaps. The (preschool) education
curriculum (National Agency for Education, 2018) provides children with the means to develop adequate digital competence related to their everyday lives. The reason for using the term 'adequate' in Swedish steering documents is that the pace of change is so high in this area – what is digitally competent today might no longer be digitally competent tomorrow. The term 'digital competence' is the one used in Swedish educational policy, not so much 'digital literacy'. The Swedish Association of Local Authorities and Regions (2016) recommends that digital competence should be broken down into specific skills, divided into levels of development with clear examples to ensure that all children get the same opportunities to benefit from the knowledge and experience they need in their future professional lives and in the global and digital world in which they will be citizens.

The notions of 'digital competence' and 'programming' were introduced at the same time in the Swedish curriculum, which creates a close connection. Additional material has clarified that the focus is not on coding skills, but on programming as a pedagogical tool and as problem-solving. Programming includes ‘creation, controlling and regulating, simulations and democratic dimensions’ (p. 10), highlighting programming in this wider perspective as part of several aspects of digital competence (Heintz, et al., 2015).

Two key research projects concerning digital competence in a Swedish context are ‘Trippel Helix’ (2013-2017) and ‘Unos Uno’ (2010-2013). The objective of Trippel Helix was that school, business, and academia formulate a common agenda, based on theoretical and operational changes in the school of the future, related to the digital opportunities and the knowledge requirements that come with it. It concludes in a set of national seminars where digital competence is discussed and defined. The project’s results are incorporated into the Swedish national curriculum. ‘Unos Uno’ studied 1:1 schools with the objective of studying effects and results of the 1:1 implementation from different perspectives. The findings showed that at some schools, ‘increased digital competence has increased the ability of the school’ (Grönlund, et al., 2014, p. 3), meaning that, for example, information searching, writing and presenting are made with more effective time allocation since 1:1 has been implemented.

To summarize, Swedish schools have used digital resources for a long time, but without equal access because the national digitalization plan did not appear until 2017. Digital competence is, since 2018, highlighted in the preschool curriculum. The school curriculum now introduces digital competence, computational thinking and programming. The curriculum aims to strengthen children’s digital competence: the goal is that all children shall develop an understanding of how digitalization can impact upon society and the individual.

Conclusion and challenges
Our main focus in this article has been on the positioning of ‘digital competence’ within broader processes of curriculum change, and how this positioning represents new developments in the implementation and use of digital technologies in schools, as documented by research in this area. We conclude that ‘digital competence’ has become a key term in curriculum development during the last decade in Norway, Finland and Sweden. Across the three countries presented here, we can conclude that the way this competence area has been written into national curricula represents increased complexity in conceptual understanding as part of 21st century skills agendas. Part of this complexity is also the interrelationship between the three theoretical positions informing contemporary conceptions of digital competence.

We identify four developments in all three countries at the moment that signal transfor-
mations in the way digital competence is now positioned as part of curriculum development. **First**, an important change is the way digital competence is now defined as part of broader processes of 21st century skills and key competences frameworks. **Second**, a similar development in Norway, Sweden and Finland is the focus on coding and programming as a new subject area in schools. Computational and algorithmic thinking are regarded as part of 21st century skills, both as a way to foster understanding of systems and technological processes of importance for contemporary societies, and as a way of fostering problem-solving and analytical thinking (Berge, 2017). A **third** point is that all three countries emphasize the professional development of teachers as important for further development of digital competence in schools. In a research overview on programming and computational thinking (Kjällander, Åkerfeldt, & Petersen, 2016), it was shown that many articles highlight the importance of the teachers’ digital competence but with a lack of consistency in ways of developing such competence. **Fourth**, attention is drawn towards pre-school and early years usage of digital technologies, both in curriculum development for pre-schools and research initiatives. One implication is that lifelong learning and digital competence as people progress through life is becoming more prominent in educational policy.

As concluded by Godhe (2019), one characteristic of Nordic curricula compared to other countries, concerning digital competence, is the emphasis on societal issues and a critical and ethical approach. This has also been shown in our analysis as an important part of contemporary curriculum developments. Still, more systematic approaches are needed to strengthen research on digital competence per se and how it is developed in schools, of relevance for both policy and practice. The concept is complex and there is a potential risk that digital competence becomes a term that suits diverse political agendas without a coherent empirical understanding of it.

**References**


Comprehensive Schools in the Digital Age (2020). *Key results of the final report for 2020 and an overall picture of digital transformation in comprehensive school education*. [https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/162284/Comprehensive_SchoolsII.pdf?sequence=1&isAllowed=y](https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/162284/Comprehensive_SchoolsII.pdf?sequence=1&isAllowed=y)


