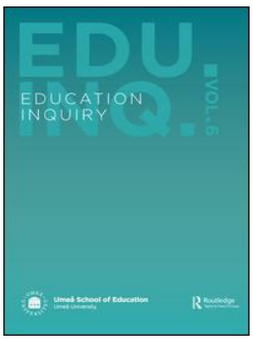

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25+ years of ICT in policy documents for teacher education in Norway and Denmark (1992 to 2020): a study of how digital technology is integrated into policy documents

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ABSTRACT

This paper examines the role of digital technology in national guidelines and regulations in Norwegian and Danish teacher education over the course of 28 years (1992–2020). These policy documents are used to examine policy perspectives on digital technology through an analytical framework based on Wartofsky's artifact categories. The analytical categories developed for this study are tool artifacts, teacher professional artifacts and discursive artifacts. The results show that the different categories dominate at different times. The Norwegian policy documents indicate an increase in teacher professional artifacts and a decrease in tool artifacts over time, whereas the Danish policy documents show the opposite tendency. Discursive artifacts are absent in Danish policy documents while their presence diminishes over time in the Norwegian policy documents. As teachers, and ITE in particular, are still struggling to realise educational policy aims, there is still a need for direction, this absence seems to run counter to the goal of increasing PDC in ITE.

KEYWORDS

Initial teacher education; professional digital competence; ICT; policy; Nordic perspective

Introduction

Throughout the past decades, Norwegian and Danish initial teacher education (ITE) have followed very similar, and in some ways even parallel, paths (Elstad, 2020), but there are nevertheless differences, such as in the extent to which digital technology is integrated into ITE (Daus, Aamodt, & Tømte, 2019).

Norway was one of the first countries in the world to include digital skills as one of five basic skills in its national curriculum as part of the so-called Knowledge Promotion reform (Ministry of Education and Research, 2006; Tømte, 2013). This reform was intended for the school sector but it also made its way into reforms of ITE due to the nature of ITE as educating future teachers. Research found an increase in the use of ICT in Norwegian schools (Egeberg et al., 2012), while a 2013 report on ITE showed that newly qualified teachers had developed their digital competence only to a limited extent through ITE (Guðmundsdóttir, Loftsgarden, & Ottestad, 2013). This was followed by a digitalisation strategy for basic education, including ITE, for 2017–2021 (Ministry of Education and Research, 2018). In 2017, a national framework for teachers' professional

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digital competence (PDC) (Kelentrić, Helland, & Arstorp, 2017) was introduced and the Ministry for Education and Research funded five large digitisation projects for ITE programmes.

In Denmark, the approach to digital technology in schools and ITE has been driven by a focus on developing ICT skills (Arstorp, 2015), increasing internet and computer access in schools, being competitive as a nation (Danish Government, 2003a) and, finally, integrating ICT into all subjects (Bundsgaard & Kuhn, 2007; Engel, Stokholm, Holm-Larsen, & Brandt, 2013). In 2007, the Ministry of Education (2007) published an ICT guide for ITE, but the responsibility for further interpreting how to integrate digital technology in ITE was left with the individual ITE institutions (Arstorp, 2015). In 2019, the launch of *technology comprehension* [Teknologiforståelse], a new subject with a clear STEM influence, in schools and ITE (Smith, Iversen, & Hjorth, 2015) was followed by funding to increase digital competence among educators in HE and in ITE (University College Copenhagen, 2020) and a teaching guide for *technology comprehension* in ITE (Rehder et al., 2019).

Research into digitalisation in higher education in Norway and Denmark show that it has been more prioritised and contractually binding for HE institutions in Denmark than in Norway (Tømte, Fossland, Aamodt, & Degn, 2019). When it comes to the integration of digital technology into ITE in policy documents, studies show that is low (Tømte, Kårstein, & Olsen, 2013); the difficulty of integrating digital technology must be directly addressed to improve its integration into ITE (Arstorp, 2015; Wilhelmsen, Ørnes, Kristiansen, & Breivik, 2009). The latest Norwegian study shows improvement in technology integration and awareness in ITE (Daus et al., 2019). However, research in this area tends to focus on implementation studies and what students and educators experience related to digital technology rather than implementation at the policy level (Hjukse, Aagaard, Bueie, Moser, & Vika, 2020). The only recent study addressing this is the Norwegian study by Instefjord and Munthe (2016), which found "little evidence of technology integration in curriculum documents for teacher education programmes" (p. 89). The dearth of research on digital technology in ITE policy documents serves as the backdrop for this article. By studying the perspectives on digital technology in ITE policy in Norway and Denmark over time, this work aims to inform future policy making while helping researchers in the field gain a broad understanding of how the approach to technology in ITE policy has changed over time.

The research question guiding this study is: *What characterises the perspective on digital technology as an artifact in Norwegian and Danish national guidelines and regulations for initial teacher education over time from the early 1990s to the present date?*

The paper is organised as follows: first, what is meant by technology is explained followed by a presentation of the theoretical framework for the study and a description of ITE in the two countries. Thereafter, the policy data and the methods used are presented, followed by the analytical categories and their application. Finally, the results are presented, discussed, and contextualised.

Technology definition

Technology, in the broadest sense, includes all man-made artifacts (Aagaard & Lund, 2019; Cole & Derry, 2005; Säljö, 2010) such as blackboards, screwdrivers, computers,

cars, and so forth. Many such man-made technologies are mentioned in the policy documents under study, including in the subjects of Physics, Nature & Technology, Arts & Crafts and Food & Health (to name a few); these include biotechnology, tools for the production of goods and tools for making crafts (knitting needles, hammer, food processor, etc.). However, this study uses a narrower definition of technology as *digital technology*, which includes what is refered to as information and communication technology (ICT) in the earliest documents. (Tables 4 and 5 provide a complete list of phrases found in each document.) While this could imply a tool-oriented perspective on technology, that is not the case. Rather, this study draws on the socio-cultural tradition of viewing human tools as culturally embedded, transcending the physical object and mediating accumulated knowledge, tradition and meaning as a *sign* (Säljö, 2004) with the potential to transform the culture in which it is brought into action (Aagaard & Lund, 2019; Wertsch, 1993).

