

# Purposeful Actions in Leadership of Learning Processes: A Mixed Methods Study of Classroom Management in Digital Learning Environments

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Synnøve Moltudal

Thesis for the degree of Philosophiae Doctor (PhD)  
University of Bergen, Norway  
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Thesis for the degree of Philosophiae Doctor (PhD)  
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Name: Synnøve Moltudal

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## **Scientific environment**

This thesis was written between August 2015 and July 2020 at the Department of Arts and Physical Education (AKF) at Volda University College (HVO). During this five-year period, I have also been working as an Assistant Professor in Digital Competence in Learning at AKF between 2015 and 2018, and at the Department of Media and Communication (AMF at HVO) between 2018 and 2020, in addition to being a doctoral student at the Institute of Pedagogy (IPED)/the Faculty of Psychology at the University of Bergen (UiB).

I have been a member of the research group Digital Learning Communities (DLC at UiB) since 2015 and the Western Norway Graduate School of Educational Research II (WNGER II) from 2017 to 2020.



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In every classroom you find teachers and pupils, each person has their own individual background and lived experience. Their lives, development, and learning are intertwined with those around them, and, together, they form a learning environment in which both pupils and teachers learn, grow, and develop together. In my project, I have been fortunate enough to visit such learning environments, and I want to start by thanking the pupils, teachers, and school leaders for letting me into their schools, their classrooms, and everyday school lives.

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## Abstract

Most Norwegian primary and secondary pupils now have access to their own computer or tablet at school (1:1 access), and 1:1 access to information and communication technology (ICT) has a variety of implications for teachers' classroom management practices and leadership of learning processes. In this doctoral thesis, I explore the experiences and needs that arise in the field of practice as premises for why classroom management is changing.

In order to solve real-life challenges, we must first understand them, and I therefore set out to explore how we can understand the challenges primary and secondary teachers are facing in their 1:1 ICT classroom management practices. Using a qualitatively driven mixed research design, I seek to contribute to the field of classroom management in 1:1 learning environments by combining emic and etic viewpoints and perspectives within a pluralistic pragmatist framework. In this partly sequential and partly convergent (concurrent) mixed methods design, qualitative and quantitative strands occurred across chronological phases, and the research questions were interrelated and partly evolved during the study. The doctoral thesis consists of three articles and an extended synopsis.

Article 1 presents and discuss findings from Study 1 of this thesis. The aim of Study 1 was to explore the relationship between digital competence and classroom management in 1:1 learning contexts. Qualitative interview datasets and quantitative survey datasets from a large-scale study were first analysed separately in order to explore the nature of the relationship (QUAL) and whether it holds beyond the local setting (quan). The results were then integrated for the purpose of expansion and elaboration. The findings from this article indicated a complex, intertwined relationship between classroom management and digital competence, revealing a prevalent tension between controlling and relational approaches to classroom management when ICT was used. The article concluded that different classroom management understandings and practices appeared to exist simultaneously in schools, which could lead to very different learning contexts for pupils. Article 1

informed the design of Studies 2 and 3, which are interconnected both contextually and thematically.

Article 2 presents and discusses findings from Study 2 of this thesis. Study 2 aimed to explore the aims of contextual classroom management by investigating how the systematic introduction of adaptive learning technology (ALT) affected pupils' learning and motivation. The real-life intervention design of Study 2 was observed through the use of both qualitative (classroom observation and focus group interviews) and quantitative (pre-/post-test and pre-/post-survey) methods. The (quan + QUAL) data were analysed both separately and integrated to both explore and explain how the aims of classroom management were affected when cutting-edge technology was introduced to the learning context. The findings from Article 2 indicated that ALT could facilitate basic learning across classroom practices. Most pupils perceived ALT tasks to be fun and varied; however, the results also revealed that, for some pupils, the aim of flow and motivation in the ALT activities could be replaced by spirals of frustration and amotivation and that the registered learning outcome could even decrease after the intervention. Article 2 thus demonstrated the complexity of facilitating ALT for learning in a real-life context.

Article 3 presents and discusses findings from Study 3 of this thesis. Study 3 aimed to explore how teachers implemented new, cutting-edge technology (ALT) in their contextual classroom management practices and how they reasoned about their attitudes to and experiences with this integration. The planning and conduct of the real-life intervention design (from Study 2) was observed through the use of qualitative methods (fieldwork, classroom observation, and individual semi-structured interviews). The findings from Article 3 indicated that the teachers perceived the same affordances in ALT somewhat differently based on their overall classroom practice and the integration of their professional knowledge bases. Their different attitudes were interpreted as an expression of their scepticism about outsourcing educational assessments and judgment of a self-driven and automated system that only partially overlaps with their shared and individual educational knowledge bases, values, and beliefs.

Across the studies, we found that the complex relationship between digital competence and classroom management was affected by teachers' professional understanding and knowledge base beyond technology. We therefore suggest that the challenges and opportunities primary and secondary teachers face in technology-rich learning environments are not merely related to technology but also to teachers' understanding of knowledge domains and the flexibility required to manage and lead adapted and highly complex learning environments. As a result, we propose increasing awareness of the importance of teachers' self-reflection about their roles and pedagogical beliefs as a starting point for purposeful classroom management actions and strategies in ICT learning environments.

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## List of Publications

### Article 1

Moltudal, S., Krumsvik, R., Jones, L., Eikeland, O. J., & Johnson, B. (2019). The relationship between teachers' perceived classroom management abilities and their professional digital competence. *Designs for Learning*, *11*(1), 80–98.

<https://doi.org/10.16993/dfl.128>

### Article 2

Moltudal, S., Høydal, K., & Krumsvik, R. J. (2020). Glimpses into real-life introduction of adaptive learning technology: A mixed methods research approach to personalised pupil learning. *Designs for Learning*, *12*(1), 13–28.

<https://doi.org/10.16993/dfl.138>

### Article 3

Moltudal, S., Høydal, K., & Krumsvik, R. J. (Submitted). Adaptive learning technology and learning analytics in primary education: Implications for teacher professional knowledge and classroom management. *Frontiers in Education*.

The publisher of Article 1 and 2 (Designs for Learning) has an open access policy, and the authors remain the copyright holders.



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## 1. Introduction

*When I was a child, my mother always cooked Sunday roast. I used to watch her as she cut off a tiny piece of one end of the roast, placed it in the roasting tin, and seasoned the roast. As I grew older, I started to cook Sunday roast on my own for my own family. I cut off a tiny piece of one end of the roast, placed it in the roasting tin, and seasoned the roast just like my mother always did. As time went by, I started to wonder, ‘Why do I cut the end off? What is really the purpose of that? Does it contribute to the juiciness or to the taste of the roast? What is the deal?’*

*I eventually asked my mother and she said. ‘Well, I had to do it. My tin was just not large enough for the whole roast to fit’.*

A school leader told me this anecdote during a lunch break during a workshop at which I had been speaking. We had talked about the forthcoming Norwegian reform, classroom management, learning in general, and how to use tablet and computer technology in school; reflecting upon the purpose of it all, she further added: ‘What we must do in our schools now is kind of the same thing, isn’t it? We have to question what we have been doing, what we are doing now, why we are doing it, and how it contributes to learning and development’.

### 1.1 Background

The educational use of technology has become increasingly central to the everyday lives of teachers and pupils. Since the 1990s, research on educational technology has generally demonstrated moderately positive effects on learning and achievement; however, the way in which technology is used also has been found to have an impact on its contribution to learning (Cheung & Slavin, 2012, 2013; Kulik & Kulik, 1991; Rosen & Salomon, 2007; Sung et al., 2016; Tamim et al., 2011, 2015). The successful use of learning technology is thus context-specific and requires the teacher to contextualize its use in a purposeful way. This makes educational technology a multifaceted and complex field of research.

The teacher's role is to facilitate pupils' academic and socio-emotional learning and development; thus, their integration of technology into teaching and learning activities has implications for pupils' learning outcomes. Classroom management is a growing field of research comprised of different perspectives on the relationship between the teacher's facilitation of learning and pupils' learning and motivation (Emmer & Sabornie, 2015; Evertson & Weinstein, 2006). Classroom management is thus a concept that is closely connected with teachers' professional role and their individual perceptions of how that role should be interpreted and practiced. However, little research has investigated the relationship between the educational use of information and communication technology (ICT) and classroom management (Bolick & Barthels, 2015; Bolick & Cooper, 2006). Despite the multifaceted and complex nature of educational technology integration, research in the field rarely uses mixed methods approaches (Lai & Bower, 2019). This thesis therefore aims to fill an existing knowledge gap by examining the relationship between classroom management and educational technology through the use of a Mixed methods research (MMR) design.

### **An Introduction to Classroom Management**

During the last few decades, classroom management has emerged as its own field of research; at its core are the management strategies used by teachers to maintain order, promote pupil engagement, and respond to problems (Emmer & Sabornie, 2015; Evertson & Weinstein, 2006). It is much wider in scope than the treatment of misbehaviour and includes a variety of activities teachers engage in to gain pupil cooperation and establish order (Doyle, 1986, 2006). Classroom management is considered an essential teaching skill, and by providing activities that lead to pupil self-control, teachers are less likely to spend time managing misbehaviour and more likely to spend time providing meaningful instructions and related tasks (Henley, 2010, p. 4). Different teaching contexts and instructional formats add variation to teacher and pupil behaviour, thus also creating different lenses to what components like 'order', 'engagement', and 'misbehaviour' actually mean for pupils, teachers, policy makers, and researchers. Some learning contexts may, for example, benefit from (or even encourage) chatter, shouting, or pupils walking around the classroom,

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while others may not. The variety of definitions of classroom management include certain widely agreed upon components; however, overall, its definition is dynamic (Emmer & Sabornie, 2015, p. 3). The most commonly used definition of classroom management is as follows: ‘The actions teachers take to create an environment that supports and facilitates both academic and social-emotional learning. [...] It not only seeks to establish and sustain an orderly environment so pupils can engage in meaningful academic learning, it also aims to enhance pupils’ social and moral growth’ (Evertson & Weinstein, 2006, p. 4). This definition implies classroom management as a key pedagogical competence while also reflecting the pluralistic and complex nature of the field (Emmer & Sabornie, 2015; Evertson & Weinstein, 2006).

A review of effective classroom management and rule practicing found that the two characteristics of classroom rules most important to their overall effectiveness were rules being taught and being tied to the appropriate positive or negative consequences (Alter & Haydon, 2017). The authors note that classroom management textbooks and practice-oriented journal articles are not uniform in their classroom management recommendations, implying that recommendations for classroom management could and should ideally be so. A later review of classroom management practices in Australia and the United States concluded that there is a critical need for pre-service teacher education programs to include more classroom management content (Hepburn & Beamish, 2019). The authors suggest that teacher education programs should primarily focus on evidence-based practices but also include more opportunities for preservice teachers to practice classroom management in real-life settings: ‘[I]t is important to acknowledge the complexity of teaching and the increasing demands being made on classroom teachers. [...] Time must be spent ensuring that teachers have opportunities to engage with research in meaningful ways, opportunities to learn from each other, and experience recognition of effective practice in the classroom’ (Hepburn & Beamish, 2019, p. 93). A third review, a mixed methods systematic review of the Incredible Years Teacher Classroom Management (IYTCM) programme, found that the intervention significantly reduced teachers’ use of negative classroom management strategies and reduced conduct

problems among high-risk pupils (Nye et al., 2019). However, the qualitative analyses also revealed three main critiques of the IYTCM: its manualized nature, its specific learning techniques, and the presence of extra challenges.

Even if these three reviews all recognize the complexity of managing classroom environments and highlight the need for knowledge-based practices, they also demonstrate and exemplify divergent and partly contradictory approaches to classroom management. While the first study emphasizes the positive and negative affirmation of rules as an effective strategy (Alter & Haydon, 2017), the second study emphasizes classroom management as a competence that needs to be taught and learned in real-life settings (Hepburn & Beamish, 2019). The third study informs the field by showing that context and perceived challenges in classrooms vary and that even if an intervention program produced a quantitative effect according to specific variables, the same intervention might generally be perceived negatively by different stakeholders (Nye et al., 2019). The comparison highlights the different perceptions about the extent to which classroom management practices should be prescriptive and standardized and a tension between control- and rule-based practices and relational practices.

In a meta-analysis of the effects of classroom management strategies and programs, Korpershoek et al. (2016, p. 646) classified classroom management strategies and programs into four categories: (1) pupils' social-emotional development interventions, (2) pupil-teacher relationship interventions, (3) pupils' behaviour interventions, and (4) pupils' social-emotional development interventions. Their findings indicate that interventions and programs focusing on social-emotional development had the strongest impact, especially in terms of socio-emotional outcome measures, which are considered important for future academic achievement and career success (Korpershoek et al., 2016). Variation in context and teaching and learning activity format adds depth and complexity to the field of classroom management, with the use of ICT adding new layers of complexity (Bolick & Barthels, 2015; Emmer & Sabornie, 2015). In this thesis, I address whether – and, eventually, how – the premise for classroom management is currently changing and

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how real-life challenges for classroom management can be understood as new technologies are continually applied to teaching and learning practices. This is achieved by the three studies included in this thesis. Study 1 examines teachers' conceptual understanding of classroom management, and Studies 2 and 3 examine teachers' contextual classroom management.

### **Norwegian Policies for Educational Changes**

During the last decade, laptops, tablets, and other hardware tools have become increasingly available for educational purposes. From 2006 to 2008, all upper secondary pupils in Norway gradually received one-to-one (1:1) access to their own laptops for schoolwork, both inside and outside school buildings. Lower secondary and primary schools were to follow and, even if no formal overview exists, it is estimated that approximately 70-80 % of all pupils now have access to a computer or tablet at school (SINTEF, 2019; University of Oslo, 2019). Investments in laptops and tablets have been encouraged and funded by both central and local authorities. Investment in and use of technology must therefore be viewed in the context of educational policy for school development in Norway. The policies for teaching and learning formats are currently evolving in primary and secondary schools, as are the policies for pre- and in-service teacher training. It is therefore necessary to provide a short summary of changes in Norwegian educational policy, with the pedagogical use of technology as a backdrop.

In autumn 2006, the Knowledge Promotion Reform (KL06) was introduced in Norway's 10-year compulsory schools and upper secondary education and training institutions. The Programme for International Student Assessment (PISA) 2000 revealed that Norwegian education was far from a global leader in mathematics, natural science, and reading when compared to other Organisation for Economic Co-operation and Development (OECD) countries, and PISA 2003 confirmed revealed a persistent and even downward trend (Hølleland, 2007). Another large-scale assessment, Trends in International Mathematics and Science Studies (TIMSS) 2003, supplemented the PISA findings and found that mathematics and science education in Norway was less systematic than in other countries, that teaching there was more

theoretical and less practical, and that Norwegian teachers had lower academic and didactic prerequisites than those in countries that Norway generally regards as peers. Norwegian pupils also appeared to be more disruptive and less motivated than pupils in other countries (Hølleland, 2007, p. 22).

The Official Norwegian Report *I Første rekke* (Kyrkje-, utdanning-og forskningsdepartementet, 2003) laid the foundation for the Knowledge Promotion Reform, and, with the white paper *Kultur for Læring* (Utdannings-og forskningsdepartementet, 2003–2004), identified five basic skills as central to the introduction of a new curriculum: *oral skills, reading, writing, numeracy, and digital skills*. They were considered ‘basic’ in the sense that they are fundamental for learning in all subjects and prerequisites for pupils to demonstrate their competence and qualifications (The Norwegian Directorate for Education and Training [UDIR], 2012). A main aim was that these basic skills should permeate learning across all subjects at all primary and secondary school levels.

The first four skills already enjoyed roughly a century of tradition in Norwegian schools; in addition, they are closely related to core school subjects taught across grade levels. However, the category of digital skills (i.e., pupils’ digital competence) was new to most teachers and pupils. The use of ICT was neither historically nor traditionally linked to any of the core subjects in Norwegian education, even if most schools had desktop computers available for special education purposes or IT/ICT specialized topics or subjects. So, although the reform was not primarily ICT-based, ICT use was launched as one of the measures to combat the challenges Norwegian schools were facing 15 to 20 years ago.

The Knowledge Promotion Reform was not solely about content; it also addressed governance (Hølleland, 2007; Møller et al., 2009; Ottesen & Møller, 2010). The objectives for education are formulated by national authorities, but the responsibility for achieving them was delegated to local authorities, school owners, and the individual schools themselves. Schools and teachers were expected to adopt the new curriculum by developing their practices and introducing new forms of teaching and

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learning activities, including the use of ICT and digital tools. However, current knowledge shows that there is often a gap between the arenas of formulation and realization (Lindensjö & Lundgren, 2000), and follow-up research on the Knowledge Promotion Reform showed relatively large differences among schools in the way it was understood, implemented, and practiced (Møller et al., 2009; Ottesen & Møller, 2010). The most extensive curriculum integration and school development seemed to take place in small collegiate cultures at certain schools that had enthusiastically embraced the content and possibilities embedded in the reform (Møller et al., 2009, p. 179).

