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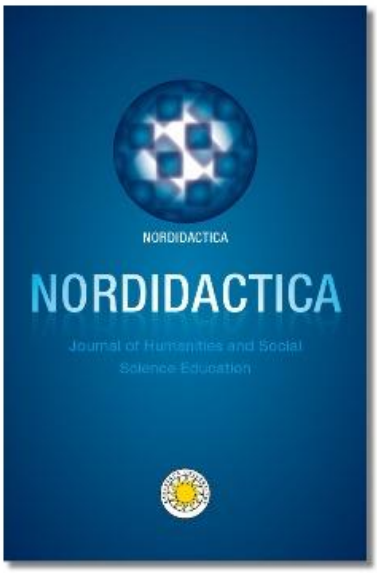

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Going Digital? Geography Education in Swedish Secondary School

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Abstract: In this article we explore teachers' view of what secondary geography education implies in a digital teaching and learning environment. Based on a regional survey with subject teachers (n=47) in the Swedish county of Värmland, this study relies on theories of teachers' professional management competences. The survey revolves around two broad themes: the teachers' personal relation to the subject and geography teaching in relation to digitalisation. One main interest of the study was to find out what digital tools and subject-specific digital tools are used when teaching certain aspects of geography. Overall, managing geographical methods and analysis (for example executing field studies) stands out as the geographical aim that challenges teachers' professional management. The usage of digital tools and subject-specific digital tools, such as GIS, varies in geography education, but when dealing with more complex subject content, the usage of subject-specific tools tends to be less frequent.

KEYWORDS**:** GEOGRAPHY TEACHING, DIGITAL TOOLS, SUBJECT-SPECIFIC DIGITAL TOOLS, DIGITAL COMPETENCE, TEACHERS' KNOWLEDGE BASE

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Geography education in a digital learning environment

The field of geography is part of an increasingly dynamic field of knowledge affected by societal changes such as globalisation, urbanisation, climate change and a rapid technological development concerning spatial information and data. This leads to new challenges for geography as a school subject, and teaching geography is an increasingly complex issue in what can be called a "hyper-socialised" educational context (Mitchell 2019). Especially technology and ongoing digitalisation processes are augmenting education and teachers' work and curriculum enactment today. For instance, the fact that vast resources are available online brings about new challenges for teachers who work in a digital context, such as the need for source criticism, the need to recontextualise ready-made material in relation to their own teaching and not to forget, the need to balance and combine the aim to educate students in subject-specific knowledge acquisition and the aim to educate students in generic overall digital competence.

Putting this in a Swedish perspective, the National Digitalisation Strategy states that schools should encourage students to develop their digital competence and their understanding of how digital technique is used as well as using technology for creative exercises, for instance by creating different solutions. Students should also be given the opportunity to attain a critical and responsible relationship to digital technology (Utbildningsdepartementet 2017). Since the implementation of the national curriculum (Lgr11), aspects of digitalisation have been present in the geography curriculum, for instance in the following passage: "… education in geography should deal with methods for collecting, processing, assessing and presenting geographical data, covering climate, health and trade, using maps, Geographical Information Systems (GIS)[1] and geographical tools available on the internet, such as satellite images" (Skolverket 2011, reviderad 2018).

Based on this context, may geography teachers in Swedish secondary schools possibly be accustomed to using and utilizing digital technology and tools when teaching? Previous research, however, tends to indicate the opposite: secondary and upper secondary teachers often lack sufficient knowledge of GIS (Schubert & Johansson 2019). Teachers also tend not to use digital tools they are not educated in (Kerski 2003; Schubert & Johansson 2019; Wechsler & Pitts 2004). In other words, geography teachers tend not use GIS extensively, but what digital tools do they actually use? Furthermore, acknowledging the complexity of geography as a school subject, what challenges and possibilities are geography teachers facing as teachers and in their teaching? The purpose of the study presented in this article is to investigate teachers' view of what secondary school geography education implies in a digital teaching and learning environment. The study was carried out through a survey of teachers teaching

[1] There are many definitions of GIS, see for instance the discussion in Andersland (2011). In this article GIS is interpreted in its widest sense.

geography in secondary schools focusing, on their view of geography education and their use of digital tools in geography teaching.

The study is part of a regional research school (FUNDIG) and based on the overall aim to develop empirical knowledge and contribute to teachers' communities of practice in relation to digitalisation as a part of education and teaching. A specific aim of this study is to acquire a deeper understanding of geography teachers' usage of digital tools and technology in the region of Värmland. In turn, this enables the development of a knowledge base for further practical interventions such as professional development ventures. Hence, a regional perspective on geography teaching and digitalisation has been the empirical focus of this study.

Geography teaching, digitalisation and geographical thinking

From a Nordic perspective, the field of research engaging in geography education, geography teaching and teachers' subject-specific knowledge would not be described as a broad research field (Bladh & Molin 2012). Adding different aspects of digitalisation to geography teaching in secondary schools, the Nordic research field decreases further. However, research on the usage of GIS (Geographical Information Systems) in teaching and learning situations is a broad research field worldwide (Andersland 2011; Bednarz 2004; Fargher 2019; Hong 2014, 2017; Lam et al. 2009; Ratinen & Keinonen 2011). Furthermore, especially in the American context, geospatial technologies are used as an overall framing concept for a rapidly growing area of research (Baker et al. 2015). The term *geomedia* expands the perspective to the broader field of digital learning materials in geography education, and this has also been an extensive, but diverse research area (for Germany, see Klein 2007). There is an ambiguity in the classification of what is considered GIS and geomedia, which also includes a discussion on how to classify digital tools in a generic sense and digital tools used in a subject-specific context (see Hilander 2016 for a discussion on geomedia). New simpler forms of GIS, such as web-GIS and multimedia-based forms of digital mapping, are rapidly changing the availability of useful digital tools. Technological development has also brought a changed context where any spatial tools, digital maps and data sets that were formerly only used by scientists are now in the hands of the general public, for instance in our mobile phones.

Kerski (2015) highlights the potential of the technology that introduces issues central to geography as part of everyday knowledge. While this development constitutes a global possibility of geo-awareness and geo-enablement, it might also call for increased attention to geography education, both in relation to specifically educational concerns and in relation to society at large. Geospatial technologies put issues about place and space in focus. Kerski states that geoliteracy competences are needed for assessing and using geographical information. He divides *geoliteracy* into three building blocks (i) core content, (ii) skills in using geographic tools, and (iii) the geographic perspective.