Theoretical perspective

As mentioned, in a socio-cultural perspective, tools like technology are viewed as deeply embedded in the cultural and historical setting and as such are considered bearers of the accumulated collective human experience and knowledge in that cultural context (Vygotsky, 1978). As humans, we create change by developing and using tools; at the same time, tools change us, our perceptions, and our thinking (Vygotsky, 1978; Vygotsky & Luria, 1930/1994). In this study, a socio-cultural perspective was chosen as the analytical point of departure because it allows us to understand digital technology as situated in and dialectically connected to the cultural context (Cole & Derry, 2005; Engeström, 1990; Säljö, 2004). Wartofsky's theory (1973/1979) of artifacts builds on exactly this kind of dialectical thinking about human tools. In this perspective, ITE becomes the cultural bearer of history, tradition and pedagogical thinking.

Teacher education reforms and digital competence in Denmark and Norway

In Denmark, ITE is a Bachelor of Education (B.Ed.) (240 ECTS) for teaching in primary and lower secondary schools at either levels 1–6 or levels 4–10. ITE is only offered at university colleges as a four-year programme. In Norway, ITE is a five-year integrated master's programme (300 ECTS) for teaching at primary and lower secondary schools in three subjects specialising in either levels 1–7 or 5–10; it is offered at both universities and university colleges. Up until 2017, however, both countries had bachelor's degree programmes for ITE (Elstad, 2020). The most recent policy documents at the time of data analysis were from 2015 (DK) and 2012 (NO), which was before Norwegian ITE became a 5-year programme.[1]

Teacher standards, certification requirements and what institutions are allowed to offer ITE are highly regulated and continuously evaluated in both countries. In the last hundred years, Danish ITE was reformed in 1930, 1954, 1966, 1991, 1997, 2006, 2012 and 2015 (with minor revisions in between) (Arstorp, 2015) and Norwegian ITE in 1938, 1973, 1980, 1992, 1999, 2003, 2010 and 2016 (with minor revisions in between) (Karlsen, 2005), making ITE the most frequently reformed education in both countries (Elstad, 2020; Hansen, Phelan, &

Qvortrup, 2015; Karlsen, 2005). The reforms were influenced by a global New Public Management trend that began in the 1980s and pushed for modernisation, efficiency and accountability through centralised educational reforms (Tolofari, 2005).

Norway

The OECD's 1988 review of the Norwegian educational system led to a reorganisation of ITE, increased accountability and ultimately the inclusion of ITE in the higher education system in 1991 (Ministry of Education, 1990; Møller & Skedsmo, 2013). At that time, growing criticism of the quality of education and the competencies acquired by teaching students led to the Quality Reform in 2001 (Norwegian Agency for Quality Assurance in Education, 2006). In 2006, as mentioned, Norway added digital skills to its list of basic skills, all considered equally important, bringing their number to five (Ministry of Education and Research, 2006; Tømte, 2013): oral skills, reading skills, writing skills, numeric skills and digital skills. This led to a digitalisation strategy for basic education 2017–2021 (Ministry of Education and Research, 2018), a national framework for teachers' professional digital competence (PDC) (Kelentrić et al., 2017) and digitisation projects in Norwegian ITE.

Denmark

In Denmark, the New Public Management trend led to the same types of policy reforms to ensure higher educational quality (Bjerre & Dorf, 2019) particularly in ITE, which had been subject to criticism throughout the 1990s and on (Hansen et al., 2015). This eagerness for reform to increase educational quality has impacted the implementation of ICT as well. In Denmark, this was done through several national initiatives, one of the more extensive of which was the Pedagogical ICT Licence [Pædagogisk IT-kørekort] in the 1990s and early 2000s for schools, in-service teachers and ITE (Rizza, 2011). This led to a number of large-scale national projects in the early 2000s (Danish Government, 2003b; Ministry of Science, 2007; Rambøll Management, 2005) and ICT was considered a way *"to increase quality and make sure that more people complete their education"* [author's translation] (Danish Government, 2011, p. 2). In 2001, following the launch of the Partnership for 21st Century Learning (Bertelsen, 2016; P21 Partnership for 21st Century Learning, n.d.), there was a shift towards seeing students as active learners, critical towards information and capable of creating with technology (referred to as *didactic designers*) (Andreasen, Meyer, & Rattleff, 2008; Selander, 2008). And in 2019, *technology comprehension* was launched as a new subject in schools and ITE (University College Copenhagen, 2020).

Data and methods

Policy data

In both countries, ITE is regulated by laws and policy that specify its purpose and structure and the learning objectives for all subjects. These national documents are binding regulations, which the ITE institutions are involved in drafting (Ministry of

Education and Research, 2010b), but the overall responsibility for the content lies with the Ministry of Higher Education (DK) and the Ministry of Education and Research (NO). Between 1992 and 2020, ITE was under the responsibility of various ministries in both countries, but there are no indications that this affected the content or scope of the regulations.

In this study, policy documents are considered representative of, and even *signs* of, political and societal objectives and motives or *political streams* (Lewis & Young, 2013), and this also goes for documents that describe the curriculum. Levin defines curriculum "as an official statement of what students are expected to know and be able to do" (Levin, 2008, p. 8) and this means that policy documents as data capture the embedded intentions and expectations of students in relation to digital technology.