Mishra and Koehler (2006, pp. 1031–1033) criticized traditional implementation strategies for ICT in schools and the educational sector for ignoring four key points: (1) rapid technology development means that tools and technologies are constantly changing and evolving; (2) software is rarely developed for school education purposes; (3) learning is situated, and the use of technology must be adapted to different pupils and groups of pupils; and (4) teachers are required to use technology and digital tools, but there is little guidance on precisely how this should be done. However, in Norway, pattern-breaking groups of teachers were developing new teaching, learning, and assessment practices that included the use of computer (and gradually tablet) technologies (Krumsvik, 2006). These teachers were known as innovators and early adopters (e.g., Rogers, 2003) and frontrunners and power teachers who ‘[...] seek information, learn what they want to know, when they want to learn it, to the level of depth that satisfies their immediate quest for knowledge in order to use and find pedagogical advantages in technology, also not intended for pedagogy, and put it into a pedagogical setting, beyond the abilities of a normal teacher’ (Wasson & Hansen, 2014, p. 60).

During the first 10 years of the Knowledge Promotion Reform, gaps between teaching and learning practices in Norwegian education became increasingly visible. While some teachers and schools generally maintained the status quo in their teaching practices, others made small adjustments to their existing practices in line with the requirements of the new reform. The educational use of ICT in school was still



generally limited, with teachers mainly using ICT for word processing, presentations, and simple information searches (Thronsen & Hatlevik, 2015). However, the frontrunners increasingly integrated ICT seamlessly into teaching and learning activities and made relatively extensive – albeit gradual – changes to their practices.

As a thinking model, the gap between practices can be illustrated in Figure 1):

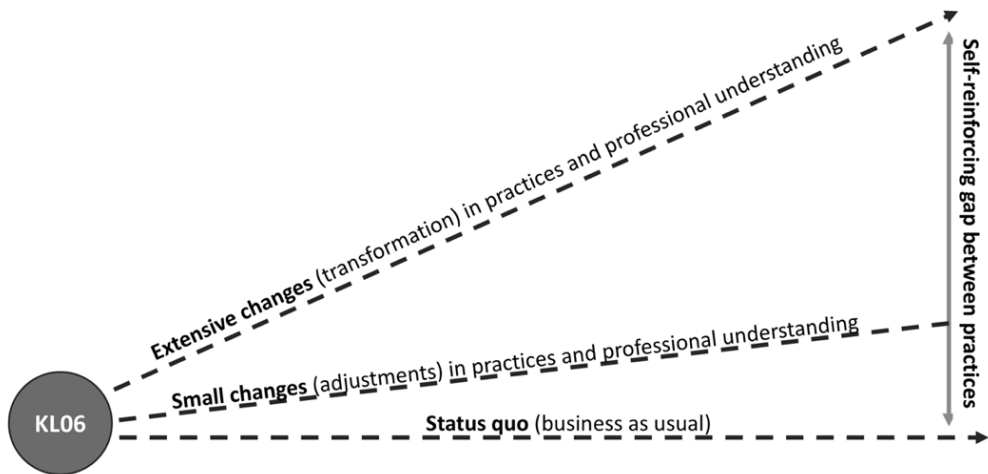


Figure 1: Self-reinforcing gap between practices.

The model demonstrates how the difference between no changes in practice, small changes in practice, and extensive changes in practice over time could create self-reinforcing gaps between practices at different schools or even within the same school. The differences are not necessarily large, profound, or obvious in the short term, but over time these changes can transform practices and understandings in some (innovative) learning environments and school cultures while the majority are still relying largely on traditional and established practices. The model's intention is not to rate some practices as more valuable than others but rather to visually demonstrate how and why a variety of practices and understandings can exist simultaneously in schools that are all subject to the same reform framework and central aims for education. Similar gap-related perspectives have previously been proposed by Cuban et al. (2001), among others.

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From 2015 to 2017, several change initiatives for long-term school development were launched by the Norwegian authorities. To ensure that teacher education institutions offered integrated, profession-orientated teacher education rooted in research and experience-based knowledge, a new regulation for Norwegian teacher education was released in 2016. This regulation transformed teacher education into a five-year master's program, and, starting in the fall of 2017, integrating digital competence in teacher training programs was regulated by the law (Kunnskapsdepartementet, 2016a, 2016b). The five basic skills were strongly emphasized in the process leading up to the new teacher education program, and a Framework for Teachers' Professional Digital Competence (PfdK; UDIR, 2018) was launched in 2017 to provide momentum for further development. A prerequisite for being accredited as a teacher education institution was an explicit and comprehensive integration of the PfdK framework throughout the study program. It is worth noting that, even if the work that led to the PfdK included a review of relevant research, the framework itself is still primarily a policy document framework that consists of the following subareas: subjects and basic skills, school in society, ethics, pedagogy and subject didactics, leadership of learning processes, interaction and communication, and change and development. 'All of the areas of competence are equally important, but it is the sum of the competence areas that makes up a professional, digitally competent teacher' (UDIR, 2018, p. 3).

At the same time, extensive work on renewing subjects and curricula in primary and secondary education was initiated by Norway's Ministry of Education. The white paper *Fag-Fordypning-Forståelse* (Kunnskapsdepartementet, 2015) set the course for the new reform *Fagfornyelsen*<sup>2</sup>. The white paper suggested broad involvement by teachers and school leaders in the development of new core elements and curricula in and across subjects, with the professional communities of schoolteachers being emphasized as important arenas for professional learning and development. *Fagfornyelsen* was implemented in the fall of 2020, and central authorities have invested considerable resources in developing support materials for schools'

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<sup>2</sup> 'Renewal of Subjects'.

implementation of the reform in order to apply its intentions for school development to the field of practice.

### **Implications for Classroom Management**

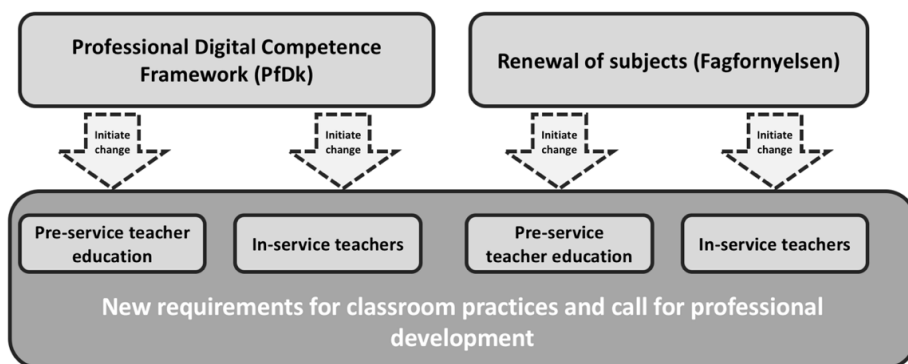
PfDK and the new curricular reform both call for new classroom practices in primary and secondary schools, with the core expectation being that teachers should facilitate learning in adapted, motivating, and student-active learning environments in which the use of technology contributes to academic and social learning. We know the facilitation of learning to be a key ingredient in various classroom management definitions. Facilitation includes anything and everything the teacher or facilitator does before, during, or after the learning experience to enhance reflection, integration, and the continuation of lasting change (Estes, 2004; Priest et al., 2000); it is thus closely linked to the teacher's professional understanding and identity.

*Student-centred learning* describes a learning process in which much of the power during the learning experience resides with pupils, as opposed to teacher-centred learning in which the empowered teacher wields control (Estes, 2004, p. 144).

The Fagfornyelsen framework emphasizes the importance of pupils having basic knowledge in and across subjects and their engagement in deep learning in and across subjects. Deep learning requires basic skills and competencies, and the mutual interaction between these two factors will be an important determinant in the degree of success that the new curricular reform will enjoy. However, in order for such interaction to work in practice, the teacher must be able to flexibly facilitate learning through a variety of teaching and learning activities and the educational use of different types of analogue and digital learning technologies. The core curriculum emphasizes that the 'school shall develop an inclusive environment that promotes health, well-being and learning for all. [...] Good classroom management is based on insight into the needs of the pupils, warm relations and professional judgment. To create motivation and the joy of learning in the teaching situation, a broad repertoire of learning activities and resources within a predictable framework is needed' (UDIR, 2017, pp. 15–16).

The PfdK framework explicitly states that a professional, digitally competent leader of learning processes ‘possesses the competence to guide learning work in a digital environment. This entails understanding and managing how this environment is constantly changing and challenging the role of the teacher. The teacher makes use of the opportunities inherent in digital resources in order to develop a constructive and inclusive learning environment, and to adapt the teaching to both diverse groups of pupils, and pupils’ individual needs’ (UDIR, 2018, p. 8).

Together, the PfdK framework and core curriculum assume a relational and flexible student-centred classroom management practice in diverse 1:1 learning environments and could therefore be perceived as mutually reinforcing change initiatives for Norwegian schools and education in general. They also imply extensive new requirements for classroom practices and call for professional development, as illustrated in Figure 2.



*Figure 2: PfdK and Fagfornyelsen as change initiatives for teacher practices.*

Policy might initiate change, but the road from policy documents to classroom practices is often long and winding (e.g., Goodlad, 1979; Lindensjö & Lundgren, 2000). It was well documented during the introduction of the Knowledge Promotion Reform that a change in policy was not sufficient to ensure the real-world educational change that was intended (Møller et al., 2009). As Robinson (2018) and Hargreaves and Fullan (2012) among others note, the most important agents for educational

change in practice are teachers. The assumptions and beliefs teachers hold about *what* pupils are supposed to learn and *how* they are supposed to learn are closely connected to their classroom management and professional practices. However, even if teachers are important agents of change, one can still not place all the responsibility for school development on them. Teachers need supportive structures around them to change and develop their practices (Hargreaves & Fullan, 2012; Koehler & Mishra, 2009; Mishra & Koehler, 2006; Robinson, 2018), and some teachers are also more capable than others of developing and improving their own practice (Hattie, 2012; Slater et al., 2009).

As requirements for teaching and learning formats, contexts, and practices are changing at the policy level, so are the premises for classroom management. However, teachers have often been provided with inadequate training in integrating technology into their teaching, and '[m]any approaches to teachers' professional development offer a one-size-fits-all approach to technology integration when, in fact, teachers operate in diverse contexts of teaching and learning' (Koehler & Mishra, 2009, p. 62). Student-centred approaches to learning, cooperative learning, and the increased use of technology in the classroom have been identified as new challenges for classroom management, and these changes have had a large impact on the demands placed on teachers' classroom management skills (e.g., Korpershoek et al., 2016, p. 644). Technology advances rapidly, and new technologies are continually emerging, merging, and converging (e.g., Tamim et al., 2015). One aim of the present study is therefore to contribute knowledge-based insights into how teachers experience opportunities and challenges in their classroom management practices in technology-rich learning environments, especially when it comes to new and cutting-edge technology.

### **1.1.1 Review of Literature**

Researchers must understand the strengths and weaknesses of prior research in their field before they can be expected to choose appropriate methods for data collection and analysis. In this part of Chapter 1, I first chronologically present the process of reviewing literature that took place during the five-year trajectory of this project. I

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further describe how the thesis is positioned within recent peer-reviewed literature on classroom management and ICT.

### **The Process of Iterative Review**

According to Shulman (1999, pp. 162–163), *generativity* is one of four hallmarks of scholarship, and the ability to build on the work of others provides integrity and sophistication to the work of any researcher. ‘Good’ research is good because it advances the collective understanding, and useful and meaningful educational research must be *cumulative* (Boote & Beile, 2005, p. 3; Shulman, 1999). The complicated nature of problems in education makes generativity in educational research more difficult than in many other fields and demands that researchers undertake thorough and sophisticated literature reviews (Boote & Beile, 2005). In this section, the overall thesis is presented in an effort to demonstrate with transparency the iterations of the review throughout the project. I have used the literature review categories and criteria framework proposed by Hart (1998) and refined by Boote and Beile (2005) to guide me during the project.

*Coverage* as a framework category addresses the criteria for inclusion in and exclusion from review. Doctoral students too often interpret coverage as being exhaustive of everything previously written about a topic, which makes it difficult to critically synthesize the literature (Boote & Beile, 2005; Bruce, 2001). Reviewing concepts and refining search strings in educational research tends to feel like ‘falling down a rabbit hole’. One keyword often implies another because of conceptual connections. Instead of aiming to read ‘everything’, Bruce (2001) suggests that coverage should be examined more broadly according to eight criteria – topicality, comprehensiveness, breadth, exclusion, relevance, currency, availability, and authority – and concludes that ‘[...]some students need to be encouraged to shift from a “topical” to a “psychological” view of relevance and from an “objective” to a “subjective” view of information’ (p. 165). The review criteria framework has thus inspired a reflexive attitude towards the literature review throughout the project; I have aimed to achieve a balance between pre-defined search strings, keyword

searches, snowballing references, and expert suggestions while generally working towards an ever-growing understanding of an emerging field of study.

The first edition of the *Handbook of Classroom Management* (Evertson & Weinstein, 2006) organized the field of classroom management. Authorities in the field reviewed, addressed, and determined the core areas and subfields in 42 chapters and over 1,200 pages, filling an existing knowledge gap (Wubbels, 2011). Norway's policy for the use of ICT in schools in 2005 made the Norwegian context valuable for large-scale research on pupils' and teachers' educational use of computers. The *Rogaland study* (Krumsvik et al., 2011) and the *Sammenhengen mellom IKT-bruk og Læringsutbytte* (SMIL) study (Krumsvik et al., 2013), along with the reviews and syntheses included in *Klasseledelse i den digitale skolen* (Krumsvik, 2014a), further contributed theoretical and empirical perspectives on classroom management in ICT learning environments as a starting point for the project review and for the positioning of this study. I considered all these sources as providing authority and contributing important comprehensive, cumulative, and generative value to this thesis project; thus, they were the starting point of the project review.

The second edition of the *Handbook of Classroom Management* (Emmer & Sabornie, 2015) identified the lines that had been extended during the decade since the first edition appeared. The handbook chapters addressing classroom management and technology in both editions (Bolick & Barthels, 2015, p. 481; Bolick & Cooper, 2006) reveal that there was little research to document how the introduction of technology affects classroom management, other than some small-scale investigations examining the interactions between technology use and classroom management. In collaboration with a university college librarian, I explored a few search strings (in the ERIC and PsycInfo databases) early in my project; we were both surprised to find very little peer-reviewed research on the topic of classroom management, ICT, and digital competence. Our searches were either too narrow (classroom management AND digital comp\* OR ICT) or too broad (classroom management AND technology OR tablet\* OR computer\*) for a thorough review in line with the criteria presented by Hart (1998) and Boote and Beile (2005).

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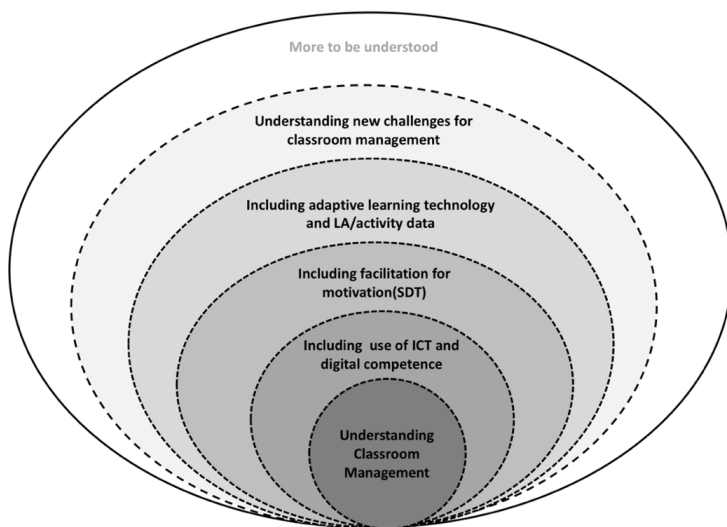
One reason for this might be that identifying and comprehensively understanding the field of classroom management is a complicated task (Emmer & Sabornie, 2015; Evertson & Weinstein, 2006; Postholm, 2013; Wubbels, 2011), and the foundation on which the field is based is primarily studied and disseminated within separate curricular areas (Morine-Dershimer, 2006). Studies in the fields of medicine and natural sciences, for example, are often recorded in well-indexed databases that are constantly expanding, which makes it easier to identify research in a systematic fashion. The literature in the field of educational science, by contrast, is not fully adapted to systematic searches. The articles themselves are not often sufficiently systematically indexed in the databases, and article abstracts and summaries do not always explicitly mention the research methods used (Krumsvik, 2019, pp. 127–132).