In a broad geography education context, inspired by the capability approach developed by Sen and Nussbaum, Lambert and Morgan (2010) (see also Lambert 2016) argue that a specific *geocapability perspective* can contribute to specifying what

geographical knowledge can bring to young people's education. They summarize powerful knowledge in geography as: a) deep descriptive "world knowledge", b) a theoretically informed relational understanding of people and places in the world, and c) the propensity and disposition to think about alternative social, economic and environmental futures.

This connects to an extensive discussion of what constitutes the "big ideas" in geography, powerful knowledge, central geographical concepts or "core content" more in detail (Bonnett 2012; Lambert 2016; Maude 2017; Taylor 2008) and what different kinds of geographical knowledges should be important in geography education (propositional, procedural, inferential, affective and so on) (Roberts 2016, Catling 2019). However, a more common agreement emphasizes a specific type of geographical gaze which defines the subject of geography, namely what Kerski (2015, p. 18) calls geographic perspective, understood as "a certain way of seeing the world, working through a series of interwoven and changing spatial relationships", or what Lambert and Morgan (2010, p. 66) define as "relational understanding of people and places in the world".

Variations in terminology indicate a range of complex, subject-specific aspects of geography teaching and learning. Such variation and complexity concern spatial issues and how to understand and categorize geographical information in terms of: *geographical thinking*, *spatial thinking* and *relational thinking*. Peter Jackson (2006) compares this perspective to the general notion of geography as a subject that deals with knowledge of the world learned by heart, a sort of Trivial Pursuit knowledge. According to Jackson, geographical thinking offers a unique and powerful way to study the world from different perspectives, for example local and global, and an opportunity to understand complex problems. Brooks (2018) argues for the usage of geographical concepts for the purpose of developing the ability to engage in geographical thinking. The way we understand geographical concepts affects our understanding of geographical phenomena. In addition, the ability to reason about spatial distributions and patterns, spatial interactivity and spatial relations is considered as spatial thinking in a geographical context, sometimes defined as geospatial thinking (Favier & van der Schee 2014).

Kerski (2015) and Lambert and Morgan (2010) also in both cases implicitly acknowledge the significance of the geographic inquiry process, which involves asking geographical questions, using geographical concepts, thinking geographically and doing geography, thus combining "the building blocks" of geoliteracy or the three central geocapabilities presented above, often in more complex ways.

Turning back to a Swedish and Nordic perspective, a national evaluation of compulsory school in Sweden was conducted in 2003 and the results revealed that geography education was mainly focused on factual knowledge such as names and locations of places while for instance relational thinking skills, did not attract the same attention (Lundahl et al. 2006). Bladh (2014) confirms this and highlights the

differences between teachers who are educated in geography[2] and teachers who teach geography but lack university credits in the subject. Teachers who are educated in geography tend to address these more demanding aspects of the geography subject in their teaching to a greater extent than teachers who have no university-level in geography. Witzel Clausen (2016) shows a similar result from a Danish context when investigating Danish lower secondary geography teachers' topic-specific pedagogical knowledge when teaching weather formation and climate change: approximately half of the teachers who teach geography (52 %) have university credits and diplomas in geography.

Nordic research on geography teaching and learning with digital tools and GIS adds up in a few examples: Kankaarinta (2009) investigated how web-based material and its use have developed within the field of geography didactics and Andersland's (2011) research elucidates perspectives on how GIS can be used and developed within geography education in secondary schools. In this context, Arrhenius' research on upper secondary students learning when meeting computer-based animations about the rock cycle in geography education also makes an interesting contribution. Both Susanne Kjällander (2011) and Linnea Stenliden (2014) focused on learning with digital tools in a social science context. However, their studies did not deal primarily with subject-specific content knowledge but mainly with digital tools as a source for learning general competences used in all social science subjects.

As a whole, research on geography teaching in a digital learning and teaching environment has a gap to fill.

Definitions and analytical aspects

One of the main issues while designing the study was how to deal with the concept *digital tools*. As a concept, it is often discussed in research concerning education and digitalisation; often in contexts where *digital competence* or similar capabilities are discussed and defined. Mishra and Koehler's framework of technological pedagogical content knowledge (TPACK) enables clarifications when discussing what kind of versatile knowledge a teacher needs when teaching a specific subject in a digitalised classroom. TPACK also emphasizes how the connections between teachers' understanding of content, pedagogy and technology interact to produce effective teaching (Koehler et al. 2014). This perspective draws attention to the question whether digital competence could be regarded as a generic or a subject-specific competence.

In policy documents, such as the national curriculum, the concepts digital technology, digital tools and digital media are used almost interchangeably. According to the Swedish National Agency for Education, digital competence has no rigid

[2] To exemplify and explain: an educated teacher in secondary schools in Sweden might have an exam, or teaching degree, in history, religion and civics, but not in geography, but still be teaching geography. The most common way to organize education in Sweden is that social science teachers teach all social science subjects, that is history, religion, civics and geography.

definition, and consequently it changes as technology and society change. A digital tool could be a physical device, such as a computer or a tablet, a software program or an internet-based service (Skolverket 2017). In this sense, the word *service* includes a wide range of web-based resources, tools or items that can be used in education or for educational purposes; it could equally be an open source as a school-financed resource. Adding the terms used within geographical educational research, such as *geospatial technologies*, *geomedia* and *geoliteracy*, the number of definitions increases further.

Most teachers are familiar with the concept digital tools, but some clarifications were needed in the context of this study. To specify the digital tools and resources used in geography education, an additional definition was developed: *subject-specific digital tools*. A *digital tool* was defined in a wider sense in the survey: that is as hardware (for instance a computer, an iPad) or software such as a program or an internet-based program/resource. A *subject-specific digital tool* was defined as a digital tool or learning resource that is developed to manage geographical data/information. Our model below (figure 1) shows the relationship between digital tools and subject-specific digital tools (SSDT). The relationship is non-hierarchical. Rather it is a move from a general usage level to a more subject-specific usage level, making SSDT a particular example in relation to a range of digital tools. For instance, a subject-specific digital game is an example of a subject-specific digital tool.