In Norway the *regulations* [Forskrift] for teacher education programs are crafted by the Ministry of Education and Research and provide the overarching policy for the content of the *national curriculum regulations* [Forskrift for rammeplan], as well as the *national guidelines* [Rammeplan/Nasjonale retningslinjer]. The national curriculum regulations and the national guidelines are written by a committee representing the ITE institutions appointed by the Ministry of Education and Research. These regulations and guidelines provide the binding policy foundation for the individual institutions' programme descriptions (Ministry of Education and Research, 2010b). For this study, the Norwegian national guidelines were used as data as they are highest national policy documents specifying the intended learning outcomes for each subject (knowledge, skills and general competence) and thus show "what students are expected to know and be able to do" (Levin, 2008, p. 8).

Table 1 lists the Norwegian policy documents included in this study.

Table 1. The Norwegian policy documents included in this study.

Norway	National policy documents
1992/1994	Ministry of Education Research and Church Affairs (1992/1994), Rammeplan for 4-årig Allmennlærerutdanning, [Framework Plan for 4-year Teacher Education, (1992/1994)]
1999	Ministry of Education Research and Church Affairs (1999), Rammeplan for 4-årig Allmennlærerutdanning [Framework Plan for 4-year Teacher Education]
2003	Ministry of Education and Research (2003), Rammeplan for Allmennlærerutdanningen [Framework Plan for Teacher Education, (2003)].
2010	Ministry of Education and Research (2010a), Nasjonale retningslinjer for grunnskolelærerutdanningen 1. – 7. trinn [National Guidelines for Teacher Education levels 1–7]. Ministry of Education and Research (2010b), Nasjonale retningslinjer for grunnskolelærerutdanningen 5. – 10. trinn [National Guidelines for Teacher Education levels 1–7].
2016	Ministry of Education and Research (2016), Nasjonale retningslinjer for grunnskolelærerutdanningen 1. – 7. trinn [National Guidelines for Teacher Education levels 1–7]. Ministry of Education and Research (2016), Nasjonale retningslinjer for grunnskolelærerutdanningen 5.-10. trinn [National Guidelines for Teacher Education levels 5–10].

In Denmark, the *regulations* for teacher education programs [Lov om uddannelsen] are crafted by the Ministry of Education and Research and provide the overarching policy for the *national curriculum regulations* [Bekendtgørelse]. The latter documents are written by the Ministry of Children and Research but presented to the ITE institutions in early drafts for feedback. Since 2013, Danish ITE has also had *national guidelines* [Studieordningens fælles del] written collectively by the ITE institutions. Before 2013, there were no national guidelines; instead, the national curriculum regulations were implemented directly into *local guidelines*. For this study, the Danish

national curriculum regulations are used as data, as they are the highest national policy documents specifying the intended learning outcomes for each subject (knowledge and skills) and thus show what students are expected to learn related to technology.

Table 2 lists the Danish policy documents included in this study.

Table 2. The Danish policy documents included in this study.

Denmark	National policy documents
1992/1994	Ministry of Higher Education (1992), Bekendtgørelse om uddannelse af lærere til folkeskolen [Ministerial Order on the teacher training bachelor's programme].
1997	Ministry of Higher Education (1998), Bekendtgørelse om uddannelse af lærere til folkeskolen [Ministerial Order on the teacher training bachelor's programme].
2006	Ministry of Higher Education (2006), Bekendtgørelse om uddannelse til professionsbachelor som lærer i Folkeskolen [Ministerial Order on the Professional Bachelor of Teaching Programme]
2012	Ministry of Higher Education (2012), Bekendtgørelse om uddannelse til professionsbachelor som lærer i folkeskolen [Ministerial Order on the Professional Bachelor of Teaching Programme]
2015	Ministry of Children and Education (2015). Bekendtgørelse om uddannelse til professionsbachelor som lærer i folkeskolen [Ministerial Order on the Professional Bachelor of Teaching Programme].

Prior to 1992/1994, Denmark reformed its ITE programs in 1966 and Norway in 1980, but as digital technology was still rather new and had not yet made its way into policy documents, the decision was made to exclude the documents related to these reforms from the study.

Methodology

This study uses document analysis of national curriculum regulations and guidelines, as these policy documents consist of written language that symbolically represents meaning such as values and beliefs (Mik-Meyer, 2005; Yanow, 2000), which Hammersley and Atkinson (2019) refer to as "social products". As such, these policy documents are viewed as a way to access the perspectives, discourses, and intentions related to the role of technology in ITE over time.

The analytical approach used here is inspired by Spradley's *Developmental Research Analysis* (Spradley, 1980) in which the analytical process moves between the empirical (the data analysis) and the analytical field (the theoretical perspective). Hammersley and Atkinson (2019) describe this process as iterative because of the constant moving back and forth between the empirical and analytical fields and note similarities with abductive research processes, including the formation of an initial hypothesis about the object of investigation and movement back and forth between data and theory. The particular quality of this oscillating process is the appearance of patterns and connections that the researcher hadn't noticed earlier, but which emerged when revisiting the data (Hastrup, 1992). Furthermore, the analytical process involves "searching for domains" (Spradley, 1980), or what Hammersley and Atkinson (2019) call "patterns", in the data.

The initial hypothesis was that there would be differences between the countries, such as Denmark having a more dominant focus on the technology itself (Tømte et al., 2019) and Norway having a clearer integrated perspective on the teachers profession due to the Framework for Teachers' Professional Digital Competence (Kelentrić et al.,

2017). Although they served as the starting point for the *developmental research analysis* applied here, these hypotheses were eventually challenged.

The first step of the process was to identify and extract relevant sentences in the policy documents. This was done manually, and the results were supplemented by word searches for words possibly connected to digital technology.[2] In the dialectical process of testing the hypothesis and searching for patterns, different rounds of analysis were conducted[3] and different versions of the analytical framework were developed and discarded in the process of "dancing between the empirical and the analytical field" (Hasse, 2011, p. 141). While time-consuming, the process led to familiarity with the material, and new patterns and domains surfaced. An important part of this method is remaining open to new patterns and domains that surface during the analytical work and moving beyond the initial often mundane categories (Hammersley & Atkinson, 2019). In conjunction with the theoretical perspective of Wartofsky's artifact categories, this process allowed the categories of "tool artifact", pedagogy", and "discourse" to emerge and eventually be consolidated into the following final analytical categories: tool artifacts, teacher professional artifacts and discursive artifacts.