To address this weakness, I chose to complement sensitive literature searches in large databases with hand-searching personal archives, expert and authority suggestions from supervisors, course experts, and syllabus lists. This study is therefore positioned within the traditional narrative literature review (Krumsvik & Røkenes, 2016; Petticrew & Roberts, 2006). I describe the comprehensive literature review of this thesis as a combination of pre-defined search strings, topical searches in databases, and snowballing reference lists and citations backwards and forward (e.g., Badampudi et al., 2015). In this way, I have tried to reduce the risk of overlooking relevant literature related to my research question, since database searches alone have limitations in this field.

The full review process of this thesis has thus been iterative and aligned with the emergence of the study design (which is elaborated on in Chapter 3) and each of the three studies. The iterations of the review were also connected to doctoral courses I participated in during the PhD journey. A systematized – but not exhaustive – overview of the review iterations appears in Appendix 1. I consider the iterations of the review as a growing understanding of the comprehensiveness of the field of classroom management (Figure 3). I have added to the understanding by including the use of ICT and digital competence, the facilitation of motivation, adaptive



learning, and learning analytics (LA), as illustrated in Figure 4 and reflected in the conceptual framework elaborated on in Chapter 2.



*Figure 3: The growing understanding based on the iterative review.*

To position the thesis within recent literature, I used the EBSCO host from the University of Bergen library for systematic searches. I selected ERIC as a database because it provides access to education literature and research, and I used the search string ICT AND classroom management. I included peer-reviewed journal articles and did not restrict publication date. However, the year of publication restricted itself to 2003–2020, as no registered publication results were found prior to that time period. My last search for updates in the search string was conducted in April 2020. This search resulted in 53 hits (including Article 1 of this thesis). During the search, I worked in both the ERIC (via the EBSCO host) and Oria library databases in the following pattern: The search was conducted in ERIC and, if full access was provided either directly via the EBSCO host login or a supplemental Oria search for the article title, the article was considered accessed. If access was denied (or not found) through the formal login and/or library access to Oria, I did not perform any additional searches. I chose this approach due to ethical copyright considerations. All 52 abstracts were read and considered for inclusion or exclusion. The access-denied article abstracts were read as provided by ERIC, but the rest were read as they were

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originally published. The table in Appendix 2 presents the excluded articles and states the reasons for their exclusion from further review.

### **Positioning of the Thesis Within Recent Literature**

While the previous section focuses on search and retrieval, in this section, I now position my study within the current state of knowledge through the literature review. To some extent, the literature review overlaps with those in the three enclosed articles (and their research questions), but it mostly differs from them since this chapter has a broader scope and focuses on the overall research question of the thesis.

Most articles emphasized that the successful integration of ICT in teaching and learning activities depends on how the teacher facilitates learning. According to Breeze (2009, p. 216), the teacher can be viewed as an *orchestrator of potentials* and help guide the balance between a) boundaries to form initial ideas and b) freedom for experimentation. Beauchamp (2011) distinguishes between technology-mediated classroom interaction and other categories of interaction in the classroom. According to his research, teachers have varied views on what interactive teaching can entail but agree that the role of the teacher should be to facilitate active involvement, hands-on work, a wide range of activities, and the involvement of all classroom members.

While linking the concepts of interactive teaching and interactive technology, Beauchamp and Kennewell (2010) argue that interaction ranges from authoritative to dialogic, noting that the dialogic end of the scale would improve the learning process and, consequently, the learning outcomes of that process. The approaches described by Breeze (2009), Beauchamp (2011), and Beauchamp and Kennewell (2010) require the teacher to be flexible and able to make decisions beyond prescriptive procedures and planned transitions. Chinyere and Emechebe (2016) sought out to identify both the prospects of and problems with ICT in teaching reading comprehension.

Improvement in pupil vocabulary and excitement about reading comprehension lessons were registered, but so were difficulties in classroom control and distractions (Chinyere & Emechebe, 2016). Overall, the balance between flexibility and control arises as a core classroom management issue.

Research in learning through individual interaction with ICT is, according to Beauchamp and Kennewell (2010), likely to become an important element of the movement for autonomy support and student-centred learning. However, they note that we cannot assume that learning will improve merely by moving power from teacher to pupil. Prieto et al. (2014) suggest that there could be pedagogical tensions between flexible and automated learning systems, as automated systems require prescribed use. The facets of autonomy support and standardized automation in interactions with ICT are thus described in the existing literature.

Assan and Thomas (2012) remind us that ICT does not create changes in schools *per se*. Schools must change themselves, as it is teachers who make use of ICT, and school administrations must make good structural decisions. According to Cakir and Yildirim (2013), effective use of technology in classrooms depends on dedicated ICT teachers, but even dedicated ICT teachers face difficulties like classroom management and hardware-software issues, with cutting-edge technology particularly daunting for many. These findings contribute important perspectives to the current thesis, as they imply a link between digital competence in classroom management and the ability to make pedagogical use of various emerging ICT technologies. They inform the thesis in that digital competence is a dynamic rather than a static competence and that affordances for learning vary between technologies. But what does the review tell us about the digital competence of prospective teachers?

According to Fook et al. (2011), pre-service teachers seem to possess positive attitudes and a moderate level of competency, but they argue that both pre- and in-service teachers should use ICT more frequently. They suggest that apprenticeship through modelling could help reduce anxiety and increase confidence in using technology for educational purposes. Elstad and Christophersen (2017) argue that digital competence among student teachers is important for instructional self-efficacy in technology-rich classrooms. They found a strong relationship between student teachers' perceptions of digital competence and their instructional self-efficacy for maintaining discipline and influencing students' use of ICT. Sime and Priestley (2005) found that the perceptions students held about the use of ICT were complex

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and varied. Specifically, students associated the use of ICT with changes in the nature of classroom relations and alterations in teaching and learning formats.

It may appear that the digital competence of pre-service teachers varies and that their ability to perceive affordances also influences how they experience classroom instruction in ICT environments. Teaching with ICT requires more than basic digital skills, and teacher educators facilitating the development of their students' digital competence is a complex task (Røkenes & Krumsvik, 2016). Therefore, some teacher education programs use approaches such as collaboration, metacognition, blended learning, modelling, authentic learning, student-active learning assessment, and aims to bridge the gap between theory and practice and develop pre-service teachers' digital competence (Røkenes & Krumsvik, 2014).

According to Jordan (2011), beginning teachers have high levels of confidence in integrating ICT into their practice, with male beginning teachers more confident in this knowledge than their female counterparts. Gao et al. (2011) found that beginning teachers who discover and teach with their strengths could become catalysts for ICT integration for classroom teaching and collaborations in the broader teacher community. ICT integration could also benefit from learning across generations. Geeraerts et al. (2018) investigated how and what teachers learn from their older and younger colleagues and found that younger teachers taught innovative teaching methods and ICT skills to their older colleagues, while older teachers taught practical information, classroom management skills, self-regulation, and community-building to their younger colleagues (Geeraerts et al., 2018). These findings demonstrate the learning potential of the professional teacher community across generations, practices, understandings, and experiences.

The articles included in the review also reveal different perspectives on teachers' integration of technology in their professional understanding. Otrei-Cass et al. (2012) demonstrated how the Technological Pedagogical Content Knowledge (TPACK) framework could provide teachers and teacher educators with ways to raise the critical awareness needed for teachers to reflect on their practices. According to

Roussinos and Jimoyiannis (2019), teachers generally believe that they have a good level of knowledge with regards to the primary TPACK domains of content, pedagogy, and technology. However, most teachers perceived the domains separately and were not able to integrate their TPACK knowledge in order to design and implement meaningful ICT-based interventions in their classroom practice (Roussinos & Jimoyiannis, 2019). Similar findings are described by Gray et al. (2005), who studied a group of language teachers while they integrated the use of interactive whiteboards in their classroom practice. Some teachers gradually became aware of the integrational potential of content, pedagogy, and technology and thus the general transformational potential of ICT, but most teachers used the whiteboards in line with their previous strategies for 'daily survival'. Teachers' use of ICT is thus not necessarily based on core pedagogical competence and, according to Shin (2015), the motivations of teachers for integrating technology could be based on personal convenience rather than the desire to enhance pupil learning. It may appear that teachers' motivations for integrating ICT into their classroom practices range from personal convenience and everyday survival to a desire to transform practices in order to benefit their pupils' learning processes.

A general finding across the articles is a call for encouragement, support, and opportunities to increase teachers' motivation to improve the level and quality of ICT use in classrooms (e.g., Raman et al., 2019; Uluyol & Şahin, 2016), and most of the reviewed papers emphasize the need for professional development. Dlamini and Mbatha (2018) argue that the adoption of ICT in education has been politically motivated and reflects a lack of knowledge about differences in school contexts and teachers' professional development needs. According to them, professional development activities should be meaningful to participants and should not be 'funnelled through utopian perspectives' (Dlamini & Mbatha, 2018, p. 28). Similarly, Sasseville (2004, p. 197) argues that technological tools are commonly perceived as tools of performance: a way of doing things better, faster, and cheaper. According to Sasseville (2004), academic success cannot be evaluated by sheer performance alone,

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since teachers' professionalism extends far beyond academic success; this is why stability is so important to teachers.

Lim et al. (2003) found the following elements to be important for well-managed ICT-based lessons: the availability of ICT tools, the establishment of rules and procedures, supporting ICT and non-ICT tools for ICT-based activities, and the division of labour among teachers, teacher assistants, and pupils. In one study, Wang et al. (2014) aimed to shift teacher practices from traditional teacher-centred methods to constructivist, student-centred ones and found 11 implications for the refinement of professional development. They concluded that professional development takes time and requires teacher ownership of the process; teachers must understand and accept the relevance of designs and learning activities.

The relationship between professional learning and reflection in both the individual classroom context and the wider school context is also emphasized in most of the papers in the literature review (e.g., Raman et al., 2019; Uluyol & Şahin, 2016; Yoon et al., 2005). Heitink et al. (2017) suggest that underlying teachers' practice is a professional reasoning process, and teachers need to be aware of this reasoning to be able to adapt others' examples into their own practice. This finding implies that the development of TPACK (and digital competence in general) must be anchored in, but still challenge, teachers' thinking and reflection on their own practice. Teachers should reflect on their experiences and how ICT could support them (Heitink et al., 2017).

Knowing how to use ICT tools to transform learning is described by Sutherland et al. (2004) as a complicated task, and new technologies often challenge existing practices of teaching and threaten well-established knowledge domains. There appears to be a kind of polarization in schools regarding the use of digital and non-digital tools because they emphasize knowledge domains differently, both across and within subjects (Kretschmann, 2015; Savage, 2005). There is also a difference between pupils' physical and cognitive task engagement, and the teacher, as a designer of the

learning environment, needs to make the cognitive processes involved in using the tool explicit (Yoon et al., 2005).

The need for educational transformation and change is, in a variety of ways, explicitly emphasized across the papers and linked to changing traditional approaches to teaching and learning (e.g., Assan & Thomas, 2012; Fauville et al., 2014; Raman et al., 2019; Savage, 2005). The rhetoric surrounding the need for change generally comes close to that of the Norwegian policy context. Lim (2007) investigated whether ICT could be used to engage pupils in higher-order thinking activities and argues that pupils need to learn how to seek out new information, think critically, and show initiative in meeting the challenges of a rapidly changing world. Lim concludes with the following classroom management implications: ‘Teachers have to set clear disciplinary and educational rules and procedures to mediate between the community of participants and his/her object of effective management of ICT-mediated lessons’ (2007, p. 110). Abulibdeh (2013) investigated whether the use of blogs could support learning through autonomous and self-regulated learning. However, the findings indicate that pupils are not autonomous or self-regulated in their own learning, because they are not able to learn and use technology on their own. Doult and Walker (2014) explored whether pupils could have their attitudes toward and engagement in writing practices transformed through collaborative writing. Although an increase in motivation was expected and registered, the teachers noticed that the quality and quantity of writing increased, and the collaborative practices of the pupils contributed to their sharing of perspectives and knowledge (Doult & Walker, 2014). In another study, pupils perceived the experience of using ICT in mathematics as useful for their learning process and appreciated working in a practical teaching-learning environment (Mota et al., 2016). The pupils emphasized the importance of their peers’ support; however, some still reported feelings of distress while others reported indifference (Mota et al., 2016). These studies demonstrate that, even if ICT-based learning designs aim to transform teaching and learning activities and use collaborative tools for higher-order skills, both positive and negative outcomes can result from such designs.

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Although research from different countries describes varied infrastructural contexts (and appear to be at different stages in the implementation of ICT policies), the objectives of deep learning and higher-order thinking are thus pervasive. However, the examples noted above also demonstrate how different levels of technological and/or digital competence can enable or hinder associated learning and that learning designs that work well in a particular context do not necessarily work as well in another context. The findings also pinpoint that motivation and engagement should not merely be evaluated at the group level if the goal is to facilitate learning for each pupil at the individual level.

The review reveals that ICT infrastructure and policies vary both within and between countries (Chinyere & Emechebe, 2016; Dlamini & Mbatha, 2018; Fook et al., 2011). Studies thus need to be performed in different educational contexts to determine how teachers and pupils are using technology in the classroom (Shin, 2015). The present review highlights a general need for professional development as teachers increasingly apply ICT into their practice. The investigated papers emphasize different aspects related to classroom management across a variety of research questions and methodological approaches; consequently, they demonstrate how teachers must navigate a variety of challenges, expectations, and possibilities as they integrate ICT into their classroom practice and management. The close connection between context and results in the studies also makes it difficult to determine generalizability and transferability of findings across countries and educational levels. However, the key findings from this review inform the purpose, aim, and research questions of the thesis: that teachers' and classroom managers' motivation for integrating ICT into their classroom practices may vary, ranging from personal convenience to a desire to transform practices to benefit pupils. The integration of technology, pedagogy, and content begins where the teachers are, but teachers' starting points, pupils' starting points, and the overall ICT policy and infrastructure vary between context and learning environment.

A prerequisite for creating good learning designs incorporating ICT is knowledge of the advantages and disadvantages of using specific digital technologies (affordances)



for learning. The fact that technology is constantly emerging, merging, and converging at a rapid pace is a challenge, and even dedicated ICT teachers have trouble staying updated on cutting-edge technology (Cakir and Yildirim, 2013; Norman, 1990, 1999). An additional issue is that new technologies often challenge existing practices of teaching and hence threaten well-established knowledge domains. Change comes with a price, and the review shows that teachers must balance policies of change against existing knowledge domains and established professional thinking and reasoning. Professional development is needed, but the review demonstrates that those professional development activities must be perceived as relevant and meaningful by teachers.

Overall, the review describes a complex, multi-faceted, and ultimately unclear field while highlighting the pressing need for more research on classroom management in ICT learning environments. The complexity of the field's ongoing development invites an exploratory design in which the use of mixed methods can contribute supplementary, complementary, and contrasting findings. A mixed methods approach could also contribute ecological validation, which has been described as 'the degree of correspondence between the research conditions and the phenomenon being studied as it occurs naturally or outside of the research setting' (Gehrke, 2018, p. 563). Additionally, grey literature can contribute contextual information and thus supplement peer-reviewed journal articles and literature.

### **1.1.2 Purpose, Aim, and Research Questions**

Throughout the introduction and the literature review presented above, I identified a lack of mixed methods studies describing the introduction of educational technology (Lai & Bower, 2019). Research on classroom management in technology-rich learning environments is also limited, and the nature of the field is, in a word, messy. However, some tendencies have been identified, and in the following sections I present each of the research questions and briefly relate them thematically to the introduction and backdrop, to the review, and to one another. The research questions are further conceptually unpacked in Chapter 2 and methodologically unpacked in Chapter 3.

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One striking pattern that emerged from the reviewed articles is how few of them apply classroom management as a key concept that is explained, elaborated, and nuanced within the context of ICT learning environments. The scopes and focuses of the articles range broadly, according to their research questions, aims, and conceptual frameworks. But the term ‘classroom management’ is often not explicitly used until the reasons for – or implications of – the findings are discussed or in concluding sections. Given the internal coherence and inner logic of each article that has been examined, it is both understandable and natural to conclude in formulations indicating that classroom management proved to be a challenge or that teachers should have an increased focus on classroom management when using ICT. But such brief statements fail to communicate and elaborate on what ‘better’ classroom management might be or how ‘more focus’ on classroom management could assist the teacher’s *orchestration of potential* (e.g., Breeze, 2009). The totality of individual articles’ mention of classroom management either as a *challenge* or a *solution* could both establish (and in time even amplify) the impression that classroom management in ICT learning environments is somewhat detached from the teaching and learning practices and activities ICT is supposed to help mediate and facilitate. An important aim of this project was therefore to examine classroom management in a real-life ICT teaching and learning context, in order to increase its ecological validity (Gehrke 2018, p. 563) by exploring how and why classroom management is important rather than merely stating that it is.

