

Applying digital technologies to enable communities of inquiry in the design of higher educational settings

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Keywords: Higher education, Technology enhanced learning, Community of Inquiry, Mixed methods.

General description on research questions, objectives and theoretical

This extended abstract attempts to describe the current status for the introductory chapters (kappa) of a compilation thesis ('Kappa till avhandling', n.d) with four articles (Sundgren, 2017; Sundgren & Jaldemark, 2020; Sundgren & Mozelius, [Submitted]; Sundgren et al., [Manuscript]).

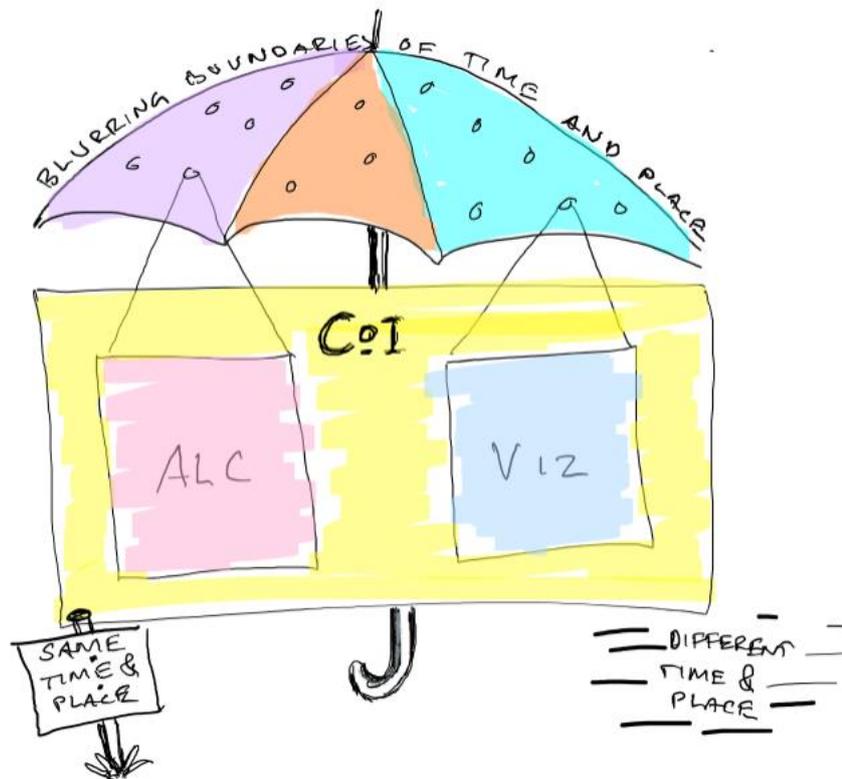
The thesis aims to explore the application of digital technologies in the design of (hybrid) higher educational settings to enable a community of inquiry. To that end, the overarching research question to be answered is:

- How are digital technologies applied in the design of hybrid higher educational settings to enable a community of inquiry?

To connect the introductory chapters with the four papers, these two additional research questions will be helpful:

- How can digital technologies enable communities of inquiry in hybrid higher educational settings?
- How can presences in the community of inquiry framework be accommodated to support hybrid higher educational settings?

The onto-epistemological stance for the introductory chapters is pragmatist. This ties in to Dewey's views on education, which in turn are the basis for the community of inquiry framework (Garrison, 2017). A pragmatist view also allows the mixing of qualitative and quantitative data in the same research project, e.g. mixed methods research (Creswell & Plano Clark, 2018).

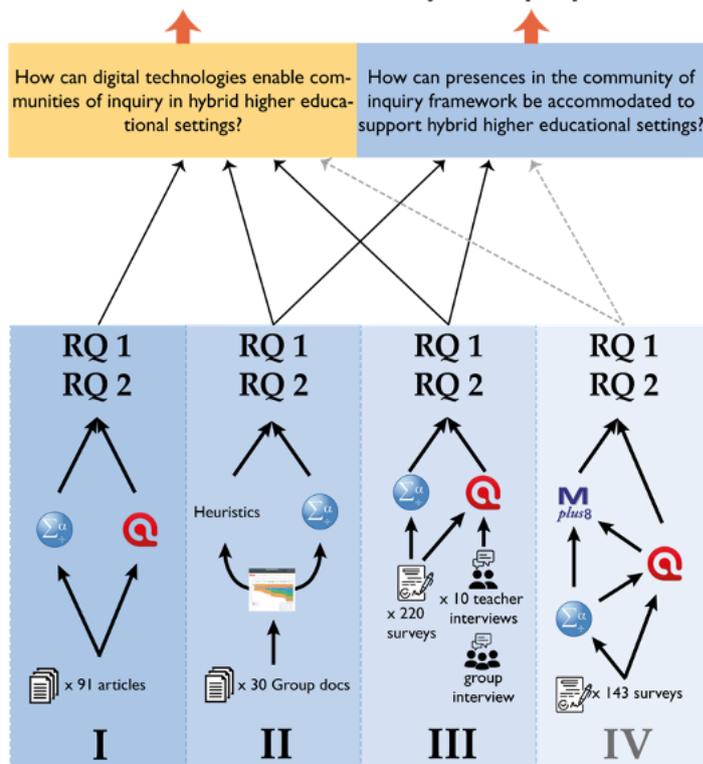


The sketched figure above tries to visualise the logical relationship between the papers in the thesis. The *umbrella* represents Paper I, a literature review that examines what BYOD applications within higher education contexts that were being studied in the period 2009–2015 (Sundgren, 2017). Specific applications that are studied in-depth are the paper on student- and teacher perceptions of Active Learning classrooms (paper III), and the paper on visualisations of online collaborative writing strategies (paper II). These two papers will be used to contrast the dimensions of time and place. The fourth paper explores a possible expansion of the community of inquiry framework with emotional presence (paper IV). The discussion on time and place dimensions will therefore be made in light of the principles put forward in the community of inquiry framework.

Methods/methodology

The thesis uses a convergent mixed methods design, where all the individual papers in this thesis use some level of mixing, although three papers use mixed *data* rather than mixed data *collection* methods. Paper III uses mixed data collection methods, as both interviews and a survey were employed, the others used mixed data from single data collections, e.g. documents, or survey data. The figure below illustrates what types of data each paper uses, and how the papers relate to the research questions:

How are digital technologies applied in the design of hybrid higher educational settings to enable a community of inquiry?



A description of the mixed methods designs of the four papers in this thesis follows below. Each description is followed by a mixed methods classification using a notation system proposed by Morse (1991):

In **paper I**, "Blurring time and place in higher education with bring your own device applications: a literature review", data consisted of 91 journal articles which were analysed qualitatively through thematic analysis, using both a priori and in vivo coding procedures. Further, quantitative coding was performed to enable descriptive and inferential statistical analyses to supplement the qualitative findings.

QUAL quan = explore and generalise findings

In **paper II**, "Visualizing online collaborative writing strategies in higher education group assignments", data consisted of 30 Google Documents from a study group online writing task, including their revision history. These documents were primarily analysed quantitatively, employing conversation analysis to identify turn-takings during the writing process. In addition, a qualitative heuristic analysis of visualisations of the revision history was undertaken to identify patterns of document growth.

QUAN + qual = explain quantitative results

In **paper III**, “Active learning in the 21st century – perceptions of a classroom redesign” multiple data sources was combined in the results, 10 teacher interviews, one group interview, and 220 responses to a student survey with both quantitatively and qualitatively oriented questions. The teacher interviews and the open-ended student survey responses was coded in vivo using thematic analysis. The closed-ended student survey responses were analysed statistically.

QUAL + QUAN = converge results

For **paper IV**, “Teachers and the Community of Inquiry: Guiding digital design in higher education”, the data set consists of 143 responses to a teacher survey with quantitatively and qualitatively oriented questions. This material was primarily analysed quantitatively using confirmatory (SEM) factor analysis. However, the quantitative results needed to be interpreted in the light of a qualitative thematic analysis of the open-ended responses.

QUAN + qual = explain quantitative results

Expected outcomes/results

Paper II provides teachers with a tool that can provide insight on collaborative patterns and strategies in online collaborative writing tasks, that in turn can be of use to design scaffolding measures that will guide a study group towards higher-level thinking and learning practices.

Paper III establishes that the combination of technology and ALC space supports a collaborative constructivist pedagogy that is perceived by both teachers and students to stimulate discussions and interaction. However, even if the rooms were found to be largely pedagogy agnostic in relation to pedagogies of engagement, students in particular reported dissatisfaction when teachers chose to lecture extensively and/or ignore the collaborative features of the rooms.

Paper IV (under production) explores the feasibility of extending the original three presences of the community of practice framework – teaching-, social-, and cognitive presence – with a fourth emotional presence. Early results of a confirmatory SEM analysis supports a theoretical model where emotional presence extends the previously validated model of CoI (Arbaugh et al., 2010; Swan et al., 2008)

In the introductory chapters, the results above will be discussed to explore and examine possible design considerations relevant for a teacher engaged in hybrid higher education where higher-order thinking and learning in line with the community of inquiry is a desired outcome.

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Teachers' use and Perceived Affordances of Programming as a Tool for K-12 Mathematics and Technology

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Extended abstract

Introduction

A global trend in K-12 education has been the integration of programming. The integration has been explained by the need of professionals with competence in programming on future labour market and that it will prepare students for a digitalised society in general. There are mainly two approaches to integrate programming in K-12 education: 1) as part of a separate subject, or 2) integrated in already existing subjects. Sweden has chosen the latter and as of 2017, programming is part of K-12 mathematics and technology. Previous research has highlighted both potential opportunities and challenges with programming in K-12 education; but to lesser extent examined what programming can provide for the school subjects in which programming is used. This thesis focuses on the teacher perspective and how teachers use and perceive programming as a tool for K-12 mathematics and technology.

Aim and research questions: The aim of the thesis is to examine teachers' use and perceived affordances of programming for K-12 mathematics and technology. The thesis is guided by the following research questions: RQ 1) How are programming used by teachers in K-12 mathematics and technology? RQ 2) What are teachers' perceived affordances of programming for K-12 mathematics and technology?

Included articles: The thesis is based on five studies that are/will be conducted and presented in five separate articles. Article I and II are published, article III and IV are manuscripts not yet published, and article V is in the process of data collection and analysis.

Theoretical framework

The term *Affordances* was first coined by James J. Gibson and is a theory of what the environment provides for the animal, observer, or actor. Affordances are not physical but based in the relationship between the environment and the animal that utilise it through actions. For example, a chair affords sitting and a stone affords throwing. In the works of Donald A. Norman, a designer perspective is introduced to the theory of affordances and a focus on what actions are perceived as possible, *perceived affordances*. Besides perceived affordances, Norman introduces *constraints*, which limits what affordances the actor perceives as possible. There are four classes of constraints: logical, semantic, cultural, and physical. The theory of affordances, as formulated by Norman, constitutes the main theoretical framework for the thesis.

Related work

Previous research has identified several types of programming tools that are used in K-12 education, and related challenges and opportunities with these tools. The tools are often categorised in three main types, based in the user interaction: textual, block and unplugged programming.

Methodology

The overall research approach in the thesis is qualitative. The methods used for data collection and analysis in each study are presented below.

Article I: The study was conducted with a case study approach. Data were collected during 2018 and 2019 in three instances of a professional development course on programming for teachers in grade 7-12 mathematics and technology (a total of 107 participants). Three different data sources were used: workshop observations (total of 20), essay assignments (total of 55), and online postings in the course forums (total of 33). Content analysis with deductive-inductive coding were used to analyse the collected data: 1) deductive coding was used to structure data according to predetermined categories based in the research questions of the study, 2) inductive coding was used to analyse and group emerging themes in categories of challenges and opportunities.

Article II: The study was conducted as a document review. Data were collected in late 2019 from the website Lektion.se. A selection process inspired by systematic literature review were used to select 26 (out of 332 potentially relevant) teaching and learning materials on programming in K-12 education. Content analysis with deductive-inductive coding were used to analyse the collected data: 1) deductive coding was used to structure data according to predetermined categories based in previous research and research questions of the study, 2) inductive coding was used to identify emerging themes of 'programming use' in the collected material.

Article III: The study was conducted as focus group discussions with semi-structured questions. Data were collected in the spring and autumn semester of 2019 with three teacher teams at three different K-12 schools in the Mid Sweden region. 21 teachers participated in the study, all teach grade 7-9 mathematics, and 8 teach grade 7-9 technology. Thematic analysis with a deductive-inductive approach were used to analyse the collected data: 1) a deductive approach was used to identify themes of interests based on the theoretical framework of *affordances*, 2) an inductive approach was used to group the identified themes in categories based on their similarities.