Analytical categories

Many studies have applied Wartofsky's artifact categories as an analytical framework for analysis. In his study of the Finnish healthcare system, Engeström further developed these categories into *where to, why, how* and *what* artifacts (Engeström, 1990). They have also been used to analyse the use of textbooks in a school setting (McDonald, Le, Higgins, and Podmore (2005), to understand digital technology and cognitive processes (Cole and Derry (2005), and to assess the pedagogical potential in digital technology (Stenild and Iversen (2011). A common issue raised in these studies is the interpretation and overlap of the categories. For example, Stenild and Iversen (2011) consider textbooks to be tertiary artifacts (p. 141); however, Gillespie and Zittoun (2010) find them more difficult to categorise as a textbook can be perceived by a teacher as a tool for learning/teaching (primary artifact) but also as a means of transmitting content as cultural knowledge (secondary artifact) while to a bored student it might represent daydreaming (tertiary artifact). This illustrates how an artifact can move between categories depending on the perspective applied, which means that although Wartofsky's categories offer analytical opportunities, they can also create ambiguity. The theoretical framing of this analysis aims to delineate the boundaries of each category to enhance clarity and minimise ambiguity.

Tool artifacts

This category is based on Wartofsky's category of primary artifacts, which are physical tools, such as a hammer, a needle or a camera (Cole, 1996, 2019; Wartofsky, 1973/1979), that allow people to transform their material reality when using them for specific actions in an activity such as nailing something to the wall, sewing or preserving a memory. In this perspective, technology becomes a tool supporting different actions and processes in the classroom, such as calculating, visualising, drawing, recording, learning languages, and being creative.

The following are examples of technology as a tool artifact in the policy documents

DK [German as a Foreign Language]: "The student **can use digital technologies and interactive media** appropriately in German lessons" (Ministry of Children and Education, 2015, p. n.a.).

NO [Arts and Crafts]: "[The student] **can use digital tools** in creative processes" (Ministry of Education and Research, 2010a, p. 52).

As these examples show, the tool artifact category was applied when technology is used as a tool for a process, when focus is on the specific use, or even in some cases on mastering the technology or requiring the right digital skills.

Teacher professional artifacts

This category is based on that of secondary artifacts. Secondary artifacts are internal or external representations of primary artifacts and their use (Wartofsky, 1973/1979), which Wartofsky describes as "representation of modes of praxis themselves (… .) representation of its uses, and of the modes of praxis appropriate to such uses" (Wartofsky, 1973/1979, p. 206). Manuals, norms, customs and traditions are secondary artifacts as they are representations of modes of action related to primary artifacts (Cole, 1996). A manual, for example, is a representation of an action with a physical tool: "whenever we contemplate on the nature and use of a tool, we activate and manipulate secondary artifacts, internal and external representations concerning that tool" (Engeström, 1990, p. 173).

This category relates to modes of action and goals connected to the use of tools, or in other words, it applies when the physical tool is connected to an internal, abstract representation (Cole & Derry, 2005). In this study, pedagogical and didactical aspects are considered such representations; whereas ideas and concepts of pedagogy are abstract, they can be put into action with the use of a physical tool or artifact. This could be evaluating digital learning materials or using them to ensure inclusion and adapted education, but also teaching students reading or understanding algebra. Technology in this category includes internal representations of pedagogical ideas brought into an external representation such as a pedagogical practice with a physical tool.

The following examples are found in the policy documents:

NO [Practice period]: "[The student can] assess and use varied learning materials based on **pedagogical and didactic reflections**, for instance learning **materials based on information and communication technology**" (Ministry of Education, 1999, p. 51).

DK [French as a foreign language]: "**Analyse and assess materials** for French lessons, including **media and information and communication technology**" (Ministry of Higher Education, 1998) (appendix 6).

As these examples show, the teacher professional artifact category applies when technology is being used in a way that represents pedagogical ideas or models a pedagogical practice such as planning, analysing or reflecting, to name a few.

Discursive artifacts

This category is based on that of tertiary artifacts. Tertiary artifacts and are "forms of representation themselves come to constitute a 'world' (or 'worlds') of imaginative

practice" (Wartofsky, 1973/1979, p. 207). Engeström gives the examples of novels, art, socio-political visions, and paradigms (Engeström, 1990). These artifacts are not directly connected to primary or secondary artifacts; they constitute "a relatively autonomous 'world'" (Wartofsky, 1973/1979, p. 208) and are "embodied in actual artifacts, which express or picture this alternative perceptual mode" (Wartofsky, 1973/1979, p. 209). Stenild and Iversen add that this type of artifact invites future use of other artifacts (Stenild & Iversen, 2011). Säljö (2000) suggests calling this type of artifact *discursive artifacts* because they mediate collective thinking and thus discursive notions about the world and us in it.

When combining this understanding of socio-political visions, discourses and future use, technology in this category becomes a sign of something beyond its physical representation and its pedagogical use: it becomes an abstract, a symbol/sign of change, or in some cases it may even be seen as the actual driver of change.

The following are some examples from the policy documents:

DK [History]: "The objective is that the student acquire . . . .competence and be able to understand and reflect upon the connection between present-day understandings, past interpretations and future explanations, including **the influence of IT, media and context on perceptions of historical explanations**" (Ministry of Higher Education, 2012) (section 2.2).

NO: "The problem will be to overcome and compensate for **the spectator role and the passivity that media can offer**" (Ministry of Education, 1992/1994, p. 14).

As these examples show, the discursive artifact category applies when discourses are connected to technology, namely its potential for the future beyond the physical artifact and pedagogical practice.