Based on state-of-the-art perspectives on classroom management, the concept is interwoven with the pedagogical and didactic choices that are otherwise made by teachers (Emmer & Sabornie, 2015; Evertson & Weinstein, 2006). Classroom management practices are an integral part of the teacher’s professional practice, and exploring the integration between teachers’ classroom management and their pedagogical and didactic understanding and practice (when ICT is used) was perceived an important contribution to understanding contextual classroom management in 1:1 learning environments. Bolick and Bartels (2015) suggest that the lack of research on classroom management in ICT learning environments could be explained by the multiplexity involved in both concepts: Classroom management is in

itself a complex field of research, and involving ICT adds another layer of complexity. But classrooms, learning environments, and teaching and learning activities increasingly involve laptops, tablets and other technologies, and teachers thus have to face and handle these layers of complexity every day. Piercing the layers of complexity in an effort to understand and explain the complexity of classroom management in ICT learning environments is therefore another important aim of the project.

The review also demonstrates that policies associated with the educational use of ICT have generally been linked to expectations that pupils will learn more, better, and in different ways than they previously did (Sasseville, 2004; Sutherland et al., 2004). Such expectations require the teacher to be flexible and make intuitive decisions (Beauchamp, 2011, Beauchamp & Kennewell, 2010; Breeze, 2009). In Norway, school development policies are formulated through white papers and curricular reform. The integration and use of ICT is closely linked not only to motivational, inclusive, and adaptive learning environments, but also to digital bildung and how technology affects society in general (UDIR, 2017, 2018). Teachers' classroom management practices and their didactic and pedagogical choices when ICT is used are thus linked to certain explicit expectations and principles that are integrated into the core curriculum and subject curricula they are expected to translate into practice. The purpose of this project is thus to explore classroom management in ICT learning environments within the expectations of the teacher's real-life context. Based on the reasoning so far, the overarching research question that has driven this project is as follows: How can we understand and explain the challenges and opportunities primary and secondary teachers are facing in their 1:1 (ICT) classroom management practices?

As described in the introduction, the concept of digital competence has been established as an important element in the Norwegian school context. The term is closely linked to policies for school development, with particular emphasis on the skills, knowledge, and competencies pupils should possess in order to be digitally competent. Teachers must therefore also be digitally competent in order to facilitate

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pupils' learning and bildung. But teachers themselves, school owners, school leaders, and students appear to have different expectations regarding how to facilitate learning and lead learning processes in 1:1 learning environment contexts. To explore how the connection between teachers' classroom management and their digital competence is perceived and understood in schools, the first sub-question (RQ1) of the thesis was developed: How do teachers, school leaders and student representatives describe the relationship between teachers' professional digital competence, student- teacher relations and their classroom management practices?

What teachers, school leaders, and student representatives think about the connection between classroom management and digital competence can provide insights into their experiences of and expectations about classroom management when ICT is used. But although descriptions can provide insight into patterns, variations, or both, they cannot be used to determine a general relationship between two concepts. To be able to say something about whether a general relationship between digital competence and classroom management abilities appears to exist, we must operationalize and index the two concepts and examine the connection between them more systematically in a larger group. The second sub-question (RQ2) of the project is thus as follows: Is there a statistical relationship between upper secondary teachers' professional digital competence and their classroom management?

Describing through RQ1 and measuring through RQ2 the relationship between classroom management and digital competence thus provides two different methodological perspectives on the relationship. Descriptions are qualitative data from a perspective that is mainly subjective, whereas measurements are quantitative data from a perspective that is primarily objective, but the sum of the two perspectives can add value to each. By integrating (or mixing) qualitative and quantitative findings, one can see quantitative measurements and qualitative descriptions in light of each other, and that can lead to new insights. The third sub-question (RQ3) of this thesis is therefore: How can one explain the observed relationship between upper secondary teachers' professional digital competence and their classroom management practices? RQ1–RQ3 thus invite a qualitative, a

quantitative, and a mixed exploration of the relationship between digital competence and classroom management, which serve as a gateway to understanding the challenges and opportunities teachers face in their ICT classroom practices. The qualitative data show the nature of associations (between classroom management and digital competence), while the quantitative data show the strength of associations (Fetters et al., 2013).

But findings describing, measuring, and elaborating on a general relationship between classroom management and digital competence is not sufficient if we are to understand and explain the challenges and opportunities that teachers face in their 1:1 (ICT) classroom management practices. Those practices are intertwined with teachers' pedagogical and didactic choices and their general classroom practice, and one important aim of this project was to explore the interplay between didactic and pedagogical justifications and choices, contextual classroom management, and the choice and use of ICT within real-life practices. In the project, adaptive learning technology (ALT) was applied as an example of new, cutting-edge technology, so that the researchers could study the process of introducing and integrating ICT that had not yet been established as an integral part of teachers' practice and students' learning activities. In real-life contexts, teachers are expected to constantly integrate new technologies and ICT software and hardware in their classroom management practices. Exploring the integration process of new technologies could thus provide insight into how they make sense of new technologies in their own practices.

However, classroom management (and thus didactic integration of technology) is not an end in itself (Brophy, 2006). Classroom management and the facilitation of learning are means for students and pupils to remain (or become) motivated and, above all, for them to learn. In order to be able to say something about the extent to which ALT was well integrated into teachers' didactics and classroom management, we therefore chose to investigate how the introduction of ALT in an established learning context affected pupils' learning environment, motivation, and learning. The fourth sub-question of the thesis (RQ4) is thus as follows: How do systematic use of adaptive learning technology influence pupils' learning and motivation? The

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literature review shows that classroom management appears to be a particular challenge when cutting-edge technology is applied (Cakir & Yildirim, 2013). This notion supports the earlier claim that investigating the process of integration could provide valuable insight into the benefits and challenges of teachers' classroom management practices in 1:1 learning environments. Contrasts are also found between teachers who see the potential in transforming practice for the benefit of students and teachers who use technology for daily survival (Gray et al., 2005; Shin, 2015). Examining the introduction of new technology would give us the opportunity to study how teachers reason about the introduction, how they act according to their own reasoning, and how the integration plays out in practice. We therefore aimed to explore teachers' experiences with integrating ALT into their own practices through the fifth sub-question (RQ5): What, if any, are the benefits and challenges upper-primary teachers experience when they apply ALT in real-life contexts? Such knowledge would bring us closer to understanding emic perspectives on the challenges and opportunities that teachers face in their 1:1 (ICT) classroom management practices.

The review also reveals that, although many teachers have experience using ICT in their own practice and students' learning activities, it appears that many teachers think that they integrate technology into their didactic practice and classroom management to a greater extent than they actually do (Roussinos & Jimoyiannis, 2019). In order to more effectively explore etic perspectives on the challenges and opportunities teachers face in their 1:1 (ICT) classroom management practices, the sixth and final sub-question of the project was applied (RQ6): What can these experiences tell us about the coherence or incoherence of classroom management, professional knowledge, ALT and learning analytics?

## 1.2 The Design of the Study

The aim of this thesis is to understand and explain the challenges and opportunities that teachers face in their 1:1 (ICT) classroom management practices, and the sub-questions are designed to inform the overall research question according to the

following structure: Sub-questions 1–3 explore the *relationship between digital competence and classroom management* as both theoretical concepts and as emic terms (e.g., B. Johnson & Christensen, 2017) as they are used in school. Sub-questions 4–6 explore *classroom management within real-life context* through two lenses: *Aims of contextual classroom management* (RQ4) and *contextual classroom management practices* (RQs 5 and 6).

**Study 1** (RQ1–RQ3) aimed to inform the overall research question about the general relationship between classroom management and digital competence by using a mixed methods approach. Through semi-structured interviews, the relationship as perceived and described by teachers, leaders, and students is explored (RQ1). Through a survey, the statistical relationship between teachers' perceived digital competence and classroom management abilities is measured (RQ2). By integrating the findings from RQs 1 and 2, the relationship is further explored, contrasted, and expanded (RQ3). The findings from Study 1 also informed the design of Studies 2 and 3 on the importance of examining contextual classroom management in 1:1 learning environments, in addition to investigating the general relationship between digital competence and classroom management, if we are to understand and explain the challenges and opportunities that teachers face in their classroom practices beyond general (albeit varied) patterns.

**Study 2** (RQ4) aimed to inform the overall research question about contextual classroom management issues through a (QUAL+quan) MMR approach investigating aims for contextual classroom management in ICT learning environments. Through a mathematics test and survey of pupil learning outcome, motivation and learning environment were measured quantitatively before and after integrating ALT systematically in the existing learning context. Through semi-structured focus group interviews, pupils' experiences and descriptions were explored qualitatively. By mixing quantitative and qualitative findings, Study 2 informed the overarching research question about the complexity of facilitating and individualizing teaching and learning activities in 1:1 learning environments.

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**Study 3** (RQs 5–6) aimed to inform the overall research question about contextual classroom management issues through a MMR approach investigating the integration of new technology into existing classroom management practices. Through semi-structured interviews, fieldwork, and classroom observation, the process of integrating ALT systematically was analysed qualitatively from both the emic and etic viewpoints. The findings informed the overarching research question of the thesis about individual and general patterns of experiences, which illuminates how we can understand the challenges and opportunities that teachers face in their 1:1 classroom management practices.

### **1.2.1 A Third Paradigm Positioning**

Mixing methods is not uncontroversial, and the explicit use of MMR in educational technology research is limited (Lai & Bower, 2019). An important source of criticism of mixed methods is that it combines methods and perspectives from paradigms that many scholars and academics perceive as mutually exclusive. Paradigms describe the worldviews of belief systems that guide researchers (Guba & Lincoln, 1994), and paradigm purists have for decades argued that the qualitative and quantitative paradigms were generally perceived as dualistically opposite and mutually exclusive (Maxwell, 2010). One paradigm was thus not merely defined by what it was but also by what it was not. Paradigm purists implicitly or explicitly presuppose the incompatibility thesis with regard to research methodology by insisting that the compatibility of quantitative and qualitative methods is impossible due to the incompatibility of the paradigms that underlie these methods (R. B. Johnson & Onwuegbuzie, 2004; Tashakkori & Teddlie, 2008).

Pragmatists, on the other hand, either implicitly or explicitly reject the incompatibility thesis by embracing the value of both quantitative and qualitative ontologies and epistemologies and considering them to be complementary rather than mutually exclusive (R. B. Johnson, 2017; R. B. Johnson et al., 2007; Tashakkori & Teddlie, 2008). Pragmatically oriented theorists and researchers now refer to the mixed methods approach, which contains (or mixes) both qualitative and quantitative elements (Tashakkori & Teddlie, 2008). The present research is positioned within this



pragmatist paradigm. The overall research question of the project invites *pragmatic knowledge* acquired through a research design planned and conducted based on what will best help answer the research questions (B. Johnson & Christensen, 2017; Onwuegbuzie and Leech, 2006, p. 477).

Morgan (2008, p. 58) perceives pragmatism as an alternative to the quantitative and qualitative approaches in which *abduction* connects theory and data, *intersubjectivity* characterizes the relationship to the research process, and *transferability* is the aim of inference from the data. According to Morgan (2008), pragmatism transcends the dualist distinction between qualitative and quantitative approaches, implying a replacement of ‘either/or’ with ‘both/and’. The aim of this thesis is transferability rather than generalizability, and the research questions addressed in each of the studies invite contributions from both paradigms.

In line with the pragmatically oriented driving research question of the study, each research question, along with its associated methodological assumptions and stances, helps to bridge the gap between *emic* and *etic* understandings (B. Johnson & Christensen, 2017). The difference between *combining*, *integrating*, or *mixing* quantitative and qualitative methods could be perceived mainly as a choice of preferred language. However, Morgan (2008) argues that the word preferred by each researcher is also linked to the following question: Is mixing methods simply about how we use methods, or does it also raise some basic issues about the overall research methodology of the social sciences?

The evolution of mixed methods is described by Tashakkori and Teddlie (2008, pp. 21–23) as a three-step taxonomy from (1) *monomethod studies* conducted by purists through (2) *mixed method studies* to (3) *mixed model studies*. Mixed methods studies may be most easily articulated using quan+qual triangulation for verification or elaboration purposes, increasing the ecological validity. Mixed model studies represent the highest degree of mixing methods at all or at the very least many steps during the research process, and Tashakkori and Teddlie (2008, p. 22) describe mixed-model studies as follows: ‘These are studies that are the products of the

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pragmatist paradigm and that combine the qualitative and quantitative approaches within different phases of the research process'. Mixing methods at many steps is described as *multiple points of integration* (Greene et al., 1989; Schoonenboom & Johnson, 2017).

Tashakkori and Teddlie's (2008) taxonomy provides a useful starting point for understanding the difference between mixing methods and MMR as a third paradigm approach. MMR, or simply mixed research (MR), has emerged and become increasingly recognized as a third major research approach or paradigm, in addition to the qualitative and the quantitative paradigms (R. B. Johnson et al., 2007). The MR starting point is that both quantitative and qualitative viewpoints can be valuable when approaching the research question(s) of interest. 'If one prefers to think categorically, mixed methods research sits in a new third chair, with qualitative research sitting on the left side and quantitative research sitting on the right side' (R. B. Johnson & Onwuegbuzie, 2004, p. 15).

The methodological positioning of the current study is a third-chair approach, in which both quantitative and qualitative viewpoints are perceived as valuable and complementary. Morgan (2008, 2014) uses the term *pragmatism* to describe this position, while R. B. Johnson and Onwuegbuzie (2004) use the term *mixed research*. Both approaches treat research as a human experience that is based on the beliefs and actions of researchers. The project could thus be described as positioned within a pragmatic MR paradigm that is inspired by dialectical and pluralistic pragmatism (Greene, 2007; R. B. Johnson, 2017). As Table 1 shows, Article 1 (Study 1) examines the strength of associations between classroom management and digital competence and the nature of those associations. Article 2 (Study 2) digs deeper into how classroom management and professional digital competence play out in teachers' everyday practices and examines the strength of associations between ALT and pupils' learning and motivation and the nature of those associations; finally, Article 3 (Study 3) examines the benefits and challenges that teachers experiences when applying ALT in real-life contexts as part of their classroom management.

Table 1: The design of the overall study.

<b>Aim of the project</b>	Examine if and eventually how and why classroom management is important in real-life 1:1 learning environments		
<b>Research question</b>	How can we understand and explain the challenges and opportunities teachers are facing in their 1:1 (ICT) classroom management practices?		
<b>Title</b>	The relationship between teachers' perceived classroom management abilities and their professional digital competence.	Glimpses into real-life introduction of adaptive learning technology: A mixed methods research approach to personalized pupil learning.	Adaptive learning technology and learning analytics in primary education: Implications for teacher professional knowledge and classroom management.
<b>Journal</b>	<i>Designs for Learning</i>	<i>Designs for Learning</i>	<i>Frontiers in Education</i> (submitted)
<b>Research question(s)</b>	<p><b>RQ1:</b> How do teachers, school leaders and student representatives describe the relationship between teachers' professional digital competence, student- teacher relations and their classroom management practices?</p> <p><b>RQ2:</b> Is there a statistical relationship between upper secondary teachers' professional digital competence and their classroom management?</p> <p><b>RQ3:</b> How can one explain the observed relationship between upper secondary teachers' professional digital competence and their classroom management practices?</p>	<p><b>RQ4:</b> How do systematic use of adaptive learning technology influence pupils' learning and motivation?</p>	<p><b>RQ5:</b> What, if any, are the benefits and challenges upper-primary teachers experience when they apply ALT in real-life contexts?</p> <p><b>RQ6:</b> What can these experiences tell us about the coherence or incoherence of classroom management, professional knowledge, ALT and learning analytics?</p>
<b>Theoretical framework</b>	Classroom Management Digital Competence	Classroom Management Self-Determination Theory  Adaptive learning technology (applied in existing practice)	Classroom Management Technological Pedagogical Content (TPACK) Framework  Adaptive learning technology (applied in existing practice)
<b>Data</b>	Survey Qualitative interviews	Pre-and post-test Survey Qualitative interviews	Fieldwork Classroom observation Qualitative interviews
<b>Approach to classroom management</b>	General/conceptual	Contextual (aims for classroom management)	Contextual (didactic integration of technology)

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According to the mixed methods design dimensions proposed by Schoonenboom and Johnson (2017) and the integrational dimensions proposed by Fetters et al. (2013), the overall Ph.D. study reported here can be described as a high-complexity hybrid MMR design. The study is inspired by an interactive approach in which design is perceived as an interactive process (rather than a typological product) and components are continually compared and adapted to each other (Schoonenboom & Johnson, 2017). The research is partly sequential, since Study 1 informed Studies 2 and 3, and partly convergent (concurrent), since the Study 2 and 3 data were collected simultaneously.