Article IV: The study was conducted with semi-structured interviews during the spring semester of 2021. 19 teachers from all over Sweden were selected to be included in the study based on their experience of programming in grade 7-9 mathematics and technology. 13 of the teachers use programming in mathematics, and 15 use programming in technology. The interviews were conducted and recorded with video conference tools. Thematic analysis with an inductive-deductive approach were used to analyse the collected data: 1) an inductive approach was used to highlight themes of potential interest in each interview, 2) a deductive approach was used to select and group the identified themes in categories based on their relevance for the theoretical framework of *affordances*.

Article V: The study is planned to be conducted as a content analysis of lesson plans for integrating programming in grade 7-12 mathematics and technology. The lesson plans are produced by teachers in three instances of a professional development course on programming (2020-2021).

Findings

The thesis presents findings on teachers' use and perceived affordances of programming for K-12 mathematics and technology. So far, the thesis can present several identified perceived affordances, and related constraints, of programming and programming tools for K-12 mathematics and

technology. The thesis has further identified three aspects of K-12 mathematics and technology that the identified perceived affordances relate to: 1) supporting subject content and learning, 2) facilitate student engagement and motivation, and 3) foster developmental skills. A summary of findings in each conducted study is presented below.

Article I: The aim was to analyse and discuss K-12 mathematics and technology teachers' perceptions on integrating programming in their teaching and learning activities, and perceptions on different programming tools. The results show that the teachers perceive both challenges and opportunities in learning and integrating programming; and with the different types of programming tools: textual, block and unplugged programming. Recurring in the collected material is that programming is perceived as fun but difficult to learn and integrate due to lack of time and directives for the integration. An interesting finding was a complementary view of different types programming tools, which could be used to draw on their individual opportunities and limit their individual challenges in a large-scale introduction of programming in K-12 education.

Article II: The aim was to examine the use of programming tools in teaching and learning material by K-12 teachers. The results indicate potential relationships between the use of different programming tools and school subjects and student grades. Block and tangible programming are used in most grades, and in subjects and activities focused on controlling virtual or physical objects. Textual programming has the most specialised use and are used in upper grades mainly focused on the programming practice. Unplugged programming is used mainly to practice giving clear instructions in the lower grades and in some of the upper grades.

Article III: The aim was to examine K-12 teachers' use and perceived affordance of programming as a tool for teaching and learning activities in mathematics and technology. The results show a variety of programming tools that are used in the teachers' teaching and learning activities in K-12 mathematics and technology. The study identifies five main perceived affordances of programming for K-12 mathematics and technology that relate to both subject content and student motivation: 1) Play, 2) Discovery, 3) Adaptation, 4) Control, and 5) Freedom.

Article IV: The aim was to examine what programming affords K-12 mathematics and technology according to teachers that use programming in these subjects. The study identifies 10 main perceived affordances of programming for K-12 mathematics and technology, which relates to three aspects of teaching and learning: 1) supporting subject content and learning, 2) facilitate student engagement and motivation, and 3) foster developmental skills.

Theoretical contribution and implication for practice

The theoretical contribution of the thesis is that it extends the body of knowledge on programming in K-12 education. It adds new information of what programming can provide K-12 mathematics and technology by applying a teacher perspective on programming affordances. The findings presented can be used by teachers to design teaching and learning activities with programming in K-12 mathematics and technology; and by policymakers to develop K-12 curriculum and syllabus design.

Keywords: Programming, K-12 education, Affordances, Mathematics, Technology

Laying foundations for equitable representation in AI – *empowering K-12 teachers to inform future generations.*

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Introduction

Identifying otherwise undetectable patterns and trends in vast, ever-increasing quantities of data has been enabled by machine learning (ML) techniques used in AI systems. Permeating many aspects of our lives and affecting and influencing the choices we make, research in this field continues to advance and will continue to have an increasing impact on us. Despite this, data collection and analysis are often hidden and complex algorithms are difficult to explain. Current efforts into explainable AI offers a realistic opportunity to allow us to peek into the AI “black box”.

The risks and unintended effects such as bias stemming from input data or algorithm design has recently stirred discourse about how to inform and teach AI in K-12 education. In order to participate in shaping and adapting to a future where AI technology plays an increasingly important role there is a need to inspire the youth of today to engage in this field to acquire the skills required for the world of tomorrow. Skills such as understanding the potential impacts of its application, harnessing opportunities and identifying associated risks to guide the development of AI will become increasingly critical since these skills are not only technological but social and political related to issues of power, agency and control (Hintz, Dencik, and Wahl-Jorgensen (2019, 2). Thus, the aim of the research is to empirically investigate methods, tools, pedagogy, and goals for introducing AI and AI literacy to the curriculum. Current efforts by e.g., UNESCO are calling for member states to plan for and support incorporation of AI into the curriculum with the aim of providing the critical skills needed for the 21st century and promoting awareness and AI literacy skills required in the new human machine cooperation (UNESCO). To promote equity for both skills development and AI literacy for all, the entry levels to this kind of engagement need to be lowered and available to all independent of socioeconomic factors and individual circumstance.

Main Research Questions

- 1) What methods, tools and pedagogical approach is useful for engaging K-12 students in AI education and what challenges and opportunities do they bring?
- 2) How does this particular teaching contribute to AI literacy (& digital & data literacy) – what are the possible impacts of teaching AI in schools (on students skills and on society)

Sub Studies with research questions and methods contributing to the main RQs.

Substudy one - Literature review

The aim of this SLR is to identify current efforts and uptake of teaching AI in (elementary) education.

RQs

What are the main motivations (and learning goals) for introducing AI in teaching?

What methods and tools are used for teaching AI?

What ethical implications, challenges and opportunities are associated with teaching AI?

Value Sensitive Algorithmic Design to guide substudy two and three

Algorithms, being designed and purposed by humans, are prone to inherit our biases and flaws (Prinsloo, 2017). As such, it can perpetuate and enhance these current assumptions and biases “in the wild” with unintended consequences. The complexity of the algorithms themselves makes it difficult to engage with these explicitly and therefore this study would engage with these algorithms by “looking around, rather than inside, increasingly opaque and unknowable black boxes” (Perrotta & Selwyn, 2020. p. 254). This study intends to include the socio-technical nature of predictive modelling through the suggested VSAD as proposed by Zhu et al. (2018). This tripartite method addresses ethics in praxis upstream (Jones & McCoy, 2019) where stakeholder values concerning algorithm design (such as human-algorithmic decision making e.g. in on our out the loop related to data in different dimensions such as automation, visibility, directionality, assemblage, temporality, sorting and structuring (Prinsloo, 2017. p. 138) are identified, algorithmic approaches can then be prototyped based on these values. This prototyping of algorithms would be based on values identified by stakeholders and would also extend the VSAD with inspiration from Prinsloo’s experimental matrix of human-algorithmic decision-making and insights from a study by Holstein et al. (2019).

Substudy two - Involving teachers in refining VSAD for teaching K-12 students algorithmic design

This would involve teachers in a series of workshops and focus groups to improve and extend the VSAD for teaching AI to K-12 students. The result would include methods, pedagogical approach and learning goals for manipulating and meaningfully engage with algorithmic design for K-12 students.

Substudy three - Observing the proposed algorithm design teaching in real classrooms

What skills and knowledge can be identified using this approach?

How does this particular teaching contribute to AI literacy?

What challenges and opportunities can be identified?

What are students' insights from this teaching and on the topic of AI?

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Extended Abstract: From Deadpan Machine to Relating Socially



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Keywords: Spoken dialogue-system with conversational agent (SDS/CA), lower secondary school students, Experience, Speaking Skills, Foreign Language.

Contribution

Immersive technology (Blyth, 2018) involving natural language processing enables students to engage in everyday-life learning situations for the development of foreign language (FL) speaking and listening skills (Blake, 2017; Golonka et al., 2014). However, there is still a lack of research explaining such outcomes from lower secondary school students' perspectives. The students engage in spoken interaction with conversational agents (CA) (Bibauw et al., 2019), where building social relationships is recognized as important for engagement and learning (Walker & Ogan, 2016).

The aim of this presentation is to report on a longitudinal study where Swedish 13-year-old students (n=22) were introduced to embodied virtual humans (VHs) as CAs for practising English speaking skills in conversational simulations in a spoken dialogue system (SDS/CA) (Bibauw et al., 2019). It is the final study in my doctoral thesis, and the design of methods, instruments and analytical lens has developed iteratively. The results will primarily represent the first part of this study examining the students' self-reported experiences (Levy, 2015) with regards to practising speaking with VHs in the selected SDS/CA (Enskill) (Alelo, n.d.). The research question is: How did 13-year-old students experience speaking English with a VH in an SDS/CA? This question is embedded in the study's overall research question: How did 13-year old students educationally experience practising FL speaking skills in an SDS/CA? There will also be a snapshot of some preliminary results from the whole conducted study. Analysis was performed on collected experiential statements provided by students through their self-reported reflections and ratings.

The study is based on the assumption that language learning occurs in social contexts and interaction between people (Swain, 2000) and is anchored in a sociocultural perspective on learning and development as the ability to participate in different social interactions with other more capable ones (e.g., Vygotsky, 1978; Lantolf et al., 2014). The construct of *speaking skills* is inspired from a Swedish FL study (TAL, n.d.), with learning and development of them based on an amalgam of key principles for language learning (Li, 2017) and desired outcome (Council of Europe, 2020). The construct of *experience* is conceptualised in close connection to development and learning (Roth, et al., 2014) integrating intellectual, affective, and social dimensions, historically seen as an undividable unity (Vygotsky, 1978; Dewey, 1959). For tapping into the students' diverse experiences (Levy, 2015), this study's approach is to delineate experiences into four dimensions

(cognitive, emotional, social and teaching) to refine the concept (de Vaus, 2001), well aware of its complexity (Roth, 2014).

The first dimension is about students' experiences in relation to their cognitive ability to interact in English and the demands they face in the system. The second dimension brings up the students' emotional judgements, and feelings during the human-machine interaction. The third dimension shows the social relating to the VHS. Finally, all three interrelated (and sometimes overlapping) dimensions together give the students' self-rated overall experience of speaking with a VH to answer the first research question. To investigate the second research question, there was also a fourth dimension (teaching experience) relating to the students' experiences of the system seen as a teacher including supportive features facilitating the students' learning and their self-regulation in the learning activity. The framework of this study used as an analytical lens and for organising data collection was created with inspiration from two frameworks, historically used to study online learning in higher education, collaborative (Garrison et al., 2000), and one-to-one learning (Stenbom et al., 2016), respectively. Those frameworks focus on three categories of presence (cognitive, social, and teaching) and sometimes separate a fourth, emotional presence (ibid).

Method

Participants were a convenience sample of 13-year-old students ($n=22$) studying English as an FL, in a lower secondary school in Sweden. The longitudinal study covers ten speaking sessions in the selected SDS/CA Enskill (Alelo, n.d.), followed by written reflection. The students were encouraged to maintain a dialogue with the CA in English dealing with an everyday life situation, by asking questions, answering and solving practical tasks such as ordering at a restaurant. The VH was their "communicational counterpart" [Bibaw et al., 2019, p. 7], someone mastering English (expert) and assisting (Lantolf et al., 2014) in taking turns and giving instant feedback. The constraints predetermined for balancing the system's conversational freedom were affecting the complexity and how the interaction was carried through, although alternative utterances were recognised. Finally, an individual assessment was provided.

Data were generated longitudinally through four questionnaires and digital logbooks (Lackéus, 2020) as visualised in figure 1 together with system-generated metrics (M) about mastery score, fulfilled learning objectives and time. For background information of the students, one pretrial questionnaire ($n=22$) was distributed about demography, digital experiences, affective, behavioural and cognitive aspects in relation to learning and speaking an FL (Q1). In the logbook, after each speaking session, the students reflected on repeated open-ended items and rated their experiences by selecting tags and a suitable emoji. The battery of eligible tags is word labels predefined by the researcher. The eligible emojis, representing a five-graded Likert scale (rating -2 to 2), measure the overall experience of the speaking session.

After two sessions the students answered a questionnaire ($n=21$), drawing on and inspired from a validated questionnaire (Stenbom et al., 2016) adapted to this context (Q2). Questions investigated cognitive experiences; making oneself understood, understanding VHS, and keeping an ongoing conversation in relation to the tasks and if individually challenged in the activity (Zone of Proximal Development) (Vygotsky, 1978). Emotionally related questions focused on the speaking activity and students could choose from feelings (eg., “fun”, “safe”, “happy”, “sad”) and signals experienced from VHS (e.g., “human”, “deadpan/stiff”, neutral). Questions on the social dimension inquired about how natural it felt and the level of social connection with the VHS. Some questions overlapped two dimensions. Overall experience was investigated by rating “overall experience” and “feeling satisfied after the conversation”.

Analysis of students’ ratings was performed using descriptive statistics. For finding themes of analysis, the dataset was read through and interpreted in a data-driven (bottom-up) approach, combined with a theoretical interest-driven (top-down) approach from the predefined dimensions. Seven analytical themes (Braun & Clarke, 2006) were identified. All dimensions/themes were synthesized into students’ overall experience of speaking with a VH.