These three categories represent a continuum from the concrete (tool artifacts) to the abstract (discursive artifacts), with teacher professional artifacts in the middle, as illustrated by the arrow on the right column in this table.

Table 3, the three analytical categories developed for this study.

Table 3. The three analytical categories developed for this study.

Type of artifact	Perspective on technology	
Tool artifact	Technology is used for a specific action, to support processes in the classroom, e.g. calculating, showing a video or as a tool for creative and productive processes. *Technology is a supporting tool to be mastered.*	Concrete
Teacher professional artifact	Technology is an internal representation of pedagogical ideas brought into an external representation such as a pedagogical practice with a physical tool. Examples are evaluating digital learning materials, ensuring inclusion of all students with digital tools, but it could also be teaching reading or understanding algebra etc. *Technology is interwoven in teachers' pedagogical thinking and professional practice.*	
Discursive artifact	Technology is connected to creating change for an unknown future (e.g. better language skills needed in a globalised world). *Technology becomes a sign of change going beyond the physical tool and the pedagogical practice.*	Abstract

Results

Digital technology in policy documents in Denmark and Norway

The frequency of each type of artifact category from all policy documents was analysed by country and later compared. Every sentence related to technology was counted and the percentage of how often each category was found in each document was calculated.

Norway

Table 4 shows the frequency and examples of all three categories from each Norwegian document, 1992–2016. The percentages have been rounded to the nearest whole number and thus do not add up to 100% in all cases.

The findings related to frequency from Table 4 are displayed by category in Figure 1 revealing a slight fluctuation in the frequency of tool artifacts over time and a steadier increase in teacher professional artifact. The discursive artifact category shows a decrease over time and is barely present in the latest documents.

Figure 1 shows each of the three artifact categories in Norwegian policy documents from 1992 to 2016.

Denmark

In the Danish policy documents, the results are slightly different.

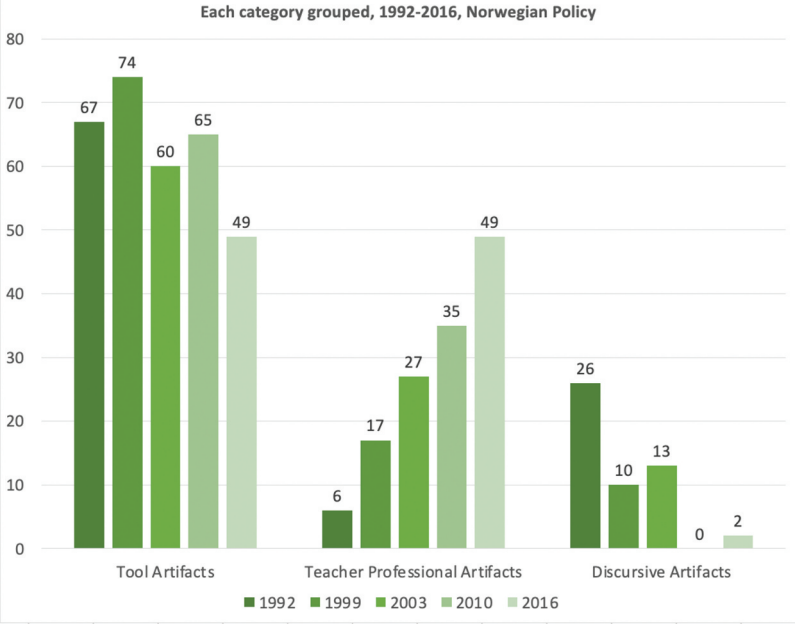

Figure 1. Each category grouped, 1992–2016, Norwegian policy

Table 4. Frequency and examples of all three categories from each Norwegian document, 1992-2016.

Technology in Norwegian policy documents (see Table 1 for a list of documents)				
Year	Words used	Tool Artifacts	Teacher Professional Artifacts	Discursive Artifacts
1992, examples	• information technology • new media • computer	• becoming familiar with technological tools through courses if they have low familiarity with such tools	• using technology in a subject didactical context • understanding the demand for a practical and theoretical basis for using information technology for pedagogical purposes due to increased information flow	• understanding the challenges in society due to increased amounts of information • understanding the changing world view and the new conditions for pedagogical work
Frequency	30 sentences[a]	20 = 67%	2 = 6%	8 = 26%
1999, examples	• information and communication technology • ICT • newer media • mass media • computer	• finding information, learning languages • communicating • using technology as new tool for subject specific methods • creating courses for students unfamiliar with technological tools	• using technology for gathering, evaluating information • reflecting upon the use • evaluating the limitations and quality of different technologies for teaching in a critical and reflective way	• understanding the consequences of technology on learning and the difficulty of teachers staying updated
Frequency	42 sentences[b]	31 = 74%	7 = 17%	4 = 10%
2003, examples	• information and communication technology • (new) technology • electronic and ICT/ICT-based	• using technology a tool and an aid for communication and learning • working creatively and critically with technology • learning to analyse the ICT tools • evaluating ethical aspects of use	• evaluating the use of technology/technological tools • reflecting critically upon use	• understanding the consequences of the technological impact on society and new ways of learning through media and ICT
Frequency	30 sentences[c]	18 = 60%	8 = 27%	4 = 13%

(*Continued*)

Table 4. (Continued).