The research has multiple points of integration (Greene et al., 1989; Schoonenboom & Johnson, 2017). In Study 1 an exploratory, sequentially mixed methods design (Fetters et al., 2013) was applied, and QUAL+quan analysis informed the subsequent studies (2 and 3). In Studies 2 and 3, a partly planned and partly emergent design (Schoonenboom & Johnson, 2017) grounded in a real-life intervention was applied across studies; integration was achieved through embedding (Fetters et al., 2013, p. 2141), as data collection and analysis were linked at multiple points during the emergence of the study. Study 2, which is reported in Article 2, can be described as a qualitatively driven combination of parallel and conversion mixed designs, whereas Study 3, which is reported in Article 3, can be described as an inductive-simultaneous design (Schoonenboom & Johnson, 2017). In isolated, Study 3 is therefore not a mixed methods study but rather a multimethod study since the data reported were all collected by the use of methods generally perceived as qualitative. The intervention was inspired by design-based research (DBR), which 'is a form of inquiry characterized by iterative cycles of development, testing, and refinement of an intervention that is developed in collaboration with stakeholders and then deployed and evaluated in the rich, real-world contexts. DBR is simultaneously committed to providing theoretical contributions and practical solutions to educational problems. In education, DBR has been used to study curriculum, instructional strategies, professional development, and technology-enhanced learning environments' (Crippen & Brown, 2018, p. 489). While mixed methods intervention design frameworks are general and applicable across disciplines, DRB-frameworks are developed to assess and refine educational interventions. In line with the partly sequential and partly

convergent MMR-design (Schoonenboom & Johnson, 2017), the strands occurred across chronological phases; the research questions are interrelated and evolved to some extent during the study.

The project's pragmatic MR paradigm stance implied that both the conceptual framework and the methodological choices of the study be deliberately designed to help answer the overarching research question. Chapter 2 therefore explains why and how the conceptual framework was assembled, which lenses they employ, and which assumptions they reflect. Chapter 3 elaborates further on the methodological approaches by demonstrating how and why qualitative and quantitative perspectives were combined to complement each other.

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## 2. Conceptual Framework

Several change initiatives have been initiated by Norwegian authorities in the last five years. New demands for teacher education, a new educational reform (including a new core curriculum), and the framework for PfdK has created powerful momentum for rapid change within a relatively short period of time. A premise of the new reform is that teachers should be able to flexibly and purposefully vary between and combine basic learning and deep learning methods. From a classroom management perspective, this means that strictly prescriptive and standardized understandings of classroom management will be insufficient since such approaches imply that most learning activities and methods can be managed and led in the same way. In this thesis, the concept of classroom management is therefore understood and interpreted using an ecological approach (Doyle, 2006).

The research field of classroom management has developed over a long period of time, but systematic research that sheds light on classroom management in 1:1 learning environments remains sparse. According to Nygaard (2015), a body of knowledge needs theory and empirical evidence (both qualitative and quantitative) in order to keep growing, as '[t]heory provides the ideas that link the data together and give them meaning; and the empirical evidence gives the theory weight' (p. 6). To be able to explore the challenges and benefits teachers face in their 1:1 classroom management practices, it has therefore been necessary to design a theoretical and conceptual framework that underpins the real-life practice of teachers as classroom managers. In line with the aim of producing pragmatic knowledge, pluralistic pragmatism acknowledges that combining complementary theoretical approaches in a project could assist 'both/and' logic (Greene, 2007; B. Johnson & Christensen, 2017; Morgan, 2008). Theory plays a crucial role in transforming data into understanding (Biesta, 2013); according to Schoonenboom and Johnson (2017), theoretical drive is one of the primary dimensions of MMR designs. Mixing methods within the third paradigm allows for an abductive connection between theory and data, which combines inductive (qualitative) and deductive (quantitative) analysis and reasoning (Morgan, 2008; Schoonenboom & Johnson, 2017).

It is neither possible nor desirable to design a framework that reflects all aspects of the real-life complexity of classroom management practices, but in line with the project's purpose, goals, and research questions, the following domains are emphasized: classroom management, digital competence, and self-determination theory. In addition, characteristics of ALT (and inherent LA) are used as an example to discuss affordances for learning and motivation. This chapter explains in greater depth why these conceptual lenses and theoretical perspectives are brought together in the project, how they contribute to exploring the overarching research question, and how they play a role in transforming data into understanding.

## 2.1 Classroom Management: From Theoretical Concept to Contextual Practices

The interpretation and understanding of classroom management that underlies this thesis grow out of the definition that classroom management as 'the actions teachers take to create an environment that supports and facilitates both academic and social-emotional learning' (Evertson & Weinstein, 2006, p. 4). This is a comprehensive and general definition that is both applicable and easy to agree with, because it enables individual interpretation in line with one's own understandings and educational values. It also reflects and underlines the variation in teaching and learning formats that classroom management must take into account (Emmer & Sabornie, 2015) and is a dynamic and flexible definition that can be sustained over time and across contexts.

While such flexibility can be a strength, it can also present challenges, especially for operationalizing and clarification purposes. As demonstrated in Chapter 1, there are a variety of approaches to defining the nature of classroom management, how classroom management should be taught, and how it should be practiced. The tension between 'crime control' (Bullough & Richardson, 2015) and relational perspectives is particularly and consistently visible throughout the literature. The control perspective is often associated with teacher-centred learning practices, while the relational perspective is often associated with student-centred learning practices. Language, communication, and dialogue are of major importance in pupil-teacher relationships,

as they help distinguish between autonomy-supportive teaching and a controlling style of teaching (Reeve, 2016). An interesting paradox is that negative behaviours are more likely to arise in educational situations in which teachers adopt a more controlling teaching style (Haerens et al., 2016). This paradox exemplifies the importance of understanding and reflecting on matters of goal and means in real-life classroom management practices.

### **2.1.1 Classroom Management as Purposeful Actions**

The definition of classroom management proposed by Evertson and Weinstein (2006) in itself contains words and concepts that could have different meanings for different readers based on their background and experience. For example, the term *actions* could be perceived as structured, prescriptive, and conscious management actions, or as more or less everything the teacher does – consciously or unconsciously – before, during, and after a learning experience. However, the definition also explicitly links the actions and strategies used by teachers to the creation of an environment that supports and facilitates academic and social-emotional learning. The intention of classroom management is to create and maintain a given optimal learning environment (Brophy, 2006; Doyle, 2006). It is worth noting that what constitutes an ‘optimal’ learning environment is described as ‘given’. This underlines the variation in context and teaching and learning formats that classroom management must take into account (Emmer & Sabornie, 2015). While the classroom management definition allows for different understandings of individual words and concepts, it also entails an explicit connection between the actions and strategies used by teachers and the intended outcomes those actions and strategies are intended to produce. These outcomes could be directly related to learning, more indirectly related to learning (e.g., learning environment and motivation), or a combination of the two. We can thus say that classroom management, leadership of learning processes, and facilitation of learning require intentionality and awareness of intended outcomes within a specific context.

Hickey and Schafer (2006) describe five types of actions teachers take to facilitate learning in the classroom: Engagement (i.e., maximizing involvement in academic



tasks), curriculum (i.e., defining the scope and sequence of instruction), relationships (i.e., interaction with and among students), development (i.e., changing behaviour and cognition over time), and discipline (i.e., preventing and addressing behaviour problems). The shift from a (passive) teacher-centred classroom environment to an (active) pupil-centred classroom environment has instructional and managerial implications and, according to Brophy (2006), has become increasingly important to first identify the intended pupil learning outcomes and then design learning activities and reflectively acknowledge what these specific activities imply about the desired roles of pupils. The learning process benefits from stating clear expectations and helping pupils understand not only what to do (i.e., learning activities) but also why, to support their development of autonomy (Brophy, 2006; Hickey & Schafer, 2006). One can therefore argue that both 1) the intention of classroom management and 2) the definition of classroom management emphasize *purposeful actions and strategies* aimed at an intended learning environment and intended academic and socio-emotional learning. Classroom management in ICT learning environments should thus, like classroom management in non-ICT learning environments, purposefully aim to facilitate learning. However, according to the background and review of this extended synopsis, managing 1:1 learning environments and leading learning processes with ICT appears to be more difficult, due to the increase in complexity.

### **2.1.2 Making Sense of Educational Technology**

The professional digital competence framework (UDIR, 2017) may at first glance seem like a simple and readily comprehensible overview of what teachers should be able to do to be digitally competent and capable of leading learning processes in ICT learning environments. But the framework itself does not equip teachers with the skills and competencies needed to facilitate learning with ICT; nor does it address the underlying assumptions and tensions that may arise as schools are increasingly digitized.

Bringing the theoretical concept of digital competence into the overall conceptual framework of the thesis does not contribute to simplification. On the contrary, it contributes new perspectives regarding how and why the use of ICT could challenge

teachers' classroom management practices. Exploring the concepts of classroom management and digital competence in light of each other can thus help to unite perspectives regarding why ICT is being introduced in school and what is important when ICT is used for educational purposes. Study 1 (and hence the three first research questions) of this thesis therefore explores the relationship between classroom management and digital competence.

The term *digital competence* is interwoven with the core curricula and subject curricula of both the Knowledge Promotion Reform (LK06) and Fagfornyelsen (LK20). It could therefore be perceived as an everyday (emic) term in the lifeworld of teachers and school leaders who translate curricular formulations into school culture, school development, and classroom practices. However, digital competence is also a theoretical (etic) concept and an established field of research, interwoven with partially overlapping concepts like digital literacy, media literacy, and a range of other literacies that aims to describe which knowledges, skills, and competencies citizens should possess in a digitized knowledge society (Knobel & Lankshear, 2008).

The development of *digital literacy* or *digital competence* can be understood in light of overall technological development. The origin of the term first grew out of the first available digital technologies and their inherent potential for information search, word processing, calculation, and so on and were therefore described as information literacy, computer literacy or IT literacy (Bawden, 2008; Buckingham, 2008). But over the past three decades, technology has become both increasingly advanced and more accessible. Consequently, new literacy concepts were developed and introduced to describe the potential and usefulness underlying the emerging, merging, and converging technologies. The growing awareness of multimedia approaches to literacy thus marked a shift from traditional literacies to more integrated and complex understandings of what literacy is and could be (Bawden, 2008; Knobel & Lankshear, 2006; Lanham, 1995).

During the past two decades, the concept of digital literacy has often been described as a framework for integrating other literacies and skill sets (Bawden, 2008; Buckingham, 2008), but since the internet is now a provider of premises for most of the ICT available, functional internet literacy has become an essential aspect of digital literacy in general (G. M. Johnson, 2008). Fifteen years ago, Knobel and Lankshear (2006) were already pointing out that it can be misleading to talk about digital literacy or digital competence as a singly ‘thing’ in the multimedia era, as something you either do or do not have. They note that digital literacy is situational and related to specific needs in particular contexts. Navigating the knowledge society and developing functional internet literacy requires cognitive capacity and higher-order thinking skills (G. M. Johnson, 2008). Digital literacy is therefore often seen in relation to *21st-century skills*. The learning needs of the 21st century are often perceived as alternative, and even opposed, to the more traditional, structured, and streamlined learning needs in the age of printed information. The metaphor ‘centrifugal schooling’ has been used to describe the open, network-based, and process-oriented ways of creating new educational models adjusted to the needs of learning in the 21st century (Williamson, 2013, cited in Erstad & Voogt, 2018).

In addition to being perceived as a framework for integrating multiple literacies, digital literacy can also be understood in terms of levels of applications aiming at digital *bildung* (Buckingham, 2008; Martin, 2008). Drawing on the notion of digital literacy ranging from *basic skills* to *digital bildung*, Martin (2008) argues that digital literacy can be conceived on three levels. He places *digital competence* at the lowest level to describe the basic skills, conceptual understandings, approaches, attitudes, and so on that are applied at the digital competence level. At the second level, he places *digital usage* and includes professional and disciplinary applications. At the third and highest level, he places *digital transformation*, which includes innovation and creativity application. According to Martin (2008, p. 167) only digital usage and digital transformation are included in the concept of digital literacy; from this perspective, digital competence is perceived merely as a requirement or fundament for digital literacy to occur.

The overlap between digital literacy and digital competence may appear obvious but identifying specific intersections (and hence degrees of overlap) is difficult, since empirical and theoretical contributions differ in their approaches to what distinguishes and what unites the concepts and how they relate to each other. But defining the boundaries between digital competence and digital literacy is beyond the scope and aims of this project, and it is sufficient to state that digital literacy and digital competence revolve around the same educational discourses: How are students to become competent and active citizens in the knowledge society? What and how should they learn?

The complex and somewhat unresolved theoretical relationships between digital competence, digital literacy, media literacy, and the myriad additional literacies related to technology inform the overall research issue: the choice, use, and integration of technologies in the school context is not just about the technology itself. It is also linked to teachers' view of knowledge, their view of learning, and thus their professional identity. Sjøby (2008; pp. 126–127) claims that an instrumental approach to technology, viewing it merely as a tool for effective teaching and learning, has made pedagogy a perceived defence against technology. So, even though technology integration could be perceived as a catalyst for school development (e.g., Erstad & Hauge, 2011), it can also lead to resistance to change and even fear of losing authority (e.g., Bolick and Barthels, 2015). Matters of technology integration in school and their implications for professional identity appear to reveal a tension between the old and the new: Preserving school practices as they are or developing (or even transforming) them. This brings us to the question of why digital competence is considered important, since perspectives on what students should learn have major implications for how teachers should facilitate learning.

The seven competence areas of the professional digital competence framework (UDIR, 2017) reveal that digital competence at the policy level in Norway is perceived as an extensive and pervasive competence that is far beyond technical skills and knowing how to operate laptops and tablets. The competence areas recognize different perspectives on how and why teachers should be digitally competent and

imply media literacy (e.g., Potter, 2010) and media pedagogical and didactic perspectives (Vettenranta & Erichsen, 2007) as part of the digital competence concept. The PfDK framework defines digital competence as a ‘transversal key competence which enables the acquisition of other key competencies. It is related to many of the so-called ‘21st-century skills’, which should be acquired by all citizens, to ensure their active participation in society and the economy’ (UDIR, 2017, p. 12).

In Study 1 of this thesis, teachers’ digital competence is defined as ‘the individual teacher’s proficiency in using ICT with good pedagogical judgement and his/her awareness of its implications for learning strategies and the digital bildung of pupils’ (Krumsvik, 2007, p. 68). Like Buckingham (2008) and Martin (2008), Krumsvik understands the application and integration of technology as ranging across levels from basic skills to digital bildung, even though Krumsvik and Martin use the term *digital competence* somewhat differently. Krumsvik’s professional digital competence definition is linked to the teacher’s digital competence model (Figure 4), which illustrates the teachers’ digital competence as a journey from low to high self-awareness (the vertical axes) and practical proficiency (the horizontal axes).

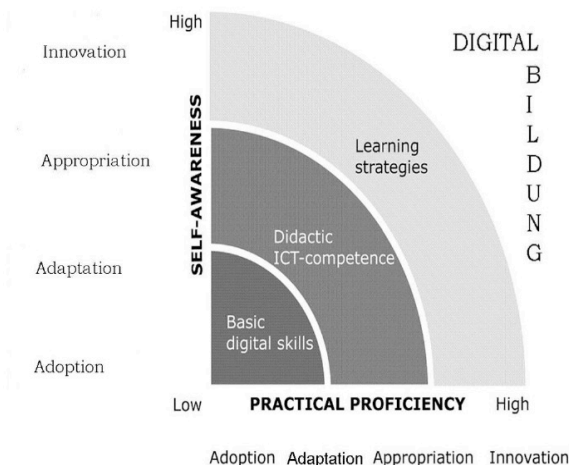


Figure 4: Teachers’ digital competence model (Krumsvik, 2007, p. 72).

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The model demonstrates how self-awareness and practical proficiency go hand-in-hand as the teacher's digital competence gradually evolves from basic digital skills through didactic ICT competence to integrated learning strategies and digital bildung. The main point made by Krumsvik (2007, 2014b) is that teachers gradually become increasingly digitally competent by adopting and adapting ICT into their teaching before they appropriate and innovate their teaching using ICT. In addition, Krumsvik et al. (2016, p. 149) note that teachers now use ICT considerably more intensively than they did ten years ago and thus argue that the first significant obstacle might now occur during the appropriation phase of ICT integration.