Furthermore, after the eighth speaking session, the students answered an identical questionnaire (Q3) about experiences of speaking with VHS, investigating eventual differences over time. The final posttrial questionnaire (Q4) reported mostly about (i) teaching and cognitive dimensions, and the total experience of practising speaking skills in an SDS/CA, and (ii) follow up questions from Q1.

Expected Outcome

Data analysed from the first part of the study yielded seven themes coinciding within the three dimensions of experiences. The key results indicate that the students overall found themselves having practised speaking skills and experiencing easy to speak with, listen to and understand the VH. They exhibited experiences relating to several of the key principles known to promote effective FL learning (Li, 2017; Swain, 2000), i.e., emotional factors, being cognitively challenged and having the opportunity to use the language in oral interaction. Some found themselves pushed forward cognitively in accordance with their ZPD (ibid; Lantolf et al., 2014). Emotionally, most of them found the speaking activity fun, safe, exciting, meaningful, and not stressful to keep up with the tempo. They were generally satisfied and emotionally engaged when speaking with a VH. Socially, there was a whole spectrum reported from some students seeing the VH like a deadpan machine, others humanising, ascribing human attributes to it, feelings, and behaviours, to finally, socially relating to the VH (or striving to). The issues with the constraints in the VH’s speaking abilities seem to affect the social experience negatively and were thoroughly commented upon. Students were frustrated over VHS limited range of speaking and interacting and wished to have more spontaneous conversations, hence less constraints in the SDS/CA. Students appreciated that the VH waited for them to speak and that they were not negatively judged. The majority’s overall experience grew stronger along the two sessions.

Additionally, these initial findings seem to be echoed in the longitudinal results based on preliminary and ongoing analysis. Above all, reflections signalled constraints and temporary bugs in the SDS, expressed as frustration by the students. Considering the overall experience of speaking with a VH, findings show gender differences with girls rating higher than boys. Both genders had raised average ratings towards the end of the trial. An association was detected between a reported feeling of social connection with VHs and positive ratings of the overall experience in the system.

Results of this study contribute to designers of SDS/CAs and researchers in the fields Artificial Intelligence in Education (AIEd) and Dialogue-based computer assisted language learning (DB-CALL) through the students' experiences shedding light on the importance of social relating for learning, also when speaking with VHs in SDS/CA (Walker & Ogan 2016). The results also implicate the importance of spontaneous and flexible interaction. Educators can learn from the result to meet students' diverse reactions and challenges when introducing SDS/CAs. The results will also contribute to responding to the RQs of my doctoral thesis, with the hope to gain FL students in the long run.

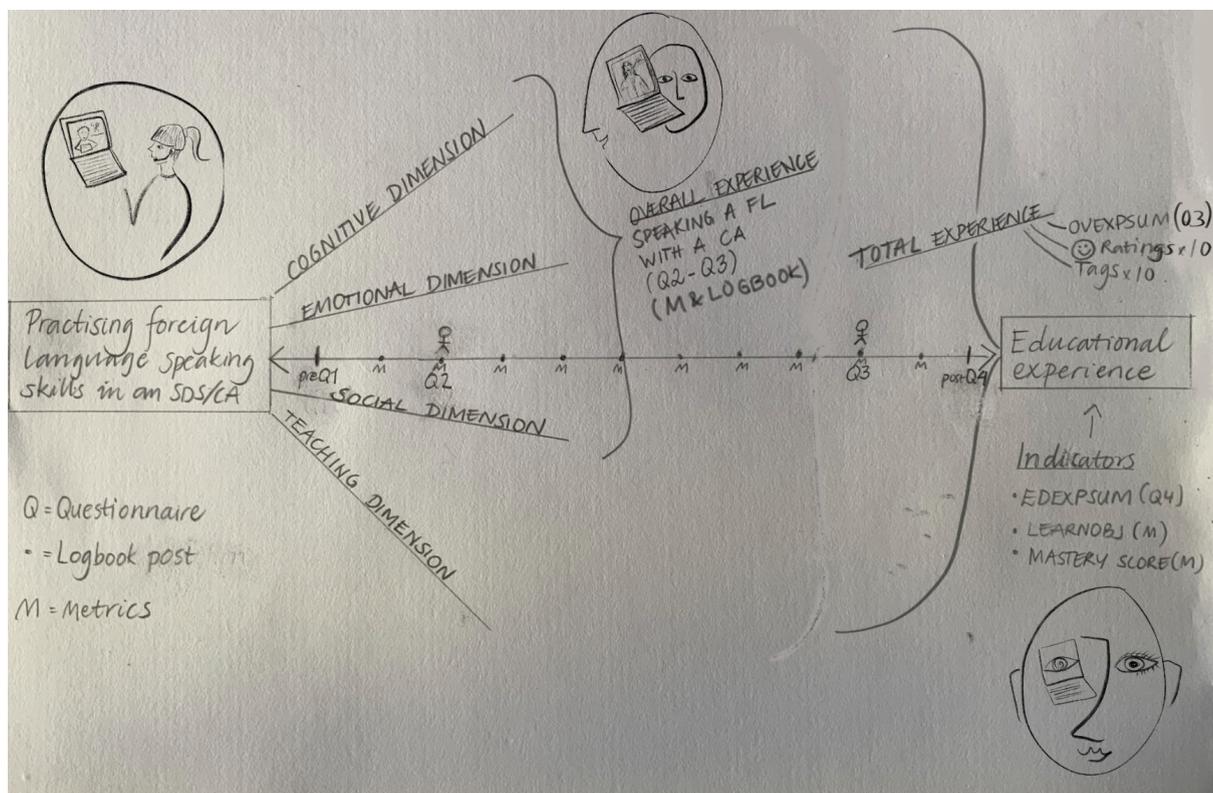


Figure 1. Design of the longitudinal study of students practising FL speaking skills with VHs in an SDS/CA.

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NATIONAL SCHOOL POLICY ON DIGITALISATION - APPROACHES AND TRANSLATIONS

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ABSTRACT

The Swedish policy work on school digitalisation has intensified during the last years which has led to new national policy documents on this behalf. However, within the Swedish school systems locally decentralized governing, the national documents are characteristically broad and visionary. Thus, the outcome of the policies rely on translations within the local governing. The research project presented in this extended abstract aims to explore national school policy on digitalisation within Sweden from the perspective of how this policy translated into practice at four different levels in the policy chain. (1) The policy-making level interviewing the management group responsible for one of the national policy texts. (2) The local authority level, studied by both a comparative cross-case study of four municipalities from different contextual settings, and one document study of local ICT-policies from rural municipalities. (3) The mid-level translator level, addressing headteachers and ICT facilitators within a comparative study, and finally, (4) the practicing teacher level. Midway through this project, the studies suggest that the national school digitalisation policies from a policy-making level is approached as an issue of motivation possible to influence by opening up the policy process. On local governing (municipal) level national policy is translated into either a collective effort (by a specific approach) or an individual effort (by a general approach). Within all levels studied so far, education equality is emphasised as challenging.

Keywords: Education policy, policy translation, local governing, school digitalisation, ICT

1. INTRODUCTION

The international trend on digital technology in schools has in many countries resulted in raised policy activity within the area of school digitalisation (Voogt, Knezek, Christensen, & Lai, 2018). In Sweden, three national policy documents has within the last five years targeted school digitalisation: The national strategy for digitalisation of schools (Government decision I:1, 2017), the revised national curriculum (Skolverket, 2018), and a national plan of action for the digitalisation of schools named #skolDigiplan (SKL, 2019). Considering that national policy efforts on school digitalisation has been argued on having poor or limited outcome in school practice (Bulfin, Johnson, & Bigum, 2015; Hammond, 2014; Kozma, 2011; Selwyn, 2018) it may be relevant to ask what happens within these policy efforts.

Criticism laid on school digitalisation policy suggest that limited outcome relates to over-simplistic policy texts with loose boundaries (Hammond, 2014; Ward & Parr, 2011) and that contextual issues, which is argued of particular importance within concerns of digital technology in schools, have not been sufficiently acknowledged within governing (Cuban, 2013; Hammond, 2020; Voogt et al., 2018). However, when discussing policy activities on school digitalisation, one need to recognize that governing power has experienced a shift in balance during the last couple of decades (Lindensjö & Lundgren, 2014; Mundy, Green, Lingard, & Verger, 2016; Newman, 2001). Within this shift, national governing has moved transferring power in three directions. First, *upwards*- towards cross-national governing bodies such as EU and OECD. Second, *outwards*- involving new and sometimes untraditional stakeholders that within school digitalisation include actors such as the technology industry (Player-Koro, Bergviken Rensfeldt, & Selwyn, 2018; Selwyn, 2018). Third and final, and of particular interest within this project, *downwards*- where governing power has been transferred to local authorities in a more decentralized organisational structure (Lindensjö & Lundgren, 2014; Mundy et al., 2016; Newman, 2001). Within this locally decentralized governing, it is argued that national policies are likely to be more general and formulated as visionary documents articulating goals in a more simplistic way with 'loose' terms, rather than specific and detailed (Kozma, 2008). Thereby, the local governing becomes more involved in how national policy on school digitalisation is practiced, or enacted (Ball, Maguire, & Braun, 2012), and as argued in this text, the contextual settings becomes more pronounced making the local translations increasingly important.

The tentative aim of my studies is to explore how school digitalisation policy can be translated into practice to enable better understanding of what enables and constrain this work. The following questions are set up for the studies:

- How can work on enabling national policy on school digitalisation in K-9 school be understood?
- What are the challenges in school digitalisation experienced and/or anticipated by stakeholders?
- How can policy travel be understood in the Swedish context?

2. METHODS

The project takes a top-down approach on national school digitalisation policy by conducting studies at different levels in the policy chain (Ärlestig & Johansson, 2020) starting at the policy making level and ending up at the teacher professional level (see Figure 1). The different studies are presented in short following.

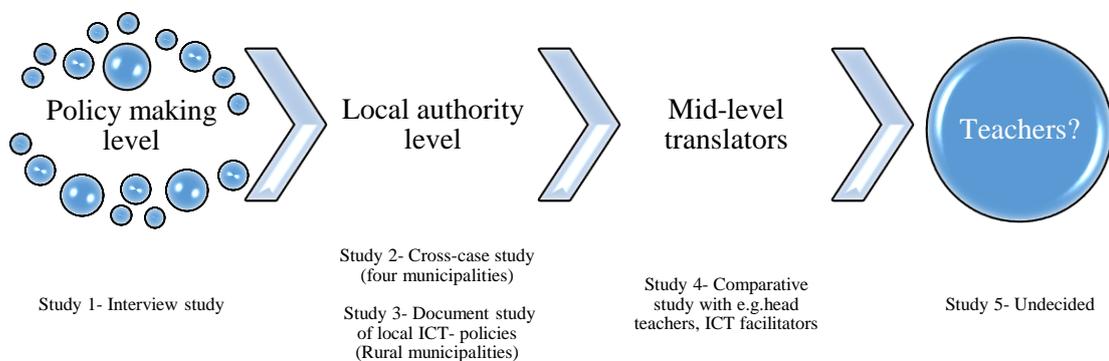


Figure 1- Structure of Studies Researching National School Digitalisation Policy

Study (1) addresses the policy making level and is conducted as an interview study with eight members of the management group responsible for the writing of #skolDigiplan.

Study (2) focus on the local authority level within the Swedish municipalities. Especially the local education office and the local education committee. The study is conducted as a cross-case study of four municipalities with different contextual settings.

Study (3) develops the local ICT policies of rural municipalities by a document study of their translation work. This study is in progress and data from 21 of the 40 rural municipalities is so far collected.

Study (4) focus on mid-level translators more precisely headteachers and ICT facilitators.

Study (5) that is still is undecided upon, intends to focus on practicing teachers.

3. RESULTS AND DISCUSSION

Study 1 has resulted in a published paper (Gustafsson, 2021) in which it is suggested that national policy-makers in this area consider their work motivational, and that mobilising support, initiating collaborations and succeeding in committing stakeholder to engage in school digitalisation policy is key. In this ambition, the policy-makers posed as keen on opening up the policy process when writing the national policy documents on the subject. Additionally, this was within the paper argued to connect with the shifting governing balance (Mundy et al., 2016) whereas national governing bodies such as national agencies could be put under pressure by stating their claims and responsibilities towards schools, and thus governing power could transfer further outwards and downwards.