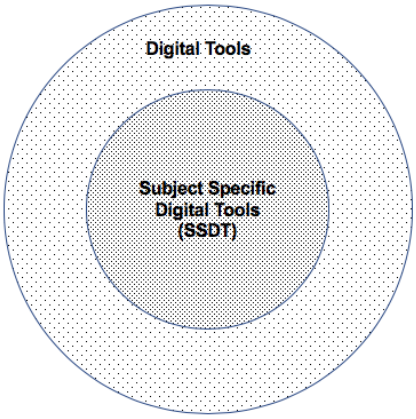


FIGURE 1.

Model of the concept digital tools and subject-specific digital tools.

We made a categorisation (see table 1) inspired by an overview of digital tools in mathematics education carried out by the Swedish Institute for Educational Research (Bergman et al. 2017). Our categorisation was based on definitions and probable areas of usage in a geography teaching and learning environment. In this context, the work carried out by Sui (1995) on how to implement GIS in teaching needs mentioning. Sui's model based on teaching *about* or *with* GIS referred to the different types of geographical knowledge that are needed when moving from using GIS to show geographical data and information to using GIS to form geographical knowledge (Rød et al. 2010).

TABLE 1

Categorisation of digital tools and subject-specific digital tools

Categories	**Description**	**Examples**
1. Digital tools	Digital tools, in a generic sense, that can be used in geography education but are not specifically developed for the geography subject.	Word processing programs, presentation programs, Quizlet, YouTube, different film programs (for instance Green-Screen by Do Ink), web publishing tools
2. Subject-specific digital tools	Subject-specific digital tools with which geographical phenomena, such as digital maps, can be presented. While using this learning resource the learner can adapt, construct and manipulate geographical phenomena, for instance by changing the scale.	Google Earth and different digital mapping programs.
3. Subject-specific digital games	Subject-specific digital tools and learning resources that use the gaming mechanism to mediate content knowledge.	Seterra, Geoguessr, Turfgames Minecraft in cooperation with the Swedish mapping, cadastral and registration authority,
4. Subject-specific programs/ software	Programs/software not necessarily developed for geography education but can be used when working with geographical big data, statistical data, and thinking skills, such as geographical analysis.	QGIS, Gapminder, Storymaps, Esris GIS-material, Lantmäteriets kartsamlingar (Geoskola)
5. Digital learning material	Digital tools and learning resources that have been developed specifically for education and for the different subjects. This is extensive, course material developed to be used over a longer period of time and for different age groups and usually comes with a teacher's manual and other resources.	Digital textbooks (See Swedish EdTech Industry map of the publishers and companies: http://www.edtechkartan.se/) NE (national encyclopedia)
6. Digital (meeting and social) platforms where information and lesson plans can be distributed and shared	Digital tools and learning resources where different lesson plans, teaching materials, screen casted or filmed presentations and other tips and tricks can be spread online.	The Swedish National Agency for Education digital assessment web page, SO-rummet, lektion.se, lektionsbanken.se, teacher blogs, channels on YouTube for instance, Facebook groups for teachers
7. Digital learning platforms used to give feedback and conduct assessment	Digital tools that are used in education for formal documentation of student learning outcome, feedback on assignments and grading.	Dexter/IST lärande, Skola24, It's learning, DigiExam

Teachers' knowledge base and digitalisation

This study revolves around the intersection of between teachers' subject matter knowledge, pedagogical knowledge and technological knowledge. In a Swedish language context, these issues would be discussed within a subject didactical framework. Here, however, we will use Shulman's framework of teachers' knowledge base in order to maintain a broader contextualization and framing of the conditions of teachers' professional knowledge (see Kansanen (2009) and Deng (2018) for some differences between the traditions). Within the tradition of teacher's knowledge base, different aspects of PCK have been fruitfully studied (Kind 2009; Shulman 1986, 1987). Gess-Newsome (2015) and Kind (2009) draw on ideas from Shulman when elaborating the content of pedagogical content knowledge (PCK) and discuss the importance of teachers' subject matter knowledge and curricular knowledge. Mishra & Koehler (Koehler et.al. 2014) have also included technological knowledge as an important aspect. When studying teachers' profession, these different aspects of teachers' *knowledge base* are crucial and this study will therefore focus on teachers' subject matter knowledge and teachers' PCK.

In order to link geospatial technologies (and geomedia) to geography teaching, there is a need for further theoretical standpoints. Building on Shulman's (1986, 1987) characterization of different types of teacher knowledge, the German educationalists Baumert and Kunter (2006) have constructed a model of teachers "professional management competence" (see figure 2).

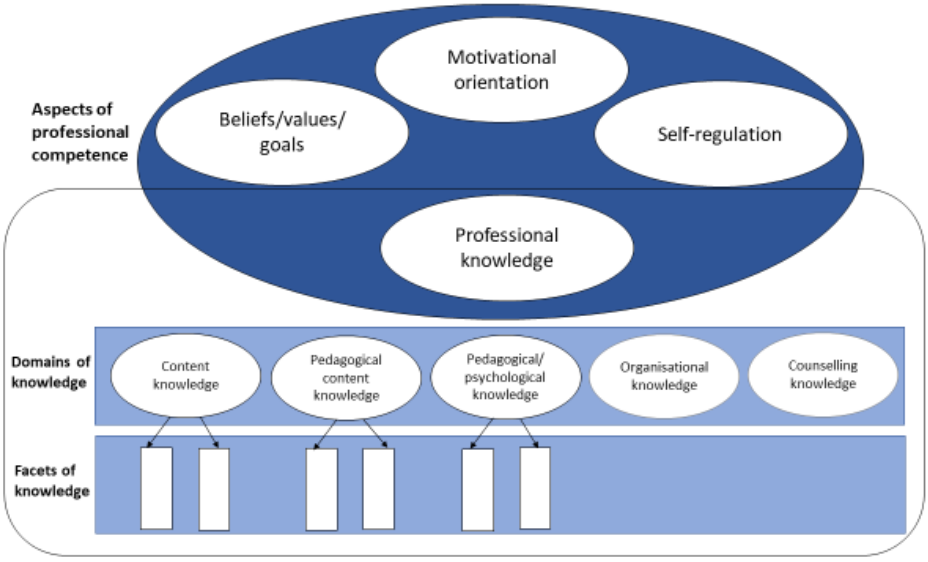


FIGURE 2.