But the barrier between adaptation and appropriation (and innovation) has implications beyond merely applying and using ICT tools in education. From both a digital literacy and a digital competence perspective, transformation and innovation require teachers to challenge and change practices that have long traditions in school. In the exploration of the relationship between digital competence and classroom management in Study 1, some of the tensions between traditional and transformative perspectives on classroom management are described. Such depictions created a springboard for further exploration of the contextual judgements teachers make in their real-life practices.

## 2.2 Contextual Classroom Management

When certain elements are chosen as the focus in a study, other elements will necessarily retreat into the background, at least to some extent. The qualitative data analysis in Study 1 shows the nature of the relationship between classroom management and digital competence, and the quantitative data analysis shows the strength of the associations between them (Fetters et al., 2013). The general and conceptual focus in Study 1 treats contextual elements of classroom management in 1:1 learning environments as general background information rather than processes under investigation. However, when seeking to understand and explain challenges and opportunities in 1:1 classroom management practices, it is also important to understand how such challenges and opportunities play out in real life. Contextual

information and investigation increase ecological validity and enables reflexive transferability across contexts. The remaining research studies in the thesis (RQ4–RQ6) thus seek to explore classroom management as contextual practices in 1:1 learning environments.

Classroom management is a means for creating and maintaining a productive and fruitful learning environment for pupils, but what does this mean in the today's Norwegian context? The core curricula of Fagfornyelsen and the PfdK framework emphasize that schools and teachers should facilitate learning by creating and maintaining an inclusive learning environment in which pupils actively participate and engage in their own learning. Motivation is considered both an aim for classroom management and leadership of learning processes and as a prerequisite for active student learning in line with the core competencies, basic competencies, and academic and social competencies pupils are expected to develop. Study 2 of this thesis therefore explores learning, motivation, and learning environment characteristics as aims of contextual classroom management in order to better understand the complexity of classroom management practices in 1:1 learning environments.

### **2.2.1 Classroom Management Aims: Motivation and Learning**

A recurring argument for using ICT in school and education is that it can lead to increased motivation and learning (Koh, 2016); including self-determination theory (SDT) in this dissertation helps create a framework for discussing how and why ICT can contribute to motivation and learning. A fruitful learning environment in the field of classroom management often referred to as supportive of pupils' autonomy, their feeling of being competent, and their sense of belonging, and SDT is a theoretical framework which systematically brings together these elements and aims to explain and demonstrate how they interact with motivation and learning. SDT is therefore applied to address RQ4 in Study 2: How does the systematic use of ALT influence pupils' learning and motivation?

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In SDT, *amotivation* is described as a lack of intentionality and sense of personal involvement and results from not valuing an activity, not feeling competent in it, or not believing it will yield a desired outcome (Deci & Ryan, 2004; Ryan & Deci, 2000b). Motivation, on the other hand, is considered to be the moving force of any action or behaviour, and SDT distinguishes between different types of motivation based on the reasons or goals that give rise to an action (Deci & Ryan, 2004, 2016; Ryan & Deci, 2000a, 2000b, 2020). *Intrinsic motivation* involves carrying out an activity for its inherent satisfaction rather than for some other and separate consequence and refers to performing a task or activity because one finds it enjoyable, interesting, or fun in and of itself. *Extrinsic motivation* is defined as the doing an activity for a reward or other separate consequence and is a more complex and ambiguous concept than intrinsic motivation on the one hand and amotivation on the other. Some extrinsic motivations are associated with positive motivations (sense of personal involvement), while others are associated with negative ones (sense of pressure from or a desire to please others). The framework thus operates on the assumption that negative forms of motivation can have a short-term effect on learning, but that in the long term they can lead to alienation or even amotivation.

The SDT distinction between intrinsic motivation, the positive and negative forms of extrinsic motivation, and amotivation also imply that one must consider that activities in which ICT is used could also be considered controlling, discouraging, or even amotivating. This thesis in general, and Study 2 in particular, consequently does not perceive motivation as something a pupil either does or does not have. The thesis additionally assumes that motivations can take both positive and negative forms depending on whether the motive force of an action or activity is related to students enjoying the activity in itself (or at least has an understanding of why it is important) or if it is mainly related to perceived expectations or even pressure from teachers, other students, parents, and so on.

One of the explicit competencies of the classroom manager and leader of learning processes appears in both the PfdK framework (UDIR, 2018) and the core



curriculum (UDIR, 2017)<sup>3</sup>; it is described as the ability to create a constructive and inclusive learning environment that fosters interaction, engagement, and a motivation to learn. Social, moral, and academic learning go hand-in-hand in most classroom management definitions, and according to SDT learners are naturally inclined to take in knowledge and integrate the regulation of behaviours when in supportive or nurturing social conditions (Deci & Ryan, 2016; Ryan & Deci, 2020). Basic psychological needs (autonomy, relatedness, and the feeling of competence) are generally seen as essential indicators of a productive learning environment and are the aim of classroom management (Evertson & Weinstein, 2006). They are also at the core of SDT, which grew out of research on classroom climate and learning environments through the hypothesis that ‘teachers’ orientations toward supporting pupils’ autonomy versus controlling their behaviour would create different climates or ambiances within their classrooms, which would in turn impact the pupils’ intrinsic motivation and well-being’ (Deci & Ryan, 2016, p. 12). The framework carries assumptions that a good learning environment will have a long-term positive effect on motivation and thus also learning. Based on the reasoning presented so far in this (2.2.1) section, SDT is a theoretical framework which is mainly in line with – and systematically brings together – the central principles and aims described in both the PfdK framework and the core curricula of Fagfornyelsen. The SDT framework and related quantitative items and qualitative categories therefore reflect real-life expectations regarding the research question investigated in Study 2: How does the systematic use of ALT influence pupils’ learning and motivation? But contextual classroom management is not merely defined by its aims, and complementary perspectives could therefore contribute to a broader understanding of classroom management as contextual practices.

## **2.2.2 Contextual Classroom Management as Integrative Process**

Classroom management definitions generally include actions and strategies used by teachers in an effort to achieve those specific aims, and Study 3 therefore explored

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<sup>3</sup> Both the PfdK framework and the core curriculum are policy documents rather than theoretical concepts per se; however, they do inform the conceptual framework regarding the present Norwegian context.

contextual classroom management in 1:1 learning environments as an integrative process. As noted above, intended classroom management outcomes can be directly related to learning, more indirectly related to learning (e.g., learning environment and motivation), or a combination. Study 3 aimed to explore how teachers perceived aims for their classroom management, how they practiced classroom management, and how they reflected upon the integration of ALT into their existing practice. The TPACK framework (Figure 6) developed by Mishra and Koehler (2006) was applied to the study as a process model for investigating, understanding, and demonstrating the relationship between technological knowledge (T), pedagogical knowledge (P), and content knowledge (C) within the context of leadership of learning processes and classroom management practices. TPACK builds on the integration of pedagogical knowledge and content knowledge model originally introduced by Shulman (1986, 1987), which in the Norwegian context is known as didactics. The Venn diagram logic of the TPACK framework reveals that integrating technological knowledge (T) into pedagogical content (PC) knowledge (or didactics in the Norwegian context) has both pedagogical and content implications within a given context. Using this framework to categorize and examine teachers' reasoning and experiences could thus help to capture nuanced differences in teachers' pedagogical, content, and technological understandings.

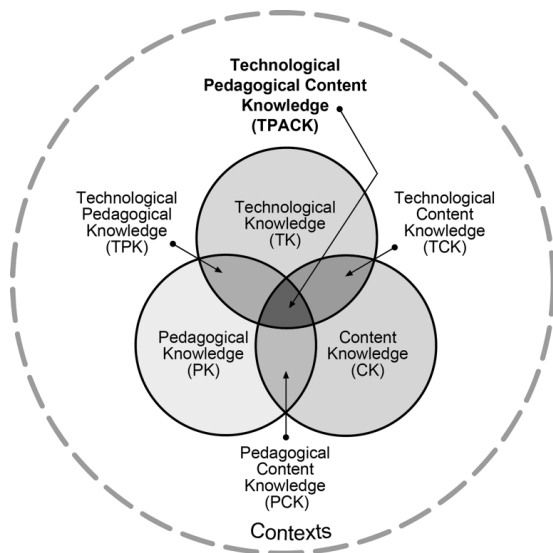


Figure 5: The original TPACK framework model (Mishra & Koehler, 2006)<sup>4</sup>.

During the literature review described in Chapter 1, the TPACK framework was found to be used extensively for measuring and describing teachers' integration of technology in their practice. Many teachers perceived the knowledge bases and domains separately, and the emphasis on describing the integration process in context is often deficient. Even though the context perspective was heavily emphasized in the original TPACK model and framework, research applying the model often uses TPACK instrumentation (e.g., Schmidt et al., 2009) without accounting for context (Rosenberg & Koehler, 2015). Mishra (2019) therefore recently proposed an upgrade of the TPACK framework, renaming context as 'conteXtual knowledge (XK)', which supplements TK, PK, and CK. The upgrade is a recognition that 'taking context seriously asks researchers to spend time in the complex settings of classrooms and schools and other settings to understand the conditions under which teaching with technology is most effective' (Rosenberg & Koehler, 2015, p. 196). Researching classroom management and ICT integration from a contextual perspective, as Studies 2 and 3 in this dissertation do, can thus provide both methodological and theoretical

<sup>4</sup> Reproduced with permission of the publisher; © 2012 by tpack.org.

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contributions to further the development and understanding of the TPACK framework.

The reasoning so far in this chapter has shown how digital competence (including Krumsvik's digital competence model and the TPACK framework) and SDT are regarded as conceptual lenses that complement each other if one is to understand and explain teachers' classroom management in 1:1 learning environments. An important intersection between the two concepts is how ICT is or can be used to facilitate students' learning and motivation, and Studies 2 and 3 of this dissertation aim to explore contextual classroom management as integrative processes aimed at pupil learning and motivation in ICT learning environments. The term *affordances* broadly describe what utility a thing or an object can offer its surroundings, and the teacher's ability to perceive, recognize, and use technology's potential in teaching and learning activities is therefore an important aspect of their digital competence (e.g., Krumsvik et al., 2016).

The original definition of affordances proposed by Gibson (1977) is as follows: 'The affordance of anything is a specific combination of the properties of its substance and its surfaces taken with reference to an animal. [...] The affordances of the environment are what it offers animals, what it provides or furnishes, for good or ill' (Gibson, 1977, pp. 67–68). In *The Theory of Affordances*, Gibson (1977) explored the relationship between animals (and humans) and their surroundings, later using the term to explore the psychological aspects of visual perceptions of the world (Gibson, 2015). Norman (1990) further developed the concept of affordances, applying and adjusting it to everyday designs, human machine interaction, and automatization. He uses the verb *affords* as a synonym for 'is for' and says that '[a]ffordance refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used' (p. 9). In interaction designs, real affordances are the built-in systems that could be recognized and used but often are not, according to Norman (1999). Both Norman (1999) and Koehler and Mishra (2009, p. 61) emphasize and discuss the difference between physical and digital technologies and their affordances. They argue that digital technologies are

much harder technologies for teachers to integrate in their practice than physical technologies because of their multifunctional possibilities, rapid changes, and the fact that the inner workings of digital technology (such as program algorithms) are hidden from users.

ICT is not a specific tool or technology but rather a collective term for myriad different technologies, each with its inherent and associated affordances. This dissertation assumes that various forms of digital tools have any number of built-in (real) affordances in addition to their obvious and intended (perceived) affordances. Whether a teacher identifies *real affordances* in addition to *perceived affordances* can thus affect that teacher's reasons for using or not using a given technology. Teachers who have reached the stage of recognizing real affordances may be more able to find and use pedagogical advantages in technology than the 'average' teacher (Krumsvik et al., 2016; Wasson & Hansen, 2014); for them, social conventions and cultural and logical constraints may consequently play less of a role. The dissertation does, nevertheless, acknowledge that cultural conventions and physical, logical, and cultural constraints are important, and exploring how teachers identify what various ICT technology 'is for', what it offers the user, and how it could be applied and used for educational purposes is an important part of understanding and exploring the 1:1 contextual classroom management practices of teachers.

Within the limits of a doctoral dissertation (or any other research project), one cannot examine the use and usefulness of all technologies, and a case technology must therefore be chosen when integration in established classroom management practice is to be investigated within that context. In the literature review, cutting-edge technology was identified as a particular classroom management challenge that cuts across levels of ICT expertise. In this thesis, ALT therefore represents emergent algorithm-based learning technologies that aim to personalize learning experiences. ALT could also be perceived as part of the 'learning through individual interaction with ICT' domain, which, in Chapter 1, is described as likely to become an important element of the movement toward greater learner influence over what is learned and how it is learned (Beauchamp & Kennewell, 2010). LA collects and systematizes

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real-time empirical data about the learner's activity and learning process, while ALT aims to facilitate learning through the personalization and individualization of curricula content. LA technology is thus integrated in the ALT technology. The interaction between ALT and LA enables several forms of personalized interventions in the learning experience of the learner, with the very intention of ALT-mediated training being to create personalized challenges in the pupils' flow zone between boredom and anxiety (e.g., Gallego-Durán et al., 2018). One prominent issue in education is that pupils may not receive timely help, hints, and feedback; in a study by Roschelle et al. (2016), the ALT technology program *ASSISTment* was found to improve homework quality, as it provided timely feedback and hints for pupils.

The integration of ALT and LA and its activity data creates new opportunities for classroom management and leadership of learning processes, as it enables adaptive and parallel learning activities at different levels (as described in the PfdK framework) and increases the transparency of pupils learning trajectories. The access to activity data could also inform the teacher about matters relevant to creating 'a constructive and inclusive learning environment, that fosters interaction, engagement, and a motivation to learn' (UDIR, 2018, p. 8). This makes it not only relevant but also essential to investigate whether this type of program works as intended when introduced in established learning contexts and contextual classroom management.

However, ALT and LA technology could have broad ethical and pedagogical implications (Slade & Prinsloo, 2013) and the potential to either support current educational practices or challenge them and reshape education (Knight & Buckingham Shum, 2017, p. 19). Knight and Buckingham Shum (2017) note that their use must support the goals and values established for education, pointing out that the technology must be used consciously and with caution. The application of SDT as part of the conceptual framework reflects the goals and values established for Norwegian education. Additionally, as noted above, the mutual interaction between deep learning and basic competence is an important intention of the new Norwegian curricular reform. The ability to flexibly facilitate a variety of learning activities and orchestrate smooth transitions between different activities is also emphasized in the

PfDK framework, as leaders of learning processes are expected to ‘adapt their teaching role to different activities, and switch between the role of tutor, guide, participant and intermediary in a digital environment’ (UDIR, 2018, p. 8). Although ALT affords automated personalization (sequencing of activities in the program, instant feedback and hints) and the organization of activity data, it also poses new challenges and constraints for classroom management and teachers’ professional knowledge. Both its possibilities and constraints are therefore explored in Study 3. Although ALT and LA are not considered key aspects of the overall theoretical framework in this extended synopsis, they are used as a gateway to discuss real and perceived affordances in learning technology and ICT.

### **2.2.3 Purposeful Actions in Contextual ICT Classroom Management**

In line with the review (Figure 3) and the overall research question of the thesis, *classroom management* is its guiding concept, but the perspectives and contributions of the other domains reflect different aspects of classroom management in ICT learning environments. A key assumption which weaves the different theoretical domains of this extended synopsis and the three articles together is that classroom management can be understood as series of *purposeful actions*. The study assumes that teachers’ classroom management practices do have purposes, that the purposes are interlinked with teachers’ didactic judgement and practices, and that they are aimed at establishing and sustaining a learning environment which benefits pupils’ learning and motivation. In other words, the study assumes that challenges and opportunities teachers face in their 1:1 (ICT) classroom management practices are related to issues regarding motivation and learning both directly and indirectly through the learning environment and pupil well-being. This rationale is neither new nor unexplored in classroom management research but in line with the background, literature review, and framework of this thesis, it is clear that 1:1 access to tablets or laptops is somehow a complicating factor.