Study 2 is a coming paper on four municipalities from different contextual settings (from big-city to rural, north to south of Sweden). The study suggest that local approaches towards school digitalisation policy may be divided into what could be called (1) a general and (2) a specific approach. Within the study, the two smaller municipalities choosing a specific approach was characterized by, in

comparison, the acceptance towards an imbalanced proficiency in digital competence among teachers with a need for acceptance to adhere to collective measures. This was accompanied by a specified local policy document in which a minimum bar was set within teaching. In addition, the smaller municipalities did not seek to compete with other municipalities but expanded in their school digitalisation work by developing collaborations with other contextually similar municipalities. The larger municipalities, on the other hand choosing a more general approach was characterized by, in comparison, unspecified local policy documents setting high trust in the professional teachers' translations of policy additionally offering an extensive variety of digital technology and support. This approach was followed by a competitive rhetoric comparing the local outcome with other municipalities. The study is argued on indicating that translations of national school digitalisation policy in Sweden is subjected to a divide (Ärlestig & Johansson, 2020) at local governing level as it is approached in two separate ways.

Study 3 is initiated with data collected from approximately half of the in total 40 rural municipalities in Sweden. So far, it seems consistent to say that the specified local policy documents, a signifying character within the specific approach (described within Study 2), is quite common within these small municipalities. However, the analysis is still undone so therefore, preliminary results will not be presented.

Study (4) and (5) are still developing however, the idea is to continue to track the policy translations within some of the municipalities of the cross-case study (Study 2).

4. CONCLUSION

The research project presented within this extended abstract bring forward that national policy on school digitalisation within the Swedish context, which is characterized by a locally decentralized governing (Jarl & Rönnberg, 2019), is highly dependent on the translations made within the policy chain (Ärlestig & Johansson, 2020). Within such governing, translations nested in the contextual factors at the local level direct the outcome of national policy. Within visionary and 'loose' termed national policy texts with wide formulations (Kozma, 2008) and local managing of policy, continuing studies may address the issue of educational equality within governing on behalf of school digitalisation. An issue that is acknowledged within both Study (1) and (2), and additionally emphasized in the national policy documents.

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Remote education - more than technology

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Keywords: relationality, resonance theory, learning, remote education, online learning

In this presentation, I elaborate on theoretical understandings of relationality in remote education, here understood as teacher and students being remotely located to each other in space but not in time, connected virtually through online devices. In online education we cannot but acknowledge that e.g. the bodily aspects of our relationship to the world is altered in a radical manner compared to education where students and teachers are bodily present in the same room. Relating through a screen creates an extra boundary between the self and the world, in addition to the skin or clothing. Further, interventions and manipulations of the world with our hands (Rosa, 2019) have primarily to be done through the keyboard, touch screen and mouse. In both these examples, the online setting creates an extra obstacle we have to overcome for relationships to form. Simultaneous eye contact is for example simply not possible as long as cameras are not integrated in the screen. On the other hand, some sensory expressions and impressions can be enhanced by e.g. increasing the volume, adding colours, or sound effects making them something more rather than less in an online context. By centre staging relational challenges and affordances, a conscious strategy can be developed on how to make the most of online educational practices. Although this presentation focuses on online education, the unpacking of relationality is relevant for any kind of educational practice where the black box of learning has eluded researchers and educational theorists a long time. What all seem to agree on is that humans have difficulties *not* to learn, why 'learning [can be described] as the constant and ubiquitous ontological dimension of human existence' (Bagga-Gupta and Messina Dahlberg, 2019: 5), i.e. we are because we learn and we learn because we are. What implications does a relational stance thus have on educational practices, in particularly in online education?

When developing a researcher identity of relevance for remote Indigenous language education (Parfa Koskinen, 2020), I noticed that many Indigenous worldviews have a relationally intertwined ontology and epistemology held together ethically by relational accountability (see especially Wilson, 2008, but also Battiste, 2000; Chilisa, 2019; Kovach, 2010 and Semali & Kincheloe, 2011). Wilson summarizes this view as:

Every individual thing that you see around you is really just a huge knot - a point where thousands and millions of relationships come together. These relationships come to you from the past, from the present and from your future. This is what surrounds us, and what forms us, our world, our cosmos and our reality. We could not be without being in relationship with everything that surrounds us and is within us. Our reality, our ontology is the relationships. /.../ some of these knots of relationships are not visible or tangible entities, but they are there just the same. They are developing ideas, grand abstractions, entire systems of thinking. This is our epistemology (Wilson, 2008: 76-77).

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The above quote rests on the worldview that humans are ontologically equal to other entities, and that epistemologically knowledge constitutes of fluctuating, constantly changing relationships (ibid, 2008). This is a stance recognized from e.g. sociomaterial approaches to education and research (Fenwick, Edwards, & Sawchuk, 2015). Although the above worldview is aligning with some of those approaches' notion that teaching practices are effects of emerging networks in constant flux, and learning as constituted of contingent transformations between relations of people and things, the fluidity still makes it challenging to centre staging relationality when designing educational practices. To express it bluntly, this kind of ontological and epistemological stance is of limited design value for educationalists in its current state why this elaboration focuses on the qualities of those relationships.

The quality aspects of relationality need to be unpacked and articulated if to help educationalists tackle common learning challenges, a gap this presentation aims at filling. I do this through resonance theory (Rosa, 2019), a sociology of our relationship to the world where relationships between self and world are understood through their resonating qualities. The resonance of our relationships affect how we play "in tune" with the parts of the world to which we are ontologically and epistemologically intertwined. Rosa suggest that 'resonance can only develop where culturally established and "practiced" strong evaluations are in play, i.e. where subjects believe that they are connected with something that is genuinely *capable of response* [italics in original]' (Rosa, 2019: 271). In addition to relationships being more or less resonating, they can be mute, which ensures survival through the consuming of those parts of the world. Resonant relationships can occur when we are touched or moved by something/one in a process moving inwards, or when experiencing connectedness as self-efficacy, a process moving outwards. The process of resonance cannot be enforced, ensured or controlled, but when occurring the self is transformed.

Rosa identifies four axes of resonance.

- a) Self-resonance, when we have a resonant relationship to ourselves not disturbed by a fear of e.g. not managing different digital technologies, lack of connectivity, scarcity of time, dark or cramped spaces.
- b) Social resonance through love, friendship, or any groups of people to whom we feel connected, (horizontal axis).
- c) Material resonance, in this case to e.g. the computer, software, the room where the remote education takes place, etc. (diagonal axis)
- d) Existential resonance, e.g. values, norms, life, spirituality or history (vertical axis).

By creating a framework where relationality is centre staged as *the* most important aspect when designing online educational practices, rather than one of many, a different set of questions will guide educational design. For example, when are relationships made possible, supported, maintained, constrained, disrupted etc.? How are relationships supported, promoted and encouraged (or disrupted, if that is preferred for a particular learning outcome)? Where do digital technologies make relationships possible, and what do we need to consider when designing for this to happen? Why is a particular technology used, i.e. what relationships does it support, maintain, promote or encourage? To what or whom

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should relationships be established, supported, strengthened etc.? What quality do we want the relationships to have? Etc.

Hence, if accepting a relational understanding of learning as a process supporting the establishment of relationships between e.g. ideas, beliefs, ideologies on the vertical axis, and students, teachers, social groupings on the horizontal axis, and objects and work related to objects on the diagonal axis, a relational ontology and epistemology makes more sense. The resonating characteristics corresponds to different qualities of these relationships, and serve as central features of learning, i.e. *mute* and/or *resonant* relationships have to be established to be considered a successful learning experience, depending on the intentions of the particular lesson/practice/occasion. The opposite would be alienated students, which would be an unsuccessful learning experience.

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Expanding the access and use of digital technologies in the Swedish educational system

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The access and use of digital technologies in society have expanded over the last few years. The need to prepare children and young people for a digital culture has motivated digitalization in the educational system, which is a trend that will continue since this development may not be stopped. Various reforms focusing on digitalization in the educational system have been an important issue in many countries. In 2017, the Swedish government presented a new digitalization plan for schools (National Agency for Education, 2019). The policy is a government position for increasing the access and use of digital technologies in the educational system. The digital development that has taken place during the last years explains the Swedish government's decision to implement digital technologies in schools. The access and use of digital technologies have increased and developed very fast, not least based on the changing labor market that requires skills that young people should bring with them. Students need to learn and gain experience in using digital technologies from a lifelong learning perspective. Therefore, schools have to prepare young people for these changes and needs (Selwyn et al., 2018).

The teachers' responsibility is to organize, plan, and implement teaching that enables students to use digital technologies to develop students' knowledge. However, it is not only an issue about which digital technologies should be used. It is also about how and why to use digital technologies (Haelermans, 2017). Therefore, teachers need the pedagogical perspective as a starting point for how and why digital technologies will be used. The school organizers and the school leaders have a special position in this policy since they have to provide schools' support to increase digital technologies used in teaching. The school organizers' and school leaders' responsibility is to allow teachers to improve their digital competence, access, and use of digital technologies in education.

The paper aims to identify, describe, and analyze the management change practice in municipal school organizers and school leaders' collaborative efforts to expand the access and use of digital technologies in the Swedish educational system. The research questions are:

- What kinds of actions emerge in the management change practice, in municipal school organizers' and school leaders' collaborative efforts to expand the access and use of digital technologies in the educational system?
- What kinds of changes occur in the management change practice, in municipal school organizers' and school leaders' collaborative efforts to expand the access and use of digital technologies in the educational system?
- What enables and limits the management change practice in municipal school organizers' and school leaders' collaborative efforts to expand the access and use of digital technologies in the educational system?

The practice architecture (Kemmis et al., 2014) is used to examine the management change practice in municipal school organizers and school leaders' collaborative effort to expand the access and use of digital technologies in the Swedish educational system. The theory makes it possible to move the focus from the individual to the practice the individuals act in a specific context. However, it is important to consider the external conditions in the practice. For example, the arrangements that shape the sayings in the semantic space, the doings in the physical space, and the relatings in the social space, according to Kemmis et al. (2014). The researchers mean that, in a practice, an individual's will, understanding, and action become visible. In order to explore the management change practice, this study applies the theory of practice architecture (Kemmis, Wilkinson, et al., 2014), which considers both internal and external conditions.

The collected data is within the framework of the project Digitalization in the educational system in municipalities (DUVKOM), an interaction between three municipalities in Sweden and Mid Sweden University. The first approach that has been used to collect data is participant observations, which means that the researcher participates and documents the observations (Cohen et al., 2011). The project's reference group had seven participant observations during November 2018 and September 2021. At each meeting, about 12 participants were attended and lasted approximately three hours. During the meetings, each municipality presented the status of its digitalization work. Four meetings were conducted via video conferencing service Zoom due to the pandemic. The second approach was a survey sent to 156 school leaders

from pre-school to upper secondary school in the three municipalities. The researcher built the questions on findings from the project's reference meetings and the research questions. The themes in the survey were access and use of digital technologies, digital competence for school leaders and teachers, school activities digitalization plan, and collaboration with school organizers. About 62 % of the school leaders have answered the survey. The third planned data collection method was group interviews with four school leaders' representatives for pre-school, year 0-6, year 7-9, and upper secondary school. The questions were connected to findings from the project's reference meetings, the survey, and the research questions. The focus area in the Swedish digitalization strategy (Swedish Association of Local Authorities and Regions, 2019) has been used as categories in the analysis. The focus areas are digital competence for all in the school system, equal access to and use of digital technologies for all in the school system, and research and follow-up on the possibilities of digitalization.

The findings show that teachers and school leaders use several digital technologies, but many of their working methods have not changed. Digital competence is an ongoing learning process both at an individual and group level. The findings also show that the school organizers form the link between technology administration and schools; it is important to the pedagogical perspective steer the implementation of digital technologies in schools. To successful work, it requires collaboration between decision-makers for both administrations. Another important key in school organizers' and school leaders' sayings and doings is equality in and between schools. According to the school organizers, one way to create equality between schools is to find a minimum common denominator that raises with time and has mandatory elements for everyone to involve them in the digitalization work. This issue must be communicated clearly in schools' chains of command. They mean that it is essential to see the schools' digitalization as a well-integrated work into the pedagogical work and not a side project in the school. The school leaders also point out that connection problems and lack of support can lead to even the driving principals withdrawing from running the digitalization work at their schools. The school leaders also mean that it should be easy to use digital technologies in classrooms, which is important with support. Therefore, it is important to be part of a system where the school organizer creates opportunities for the municipal schools to expand the access and use of digital technologies. The school organizers should also be responsible for those parts where the schools have the same needs and provide the schools' support. Both school organizers and school leaders agree that teachers' attitudes to digital technologies are important for involving children and students in using digital technologies in different ways. At the same time,

school organizers' and school leaders' interest in expanding the access and use of digital technologies may influence teachers' attitudes to digital technologies in teaching. The digitalization work needs time and must be communicated to school leaders and teachers; it does not happen from one day to the next.