Model of Teachers' Professional Management Competence (After Baumert & Kunter 2006). English translation in Wuttke & Seifried 2017.

The model of teacher professional management competence includes professional knowledge as well as beliefs, motivational orientation and self-regulation. In line with Shulman, professional knowledge includes content knowledge, pedagogical content knowledge and pedagogical knowledge. These aspects can be explained and specified

as different facets of knowledge. Organisational knowledge and counselling knowledge are also included but not further developed in the model. Technological knowledge is not specifically mentioned in the model.

The investigation of what geography teaching looks like in a digital teaching and learning environment and what types of digital tools are used when teaching specific geographical content is related to the conditions of teachers' professional knowledge. Teachers' beliefs are influenced by their subjective theories and epistemological convictions about teaching and learning. Professional commitment and self-comprehension also influence teachers' management competence. Further, there are also contextual factors such as student group, type of school and different organisational conditions for teaching.

In the context of our study, the model of teachers' professional management competence will be used to situate and analyse the relations between teachers' knowledge base, digitalisation and geography education as well as contextualise the conditions for teaching geography in a digital environment. Based on the purpose of the study, to investigate teachers' view of what secondary school geography education implies in a digital teaching and learning environment, the following research questions have been specified:

1. How do geography teachers in secondary school describe geography as a school subject and geography teaching?
2. What types of digital tools are used in geography classrooms and in what thematic context of geography education are digital tools used?
3. How do geography teachers in secondary school perceive their professional management competence in geography education?

Study design and data collection

The data presented in this article derive from a survey and were collected through a quantitative method. The idea of the survey was to conduct a regional case study and investigate what secondary school geography teaching looks like in a digital teaching and learning environment. The case study was based on the overall aim to develop empirical knowledge and contribute to teachers' communities of practice in relation to digitalisation as a part of education and teaching. The questionnaire was constructed to be answered online and anonymously, and sent out to social science (SO) teachers in secondary schools (grade 7-9) in the region of Värmland in Sweden. Most of the questions were in the form of multiple-choice and likert scale questions. Questions were organised and formulated in line with the language and content of the geography curriculum, a text most teachers are accustomed to.

Survey design

The organisation of the survey and the types of questions asked draw on ideas from the previous national survey undertaken in 2012 (Gottfridsson & Bladh 2012), leading to the following order: first, questions concerning teachers' personal relation to

teaching; second, teachers' subject knowledge and relation to geography as a subject; and third, geography teaching and digitalisation.

The questions concerning teachers' personal relation to teaching served to elicit background information about the respondent group, such as for how long they have worked as teachers, previous university studies, what subject they teach besides geography and aspects of accreditation such as teacher certifications and lead teacher positions.

The second part included questions concerning teachers' subject knowledge and their views on teaching geography in particular. This part served to obtain information about the respondents' views of geography as a subject and their subject knowledge, in other words their knowledge base. Among questions about what content they teach, the respondents were also asked to decide what aspects of geography teaching they found more and less complex. In order to attain information about the perceived management competence, questions concerning the respondents' confidence in teaching certain aspects of geography were included.

The final part focused on the usage of digital tools and subject-specific digital tools when teaching geography, and how to deal with teaching specific thematic aspect of the geography subject when using digital tools/SSDT.

Data collection and methodological considerations

Since this study has a regional research interest, headmasters, assistant headmasters or administrative staff at secondary schools in Värmland were contacted in order to inform about the research project and gain access to e-mail addresses to the teachers. In total, the questionnaire was sent out to N=117[3] teachers and the response rate was 40%, that is n=47 respondents in total.

The data collected was transferred to Statistical Package for Social Sciences (SPSS) where it was analysed, mainly by descriptive statistics such as frequencies, mode and mean comparisons (Field 2018). In table 4 and 6 mode value was used. As the use of likert scales in the survey clearly indicated a gradient in the respondents' answers, calculated mean value was used complementary in the analysis of the degree of usage of digital tools and SSDT (table 5), in order to show clear tendencies in the material at group level.

The respondents were divided into two categories: *teachers with university credits in geography* and *teachers without*, that is teachers who teach geography but lack university credits in the subject. These two categories were chosen in order to analyse whether there are differences in dealing with certain aspects of geography teaching and in the choice and usage of digital tools when teaching. However, it is important to note that teachers without subject-specific education may have a teacher degree and a teacher certification. When implementing teacher certifications in December 2013, rules regarding certifications gave secondary school teachers with more than eight years of

[3] Two schools declined to take part in the study, and one school did not respond, despite several attempts. The teachers at one of the schools piloted the questionnaire.

experience teaching a subject the opportunity to receive accreditation in that specific subject despite not having studied or completed university-level courses in the subject as part of their teaching degree (Skolverket 2019).

No specific noncompletion analyses were made but the total amount of possible respondents was compared to SiRis, the open access statistical service provided by the Swedish National Agency for Education in Sweden. According to SiRis[4], there are 143 teachers teaching social science in secondary schools in Värmland. 95% are accredited teachers in one or more subjects. 92 teachers have accreditation to teach geography. Statistics from SiRis show that 64,3% (92/143) of the social science teachers in Värmland are certified to teach geography. Similar data from the survey indicate 61,7%. This implies that the respondent group can be understood as a representative for the total amount of secondary school geography teachers in the region of Värmland.

Results

First, results concerning background information about the respondent group will be presented, followed by a presentation of the results related to the two main themes of the survey: teachers' subject knowledge and relation to geography as a subject and geography teaching and digitalisation. The results reveal differences between the two analytical entities and indicate that over all, certified teachers tend to be more secure in dealing with different aspects of the geography curriculum (subject aims and specified content). This also applies to the use of digital tools and subject-specific tools when teaching.

Background information: teachers' personal relation to teaching

Data about the respondents (n=47) comprise different information related to the respondents' teaching background (see table 2). This includes data about how long the respondents have been working as teachers, what subject they teach apart from geography and information about the respondents' teacher training and formal accreditation.