Teachers’ *digital competence* and the TPACK framework contribute established theoretical perspectives on the facilitation of learning when ICT is used, and the

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relationship between classroom management and digital competence is explored both theoretically and empirically throughout the thesis. The concept(s) of digital competence that are included inform the conceptual framework, which holds applying technology in teaching and learning practices is not merely a matter of the potential inherent in the technology itself. Identifying real and perceived affordances for learning and motivation is a contextual task, and teachers may have different technological, pedagogical, and content perspectives on whether a technology ‘is for’ or supports learning directly or indirectly in terms of motivation and learning environment. The way in which teachers contextualize and integrate technology into learning activities should be grounded in pedagogical principles. But neither pedagogy in general nor professional digital competence specifically has a unanimous view about issues such as what learning is, what leads to learning, or what the optimal balance between social and academic learning in educational settings is. When choosing how to measure and describe learning, motivation, and the learning environment, one consciously or unconsciously chooses sets of values and stances as premises. By adding SDT to the framework, the study accepts the premise that support for autonomy, competence, and belonging are important elements in a fruitful learning environment, that motivation is a driving force for learning, and that there are both positive and negative forms of motivation. However, although the study accepts these premises, it also recognizes that the learning process should lead somewhere. In this way, the study places itself in a position that recognizes that motivation and a good learning environment are important and desirable, but that they should be directed towards specific aims in an educational setting.

Computer-assisted learning and the educational use of ICT include a variety of hardware and software tools and technologies that can be contextualized and used in myriad ways. In this thesis, *ALT* is used as a specific case in Studies 2 and 3. Due to *ALT*’s relatively recent entry into education and its rapid spread in pedagogical contexts, little (published) research has explored whether and how this type of algorithm-based technology can support classroom management and leadership of learning processes. The technology’s convergence of empirically generated LA and activity data and personalized learning material customization opens up new



possibilities but also presents new challenges for classroom management and the facilitation of learning. *SDT* provides a theoretical lens for addressing, exploring, and measuring the central intended outcomes of classroom management; namely, learners' autonomy, relatedness, feelings of competence, and motivations for learning.

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### 3. Methodology

Knowledge-based classroom practice requires bridging the gap between research and practice. This can mean that the field of practice makes decisions informed by research, but it also implies that research should be informed by the challenges and understandings of the field of practice. The overarching research question that drives this study aims to understand challenges and opportunities teachers are facing in their ICT classroom management practices. Understanding the challenges is a fundamental prerequisite for supporting teachers and school leaders in their effort to solve such challenges. This study therefore aims to facilitate a dialogue between the field of research and the field of practice, resting on the assumption that good classroom management is situational, taking on different forms in different contexts.

Saunders et al. (2016, p. 719) describe methodology as ‘[t]he theory of how research should be undertaken, including the theoretical and philosophical assumptions upon which research is based and the implications of these for the method or methods adopted’. While presenting the design of the study in chapter 1, the study was described as inspired by dialectical and pluralistic pragmatism (Greene, 2007; R. B. Johnson, 2017) and positioned within a third paradigm, referred to as pragmatism (by, e.g., Morgan, 2008, 2014) and/or MR (by, e.g., R. B. Johnson and Onwuegbuzie, 2004). The overarching research question of the study<sup>5</sup> was identified as inviting *pragmatic knowledge* acquired through a research design planned and conducted based on what would best help answer the research questions (B. Johnson & Christensen, 2017; Onwuegbuzie and Leech, 2006).

According to mixed methods terms proposed by Schoonenboom and Johnson (2017) and Fetters et al. (2013), the overall study design was described as a high-complexity hybrid MMR design which is partly sequential (since Study 1 informed Studies 2 and 3) and partly convergent or concurrent (since the Study 2 and 3 data were collected simultaneously). Study 1 (RQ1–RQ3) explored the *relationship between digital*

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<sup>5</sup> How can we understand and explain the challenges and opportunities primary and secondary teachers are facing in their 1:1 (ICT) classroom management practices?

*competence and classroom management* as theoretical concepts and emic terms (e.g., B. Johnson & Christensen, 2017), whereas RQ4–RQ6 explored *classroom management within real-life context* through two lenses: *Aims of contextual classroom management* (RQ4) and *contextual classroom management practices* (RQ5 and RQ6). Aims of contextual classroom management was explored in Study 2, and *contextual classroom management practices* was explored in Study 3.

So far in this synopsis, the aims, purposes, and research questions of the study have been presented, unpacked, and explained from a mainly conceptual perspective. In this chapter those aims, purposes, and research questions will be further unpacked and explained, mainly from a methodological perspective<sup>6</sup>. According to Morgan (2008, pp. 55–56), pragmatism places methodology at the centre; no research question is inherently important and no method automatically appropriate, because a pragmatic approach includes ethical and moral concerns in the philosophy of science under the heading of *axiology*.

According to the *fundamental principle of mixed research*, MR will ideally combine quantitative and qualitative approaches that have complementary strengths and non-overlapping weaknesses (Onwuegbuzie & Johnson, 2008, pp. 280–284). The effective use of this principle is a major source of justification for MR (R. B. Johnson & Onwuegbuzie, 2004, p. 18), and aiming at this fundamental principle of MR was a driving force of the study design.

In this chapter, the three studies are first described separately according to their aims, purposes, research questions, designs, samples, methods, and analyses. Through these descriptions the studies are also linked to the conceptual framework of the thesis as whole. Later in this chapter, issues regarding transferability, validity, and ethics across studies are described and discussed.

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<sup>6</sup> The use of the word ‘mainly’ is intended to imply that theoretical and methodological reasoning and choices are mutually influential.

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## 3.1 Study 1: Conceptual Approaches to Classroom Management and Digital Competence

### **Purpose and aim of Study 1**

Studies investigating the challenges and benefits of classroom management practices in 1:1 learning environments remain sparse and, even though the concepts of classroom management and digital competence are established fields of research, little existing research explores the relationship between them. The aim of Study 1 was therefore to explore the relationship between digital competence and classroom management from both emic and etic viewpoints (B. Johnson & Christensen, 2017).

### **Sample and design**

The data that formed the empirical foundation of this study were collected in the SMIL study from 2012–2013 (Krumsvik et al., 2013), prior to the start of this PhD project. The SMIL study was funded by the Norwegian Association of Local and Regional Authorities (KS) and was conducted in all public upper secondary schools in the seven counties in the Eastern Norway County Network. In the overall SMIL study, teachers' (n = 2579) and pupils' (n = 17 529) application, scope, and use of ICT in education were explored in a broad sense, with the primary aim of mapping the relationship between use of ICT and learning outcomes. However, the study also aimed to enable monitoring (and comparing) development over time (Pelgrum, 2009), and six indicator areas were developed, piloted, and explored and measured in line with recommendations from the OECD report *Assessing the Effects of ICT in Education* (Kikis et al., 2009; Pelgrum, 2009; Scheuermann & Pedró, 2009). The overall design of the SMIL study aimed to place equal emphasis on quantitative and qualitative data via an equal-status MMR design and then combine them in the analysis (R. B. Johnson, 2017; Schoonenboom & Johnson, 2017).

The survey was piloted by two researchers visiting four schools using live surveys (Student Response System) to collect pilot data from 153 teachers and 921 pupils.

The online survey was then completed by 2,579 teachers and formed the basis of both the statistical and regression analyses of the study. The qualitative data were collected through semi-structured interviews, observations, and focus group interviews<sup>7</sup>.

Since the aim of Study 1 was to explore the relationship between classroom management and digital competence, both quantitative and qualitative datasets regarding classroom management, student-teacher relationships, and digital competence were thus abductively re-analysed according to the research questions (RQs 1–3 of this thesis), and the discussion was rooted in a conceptual framework that synthesized theoretical perspectives on the relationship between classroom management and digital competence.

A qualitatively driven mixed design (B. Johnson & Christensen, 2017; Schoonenboom & Johnson, 2017) was applied to the datasets, which means that it is a qualitatively dominant mixed methods study. In the article reporting on Study 1 (Article 1), the design is described as an exploratory sequential mixed methods design (Fetters et al., 2013).

### **Survey**

Since the overall SMIL study initially aimed for a broad and comprehensive approach to the implementation of ICT in schools, digital competence and classroom management were two of several concepts examined in the survey. The quantitative instrumentation of digital competence was divided into five categories, in line with Krumsvik's digital competence model (Krumsvik, 2007, 2014b; Krumsvik et al., 2016): Elementary ICT, basic ICT skills, didactic ICT competence, digital learning strategies, and digital bildung. Classroom management was differentiated into the two categories of student-teacher relationships and teaching control.

### **Semi-structured interviews**

The SMIL's semi-structured interviews initially had, in the same way as the survey, a broad approach to the implementation of ICT in schools. A concept- and category-

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<sup>7</sup> The interview guides and further information on the instrumentation can be found in Article 1 and Appendix 4.

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based interview guide was therefore developed to ensure coherence between the survey data and the concepts and categories in the interview data. The interview guides contained questions on non-academic use of ICT, the overall scope of ICT, and classroom management. They thus provided, both explicitly and implicitly, data on classroom management matters. A total sample of 30 school owners, school leaders, teachers, and a student representative were selected as respondents through purposeful selection (Maxwell, 2005).

### **Analysis**

The quantitative dataset (i.e., survey data) was analysed statistically with classroom management as the dependent variable and demographic, personal, and professional characteristics and teachers' professional digital competence being independent variables. The regression analysis showed that self-reported digital competence was the strongest predictor of both perceived classroom management abilities and student-teacher relationships when ICT was used.

The semi-structured interviews were previously transcribed by the initial SMIL study researchers to allow them to familiarize themselves with the data in the process 'meaning-making' (Merriam & Tisdell, 2016). The categories of non-academic use of ICT, the overall scope of ICT, and classroom management were obtained during the qualitative analysis based on the broader concept-driven categories, on former research, and on Kikis et al.'s (2009) framework. The abductive re-analysis of the previously categorized interview data related the qualitative findings to the theoretical lenses, conceptual framework, and research questions of Study 1.

The integrated MR discussion aimed to explore the coherence between the qualitative and quantitative findings and were based primarily on *confirmation* and partly on *expansion* (Fetters et al., 2013).

## 3.2 Study 2: Aims of Contextual Classroom Management

### **Purpose and aim of Study 2**

While Study 1 represents a baseline for the thesis and examines the strength of associations between classroom management and digital competence and the nature of those associations, Study 2 builds on these findings and digs deeper into how classroom management and professional digital competence play out in teachers' everyday practice by examining the strength of associations between ALT and pupils' learning and motivation and the nature of those associations. Purposeful integration of technology in classroom management practices should ideally establish or improve the aims of classroom management. In line with the overall research question and the conceptual framework of the project, Study 2 therefore aimed to explore how the introduction of cutting-edge technology would influence pupil learning, motivation, and learning environment. Although teachers often have an overview of pupils' learning, motivation, and learning environment, this overview is often general and influenced by the teachers' own experiences; even highly experienced teachers can misjudge students' level of motivation and their perceived learning environment (Deci & Ryan, 2016). Study 2 therefore examined pupils' learning, motivation, and learning environment directly.

### **Sample and design**

The upper primary case school of Studies 2 and 3 was chosen through purposeful sampling and was snowball sampled based on the accumulated knowledge of the research group Digital Learning Communities (DLC) of the school's practice and vision regarding the application and use of ICT in general. The ALT applied in the intervention was developed for primary levels, and the sample was consequently chosen according to target group levels and experience as a pilot school. The school leaders prioritized developing practice in line with the forthcoming reform (Fagfornlyelsen) and emphasized pupil motivation and the learning environment as important elements for deep learning. The school had had 1:1 access to tablets over time, and the teachers were considered accustomed to integrating technology into teaching and classroom management practices in general. The school was expected to

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serve as a locus that would answer the research question under investigation (Merriam & Tisdell, 2016; Teddlie & Yu, 2008) and was perceived to be an information-rich case ‘from which one can learn a great deal about issues of central importance to the purpose of the inquiry’ (Merriam & Tisdell, 2016, p. 96). The main respondent sample of Study 2 was 43 pupils (ages 10–13) and 3 teachers.

The study was designed as an interventional QUAL+quan mixed methods study, which has been described as an advanced design framework (Fetters et al., 2013). A survey and test provided quantitative datasets for comparison before and after the intervention, and semi-structured focus group interviews provided qualitative datasets about the viewpoints and experiences of the pupils. Classroom observations provided qualitative contextual information.

### **The real-life intervention as a contextual frame in Study 2**

The overall project design of Studies 2 and 3 aimed to investigate contextual classroom management by implementing an intervention in a real-life context to increase ecological validity (Gehrke, 2018), instead of using a controlled laboratory context. The research design was therefore inspired by DBR (Brown, 1992; The Design-Based Research Collective, 2003), which focuses on advancing theory grounded in naturalistic contexts (Barab & Squire, 2004); the design of the intervention is considered a key feature of the quality and results of the research project (Anderson & Shattuck, 2012).

The ALT technology applied in the real-life intervention in Studies 2 and 3, *Multi Smart Øving* (MSØ; Gyldendal, 2020), aims to improve schoolwork/homework quality by providing pupils with multimodal personalized tasks and activities, timely feedback, and hints. It also provides pre-organized activity data, visible for teachers, indicating the competence level of the pupils, which topics deserve more attention and which pupils need more help. MSØ is originally attached to a traditional and monomodal textbook and aims to facilitate volume training of basic mathematic skills.



According to Egelandstad et al. (2019), the main contribution of MSØ to mathematics education is that it enables quantity training, provides the teacher with a competency overview of various mathematical topics, and ensures that that pupils receive assignments adapted to their academic level. In addition, the digital format enables pupils to solve more varied tasks than would be possible with a textbook (Egelandstad et al., 2019, p. 64). According to Kynigos (2019), MSØ is a software tool that enhances traditional approaches to mathematics education, coupled with an automated, traditional, and generalized type of assessment.

Kynigos (2019) advises that each school apply models for how to use ALT technology to make procedural learning more effective so that more time can be spent on meaning-making, exploratory, and discursive learning. The real-life intervention of Study 2 aimed to do just that. The goal of the intervention was to streamline basic and procedural learning so more time could be spent on deep learning at school. The application of the systematic use of MSØ as homework, with teachers otherwise being free to employ MSØ as they found suitable beyond homework, may in itself seem like a relatively small intervention. However, in line with the conceptual assumptions of the study, even apparently small real-life interventions could have both intended and unintended consequences.

The theoretical underpinning of applying ALT in Studies 2 and 3 was informed by Roschelle et al. (2016), who found that the homework intervention including ALT provided a great benefit to pupils with low prior mathematics achievement. They also found that the amount of work and time assigned for homework was set by school policies, noting that they would conduct additional (QUAL and quan) data analyses to ‘to consider whether variations in the type and amount of homework might explain effects’ (Roschelle et al., 2016, p. 9). The use of time registration in adaptive tools also helps shed light on the relationship between perceived and reported time use and actual time use (Rawson et al., 2017).

Similar to Roschelle et al. (2016), we allotted the amount of time assigned for homework based on local school policies and collaboration with the teachers. The

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RCT study intervention described by Roschelle et al. (2016) included relatively extensive professional development and training of the participating teachers as part of their ALT intervention. The qualitatively driven real-life design of our Studies 2 and 3 did not include such systematic professional training. Rather, we aimed to identify and explore how ALT was understood and applied by teachers across existing classroom management practices and how its real-life introduction influenced pupil motivation and learning. As noted throughout Chapter 1, professional development programs are often criticized for being too prescriptive, for assuming that ‘one size fits all’, and for not sufficiently understanding local contexts. In addition, they are generally not available in most real-life contexts. In line with the aim of the project, we therefore decided to observe the introduction of ALT without formally intervening in the teacher’s implementation and use.

The intervention criteria were therefore concentrated on pupil use and in line with the purpose of the study: The pupils should perform tasks in the MSØ software program 15 minutes a day (60 minutes a week) as homework, a recommendation in line with the vendor’s recommendations. The teachers were otherwise free to include the use of MSØ as they found suitable according to their professional practice.

### **Quantitative data: Survey (Pre-Test/Post-Test)**

The pre- and post- test consisted of two separate parts. The fraction and percentage mathematics (FPM) test was developed by the three participating teachers to measure the intended learning outcome of the intervention period, in line with their interpretation mathematics competence aims in the Norwegian curriculum. The mathematics test consisted of 11 tasks and activities and was developed according to criteria established by the researchers: 1–3, easy tasks far below the national curriculum in difficulty level; 4–6, tasks approaching national curriculum level; 7–9, tasks in line with national curriculum level; and 10–11, tasks above national curriculum level. The teachers worked jointly to create the tests, but each teacher had final responsibility to adjust the content to his or her class level.