Keywords: School organizer, digital technologies, educational system

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From student to tutor and back again

Students' support of their own and other students' process of inquiry in an online tutoring environment

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As education tries to follow society in becoming more digital and online, many face-to-face environments have transformed into blended or occur completely online. Educational institutions implement different systems and tools for information and communication, such as learning management systems, video conferencing, discussion forums, and chat systems, all which students have a need to learn how to navigate and apply [1]. Course information, course material, discussions, etc. are often distributed to students through these online systems. Students are also participating in online collaborations, peer-learning, and tutoring, often relying on their peers, as their peers on them, throughout a course. Although these activities have been found to improve student learning, performance and satisfaction [2,3,4], they also force students to take on a greater role in their own and other students' learning. The purpose of this thesis is to explore how students support their own and other students' process of inquiry while engaging in an online tutoring environment. An additional purpose is to refine the Relationship of Inquiry framework, by introducing a coding scheme for transcript analysis of online tutoring.

In order to study students' interactions, chat messages were collected from an online text-based learning environment. The data was analyzed using two qualitative methods, one deductive and one inductive approach. The deductive method refers to transcript analysis from the Relationship of Inquiry (RoI) framework, developed in the frame of this thesis. The RoI framework [5] is adapted from the Community of Inquiry (CoI) framework [6]. CoI framework was developed for designing and assessing a deep and meaningful learning experience in an online text-based learning environment through the elements of *teaching*, *cognitive*, and *social presence* [6-10]. The framework was not however deemed to be adjusted for the case of only one student and one teacher, such as a tutoring environment. Stenbom [11] stated that in online tutoring the student and the tutor are encouraged to create a relationship of inquiry, whereas a community of inquiry is created in online learning between a group of students and teachers. The RoI framework adopted the three presences from the CoI framework, but also added the fourth element *emotional presence* [12,13].

Using the developed RoI coding scheme students' overall interactions was analyzed, with focus on students' expressions of teaching presence. Through analysis of these expressions, students' support of their own and other students' process of inquiry, as well as connections towards metacognitive development [14-16], may be found. Furthermore, for the inductive analysis of the data, thematic analysis [17] was used. A different method of analysis offers the possibility to find results that, using only the RoI coding scheme, otherwise might be missed.

In the first paper of the thesis, the coding scheme and transcript analysis procedure is described and tested. In the second paper, the coding scheme is further revised regarding the teaching presence expressed by students in order to explore how students' support their own and other students' inquiry process. In the third paper, students' support of their own and other students' process of inquiry is studied, analyzed with the use of the previously introduced coding scheme.

The findings show that in an online tutoring environment, students may spontaneously take on the role of a tutor by aiding their peers and willingly share their knowledge on the subject or a problem. Students were also shown to play an important role in their own inquiry process, by setting the frame of the conversation and driving the interaction forward [4]. Through their expressions of teaching presence by, for example, explaining their issues and their previous steps, or answering other students' questions and giving suggestions, students support their own as well as other students' inquiry process. Furthermore, the findings indicate that students acquire metacognitive development, through self- and co-regulation, with their expressions of teaching and cognitive presence.

The results from this project can have the practical implications of helping teachers and course designers to improve student-student and student-teacher interactions, and bring a deeper understanding of how online discussion and tutoring can support students' inquiry process as well as metacognitive development.

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Abstract

Flexible Solutions for the continued professional development of in-service educators

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Keywords: continued professional development, teacher education, higher education, learning technologies

General description of project

In a world of constant and fast societal and technological change, the teaching profession grows ever more complex and demands an increasing array of competences, knowledge and skills which makes it important that teachers continue their education throughout their working lives and that the professional development education they are provided with is of high quality. However, there is a low level of regulation around this form of education and consequently a low level of equity in professional development among teachers across the country. As shown by Bergviken Rensfeldt et al. (2018), for many teachers in Sweden the best opportunity for professional development is the sharing of material and ideas on social media, which may even be counter-productive to increasing professionalism and expertise according to their analysis. The Swedish Ministry of Education recently announced that a national programme for the professional development of principals, teachers and pre-school teachers is under development and expected to be taken into practice by 2023 (Swedish Ministry of Education, 2021). With this national programme the didactical *what* and *why* of teacher professional development is expected to be defined, and the objective of this thesis will be to investigate the *how* in terms of educational design, and to map out what teachers and school organizations have on offer today in terms of formal public higher education for continued professional development (CPD). In the concept of CPD will be included both continued education for competence and career development within the school system.

Three overarching research questions are being posed:

RQ1. What formal CPD educations for in-service educators does public HE institutions offer for the purpose of competence and career development?

RQ2. How is learning technology utilized in the pedagogic design of the CPD's to support and enhance the educational experience and outcomes for participants?

RQ3. How can the educational designs be understood in relation to socio-cultural theory?

Method

The approach will be of the inductive-descriptive kind and data collection will begin with a probing of the terrain to get an overview of the supply for professional development for teachers on offer at Swedish higher education institutions nationwide, through a semi-formal e-mail inquiry among educational managers across the country. The information this inquiry generates will then be categorized (see below) and from it a sample selection will be taken for more detailed examination, as large as the project time allows for. The deeper examination will follow a three-step procedure:

Step 1. The regulatory documents (e.g. syllabus and/or study guide) *description* of the pedagogical designs will be analysed.

Step 2. The person behind the design will be interviewed to elicit their *intensions* with the pedagogical design.

Step 3. Participants of the professional development model will be interviewed to elicit their *experiences* of the pedagogical design.

Categories of CPD for teachers

- a. Continued education for development of subject didactical expertise
- b. Continued education for license to teach additional subjects or grades
- c. Continued education for development of general pedagogical expertise
- d. Continued education for career progression

By including document analysis and the perspectives of both designers and participants of the educational models, some degree of triangulation is attempted to gain a more nuanced picture of the object of study, which will finally be discussed in relation to socio-cultural theory.

Intent of publication

Depending on what and how much data I acquire there may be various alternative ways of organizing the material into sub studies. One possibility would be to arrange them into sub studies around the different categories of continued professional education for teachers, another option is to make a first study from the beginning outline of the field and then let each of the three perspectives form an article each. I have yet to make this decision.

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DIGITAL CITIZENSHIP IN POSTDIGITAL TEACHER EDUCATION

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Keywords: teacher education, democratic assignment, professional digital competence, digital citizenship, postdigital

1. INTRODUCTION

The fostering of democratic citizens is listed as a pillar of Swedish education (Ekman, 2007) – a democratic assignment for which teacher educators (TEDs) need to prepare student teachers. However, the embeddedness of digital technologies in society places new demands on citizenship, referred to as *digital citizenship* (Frau-Meiggs et al., 2017), and consequently new demands also on TEDs and teacher education (TE) institutions. Examples illustrating why this is important include fake news, post-truth politics, digital surveillance, and echo chambers. Focusing on Swedish subject TE, this PhD project explores the overarching question: When digital technologies disrupt citizenship, how does this impact TEDs preparing future subject teachers (teaching pupils aged 13-19) for the democratic assignment?

Studies on the democratic assignment in Swedish and international TE contexts identify a tendency among student teachers toward limited understandings of democracy, and different conceptualizations of democracy can impact how teachers engage with the democratic assignment. Thus, TEDs need to support student teachers to develop knowledge, skills, and a broad understanding of democracy (Carr, 2012; Edling & Liljestrang, 2018). However, how TEDs do this in relation to digital technologies is underexplored.

At the same time, new teachers need to be ready to teach in an increasingly digitalized society (Starkey, 2020), and recent Swedish policies and adhering documents on the digitalization of schools and pupils' development of "adequate digital competence" put pressure on TEDs who are to teach student teachers how to teach with technology (Lindfors et al., 2021). Previous studies have highlighted among others the role of support through continuous professional development and TE policy (Lindfors et al., 2021), beliefs and attitudes (Scherer et al., 2018) and role models (Gudmundsdóttir & Hatlevik, 2018), but there is a need for more research on TEDs, professional digital competence (PDC), and digital technologies in TE (Lindfors et al., 2021; Starkey, 2020), particularly TEDs' competences for teaching how to teach with digital technologies (Uertz et al., 2018).

Intersecting the democratic assignment and PDC, empirical research on digital citizenship has largely focused on teachers and pupils in K-12 classrooms while TE has not been studied to the same extent. Examples include TEDs' and student teachers' perspectives in relation to specific areas of digital citizenship, such as responsible use of digital technologies (e.g., Gudmundsdóttir & Hatlevik, 2020; Lindsey, 2015), which may be limited in conceptual scope (Heath, 2018). This indicates a need for TE research inclusive of more areas of digital citizenship.

Fundamentally, the questions addressed in this PhD project involve human relationships with digital technologies. This PhD project is grounded in postdigital theory ((Jandrić et al. 2018), which reflects a critical approach to technology, society, and grand narratives of technological development. Postdigital theory offers possibilities to discuss educational matters in ways that more aptly consider the embeddedness of digital technologies in society (Knox, 2019) and is used in this PhD project to consider questions relating to digital citizenship in TE, for instance how TEDs view the impact of digital technologies on citizenship and, subsequently, how the democratic assignment is (or ought to be) addressed in relation to digital technologies in TE.

The purpose of the PhD project is further defined by the following research questions of which RQ1 is in focus in the remaining sections of the text:

1. How do TEDs view digital citizenship and the digital competence required to teach for digital citizenship, and what are the potential implications for TEDs' role in preparing STs to teach for digital citizenship?
2. How do student teachers view digital citizenship and the digital competence required to teach for digital citizenship, and what are the potential implications for subject TE?
3. How could policy on digital citizenship impact the ways in which TEIs prepare student teachers?

2. MATERIALS AND METHODS

To date, seven (of 27) Swedish TE institutions, spread geographically and of different age and size, are represented. A purposive sampling approach was used to carry out 16 semi-structured interviews between February and April of 2021 with TEDs teaching the Education and Democracy module. This is a key area of TE addressing the democratic assignment where Expected Learning Outcomes link explicitly to the Degree Goals related to democracy, and it is part of the 60 credits of Core Education Subjects mandatory for all student teachers. In addition, course documents such as course plans and study guides were analyzed. On average, participating TEDs had taught TE for 13 years and the E&D module for 6.5 years. Using NVivo 1.5, a Reflexive Thematic Analysis (RTA) was performed on interviews transcribed verbatim (238 pages in total) and the documents collected. RTA foregrounds researcher subjectivity and self-reflexivity, viewing meaning-based themes as generated rather than discovered through iterative reading and coding (Braun, Clarke, Hayfield & Terry, 2019).

Future data will comprise interviews with TEDs teaching social studies TE, including relevant documents (RQ1), and the approach will mimic that of the first paper. Also to be carried out at a later stage but being more tentative at this stage is a survey of student teachers (RQ2) and a policy analysis (RQ3).

3. RESULTS AND DISCUSSION – A SNAPSHOT 14 MONTHS INTO THE PHD PROJECT

3.1 Digital Citizenship and Digital Competence in Swedish Subject Teacher Education: A Postdigital Perspective (RQ1; to be submitted)

As to TEDs' views of digital citizenship and the PDC required for the dual-didactic task of teaching student teachers to teach for digital citizenship, the results show that TEDs generally believe that the digitalization of society impacts the democratic assignment of school and that this requires specific dimensions of TED and teacher PDC. TEDs tend to conceptualize digital citizenship as source criticism and ethical, safe and sound use of digital technologies, and to a lesser degree also (im-)material means of democratic participation. The fact that TEDs view digital citizenship differently, if at all, may have implications for instance concerning what dimensions of digital citizenship that are emphasized (and likewise overlooked), equivalence across TE institutions, and who is to be handle questions relating to digital citizenship in TE. Important steps forward could be to highlight digital citizenship as a dimension of PDC and clarify Degree Goals concerning the relation between democracy and digital technologies, which could not only put these questions on the agenda in TE, but also contribute to broaden student teachers' understanding of democracy, including complexities that relate to the embeddedness of digital technologies in society.

While believing that TE should address questions relating to digital citizenship and that TEDs have an important role in this context, the democratic assignment is addressed in relation to digital technologies only coincidentally, and TEDs are uncertain as to the degree to which student teachers receive such training. Challenges include lack of time and unclear links among Degree Goals between teacher PDC and the democratic assignment, which is why TEDs prioritize broadening students' understanding of democracy, which other studies have highlighted as important (e.g., Edling & Liljestränd, 2018). To

include questions relating to digital citizenship in their teaching, TE institutions need to support TEDs' development of PDC by providing continuous professional development, including reviews of course content and program structure. Professional development programs could include elements such as role models and focusing on beliefs and attitudes (Gudmundsdóttir & Hatlevik, 2018; Scherer et al., 2018) generally in relation to digital technologies and specifically in relation to digital citizenship. This may be helpful also to develop TEDs' understanding of the complexities of democracy and democratic education in a society pervaded by digital technologies. Also, TE policy support is needed, and the importance of local and national support echoes previous studies (e.g., Lindfors et al., 2021).