Most of the respondents have worked as teachers between 15 and 25 years (see table 2). 81% of the respondents have teacher certification and 62% of the respondents have university credits in geography, while 19% lack teacher certification and university credits in geography. As mentioned previously, this may not necessarily imply that this group of respondents have not completed a teaching degree. Some have received accreditation to teach geography due to long experience of teaching the subject even though they may lack university credits. In Swedish secondary schools, social science teaching is often organised as a combined and interdisciplinary subject area, which generates a pedagogical situation where teachers may teach more subjects than they are accredited in.

[4] The statistics from the statistical service SiRis at the Swedish National Agency for Education were collected at the same time as the questionnaire was launched (February 2019).

The subject-specific knowledge, or university credits in geography, varies among the respondents who have attended geography studies at university level. About 30% of the respondents lack university credits in geography and 45%, have studied up to one semester/one semester, that is 30 university credits in geography. These results are similar to the findings presented in the National Survey on Geography Teachers by Gottfridsson and Bladh (2012).

A majority (90%) of respondents teach all four social science subjects. Most respondents are qualified to teach history and a majority (85%) are qualified to teach religion and/or civics. Most of the social science teachers also tend to have an interest in and identify with either history or civics. Apart from teaching the social science subjects, Swedish and Swedish as a second language were mentioned by 32% of the respondents. Other subjects were also mentioned, such as English and home economics. About 25% of the respondents have lead teacher positions and 40% state that school or specific teaching development assignments as a part of their employment.

TABLE 2

Respondent information, such as frequencies and percental distribution regarding years in practice, university credits, accreditations, teacher certificates.

Years in practice	**Percentage (frequencies)**
1-5	34 (16)
6-10	21,3 (10)
11-15	10,7 (5)
16-20	17 (8)
20>	17 (8)
Subject accreditations	
Geography	61,7 (29)
Civics	85,1 (40)
History	89,4 (42)
Religion	85,1 (40)
Other	36,2 (17)
University credits in geography	
None	29,8 (14)
Less than 1 semester[5]	6,4 (3)
1 semester	38,3 (18)
2 semesters	12,8 (6)
3 semesters	4,3 (2)
More than 3 semesters	8,5 (4)
Teacher certifications	
Yes, and I have credits in geography	16,7 (29)
Yes, but I have no credits in geography	19,15 (9)
No	19,15 (9)

[5] One semester equals 30 university credits.

When planning geography lessons and themes, 83% of the respondents state that the geography subjects receives an equal amount of time compared to the other social science subjects taught and in communities of practice, the figure drops to 57%. These findings confirm the results in the national survey undertaken in 2014 (Bladh 2014).

To sum up, the number of years practicing as a teacher was first expected to be an important factor in the analysis. When the analysis was conducted, the results showed almost no evident linkage and therefore this factor will not be regarded equally as crucial as university credits.

Subject knowledge and relation to the geography subject

The survey aimed to obtain data in order to understand how secondary teachers comprehend and describe the subject geography. This includes information about what central themes occur in their geography teaching, and what they regard as the most important task for geography as a school subject. The most frequent answers to this question included the following aspects: worldview and knowledge of the world; the interaction between human, nature and environment; and climate change and sustainable development. Worldview and knowledge of the world are mentioned in the curriculum and the respondents describe this aspect of teaching as something they should *give* the student or something the students *should attain* understanding about or knowledge of. Knowledge of the world is also mentioned. Some respondents describe and exemplify what perception of the world is: it is about attaining an overall picture of the earth/the globe, a mental map of the world, a spatial perception of the world, and an awareness of the construction of the world and its inhabitants

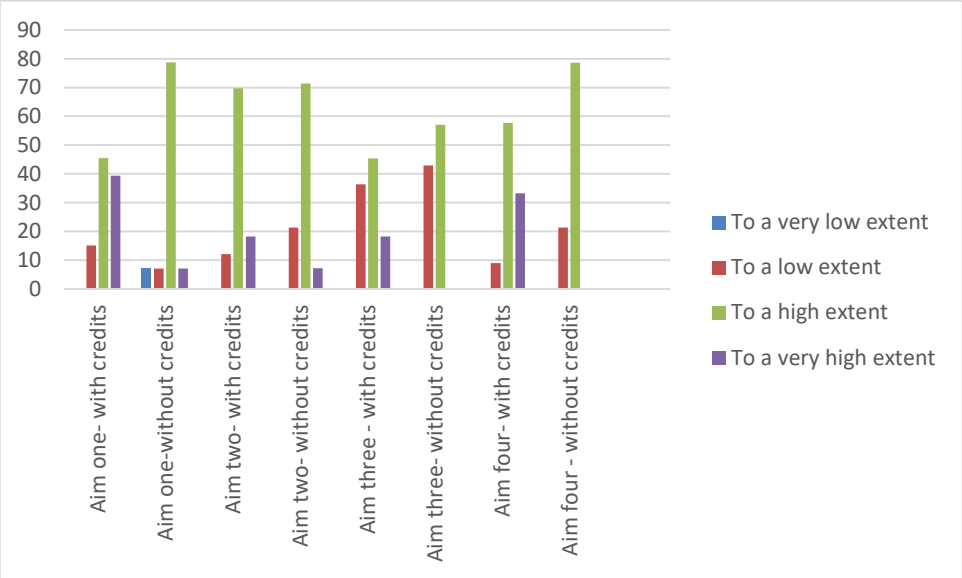
The respondents were asked to rate their level of confidence in relation to teaching the different subject aims and specified content. In this context, high confidence in dealing with a specific subject aim implies that the respondents find this aspect of teaching manageable. In other words, data concerning confidence give an idea of the respondents' knowledge base and perceived professional management competence in geography.

As a whole, teachers with credits in geography estimated their confidence to a significantly higher extent (high to a very high extent combined) than the teachers without university credits for all aims (See table 3). Regarding the subject aims, subject aim three which is about making "… geographical analyses of the surrounding world, and evaluate the results by using maps and other geographical sources, theories, methods and techniques…" (Skolverket 2018) is the subject-specific aim that most respondents report low confidence in teaching: 36% of the teachers with credits in geography and 43% of the teachers without credits.

TABLE 3; FIGURE 3

Confidence in teaching subject aims in geography, teachers with and without credits in geography

Aim one: Analyse how natural processes and human activities form and change living environments in different parts of the world.
Aim two: Explore and analyse the interaction between people, society and nature in different parts of the world.
Aim three: Make geographical analyses of the surrounding world, and evaluate the results by using maps and other geographical sources, theories, methods and techniques.
Aim four: Assess solutions to different environmental and development issues based on considerations concerning ethics and sustainable development.