Technology in Norwegian policy documents (see Table 1 for a list of documents)

Year	Words used	Tool Artifacts	Teacher Professional Artifacts	Discursive Artifacts
2010, examples	• digital tools/ learning resources/learning platforms/ arenas • media • internet	• mastering digital tools as one of the basic skills • using technology for communication, ans as learning resource • applying technology to subject specific methods	• evaluating and critically assessing use of technology in teaching and learning situations • understanding the learning potentials and limitations such as: the new role of the teacher, how to inspire students and how to differentiate learning	*not present*
Frequency	55 sentences[d]	36 = 65%	19 = 35%	0%
2016, examples	• digital tools • learning resources • learning platforms • learning arenas • digital skills • media • internet • digital competence	• developing basic skills and digital competence • using technology as a tool for dissemination and communication • understanding technology as a digital learning resource • applying technology to subject specific content and methods	• planning, executing and critically evaluating learning activities • teaching students to evaluate and critically reflect upon the learning potentials and limitations	• understanding the importance of addressing changes in students' everyday digital life [in social studies]
Frequency	43 sentences[e]	21 = 48,8%	21 = 48,8%	1 = 2,3%

[a]1 sentence represents two categories and is counted in both categories
[b]1 sentence represents two categories and is counted in both categories.
[c]5 sentences represent two categories and are counted in both categories.
[d]7 sentences represent two categories and are counted in both categories.
[e]3 sentences represent two categories and are counted in both.

Table 5. Frequency and examples of all three categories from each Danish document, 1992-2015.

Technology in the Danish policy documents (see Table 2 for a list of documents)				
Year	Words used	Tool Artifacts	Teacher Professional Artifacts	Discursive Artifacts
1992/1994, examples	• information and communication technology • technology • electronic media	• using technology as a tool, a learning material and an aid for communication and learning • using technology for data analysis	• establishing criteria for use • analysing ict as a learning material • evaluating the use of technology • using technology for argumentation, planning, dissemination and evaluating of teaching • integrating technology in subjects and subject methods	*not present*
Frequency 1998, examples	27 sentences[a] • information and communication technology	13 = 48% • using technology as an aid for communication and learning • using technology as a teaching tool and for data analysis	14 = 52% • being able to establish criteria for use of technology in teaching • analysing, planning, executing and evaluating teaching with technology	0% *not present*
Frequency 2006, examples	23 sentences[b] • information and communication technology • it • virtual • media • digital technology	10 = 43% • using technology as a tool and an aid for processes • using technology for subject specific methods and content	13 = 57% • planning teaching with technology • analysing and arguing for choices made • evaluating the use of technology	0% *not present*
Frequency	40 sentences[c]	20 = 50%	20 = 50%	0%

(*Continued*)

Table 5. (Continued).

Technology in the Danish policy documents (see Table 2 for a list of documents)

Year	Words used	Tool Artifacts	Teacher Professional Artifacts	Discursive Artifacts
2012, examples	• information and communication technology • it • virtual • media • digital technology	• using technology as a tool for subject content • using technology in subject related processes (e.g. communication)	• planning and organising teaching with technology • arguing for choices made when teaching with technology • analysing and evaluating learning materials • using technology for subject related content and methods	• understanding and reflecting upon the impact of ict and media on historical explanations and connections
Frequency	50 sentences[d]	28 = 54%	23 = 44%	1 = 2%
2015, examples	• digital media/ pictures • digital learning materials/ resources etc. • technology • it/it-based • interactive media • electronic	• using technology as a tool for subject content • using technology in subject related processes (e.g. data gathering, analysing, producing music)	• planning, organising, evaluating and developing teaching with technology • using learning materials suitable for students' abilities and knowledge • using technology in accordance with learning objective and content	*not present*
Frequency	73 sentences	57 = 79%	15 = 21%	0%

[a]One sentence represents two categories and is counted in both.
[b]One sentence represents two categories and is counted in both.
[c]One sentence represents two categories and is counted in both.
[d]Two sentences represent two categories and are counted in both.

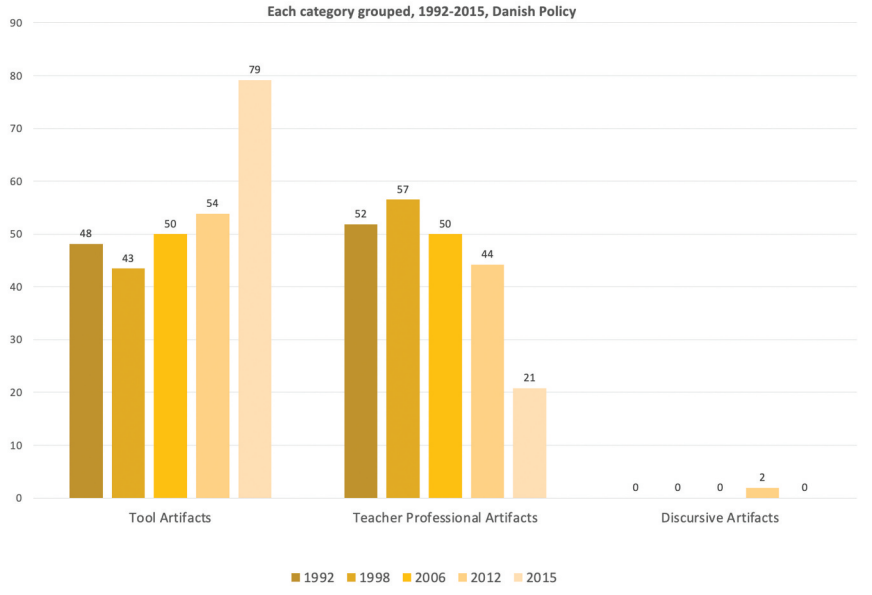

Figure 2. Each category grouped, 1992–2015, Danish policy

Table 5 shows the frequency and examples of all three categories from each Danish document, 1992–2015. The percentages have been rounded to the nearest whole number and thus do not add up to 100% in all cases.

The findings from Table 5 are displayed by category in Figure 2, revealing a steady increase in tool artifacts in the policy documents and a decline in teacher professional artifacts. Discursive artifacts are only present in 2012.

Figure 2 shows each of the three artifact categories in Danish policy documents from 1992 to 2015.

Discussion

Tool artifacts and teacher professional artifacts in Norwegian policy

Looking more closely at the early Norwegian policies, it becomes apparent that tool artifacts are more prevalent than teacher professional artifacts, which are only mentioned a few times. However, these differences even out over time and the two categories are represented equally in more recent policy documents as shown in Figure 3.