4. CONCLUSIONS

Institutions need to ensure that TEDs have the PDC necessary to include questions relating to digital citizenship as part of their dual-didactic task of teaching how to teach with digital technologies, but support is also needed at the national level through TE policy. This paper has highlighted some important steps in that direction, for instance the clarification of TE Degree Goals, who is responsible for these questions in TE, and that digital citizenship be a dimension of TEDs' and teacher PDC. Otherwise, the risk is that questions relating to digital citizenship are addressed but in imbalanced ways because of an existent plethora of conceptualizations both locally and across TE institutions. However, echoing previous calls for more research on TEDs and PDC in TE (Uertz et al., 2018), this paper highlights a need for future studies to map digital citizenship in TE, particularly social studies TE which traditionally has been responsible for citizenship formation both implicitly and explicitly, but studies also need to focus on TEDs' dual didactic task, namely teaching how to teach for digital citizenship.

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Rethinking Special Education in a Digitalised School

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Network: Upgrade

Keywords: *digitalization, digital competence, special needs, digital tools, inclusive education*

General description

The purpose of my compilation thesis is to contribute with knowledge about the new conditions for special education that school's digitalisation brings. As society is getting increasingly digitalised, expectations of the school to implement and adapt this development rises. Several arguments about the effects of this development have been published stating that school is going through a change of epistemology (Lankshear, 2003; Lund & Aagaard, 2020), a change that challenges the traditional ways of teaching and learning (Bates, 2019; Mishra & Koehler, 2006). As the view on knowledge and the ways of teaching and learning are changed, it is not bold to argue that the conditions for the special educational professions (in Swedish context: Special education needs coordinators [SENCOs] and Special Education Teachers [SETs]) are changing as well.

This aspect of the development has yet been sparsely researched, but the body of research claiming that use of digital technologies can have positive outcomes in special education is broad and still growing. A research review by Olakanmi et al. (2020) showed overwhelmingly positive outcomes in every studied aspect when using technology in special education. For students with learning disabilities and/or special needs digital technologies and ICT, if adequately used, has proven beneficial (Cozad & Riccomini, 2016; Florian, 2004). Technology can also have a compensatory function for students with disabilities (Parette & Peterson-Karlan, 2010; Roberts-Yates & Silvera-Tawil, 2019) and include otherwise excluded students (Rahamin, 2004; Sorensen & Andersen, 2017).

Numerous political efforts aiming at digitalising the Swedish school system has been initiated in the last decades (Fransson et al., 2018; Gu & Lindberg, 2021; Karlsohn, 2009), the latest dated to 2017 (Swedish Ministry of Education, 2017). Without discussing each initiative's specific contribution, the current amount, standard and access of digital technology in Swedish education is very solid (European Union, 2019; Wastiau et al., 2013). Thus, a strong digital infrastructure in combination with proven positive outcomes of adequately using digital technology in special education, formulates questions that need to be investigated. With this perspective, my research project aims at exploring how SENCOs and SETs express and talk about the digitalization of the school and the competences needed in today's special educational practice, guided by the following questions:

RQ1: What digital tools do SENCOs and SETs use in their daily practice, and to what extent?

RQ2: What competencies does SENCOs and SETs see as needed for using digital technologies in their practice?

RQ3: How is teacher education of SENCOs and SETs preparing the students for working in a digitalised school?

Theoretical framework

The project will take a relational perspective on special education, where a human is understood by its relations to the context (Persson, 2008; von Wright, 2002). With this view, analyses of both the *educational* (e.g. pedagogy, instructions, individual adaptations, social relations,) and the *physical* (e.g. classroom settings, teaching materials, audio-visual conditions) learning environment are important for understanding how and why special needs occur (Nilholm, 2007). The perspective focuses on the surrounding conditions that effects teaching and learning, rather than on the student itself. Aesaert et al. (2015) found that research on school's digitalization primarily has focused on the student level, and less on the wider level of school context in which students are included. This, I argue, can be balanced by a relational perspective in research on digitalization.

The cultural-historical activity theory (Engeström, 1987, 2015), also known as CHAT, will be used as an analytical framework. The CHAT theory focuses on changes and learning in collective activity systems. The idea about activity systems expanding (as in 'developing' or 'learning') when new conditions are causing contradictions within the system appeals to me and seems applicable on my study. New artefacts, rules, communities, and/or ways of dividing labour are implemented in contexts that already exists and carries a historical culture of dominating traditions (ibid). Thus, placing digitalization of special education in an activity system can illustrate how digitalization is transforming special educational activities.

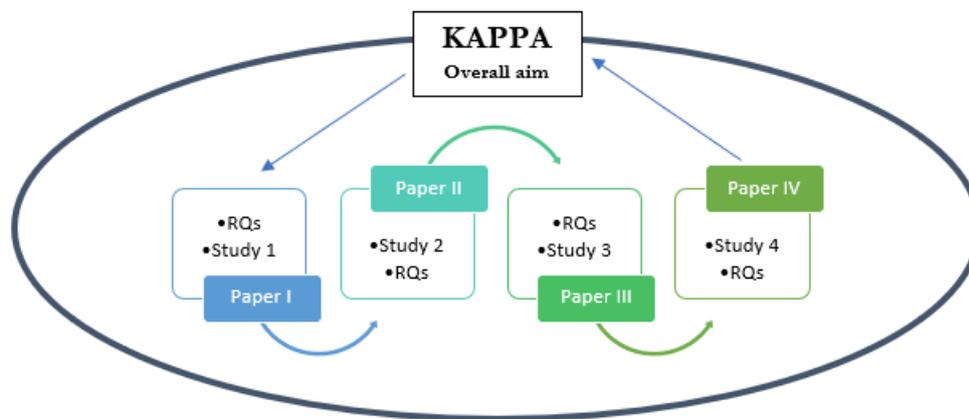
Methods and design

A mix of data will be used in this project, including surveys, interviews, and curriculums/documents. The surveys and interviews will investigate the SENCOs' and SETs' experiences, thoughts, and beliefs in relation to the overall purpose. The curriculum-part of the project will focus on special education teacher educations (TEs) in Sweden.

The first study has already been conducted using a web-based survey investigating the frequency of use of digital tools in special education. This part of the study was distributed in collaboration with a municipality and was sent to all SENCOs/SETs in the public schools. The municipality provides all schools with a number of digital tools that the school strategists see as useful for educational purposes, 12 of them were investigated in the survey. 36 answers was gathered and analysed by dividing the tools into four categories: tools for production, learning management, compensating disabilities or subject skills training. Also, a qualitative part consisting of three semi-structured interviews (Kvale & Brinkmann, 2014) with questions about how the informants perceive and talk about digitalization and the competencies needed in special educational practice, is included in this study.

Future studies will depart from the results from the first study. Questions that origins or is created from analyses of those results forms future studies, giving this project a flexible or exploratory design (see Figure 1). At the moment, additional surveys and interviews with SENCOs/SETs in other municipalities with the purpose of confirming or reconsidering the results from study 1 is a potential step to take.

Figure 1 Project research design.



Expected outcomes

One expected outcome of this project is knowledge about how frequent SENCOs use digital tools in their profession, and the rationales for that. The interviews aim to shed a light regarding the informants' thoughts, beliefs, and expectations on the digital educational development. An early analyse of the interviews indicates new understandings about the conditions for special educational practice, such as digital competencies SENCOs/SETs consider as needed for working in a digitalized practice. This knowledge, I argue, may in the longer run be of interest for special education TE's as there is a lack of knowledge about how higher education can train SENCOs/SETs capable of working in a digitalized school. The results are also of interest for school strategists, school leaders and special teacher educators as important actors in the process of digitalizing schools and special education.

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Abstract

Title: Quality, profession and sensemaking: - Digital tools for quality work in preschools

Amelie Nebes

The overall aim of the thesis is to study implementation and changes in preschool actor's profession, learning and sensemaking by using digital tools for quality work in preschool education. The thesis is planned for using sensemaking framework as a theory to analyze concepts of communication, learning and sensemaking in preschool organizations that use digital systems in their daily work with quality. Preschool profession and preschool education development are in change, mainly caused by implementations of digital tools. The study focus changes in the preschool profession, actor's sensemaking and the organization of learning. The thesis circles around questions on how sensemaking appears in a process of implementation of digital tool for quality work, how new digital tools are understood by actor's and what is expressed as important in learning processes within the organization.

The overall research questions are:

- What processes are set in motion when a digital quality tool is implemented in a preschool which provides new conditions for active educators' horizons of understanding regarding their own practice?

- In what way does the introduction of the digital tool initiate learning among the active educators in their profession?

- What is made visible or invisible by the digital quality tool and how does this affect the active educators' opportunities/obstacles in creating meaning and understanding of the pedagogical practices?

- In what ways are intentions and hopes, that are linked to the digital tool, transferred, renegotiated, and transformed when it is made sense of by active educators?

As a supplement to these overarching questions, several research questions are then formulated that are linked to four sub-studies:

Sub-study I:

- How is the implementation of digital tools for quality work carried out?
- How have actors learned to use the digital tools in quality work?
- How do actors' express skills/knowledge from the implementation of digital technologies?

Sub-study II:

- What does quality work mean for different actors?
- How do actors in preschool understand digital tool design for digital quality systems?
- What does different actors' meaning-creating work with digital tools contain?
- How does the use of digital technologies affect actors' learning?

Sub-study III:

- How is information documented through digital technologies directed and transformed?
- How do actors transform information at different levels within the preschool organization?

Sub-study IV:

- What opportunities and limitations are there in actors' work with digital tools for quality work?
- How are actors' work affected by digital tools and quality systems for quality work? (What does it mean for transformations, changes?)

The method is planned as performing multiple case studies, in four preschools within four different municipalities. Multiple case studies consists of field observations of introduction and implementation by the digital tool, interviews with twenty different actors in preschool organization and digital data containing information about preschool education. The case is thus the digital tool with web interface.

The thesis present empirical trajectories that seem to consist of the following content:

- *How implementations are conducted makes difference* – for the actors in their informal learning. Implementing and learning acquires supporting strategies. Learning in preschool organization is challenged by changes within organization and from policy calls for professional development. Professional development by a digital tool requires cooperation between actors as colleagues.
- *Professional development* - is recognized by actors' different positioning with digital use and is influenced by experience and professional knowledge. It may also affect digital use and inclusion of actors to use digital tools. There are differences and partial uncertainty in knowledge of use. But many actors express that they have a digital habit of apps and digital tools from their private life.
- *Financial management* - Affects the actors choice of what is purchased. There is an inclusion of management actors in preschool's organization that makes decisions of purchasing digital tools for the use of all actors.
- *Preschool quality work with digital tools* - There are concerns that the digital tool may appear in the foreground and disrupt the relational work together with the children and the children's needs or learning. It also emerges that work teams needs to get to know the digital tool and process the form for use. Agents in work teams bring processes to life to continue informal learning and plan their use. Part of the motivation for using a digital tool is that it should facilitate the documentation and replace the analog quality work.
- *Quality structure and design* - The communication about the education is in the form of content of templates that reproduce information about the teaching. These templates that are planned in advance need to be changed because the teaching does not turn out as intended. The templates then become misleading in their content of context. The templates that are implemented collect strict information about what the teaching contained.
- *Analysis and evaluation* - A challenge? It seems that everyone has waited with these parts?
- *Relationship* - The learning processes seem to involve informal relationship-oriented processes. It involves trustful relationships and collaborative climate that affects learning in organizations. Structures are created for continued informal learning after implementation. Hopes are expressed that actors in work teams will be able to see each other's plans and how they intend to carry out teaching. The constructors of the digital tool hope that the digital tool will facilitate planning and communication. But will they understand each other, how do actors make sense of the template for communication?

How do they need to communicate, in teams and between actors at different levels in the organization? Actors develop relationships for cooperation with each other but also with objects. After the implementation, are concerns expressed by some actors. The concern regards how they will be able to spend a lot of time in learning processes and develop their understanding of use and that this digital tool might soon be removed and replaced with another digital tool. There is a rapid digital change in organizations that is not always inclusive for all actors and that affects actors willingness to learn. Someone expressed that they “put their soul into their learning for use” and they form relationships with objects that are removed after a while.

- *Organizational changes* - Means that actors leave and new actors begin, which gives rise to a continued need for informal learning in the organization. It may also mean that the new actors want to implement other digital tools with new training and education for implementations. This continuous training, implementations and informal learning in organizations seems to be needed in a structured flow. Therefore, there are digital training videos from the company that developed the digital tool. There are also voluntary webinars and support. But the threshold from the actors seems to be that they want closeness and prefer to try to solve problems within the organization or in the work team.
- *Leadership* - needs full strength with agents to create legitimacy for implementation and continued support for learning and use. Therefore, perhaps more people should be included in purchases for use?
- *Decisions* – requires to be fact-based in organizations, the question is how actors will understand and make sense of facts contained within digital tool and system? Whether a digital tool and system will be a complement to communication or whether the digital tool will have influence on communication and relations? How will quality be shaped, based on, information in a digital tool and system?
- *Contradictions* - will the digital tool lead to contradictions based on legitimacy or values in the profession?
- *Quality* - How is quality in preschool shaped in different ways? Performance, in digital use, relational work, care, development, learning, it may occur in different expressions by different actors.