The respondents made a similar estimation of the level of confidence when teaching the specified content. The specified content includes a range of different topics within different areas of geography and is made up of 14 subject-specific aspect (or themes) that should be dealt with at least once in geography education in secondary schools (see the geography curriculum (Skolverket 2018, pp. 201-202)). As a whole, the respondents reported high confidence to very high confidence in dealing with different parts of the specified content with one explicit difference: teachers with credits in geography tend to rate their level of confidence to a very high extent whereas teachers without credits rate their confidence to a high extent. The general result at group level is presented in table 4. Teachers with credits in geography expressed very high confidence in teaching specified content A, B, D, E, F, M and N: climate and vegetation zones, climate change, population geography, names of more important locations and knowledge of different maps, development geography and relational geographical aspects of development.

Teachers without university credits on the other hand, rated their confidence as high in teaching this content. Statistically significant differences between teachers with and without credits were found in specified content A, B and F. Both respondent groups reported having the least confidence teaching specified content G and H. G deals with field work and H deals with methods to collect, process, assess and present geographical data.

TABLE 4

Confidence in teaching aspects of the specified content, mode value. Themes A-N derive from the Swedish geography curriculum (Skolverket 2018 pp. 201-202).

		Credits in geography	No credits in geography
A	Climate and vegetational zones	++	+
B	Climate change	++	+
C	Economic geography	++	+
D	Population geography	++	+
E	Names and locations	++	++
F	Knowledge about maps	++	+
G	Field studies	-	-
H	Geographical methods	-	-
I	Keywords and concepts	+	+
J	Vulnerable places and areas	+	+
K	Conflicts about natural resources	+	+
L	Energy	+	+
M	Development geography	++	+
N	Relational geographical aspects of development	++	+

Scale (confidence): ++ Very high; + High; - Low; -- Very low

Geography teaching and digitalisation

Before proceeding to the results concerning what digital tools and subject-specific digital tools (SSDT) are used in geography teaching, some general results concerning digitalisation and teaching will be presented.

A majority of the respondents, 66%, are positive to the digital changes in the policy documents, on all different levels, both in the overall aims of education as well as the subject curricula. The respondents with 15-20 years in practice tend to be more positive towards digitalisation. Those who regard themselves as more negative towards digitalisation are mostly found in the group of teachers who has the least number of years as practicing teachers.

The schools provide their staff with digital equipment. All respondents mention having a personal computer provided by the school. Approximately 38% of respondents also have access to a tablet, and 36% mention having access to GPS for instance via a smart phone.

Furthermore, the respondents were asked to estimate their acquisition of digital knowledge and competence, such as knowledge about what digital tools to use and how to plan and teach with these tools. Most respondents acquired knowledge on their own (79%) or from co-workers (60%). 19% mention having attended programs or education, focused on digital competence, arranged by the municipalities or the Swedish National Agency for Education. 43% mention social media as places to acquire new digital knowledge. The results follow a similar pattern in both groups of teachers, with or without credits in geography. A majority of the respondents, more than 90%, express a great need of further education in how to use digital tools and SSDT when teaching. At the same time, a majority of the respondents, in both groups, express having high confidence in using SSDT when teaching.

As a whole, when looking at the estimated usage of digital tools and SSDT in different teaching situations, there are minor differences between the respondents. Both teachers with credits and teachers without encourage the usage of digital tools and SSDT and estimated their own usage to a high and very high extent when their students engage in project work (89%), information search (98%), take part in teacher led activities (68%) and group work (70%) or studied on their own. Digital tools and SSDT are least used when students are engaged in discussions (62% low to a very low extent).

Let us now turn to the main interest of the study: to investigate what types of digital tools and subject specific-digital tools are used in geography teaching. The results presented in table 5 show a tendency of a large spread in the usage of digital tools and SSDT in geography education. The overall usage of digital tools and SSDT varies within the two respondent groups except for categories 1 (general digital tools), 3 (subject-specific digital games) and 5 (digital textbooks), where both groups of respondents follow a similar pattern. Teachers with credits in geography tend to have a slightly higher usage than teachers without credits, and in category 1 there is a substantially higher usage. The large spread in the usage of digital tools in general can be clearly seen in categories 5 and 7, digital textbooks and digital learning platforms.

Proceeding to the subject-specific digital tools, the results concerning categories 3 and 4 reveal evident differences. The usage of category, 3 subject-specific games, is much higher than category 4, subject-specific software programs that can be used when describing and analysing larger amounts of digital information and data. A scant majority of the respondents use subject-specific software programs to a low or very low degree.

TABLE 5

The usage of digital tools and subject-specific tools; percentage.

Digital tools and subject-specific digital tools		To a very low extent	To a low extent	To a high extent	To a very high extent
1. Digital tools where exercises and lesson plans can be created with a greater amount of interactivity compared to a non-digital textbook, for instance a web publishing tool.	Teachers with credits in geography (pct)	12,1	12,1	51,5	24,2
	Teachers without university credits (pct)	28,6	21,4	42,9	7,1
2. Subject-specific digital tools that facilitate presentation of different geographical phenomena in different ways due to the adjustments made possible within the SSDT, for instance Google Earth.	Teachers with credits in geography (pct)	6,1	27,3	48,5	18,2
	Teachers without university credits (pct)	7,1	35,7	50,0	7,1
3. Subject-specific digital games – the subject-specific content is conveyed by using gaming mechanisms, for instance Seterra or Geoguessr.	Teachers with credits in geography (pct)	6,1	15,2	42,2	36,4
	Teachers without university credits (pct)	-	14,3	71,4	14,3
4. Subject-specific software programs that can be used when describing and analysing larger amounts of digital information and data, for instance Esri GIS or Gapminder.	Teachers with credits in geography (pct)	15,2	36,4	45,5	3,0
	Teachers without university credits (pct)	28,6	28,6	35,7	7,1
5. Digital learning material, textbooks or other major extensive/voluminous digital resources that schools pay for, for instance Gleerups or National Encyclopedia.	Teachers with credits in geography (pct)	6,1	36,4	24,2	33,3
	Teachers without university credits (pct)	14,3	21,4	50,0	14,3
6. Digital platforms where teaching ideas and lesson plans are spread and shared, for instance SO-rummet and Facebook.	Teachers with credits in geography (pct)	6,1	18,2	57,6	18,2
	Teachers without university credits (pct)	14,3	14,3	57,1	14,3
7. Digital learning platforms that are used for lesson planning, feedback and grading, for instance IST lärande or Itslearning.	Teachers with credits in geography (pct)	24,2	18,2	30,3	27,3
	Teachers without university credits (pct)	35,7	7,1	28,6	28,6