Figure 3 compares the presence of tool artifacts and teacher professional artifacts in Norwegian policy documents from 1992 to 2016.

The increase in teacher professional artifacts in the Norwegian documents can be related to a general increased focus on the professional aspects of teaching with technology such as the introduction of the Norwegian concept of teachers' professional digital competence in 2012 (Guðmundsdóttir et al., 2013; Krumsvik, 2016; Ottestad, Kelentrić, & Guðmundsdóttir, 2014) and the Framework for Teachers' Professional Digital Competence for Norwegian TE (Kelentrić et al., 2017). This can be seen as a

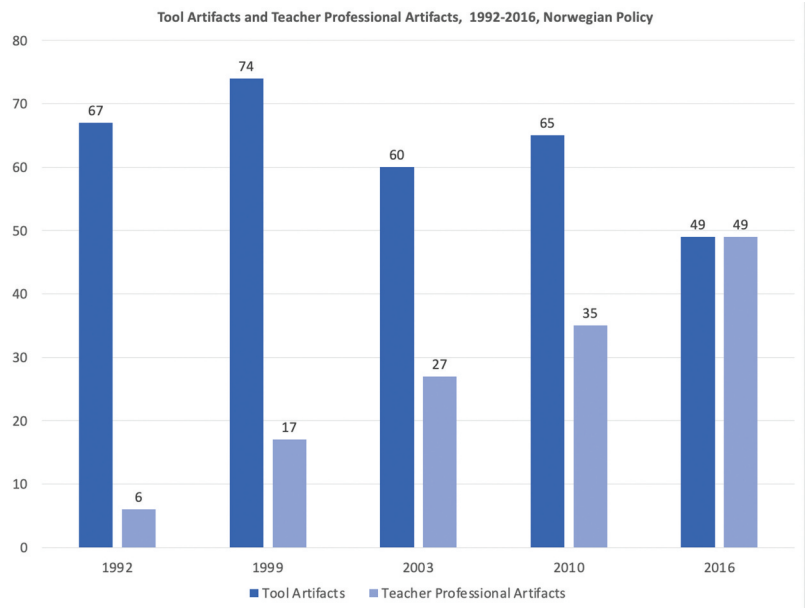

Figure 3. Tool artifacts and teacher professional artifacts, 1992–2016, Norwegian policy

shift from a tool-oriented perspective on technology to a more teacher-centred perspective.

However, the 2006 Norwegian Knowledge Promotion (Ministry of Education and Research, 2006), which defines digital skills as "a prerequisite for further learning and for active participation in working life and a society in constant change" and as "being able to use digital tools, media and resources efficiently and responsibly, to solve practical tasks, find and process information, design digital products and communicate content", seems to challenge this conclusion (Norwegian Directorate for Education and Training, 2012, p. 12). The language used in these quotes falls under the tool artifact category. While we might assume that calling for an emphasis on digital skills in 2006 would have led to an increase in the presence of tool artifacts in policy documents in the years that followed, the presence of teacher professional artifacts increased instead.

This move towards a teacher professional perspective is also supported by the Norwegian government's subsidised in-service training of teachers in many different subjects, including *professional digital competence*, through the New Competence Model (Ministry of Children and Education, 2018a; Ministry of Education and Research, 2015; OECD, 2019). Another example of an increased emphasis on the teacher professional perspective is the work of the Ministry of Education and Research to increase the professional digital competence of teachers in HE (Ministry of Children and Education, 2018a; Tømte et al., 2019) and funding for five PDC development projects with Norwegian ITE institutions in 2018–2020 (Ministry of Education and Research, 2017). These examples indicate that the implementation of digital skills in 2006 was accompanied by a strong political will to invest in the development of teachers'

professional digital competence, which could explain the increase in teacher professional artifacts.

Tool artifacts and teacher professional artifacts in Danish policy

In Denmark, things developed a bit differently: tool artifacts and teacher professional artifacts appear with nearly the same frequency from 1992 to 2012; however, this changes in 2016 with a 4:1 ratio favouring tool artifacts.

Figure 4 compares the presence of tool artifacts and teacher professional artifacts in Danish policy documents from 1992 to 2015.

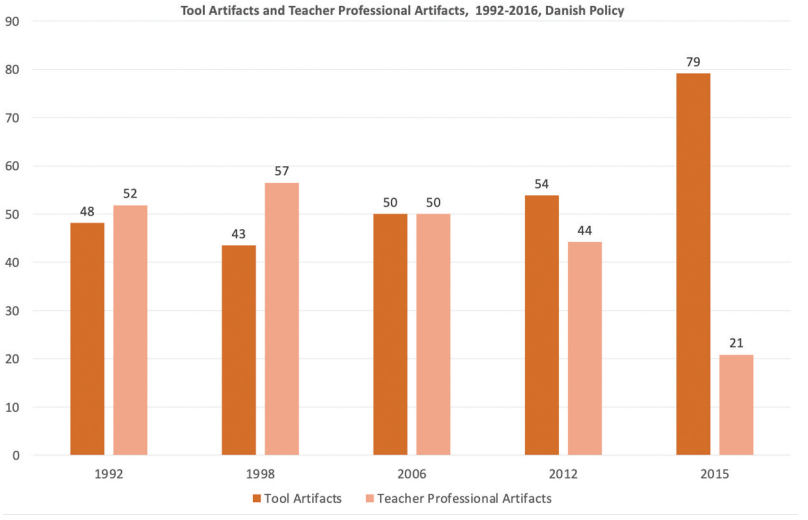

Figure 4. Tool artifacts and teacher professional artifacts, 1992–2016, Danish policy

There are contextual factors supporting this finding, one of which is the ICT guide developed for ITE in 2007 (Ministry of Children and Education, 2007). This guide describes technology as a tool for retrieving, processing, and distributing materials and knowledge and communicating about it. It also suggests that students should acquire "IT and media educational design skills" and the competence to use and produce digital products. Such references to technology can be categorised as tool artifacts (with elements of teacher professional artifacts) and thus could be seen as a sign of a wider national and political focus on the more tool-oriented aspects of digital technology implementation. This could explain the findings in Figure 4.