The thesis will contribute to in-depth knowledge of how implementing a digital tool and system for actors might initiate movements and change in preschool profession. Future results will involve knowledge of how actors creates strategies of informal learning and sensemaking, being influenced in the work with digital tools. It might also result in in-depth knowledge of how digital tools and quality systems result in movements or changes in professional practice and learning strategies required in preschools organization.

Preschool profession is in change, due to, digital development for preschool education. Information in digital tools are used for improving and making data - based decisions in preschools organizations. Actors uses of digital tools, takes part of information consisted within the digital tools, actors then start to process sensemaking and tries to make sense of transitions of information about preschool education. Quality work is thus about complex interactions between people at different levels within the organization, with different analytical skills, knowledge, prerequisites and abilities for collaboration concerning leadership, strategies and conditions.

Keywords: Digital tools, preschool education, implementing, technology acceptance model, sense making, professional development, big data, learning in organization.

Teacher educators' use of response technology

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Keywords

Teacher education, Student engagement, Formative assessment, Response technology

Introduction

It is commonly argued that student engagement positively predicts student achievement. Using response technology (RT) is one way to encourage student engagement. Response technology (RT) has been used in educational contexts for decades. Although there are many studies about the use of RT connected to learning, there is limited research connected to the use of RT in teacher education. Creating learning activities that include student engagement is relevant for teacher students since they, in their future profession, are expected to promote active participation among their own students (Swedish National Agency for Education, 2011).

Teachers typically use RT to involve and engage students during lessons or seminars in a modern educational context. Students can make contributions - often anonymously - through their smartphones, tablets, or computers, and teachers can receive and react to a real-time, comprehensive, and accurate snapshot of the students (Einum, 2019).

Aim

This study aims to explore how teacher educators use response technology to engage teacher students.

Research questions

The study is guided by the following research questions:

1. For what purposes do teacher educators describe that they use response technology?
2. What possibilities and limitations do these teacher educators experience?

Theoretical background and related research

For decades, researchers have agreed that students learn better when they are allowed to actively participate in classroom discussions, group projects, and assignments. (Auster & MacRone, 1994; Kember & Gow, 1994; McKinney &

Graham-Buxton, 1993; Petonito, 1991; Weisz, 1990). According to cross-disciplinary research, the transition from passive learning methods towards a more student-centered active learning leads to a significant increase in satisfaction, engagement, and learning (Knight and Wood 2005; Michael 2006). These teaching contexts are characterized by environments where all students participate, learn, and listen to others' ideas, comments, and questions (Wade, 1994).

According to Handelsman et al. (2005), student engagement is becoming increasingly important in higher education. Using RT can encourage students to take a more active role in learning and promote class participation (Chan et al., 2019). Research about RT reports beneficial effects for dimensions such as engagement (Blasco-Arcas et al., 2013; Henrie et al., 2015, Han & Finkelstein, 2013), motivation (Hunsu et al., 2016), participation, and learning (Stowell & Nelson, 2007), most often as a result of expanded communicative capabilities compared to traditional teaching (Keough, 2012).

Method

To address the research questions, nine semi-structured interviews were conducted with nine teacher educators employed at seven different Swedish higher education institutions during 2021. The teacher educators contacted were invited to participate in the study via email sent to several teacher educators at different Swedish higher education institutions with a teacher program. The participants ranged in prior experience connected to working as a teacher educator, institution, field/area, using RT in teaching, and frequency of use of RT.

In the email, the purpose of the study and the research questions were explained. The nine teacher educators who responded positively all considered themselves to be more or less "users of RT in a teacher education context" and were willing to be interviewed for this study. All participants were informed about the purpose of the study - to explore for what purposes teacher educators use response technology - and provided consent in writing before the interviews were conducted.

Before the interview sessions were completed, a semi-structured interview guide containing 18 open-ended questions was prepared. Due to the geographical distance, the interviews were conducted through Zoom. The interviews were conducted and transcribed in Swedish, and then specific quotes were translated to English. The data were analyzed using the six phases of thematic analysis to identify, analyze, and report themes (Braun & Clarke, 2014).

Results

The teacher educators in this study mainly used online/web-based response systems in which the teacher students could use their computers/smartphones to either write or record their answers. A majority of the teacher educators used RT

similarly during online, hybrid, and in-class teaching, mainly in synchronous learning activities.

All teacher educators interviewed mentioned the “meta task” of teaching teacher students. All strategies, methods, and (digital) tools presented and used during seminars often serve as examples that the students bring to their teaching profession. Using RT in learning activities was described as a “meta possibility” since the use of it both explicitly and implicitly could serve as a starting point for a further discussion about didactics and how to use digital tools to promote learning, as stipulated in the Swedish curriculum (Swedish National Agency for Education, 2018)

The results show that a majority of the teacher educators interviewed in this study argue that, given the right technical conditions and included in the pedagogical plan, the use of RT in teaching enhances students’ engagement and formative assessment. However, the use of RT in teaching is far from unproblematic, which all teacher educators emphasized.

A majority of the teacher educators interviewed used different RT during synchronous seminars where a maximum of 30 students was present. The purpose of using RT during these seminars with fewer teacher students present was often to engage, activate, and involve the students to interact with the material. Other essential aspects were stimulating communication and cooperation, visualizing all students’ perspectives, encouraging them to formulate themselves and participate in the discussion, and receiving and giving feedback. Almost every teacher educator referred to formative assessment to explain and motivate the arrangement; collecting evidence of the students’ learning, and based on that information modify the teaching to better meet students’ pre-conditions and needs.

Several teacher educators used RT to strengthen other aspects of formative assessment:

- engaging the students in the learning activities
- gathering quick feedback from the students, which was used to evaluate their teaching
- visualizing learning
- activating the students as learning resources for one another, and
- self-evaluations

The fact that many teacher educators reflected upon these elements in teaching as crucial for the students’ learning might have influenced their answers connected to their use of RT.

Some teacher educators used RT during whole group lectures, where up to 300 students could be present, to interact with the students. These teacher educators referred to the idea of *flipped classroom* and *peer instruction* to explain the

arrangement. The same teacher educators occasionally used RT to let the students answer questions before the seminar or lecture, in accordance with the idea of *flipped classroom*. The purpose was to investigate the teacher students' previous knowledge to plan seminars/meetings based on the students' previous knowledge.

Nevertheless, there are several limitations connected to using RT in teaching. For instance, the lack of time regarding the practical use of a specific tool (both as a teacher educator and as a teacher student). Moreover, the teacher educators' and the teacher students' digital competence, experience, and interest were important factors for a successful arrangement.

Another explicit limitation was regulations such as GDPR, which often stipulate what digital tools are allowed to be used in teaching due to the possible gathering of the students' personal data. In addition to personal data concerns, they brought up the ethical aspect of using digital tools connected to a market with a financial gain.

A few teacher educators brought up the game-based functions in some RT and described how they used them in teaching to enhance student engagement. They also highlighted that the game-based functions are not suitable for all student groups.

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Presentation Title: CT and its role in the classroom of the 21st century

Introduction

In 2018 the Swedish national agency for education (Skolverket) defined a national strategy for digitalization in K-12 education aiming at teaching digital competences to all students and achieving equal access and usage of digital tools in all schools across the country (Skolverket, 2018). This strategy poses several challenges such as developing programming skills at early age, giving the students the skills necessary to make a meaningful use of digital technologies and being able to critically analyze the impact that digital tools have in our society. In order to understand the digital world that we live in, young students must be able to use digital systems and understand how they work. In order to achieve this goal the Swedish government established that programming should be introduced in the curriculum of K-9 education so that children could understand the basis of algorithm design, which is essential to understand how digital systems work.

My doctoral research focuses on the concept of computational thinking (CT) as a critical aspect in the process of digitalization of the educational system and developing digital competences among K-12 students. This poses many challenges, especially when considering that in order to teach CT concepts and skills in primary and secondary education it is first required that teachers fully understand core CT practices (Kohen-Vacs & Milrad, 2019; Yadav et al., 2017) so that they could in turn impart this knowledge to their students.

Research objectives

The main objective with this doctoral research is to explore ways in which digital tools can be used to teach CT concepts and practices as part of the goals towards digitalization defined by the Swedish government. The goal is to provide possible guidelines for designing educational methods that foster the development of CT skills among K-12 students. Collaboration among the different stakeholders is an important aspect in this study and therefore an important goal of the research is to work collaboratively with teachers and students in order to design together the type of educational interventions required for achieving a true digitalization of schools in Sweden and hopefully around the world.

Methodology

This research is based on ethnographic analysis based, at least partly, on participatory research methodologies. This method aims at incorporating the practitioners' expertise in education as much as possible for designing teaching modules to be conducted mainly in the

form of workshops and other teaching interventions in the context of school or after school educational activities. The goal with these workshops is to collect preliminary data as a sort of exploratory study to help us get a first approach on what it is working CT concepts with young students. Another reason to start my doctoral studies with an exploratory approach is to have the opportunity to determine whether any interesting a posteriori hypothesis could be drawn from the analysis of the collected data from these teaching interventions.

The conducted workshops

Thus far, we have conducted three teaching interventions aimed at collecting data for studies of exploratory nature regarding the design of teaching modules to work with CT in K-12 education. The first study was conducted in a middle school in Växjö with students aged 13-14. For this study we designed teaching modules together with three teachers in the subject matter of technology. The second study was conducted with students aged 12-15 and it was set in the context of after school activities organized by the municipality of Växjö at the city library. In both of these studies we conducted a series of workshops, and we used a set of educational building toys with a focus on robotics and programming (Engino ERP) to teach CT concepts and practices and basic concepts of algorithmic design with a hands-on approach. The third study focused on pre-school teacher students. We conducted a series of workshops to introduce pre-service teachers of preschool level where we introduced them to the basics of CT and programming. They would then attempt to impart this knowledge to pre-school students during one of their internships and they would document their experience working with CT principles together with their students. In all these studies we used field notes, video recording and photography as well as different types of interviews and questionnaires to gather data for the analysis.

Theoretical framework

CT is a concept that has been around for several decades. Papert mentioned it back in 1980 in the book where he explains his vision regarding the important role that computers would play in education and how they have the potential to affect mental processes and learning practices (Papert, 1980). However, it would take over two decades after Papert's book for CT to acquire notoriety after the publication from Wing where she gives a more concrete definition of what this concept is all about and advocates for the incorporation of CT in K-12 curriculum (Wing, 2006). Wing explains that CT is a thought process with a focus on three main elements: problem-solving, system design and human behavior. This is important to keep in mind in order to understand what CT is really about. CT is much more than just programming and algorithmic design. Other aspects that play an important role within CT are collaborative work and communication. This human aspect of CT is emphasized by Wing as she explains that CT is a way humans can solve problems and it does not aim at getting humans thinking like computers.

CT aims at giving us the tools for identifying and defining a problem and expressing its solution effectively so that they could be carried out by any person or automated machine. Due to the fact that digital systems are becoming ubiquitous in our modern society has contributed to the growing relevance that CT has gained in recent year. Furthermore, CT is starting to be regarded by an increasingly growing number of researchers and educators as a key set of skills needed for facing the challenges of the 21st century and thus the importance of including them in K-12 education (Grover & Pea, 2017; Lee et al., 2011; Lu & Fletcher, 2009; Wing, 2006; Yadav et al., 2017).

Design is another element that plays a fundamental role in this research as it is a field of study closely related to education and computer science. In addition, participatory design is an approach that plays a crucial role when designing effective and meaningful technological tools and teaching interventions. Mor and Winters (2007) argues that the relationship Between the different stakeholders involved in the educational process, such as practitioners, researchers, students, and technology developers, is becoming ever more critical. Sharing the knowledge from different areas of expertise in order to develop technological tools and creating teaching modules and learning environments aimed at imparting knowledge of CT and modernizing educational practices in general is a complex process, but absolutely necessary when the goal is creating meaningful learning experiences. It is at the core of participatory design for education to allow all stakeholders to shape the educational practices together (Könings et al., 2014). Lastly, this research attempts to apply design-based learning (DBL) approach to develop learning instances aimed at imparting CT knowledge with a strong emphasis on problem-solving, creativity and cooperation. Design plays indeed a critical role within CT as the main purpose of it is to device or “design” a solution (Doppelt et al., 2008; Saritepeci, 2020).