This is a revised version of the table 210826

The last part of the results concerns what digital tools and subject-specific digital tools (SSDT) are used when teaching the specified content in geography. In total, the

results show that there is significant variation among the respondent teachers in both groups. The general result at group level is presented in table 6. Mode value is used, but calculated mean value was used complementary to sort out values with mixed rating in between low or high. Those values are displayed as blank fields. Therefore, table 6 identifies evident general tendencies in the material even though the analysis clearly indicated variations at individual level.

Over all, the results for the respondents in total indicate a moderate usage of digital tools and SSDT when teaching the specified content. Both groups expressed high usage in teaching specified content B, climate change, D, population geography, J, vulnerable places and areas and M, aspects on development. Teachers with credits in geography had a slightly higher usage of digital tools and SSDT in relation to specified content A, climate and vegetational zones, C, economic geography, L, energy, and N, relational geographical aspects of development. For several aspects of the content, the degree of usage of digital tools and/or SSDT is neither in a high or low extent at group level (see table 6). This is also indicated by the relatively low usage of SSDT and digital tools when teaching specified content H, geographical methods. However, individual variations occur among the respondents in both groups.

TABLE 6

The degree of usage of digital tools and/or SSDT when teaching aspects of the specified content; mode value.

		Credits in geography	No credits in geography
A	Climate and vegetational zones	+	
B	Climate change	+	+
C	Economic geography	+	
D	Population geography	+	+
E	Names and locations	++	+
F	Knowledge about maps	+	-
G	Field studies	-	--
H	Geographical methods		
I	Keywords and concepts		
J	Vulnerable places and areas	+	+
K	Conflicts about natural resources		
L	Energy	+	
M	Aspects on development	+	+
N	Relational geographical aspects of development	+	

Scale (usage): ++ Very high; + High; - Low; -- Very low

The most significant differences between teachers with and without credits were found in specified content F, knowledge about maps and content knowledge E, names and locations. There is a significant difference between teachers with and without credits in geography in using digitals tools and/or SSDT when dealing with specified content E. However, this is a theme where the usage is the highest for both groups. The

results also show that specified content G, field studies of the natural and cultural landscape such as community planning in local communities, stands out as the content aspect estimated as being taught with the least usage of digital tools and SSDT, and this counts for both respondent groups.

Discussion

This study sought to investigate teachers' view of what secondary school geography education implies in a digital teaching and learning environment. Data was collected through a survey distributed to nearly all teachers teaching secondary school geography (year 7-9) in the region of Värmland, Sweden. The study investigated different aspects of teachers' knowledge base, and specifically tried to identify how teachers perceive their own professional management competence (compare Baumert & Kunter 2006) in relation to geography teaching and digitalisation.

When the study was planned, the number of years practicing as a teacher in geography was expected to be important for grouping the respondents. This did not turn out as a significant factor, except when it comes to teachers' attitudes towards digitalisation in school as a whole. The second analytical entity, university credits, proved to be an important factor.

RQ 1 (how teachers of geography in secondary school describe geography as a school subject) relates to teachers' knowledge base, and in relation to this area of inquiry the results provide insights in several ways. The results are especially clear when it comes to respondents' confidence in relation to teaching different aspects of geography. Those aspects connect to RQ 3 (how teachers interpret their own management competence).

Over all, when reflecting on the aim of geography education, the teachers described six important themes. The most frequent answer relates to teaching about the world; worldview and knowledge of the world. Interaction between human and nature, climate and sustainable development, tools and geographical methods as well as knowledge of maps and names of places were also mentioned. The answers correspond closely to the current Swedish curriculum. These themes may hint at the selective traditions of geography teaching in Sweden, where one main focus has been on teaching geographical names (Molin & Grubbström 2013).

When asked about confidence in teaching the subject aims of geography, most teachers state having a high confidence, but teachers with credits in geography are clearly more confident in dealing with the different aspects of geography. However, subject aim 3, which deals with making geographical analysis and using geographical methods, techniques and sources, is the subject aim teachers from both respondent groups express less confidence dealing with when teaching. This aim relates to a more complex type of teaching which involves more developed pedagogical content knowledge.

Looking at the teachers' confidence in teaching the specified curricular content, both respondent groups agreed about feeling most insecure about dealing with field studies

in education and making geographical analyses and managing different methods for collecting, processing, assessing and presenting geographical data with the usage of Geographical Information Systems (GIS) and geographical tools available on internet. The subject aim and specified content concerned with geographical analyses and methods are linked to a combination of different kinds of geographical knowledge, including propositional and procedural knowledge. Geospatial thinking is important when analysing the interaction between people and their environment in different parts of the world (Favier & van der Schee 2014). This includes asking geographical questions and analysing geographical data, using geographical concepts and perspectives and different kinds of procedural skills, such as map reading and the usage of SSDT and other geographical tools. This is in line with combining the different "building blocks" of geoliteracy (Kerski 2015) when making geographical analyses. Thus, in order to teach complex aspects, teachers themselves need an understanding of geographical thinking. This points out the need for subject-specific content knowledge and the ability to connect that to relevant pedagogical content knowledge for teaching. The specified content concerning field studies is also typical geographical content knowledge which requires geographical thinking. But planning and executing excursions is also time consuming, potentially costly (more staff might be needed, transportation cost and so on) and weather dependent. Our results identified that teachers' perceived management competence in geography teaching is clearly connected to the complex area of doing geographical analysis and using different methods.