Another explanation of this surge in tool artifacts is the political push to privilege technology and STEM education (The Danish Government, 2017) to prepare students for a future with more digital technology where STEM skills are required. To this end, a *Technology Pact* was created between businesses, schools, and educational institutions working together to increase STEM skills in Danish primary and secondary schools (Teknologipagten, n.d.). Related to this political interest in STEM, the subject of *technology comprehension* [Teknologiforståelse] was launched in primary and lower secondary schools (Ministry of Children and Education, 2018b) and subsequently also in ITE (Rehder et al.,

2019; Teknologipagten, 2021). The objective was to get more students to choose STEM education, acquire STEM-related skills, understand technology, and be able to create and design new technologies. These skills can be related to the tool artifact category since technology is a supporting tool for production and processes. These examples indicate the impact of political intentions and national trends on policymaking in ITE and could explain the decrease in frequency of teacher professional artifacts compared to tool artifacts observed in policy documents.

Discursive artifacts in Norwegian and Danish policy

As shown in Figure 2 discursive artifacts are mentioned only once in Danish policy in 2012 in relation to "media's impact on historical explanations and connections" (Ministry of Higher Education, 2012, p. 33). As shown in Figure 1, the appearance of discursive artifacts in Norwegian policy diminished over time: mentioned rather frequently in the earliest policy documents, they were entirely absent in 2010 and appeared in only one sentence in 2016.

Explanations for the decrease in the frequency of discursive artifacts could be that implementing technology was no longer perceived to be a novelty that required explanation. The absence of explanations and of reasons for implementing technology is not a new phenomenon, having been observed by Cuban (2003) and Selwyn (2010). Research, including OECD studies, indicates that teachers still struggle to keep up with rapid technological development and to utilise technology in learning and teaching. A recent survey done by the OECD shows fewer teachers in Denmark reporting a need for ICT skills (11.2%) than in Norway (22.2%) (OECD average: 7.7%). When it comes to teachers feeling well or very well prepared to use ICT, this is the case for 39.5% of Danish teachers and 35.8% of Norwegian teachers (OECD average: 42.8%) (OECD, 2020a, 2020b). The results show that while more Norwegian teachers than Danish teachers have a need to develop ICT skills, they nevertheless feel better prepared to use ICT; both countries are still below the OECD average. Based on this, one could argue that the challenge of increasing teachers' digital competence persists, which, it could be argued, would necessitate clear objectives for the use of technology. What is interesting is that this is found in other policy documents, such as the Norwegian Framework for Teachers' Professional Digital Literacy (Kelentrić et al., 2017), which includes the following expectations:

- [the student] understands how digital developments are expanding and changing the subject's contents, conceptual framework, forms of assessment, and working methods (p. 4)
- [the student] has insight into how digital developments influence the world and society (p. 5)

Similar examples are found in a recent Danish status report for digitalisation in education: "we need to use technology wisely" and "along with being thrilled [at all the new opportunities] we also need to be critical" and "there's concern about the possible negative effects of digitalisation [on children's mental, social and physical health]" (Ministry of Children and Education, 2019, p. 3). These examples show that

technology can be categorised as a discursive artifact in other government publications for both countries. It remains unclear why the discursive artifact perspective isn't more present in the policy documents studied as the need for explanations and directions seems to still be present. Indeed, this absence seems to run counter to the goal of increasing PDC in ITE.

Conclusion

This study analysed policy documents from Norwegian and Danish ITE from the 1990s to the present and categorised sentences mentioning technology into three categories based on Wartofsky's work on artifacts. The analytical categories developed for this study were tool artifacts, teacher professional artifacts and discursive artifacts, and they were applied to policy documents showing interesting variations over time and between the countries. Norway moved from a tool artifact perspective towards a teacher professional artifact perspective, while Denmark moved in the opposite direction. This could be explained by political trends and research in the field the two countries, as these seem likely to have influenced policy-making. In Norway, even though digital skills (related to the tool artifact category) were implemented in 2006, there was an increase in the perspective of teacher professional artifacts in policy documents, which was connected to the 2017 introduction of the framework for teachers' professional digital competence (PDC). In Denmark, the opposite development was observed, with an increase in the tool artifact perspective and a decrease in the teacher professional artifact perspective. This was explained by a strong focus on STEM and technology comprehension (related mainly to the tool artifact perspective).

The connection between political intentions and policy was challenged by the decrease in discursive artifacts found in this study. This category appeared only once in the Danish documents (in 2012); it appeared more often in the Norwegian documents although declining over time (absent in 2010). The need for direction and purpose when implementing technology in education seems to only have increased through the years, and teachers, and ITE in particular, are struggling to implement technology and realise policy ambitions. There is a need for critical thinking and for an understanding of how technology makes sense in a teacher's professional pedagogical work that is not addressed in the Norwegian and Danish national policy documents studied here. The lack of discursive artifact perspectives and explanations related to technology could potentially result in a tool-based approach to technology in ITE rather than a teaching-based approach.

Notes

1. No new framework has been written for ITE in NO since the changes in 2017.
2. Words used in manual and digital searches in policy documents: information and communication technology, internet, media [~ digital, mass, interactive], computer, digital [~ tools, learning resources, skills, competence, learning resources, learning platforms, arenas], *electronic, virtual, technology, interactive and ICT/ICT-based*.
3. The initial codes were "Basic skills, Digital tools, Digital skills, Digital competence, ICT, Technology, Media, Net/online," followed by "Pedagogical compatibility, Technological

proficiency, Social awareness" (Instefjord & Munthe, 2016) and then by "pedagogy, tool artifact, discourse."

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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