Expected outcomes and future challenges

The series of workshop conducted during the three studies were a valuable first experience that provided preliminary data on the challenges of using digital tools to teach CT concepts and practices. In future studies I plan to get deeper into the challenges of teaching concepts of programming to young students. Through the analysis of algorithms designed by the students I expect to identify some of the critical elements that are required to effectively create functional algorithms. Using questionnaires and interviews I expect to gather relevant data concerning the views of students and teachers on different aspects of CT. This doctoral research is still at a very early stage and therefore it is still not possible to have a clear picture of the full scope of the study. The preliminary results obtained with the conducted workshops suggest that robots are an effective tool for teaching basic concepts of programming and CT, although there are still issues regarding the challenges of presenting CT knowledge so that it will be perceived as relevant by the young students.

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FALL Symposium with GRADE research.
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THEME: Learning in a digital world

**Digital technology at vocational programs - what, how, why
and for whom?**

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Extended abstract

Background

From a learning perspective knowledge about how digitalization affects teaching is necessary. Research on how digital technology affects education is one of the parts in the national Swedish strategy for digitalization of the school system (Utbildningsdepartementet, 2017). Olofsson et al., (2021) however, proclaims that both time and context is missing for teachers to develop their digital competence and that there is a lack of preparedness at the organizational level. For a long time, there has been hopes connected to digital technology in education to increase the results both for economic, democratic, and pedagogic reasons (Selwyn et al., 2020; Willermark, 2018). Even if digital technology has changed society in a revolutionary way the teaching practice has not changed to the same extent (Cuban, 2001; Rasmussen & Ludvigsen, 2009). On the other hand, it has changed the prerequisites for teachers when it comes to controlling what information the students meet (Hillman & Säljö, 2016). Player Koro (2018) is also claiming that neoliberalism and individualism can be connected to the digitalization of the school system today and calls for a dialogue close to practitioners between different actors with connection to student's knowledge development. This current project has an important task to possess because of its focus on upper secondary education in Sweden and more specifically vocational teachers' experiences of using digital technology and how their learning is expanding in a digitalized society. Especially since there is a risk that other actors than the teachers that use digital technology in their teaching are becoming more influential over the premises of the teaching (Hillman & Säljö, 2016; Player-Koro et al., 2018). Today students have access to digital technology such as mobile phones, learning tablets and computers from an early age (Skolverket, 2016) and Holmberg (2019) claims that in a digitalized society teachers are expected to take on the role of designers in their teaching and use digital technology in a way that adds value.

Vocational education in a digitalized society where students' vocational professional knowledge is expected to be adapted to professional practice requires exploration. The illustration of how digital technology is represented at vocational education programs is highly relevant while it is not only the subject for learning but also is expected to work as support for learning. Previous

research has found that when adding digital technology in teaching, teachers tend to use digital technology as replacement for old ways of teaching which would exclude many of the advantages of digital technology (Voogt & McKenney, 2017). In this teaching context that might not be the case since some of the digital technology has an application in a working life context.

Aim

The project aims at increasing knowledge of how digital technology and the digitalization of society is affecting the learning for vocational teachers as well as their teaching especially when it comes to teaching that aims at developing their student's professional knowledge. Which are the contradictions that emerge and how can those be dealt with?

Research questions

1. How are vocational teachers learning expanding when working with school development affected by the digitalization in society when it comes to their vocational teaching?
2. How are vocational teachers developing the teaching practice to develop their student's professional knowledge in a digitalized society?
3. Which contradictions are vocational teachers facing when a more digitalized teaching practice is evolving?
4. Which possibilities and challenges can a more digitalized teaching practice have to support vocational students' participation and learning?

Methodology/methods:

The project will be conducted as a cooperation between me as a doctoral student and 3-4 upper secondary schools by an appropriate selection (Denscombe & Larson, 2018). Vocational teachers will be observed in their teaching and in team meetings where questions about teaching are being discussed. During autumn 2022 one working team (team A) is being followed approximately one day a week. The project has an explorative and ethnographic orientation which in this case implies that the ethnographer is participating openly in the informants' daily activities during a longer period. What is being said and what is being done is in focus and questions will be raised continually to the informants. *On the go* as well as in more structured forms as interviews. Data relevant to the focus of the project will be collected via field-notes and recordings (Hammersley & Atkinson, 1995). According to May and Torhell (2013) Ethnography can lead to a rich, empathic, and valuable understanding of a social scene. However, it is important not to influence the field place and the presence is built on trust (Atkinson, 2001).

Observations will take place in team meetings where the development of the teaching is in focus as well as in teaching situations. The role of the researcher is participative in observations (Atkinson, 2001; May & Torhell, 2013), a process where the researcher creates many faceted and long-term relations with a group of people in their natural environment. An in-depth understanding is possible to gain by such observing and in addition to contemplating various

kinds of data (Arvastson & Ehn, 2009). The access to the environment and the trust for the researcher together with the ability to observe the normal as unfamiliar is highlighted as crucial (May & Torhell, 2013).

Fieldnotes will be conducted before, during and after the observations with both describing and reflective character. According to Atkinson (2001) fieldnotes are a form of representations and reducing of events, persons, and places into written text which also means that a selection and interpretation is inevitable. Within ethnography this kind of data is treated as loosely coherent, however possible to use even if some data will not be used.

Interviews with vocational teachers (and their students) will take place. First a semi structured interview (May & Torhell, 2013) with an interview guide including themes referring to; teaching at distance during the pandemic, teaching in general (and with digital technology) and experiences on how teaching might have developed over time (Trost, 2010). The second has more of a following-up and clarifying structure. Within ethnography interviewing can be utilized when there is a need to embrace the complexity within human experiences to gain access to the informant's experiences and interpretations of their experiences which could also increase the relevance for the study from the informant's perspective (Atkinson, 2001). Focus group interviews with the vocational students will also be conducted using a semi structured interview guide (Wibeck, 2010). As a complement to data collection above, a workshop together with vocational teacher students in their third semester will be held and conversations about vocational teaching at a distance during the pandemic will be captured on sound recordings.

The Activity theory is offering tools both to describe and to analyze the empirics and central concepts as *activity system*, *expansive learning*, *contradictions* is expected to contribute with understanding of activities within vocational education. Engeström and Sannino (2011) is highlighting that those contradictions are manifesting themselves in four diverse ways the activity system; *dilemmas*, *conflicts*, *critical conflicts*, and *double binds*. Since contradictions are historically emerging and systemic phenomenon's they can be made visible by studying the manifestations when practitioners articulate and construct them in words and in actions (Engeström & Sannino, 2011). The *expansive learning cycle* embraces the idea that the emerging of new activities is taking place in a movement from abstract ideas to concrete actions (Engeström, 1987). The idea is to study such actions where expansive learning is made visible with the help of expansive learning activities (Rantavuori et al., 2016). Knowledge about how digital technology is emerging in relation to developing professional vocational knowledge could be beneficial for vocational teachers in service as well as for vocational teacher education.

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Teacher Education as a Node in a Digitalized School System (?)

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Key-word: Teacher Education, Digitalization, Digital Technology, Practices, Practice Theory,

General description on research questions, objectives, and theoretical framework

Teacher Education shall provide pre-service teachers with the competences that they need in their future profession. In 2017, the Government of Sweden presented a National strategy of digitalization (The Government of Sweden, 2017:a) followed by a strategy for digitalization of the entire Swedish school system (The Government of Sweden, 2017:b). By this initiative the Teacher Education became an important part of the digitalization strategy with an emphasis on digital competence for everybody included in the system.

The Digitalization strategy for the school system were followed by an action plan, #skoldigiplan (Swedish Municipalities and Regions, 2019), stressing that **Teacher Education shall develop its activities to meet the needs of a digitalized school system**. By highlighting this sentence, I would like to outline a few things that are of importance for the background of my research. First, I think that it is of significance to emphasize that digitalization and digital technology is not something new for the Teacher Education practices of interest in my research. By picking out the word "develop its activities" we can get the understanding that it is a continuous work that shall be carried out. We need new understandings building on earlier knowledge, for example previous studies show that newly examined teachers experience a gap between teacher education and their professional work-life (Gudmundsdottir och Hatlevik, 2018). Second, by picking up the word "needs" we can get the understanding that there are several desires that shall be fulfilled in this work. For example, Roumbains et al. (2019) points to the complexity of the everyday life of Teacher Educators where they express a need for more support and collaboration in their work with digitalization. Third, there is the word "system" that provides the understanding that everything is connected, Teacher Education is part of a system and not an isolated entity. The school system reveals variation and in relation to children's and pupils' learning, research show that the context is crucial for the teachers use of digital technologies (Brooks, 2019; Nilsen, 2018). A basic assumption in this work is that Teacher Education is part of an education system consisting of smaller practices that all relate to each other. The aim of the picture sketched above is to outline the three different projects of interest to my research 1) Digitalization in higher education - practices and digital technologies in a department of teacher education 2) Digitalization in the school system - practices and digital technologies in pre-schools 3) Digitalization and digital technologies in an ecology of practices - connected practices in Teacher Education. The starting point is an assumption that more knowledge is needed based on the practices of key actors using digital technologies and that there are currently relationships between these practices to discover. The purpose of the different projects is to explore how Teacher Education digital technology practices is connecting, being a node in a digitalized school system. The research questions are; How is digitalization experienced and translated in Teacher Education practices? What practices of digitalisation and digital technologies are developed and how do the practices connect? The questions are explored as a case study (Yin, 2014) at a Swedish Teacher Education for pre-school teachers. The Teacher Educations practices are explored through the lens of a relational and practice theory perspective ((Kemmis et al., 2014). The key actors are the practitioners in Teacher Education, pre-service teachers, teacher educators and in-service teachers. They are the source to the information that shall answer the research questions.

Methodology and Methods

Practice theory (Kemmis et al., 2014) is central in this thesis, providing both an ontological and epistemological framing. With the practice theory follows a critical perspective influenced by Marx, the Frankfurt School and Habermas (Mahon, et al., 2017).

The practices that were of initial interest was the ones that could provide information about the digitalized school system that the Teacher Education shall prepare the students to work in, project 2. In-service teachers who took a higher education course in supervision for In-service Education (sv: verksamhetsförlagd utbildning) at the current department for Teacher Education were chose as key actors to answer a questionnaire. The questionnaire was constructed in a web-based program, Sunet Survey, and had both open-ended questions and questions that should be answered on a Likert scale. The form was sent out to all students, 75, that were registered at the course. They were all teachers with supervisor assignments, who worked in preschool, elementary school and high school. After the questionnaire had been closed, the persons that had answered it were contacted with a suggestion to participate in a conversation about the three themes digitalization, digital technology and teacher education. Three persons answered that they wanted to participate. After the interviews, three additional pre-school teachers were contacted from a selection based on availability. They filled in the questionnaire and participated in conversations. The methods can be defined as mixed methods (MM). MM is used as a concept, for example, when quantitative as well as qualitative methods of empirical study and analysis are combined (Cohen, 2018). MM can provide a richer and deeper understanding in research on education and digital technologies (Krumsvik, 2020). The quantitative materials generated in the questionnaires, can draw a picture of digitalization and digital technologies, this image contributes to the overall narrative of the practice that also are captured in the conversations. Project 1, is exploring different activities that the teacher educators provide, and the students participate in. Initial studies have been a web-based questionnaire, constructed in the same way as the one distributed to the in-service teachers, with intention to also use in project 3. Furthermore, participatory methods will be used, talking and observing in the practices, video recordings are also considered. Project 3 will include policy studies interviews and workshops.

Results from project 2 - tendencies

The web-based questionnaire in project 2 was sent out to 75 people, 18 answered. Twelve of the respondents worked in preschool, one in preschool class, three in grade 1 – 3 and two in grade 4 – 6, none in grade 7 – 9 or upper secondary school were represented in the answers. This had significant impact on the direction of the thesis. While most answers came from those working in preschools, twelve answers, preschool teachers and Teacher Education for preschool teachers were chosen for the Case study. Out of twelve, three replied that they could meet for in-depth talks, three more respondents were recruited. Five of the meetings were arranged via Zoom and one, due to technical difficulties, by phone.

The questionnaire constructed data from fifteen (15) in-service teachers, that are supervising pre-service teachers in their internship. The results from the questionnaires give answers about feelings, motivation and experiences related to the three themes digitalization, digital technology, and teacher education. The Zoom-meetings were prepared by an analyze of the respondent answers to the questionnaire. The data will be analyzed with the framework of practices architecture (Kemmis et al., 2014). The practices are held together by practice architectures, the conditions that enable and/or constrain a practice. These arrangements are cultural-discursive, material-economic, social-political. Culture-discursive arrangements unfolds in the spoken words.

For example, in the work with the material some words are more frequently used by the pre-school teacher indicating a shared language when talking about digital technology and digitalization. There is also example of words that are used by a few, for example digitality (digitalitet in Swedish) and border-crossing. Material-economic arrangements are physical, material, and economic sources that shape the doing in a practice. For example, the extensive use of Ipads is a distinct part of everyday life in all the preschools. The social-political arrangements are about power and solidarity. The pre-school teachers describe how different relations are shaped, for example to colleagues, to their headmaster and to society.

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