Turning to the digital aspect of the study (RQ 2), the majority of the respondents were positive towards the increase of digital content in the curriculum but some sceptics were found among the group with the least number of years as practicing teachers. This result could be explained by many possible reasons, among which a competence gap or negative experiences of being taught with digital tools (hence the scepticism) could serve as two tentative explanations. An interesting question to raise in this context is in what ways different teacher education programs prepare teachers for managing teaching in digital classrooms. Also, the result pinpoints teacher's acquisition of technical competence as an important part of their professional management competence. It is mainly based on their own interest and acquired through their own experience and from co-workers. Just about 20% of the respondents have attended in-service training. The newly employed teachers might not have had the time to acquire this self-learned experience needed to execute teaching with digital tools in a fruitful manner. This may draw some attention to the discussion about teacher training programs, previously brought forward by Schubert and Johansson (2019), focusing on what subject-specific digital tools are brought into the education. The result also relates to research by Kerski (2003) and Wechsler och Pitts (2004) which indicates that teachers tend not to use digital tools they think that they have insufficient knowledge of.

Over all, the respondents showed a positive attitude towards using both digital tools and SSDT and they are also positive about the assets of digital equipment provided by their schools. However, the results clearly indicate a large spread of usage of digital

tools like digital textbooks and digital learning platforms at different schools, which may anyhow signal a lack of adequate assets in some cases.

Using digital tools when teaching places demands on teachers' technological, pedagogical and content knowledge. Interesting in this context however is the fact that the responding teachers tend to estimate their own usage of SSDT to a lower extent than their usage of these when teaching. In other words, teachers are not confident enough to use this technology for their own use/purpose, but they use it when teaching. Since the curriculum specifically states that SSDT should be used in geography education when working with geographical methods, teachers might feel pressured to do so even though they lack education, experience and confidence to actually use this technology. Using SSDT when teaching pushes the demands on teachers' competences even further. Adding the results about communities of practice to the picture, geography is not as prioritized as the other social science subjects. Thus, the opportunities to share ideas and learn from colleges about how to use SSDT in different aspects of geography teaching are limited.

Another main result reveals the fact that there are few differences between the respondent groups when looking at the specific usage of digital tools and SSDT when teaching different themes in geography. The results show an apparent uneven usage of digital tools and SSDT. Even though teachers with credits in geography overall tend to estimate their confidence higher when teaching aspects of geography and significantly higher on some aspects of specified content, this tendency does not apply when adding digital tools and SSDT. Two general tendencies are revealed. *First*, the absolute highest usage of digital tools/SSDT for both respondent groups occurs when teaching specified content E, names and locations. Category 3, subject specific games (Seterra for instance), is the SSDT category which is most commonly used by the teachers from both groups. These results indicate that geography teaching with SSDT occurs more frequently when dealing with repetitive learning and factual learning of names of places and location. Using subject-specific games could also be stimulating and motivating for students to improve their results and hence learn more.

Second, geographical themes in the curriculum that are more demanding when it comes to teachers' geographical thinking and deeper content knowledge, are generally taught with lesser usage of digital tools and/or SSDT. This is most visible when looking at results on specified content G, field studies. This is also the aspect of geography teaching where teachers with and without credits differ the most in their confidence related to their usage of SSDT. In specified content H, geographical methods, it is explicitly expressed that SSDT should be used in the geography education, but the results, for both respondent groups, show a substantial spread in usage.

When looking at the categories of subject-specific digital tools used in geography education, this tendency is also revealed. Subject-specific software programs which can be used when describing and analysing larger amounts of digital information and data, for instance Esri GIS or Gapminder, stood out as the least used SSDT category. Teachers may have *learned about* SSDT but experience a competence gap when applying the knowledge into practice, *teaching about* and even *with SSDT*. This result

is similar to that presented by Osborne et al. (2019) and also verifies previous research (see Schubert och Johansson (2019)).

The rapidly changing digital world is clearly changing the role and practice of geography education. Living within a digital world influences and changes teachers' work as well as young peoples' lives. Kerski (2015) acknowledge the potential of geospatial technologies for geography teaching. He highlights the development of web-based GIS-tools and the expanding resources of digital maps and data as key factors for making those technologies more easily available in the geography classroom. He further states the need of geoliteracy competences in school and society, and the key role of geography education in that context. Fargher and Healey (2021) gives further examples of how the potential of web-based GIS can contribute to develop students' powerful geographical knowledge. While acknowledging the potential geospatial technologies for geography education, Healy and Walshe (2021) also call for a more critical reflection on how the digital world influence teachers' professional practice, and what role teachers can play in helping students navigate in their everyday digital world.

Conclusion

The study presented in this article sought to explore teachers' view of what secondary school geography education implies in a digital teaching and learning environment. The respondents were analysed in two different groups, teachers with and without credits in geography. In general, teachers with credits in geography showed more confidence in teaching certain aspects of geography. In this case subject-specific education seems to affect their perceived management competence. However, more complex specified content that combine geographical thinking, content skills, such as teaching with and about geographical methods (for example field studies) stood out as the aspect of geography teaching where both respondent groups reported the least confidence. This indicates that developing pedagogical content knowledge in these areas should be an important part of teachers' professional development in geography.

The teachers were over all positive towards digitalisation, but nonetheless the results show a tendency of a large spread in the usage of digital tools and SSDT in geography education. Based on a categorisation on digital tools and subject-specific digital tools (SSDT), the teachers from both responding groups used subject-specific software programs (which are used to describe and analyse large amounts of digital information and data) the least among the SSDT categories. In addition, the absolute highest usage of digital tools/SSDT for both respondent groups occur when teaching specified content E, names and locations. Geographical themes in the curriculum that demand the combination of thematic content knowledge, geographical thinking and procedural knowledge, are in general taught with lesser usage of digital tools and/or SSDT.

This study is a regional study based on a fairly small population. However, the results show similar tendencies as a previous large-scale study in Sweden (Bladh 2014). There are no indications that teachers and teaching conditions in Värmland differ in any particular way from the rest of Sweden. Similar results have also been presented in a

Danish study (Witzel Clausen 2016). The study addresses a complex teaching context and a dynamic field for research in geography education. It does not give an insight into *how* teachers actually use digital tools and SSDT when teaching geography in a school classroom and thus implies the need to carry out further research with an approach based on qualitative methods. Design-based research could also give important input for further explorations of how geography teaching in a digital classroom could be developed. This includes considering the complexity of combining different kinds of powerful geographical knowledge, for example when developing enquiry-based geography teaching through field studies.

This study also highlights that teachers need professional development in the areas of teaching complex aspects of geography and using SSDT in their teaching.

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