The SDT survey was developed by the researchers to collect data about the pupils’ motivations, basic psychological needs, perceived learning, and perceived

competence before and after the intervention. The survey questions (examples are presented in Appendix 7) were derived from validated items in self-determination (27 items), perceived learning (4 items), and competence (4 items) and were adapted to the pupils' context and age. Since the validated items used in this survey were originally in English, the content of the survey was translated to Norwegian, further developed, and adjusted to the primary school context over a period of several weeks. The participating teachers and professionals experienced in quantitative methodology were consulted during this period, and the survey was also piloted on other 10- to 12-year-olds during the development phase.

The pilot participants were asked to describe how they perceived and interpreted each question so the researchers would be able to validate whether the meaning of each item question was preserved through translation and contextual adaptation. The researchers were also actively conscious of monitoring for misconceptions during the actual pre-test. The process of translating, adapting, piloting, and monitoring the survey was logged in real time in an individual 'transparency' document (examples are presented in Appendix 8) to ensure all adjustments were documented and considered.

### **Qualitative Data: Classroom Observation and Focus Group Interviews**

Classroom observations were carried out during the intervention (2 × 45–60 minutes in each class). The observations contributed contextual information in Study 2 and informed the focus group interview guides. The classroom observations were more systematically analysed in Study 3 and are therefore described later in this chapter. The focus group interviews were carried out towards the end of the real-life intervention. Group interviews were preferred over individual interviews in an effort to understand more clearly the lifeworld of the pupils, balance out the power asymmetry associated with interview formats, and avoid a 'therapeutic turn of the interviews', in line with the informed consent (Kvale & Brinkmann, 2009). Three group interviews were carried out, one at each of the fifth, sixth, and seventh grades; each featured three pupils from the same class. They were asked questions about their learning environment, their relationship with their teacher, their attitudes towards ICT

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in general and ALT specifically, their typical mathematics classes, and their preferences in mathematics (more details are presented in Appendix 9). The interviews were transcribed during the first few weeks after the intervention period by the author of this extended synopsis.

Greene et al. (1989) have grouped reported mixed method data analysis and integration approaches into three categories<sup>8</sup>: 1) *no integration* – qualitative and quantitative results are analysed and interpreted separately; 2) *analyses separate* – some integration during interpretation; and 3) *integration during both analysis and interpretation*. Since the study was partly emergent due to the real-life context and explorative, we aimed to conduct analysis both separately for each of the quantitative and qualitative analyses and in an integrated fashion.

### **Quantitative Analysis**

The pre-test quantitative raw data were registered in Excel spreadsheets, which were then duplicated (to preserve the raw data for SPSS import); the duplicates were explored for preliminary findings which could inform the further development of the study or generate probes for additional qualitative or mixed investigation. The post-test quantitative raw data were also initially registered in Excel spreadsheets for later importing into SPSS.

After the real-life experiment was completed, both pre- and post-test (raw) data were exported from Excel to SPSS and statistically analysed for pre- and post-test changes using a paired sample t-test. A two-tailed  $p < 0.05$  was accepted as statistically significant for all tests. To investigate the magnitude of the effect within each group and between groups, the effect size (ES) was calculated in the form of Cohen's  $d$  (Cumming, 2012) for the primary outcome variables. We used the web-based Practical Meta-Analysis Effect Size Calculator (Lipsey & Wilson, 2001) to calculate Cohen's  $d$ . An ES of 0.2 was regarded as small, 0.5 as medium, and 0.8 as large (Cumming, 2012).

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<sup>8</sup> There were originally four categories, but the fourth was 'analysis procedures not reported'.

### **Qualitative Analysis**

The focus group interviews were first analysed according to the perceived integration between ALT practice, mainly in the form of homework, and classroom (see Figure 6 in Article 2) to find patterns or contrasts in pupils' perceptions. Classroom observation data contributed validating contextual information. The interview data were then analysed using categories derived from SDT (Ryan & Deci, 2000a; 2000b): Impersonal amotivation, external extrinsic motivations, internal extrinsic motivations, and internal intrinsic motivation (more details involving regulatory styles, associated processes, and perceived locus of causality are presented in Figure 7 in Article 2). The SDT analysis revealed a pattern indicating that pupils who described themselves at 'not very good in mathematics' were more negative towards ALT than the other pupils. They were also explicitly more negative towards ALT than other resources and methods described by the pupils as integrated into normal mathematics classes. This finding inspired both a tabular presentation of ALT and factors that increase or decrease internal forms of motivation (Table 5 in Article 2) and the following mixed analysis of the quantitative datasets.

### **Mixed Analysis and Data Transformation**

Mixed data analysis 'simply means that a researcher uses both quantitative and qualitative analytical techniques in a single research study' (B. Johnson & Christensen (2017, p. 590). According to Saldaña, coding summarizes, distils, or condenses data instead of simply reducing it (2013, p. 4). However, coding and analysis can also bring new perspectives, tensions, questions, and explanations to the table based on the points of integration, which again (re)inform subsequent analyses. Both qualitative and quantitative data were explored and preliminarily analysed during the time of the intervention. Merriam and Tisdell (2016) advise researchers to transcribe interviews themselves to familiarize themselves with the data, and the same can be said about registering and exploring quantitative raw data. Through chronological and gradual insights into the various data obtained during and after the intervention period, the contours of a nuanced overview became increasingly apparent.

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Informed by the pre-test data (the SDT survey and the mathematics test), we already knew that motivation and basic psychological needs varied across registered competence levels. SDT research often demonstrates a general correlation between high performance, high motivation, and high perceived competence (e.g., Liu et al., 2016), and it can be tempting to lean on previously demonstrated correlations to reduce the complexity in one's own project. However, preliminary analyses of the pre-test data informed us that pupils with high mathematics skills were not necessarily more motivated than those with lower skills (and vice versa). In this way, we used quantitative data to revise and refine the interview guides and as valuable background information for follow-up questions during the interviews.

Originally, we planned for a second post-test to validate the findings from the first post test. However, while entering data in Excel, we noticed that some of the individual pupils struggled even more with the post-test than they did with the pre-test, although at the group level pupils showed progress. Informed by the focus group interviews, we also knew that some of the pupils who struggled were frustrated regarding their perceived competence, that they expressed great dissatisfaction with the ALT technology, and that this was particularly striking at the fifth-grade level. Exposing the pupils to the same test for the third time, with the risk of reinforcing the feeling of a lack of competence, was therefore not considered ethically justifiable.

Informed by the datasets of Study 2, we determined that the quantitative and qualitative results provided a nuanced and partly contrasting perspective on whether ALT contributed to motivation and learning, which was difficult to describe and discuss within the word count limits of a journal article. However, by applying the principle of *data transformation* (B. Johnson & Christensen, 2017), we could visualize the mixed relationship between the quantitative and qualitative findings. Instead of basing the subsequent discussion on elaborating and assuming the meaning of the quan + QUAL analyses, we could include contextual qualitative information in a re-analysis of the quantitative data from a mixed perspective. The process of developing and discussing Figure 8 in Article 2 was thus a matter of applying the 'both/and' logic of MR. By analysing pre- and post-data at the class level and color-

coding the different levels of registered competence, we could illustrate that group-level progress that could be demonstrated statistically did not necessarily mean that all pupils were making progress. We could also emphasize that even though few pupils scored lower on the post-test than on the pre-test, the pupils who did are in a vulnerable situation, far below the expected level of skills and competence.

### 3.3 Study 3: Contextual Classroom Management with ICT

#### **Purpose and aim of Study 3**

While Study 2 built on Study 1 to dig deeper into the real-life aims of classroom management in 1:1 learning environments, Study 3 builds on Study 1 and interacts with Study 2, delivering more thoroughly into the understanding of teachers' reasoning when implementing ALT in their real-life practice. Purposeful integration of technology in classroom management practices should establish or improve the aims of classroom management. In line with the overall research question and the conceptual framework of the project, Study 3 therefore aimed to explore how teachers implemented cutting-edge technology in their contextual classroom management practices and how they reasoned about their attitudes and experiences with this integration. The aim of the study was to explore similarities and differences in the ways teachers integrated technology in their real-life practices so as to better understand and explain teachers' actions and strategies in 1:1 learning environments.

#### **The real-life intervention as contextual frame in Study 3: Sample and design**

The case school and participants in Study 3 overlap with the ones in Study 2. The main respondent sample of Study 3 included the three participating teachers, and the 43 participating pupils were perceived as part of the examined context(s).

In Study 2, the intervention's effect on students' motivation, learning, and learning environment was explored directly. The teachers' use and integration of ALT was considered a real-life contextual factor that made it difficult to determine the extent to which the technology itself directly affected the quantitative results (which is also described as a study limitation in Article 2). But examining the intervention from the

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teachers' points of view in Study 3 aimed to provide more direct insights into the teachers' use of their professional judgment, their real-life priorities, and their understandings of how and why ICT could contribute to motivation, learning, and a good learning environment.

If perceived as an isolated study, Study 3 would be described as a QUAL+qual multimethod study (e.g., Schoonenboom & Johnson, 2017). However, in this extended synopsis it is part of a larger mixed methods study design. The context investigated in Study 3 was connected with the real-life intervention described in Study 2. The design could therefore be described as a hybrid between an interventional and a case study (Fetters et. al., 2013; Schoonenboom & Johnson, 2017), with the quantitative and mixed results from Study 2 providing contextual information. Fieldwork, classroom observation, and semi-structured individual interviews provided qualitative datasets about the teachers as a culture-sharing group (from the fieldwork), the classroom management practice of teachers in the learning environment (from classroom observations), and the experiences and reasoning of each teacher (from the semi-structured individual interviews).

### **Fieldwork**

The emergence of Study 3 (and Study 2 to some extent) was rooted in fieldwork leading up to the intervention period. The process of designing and adjusting the intervention and the instrumentation of the studies was inspired by grounded theory as a systematic qualitative strategy in which the researcher derives a general, abstract theory of a process, action, or interaction grounded in the views of participants in a study (Creswell, 2019; Creswell & Clark, 2011). According to Bronfenbrenner (1996), 'an investigation is regarded as ecologically valid if it is carried out in a natural setting and involves objects and activities from everyday life' (p. 28). Fieldwork (and classroom observation to some extent) was thus carried out to understand the properties of the environment as experienced by the participants (e.g. Bronfenbrenner, 1996, p. 29). Or, to paraphrase: Investigating a real-life context does not in itself ensure ecological validity. The investigator has to understand the context to make valid inferences and interpretations of the data collected.



The fieldwork was carried out both before and during the intervention period, and the field notes were thus written over a total period of eight months. As the intervention was initiated and more methods and observations were introduced, a visual log overview of Studies 2 and 3 was developed to track the project timeline (see Appendix 11). The different squares in the visual log represent methodological observations and the subscript numbers represent the day of observation ( $O_x =$  observation, day  $x$ ). The boxes are color-coded based on the methodological observations they represent. Blue observations represent fieldwork or field notes (Study 3), orange observations represent pre and post-tests (Study 2), green observations represent interviews (Studies 2 and 3) and yellow observations represent classroom observations (Study 3 and partially Study 2).

The pre-intervention fieldwork consisted of collaborative meetings and discussions before and during the design of the study and intervention. The first meetings took place in June 2017, and the aim of observation days 1 and 2 was to understand the visions, aims, culture, and lifeworld of the case school as communicated by two of the school leaders. These discussions informed the subsequent design of the study and provided data and information at the school-leader level. Observation day 3 was dedicated to a plenum meeting with all (available) teachers at the upper and lower primary levels. This meeting served as an information meeting during which the overall study aims were presented and the teachers were invited to share their experiences with MSØ to that point. Looking for patterns and inconsistencies confirming, supplementing, or contrasting the school leader level was also an aim.

Observation days 4 and 5 were dedicated to collaborative discussions with the participating teachers ( $n = 3$ ) to make sure they understood and agreed with the design of the study and their contribution to the intervention and the data collection (in line with informed consent and intervention criteria). The purpose and aim of the study were presented, and it was also important to create a practical framework for the intervention period and adjust the intervention and research design according to the teachers' practical needs and professional integrity. The intervention started on observation day 6 and ended on observation day 14. Field notes written from  $O_6$  to

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O<sub>14</sub> thus describe observed interaction and communication between the participating teachers or between participating teachers and other colleagues, which were then and there considered relevant for the study's aims and purposes. The fieldwork was inspired by the design-based research axiology of researchers and practitioners working together to produce meaningful changes in real-life practice. Such cooperation requires researchers to be sensitive and attentive to practitioners' experiences and values. Conversations during the O<sub>1</sub>–O<sub>14</sub> period thus contributed important insights into the teachers' lifeworld and shared culture.

### **Classroom Observation**

An ethnographic approach to educational research is helpful when new elements are introduced and investigated (Schensul & LeCompte, 2013). The real-life use and application of ALT in primary schools has rarely been documented and researched, so it was considered important to look for unexpected implications or blind spots regarding its use. Ethnographically inspired fieldwork in the classroom was therefore conducted during the intervention (Fangen, 2004; Merriam & Tisdell, 2016). It was not an aim of the observation to evaluate or distinguish between good and bad practices but rather to understand and describe similarities and differences in practices to better understand how teachers perceive and use ALT and how this use influences pupil learning and motivation. A special template for classroom observation was developed (see Appendix 10). Each classroom observation was informed by previous preliminary analysis (Appendix 11), and a row in the template (Heading 5) was thus dedicated to *data-transmitting ideas* derived from previous preliminary analysis, in line with Creswell (2019) and to further inform the probes across methods through multiple points of integration. The classroom observations included two sessions in each class over a two week-period for a total of six observation sessions, each of which lasted 45–60 minutes.

### **Semi-Structured Interviews**

The semi-structured interviews were carried out as individual interviews with teachers (n = 3). The teachers, as a 'culture-sharing group', were observed via fieldwork, which provided a 'detailed day-to-day picture of events' so the researchers

could build a detailed record of their behaviours and beliefs over time (Creswell, 2019 p. 474). The interviews intended to reveal and thus reflect more individual approaches, and individual interviews were accordingly preferred.

The teachers were asked questions about their motivations for becoming a teacher, their teacher role (previously and currently), attitudes regarding ICT in general and ALT specifically, experiences with integrating ALT into their own practices, the learning environment, and how they perceived the school culture (details are in Appendix 9). The initial questions were informed by the conceptual framework of the study and the fieldwork notes and classroom observation, but they were deliberately formulated as open questions without use of conceptual terms like ‘digital competence’, ‘motivation’, ‘sense of belonging’, and the like. This approach was chosen to avoid leading the respondents in their answers and thus better grasp their own experiences and reasoning. Concepts and terms brought up by the teachers were further explored by using follow-up questions or asking them to elaborate. The interviews were transcribed during the first few weeks after the intervention period by the author of this extended synopsis.

### **Analysis**

Greene et al. (1989) identify four purposes for mixed methods evaluations<sup>9</sup>: triangulation, complementation, development initiation, and expansion. Caracelli and Greene (2008, p. 243) suggest that, in general, integrative analytic strategies are appropriate when methods are mixed for purposes of initiation, expansion, or development but less useful when triangulation is the intent of those mixed methods. In Study 3, triangulation for verification was not the purpose of the study, which was rather intended to initiate and expand the understanding of how teachers integrate new technologies into their classroom management practices. However, the different methodological lenses (fieldwork, interviews, and classroom observations) did in

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<sup>9</sup> A fifth category mentioned by Greene et al. (1989) is labelled ‘no integration’.

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some regards validate or contrast with one another, demonstrating ecological validity. This point is elaborated towards the end of this chapter.

The qualitative data from Study 3 were multi-levelled, produced over time, and repeatedly preliminarily analysed during different stages of the intervention and again after the intervention. I have previously noted how the visual log (Appendix 11) was used as a timeline for tracking the different methodological approaches during Studies 2 and 3. In addition to keeping track of the colour coded O<sub>x</sub>-observations, the log also kept track of the preliminary analyses before and during the intervention. Combined with a chronological research summary overview, the log could be described as a visual and textual analytic memo that describes the preliminary integrative mixed analysis of Study 3. An analytic memo is, according to Saldaña (2013, pp. 41–54), an overview in which reasoning can be traced back to its conception in both time and context. This analytic memo also served as *in vivo coding* (Silverman, 2019, pp. 124–125) and a summary of the preliminary analyses. We focused on small parts of the Study 3 data by conducting intensive analysis on them to begin with and developed interlinked analytical strategies and categories that were applied to the whole dataset using extensive analysis as our understanding began to form patterns (e.g., Silverman, 2019, pp. 118–119).

However, we were also informed by the conceptual framework and thus predefined categories of matters of motivation, basic psychological needs, learning, classroom management, professional knowledge, and digital competence. The emic intention of the interviews and the coding process of the overall qualitative data can thus be described as an abductive process of coding, categorization, recoding, and recategorization (Saldaña, 2013, pp. 9–10). Themes and categories were, in line with Saldaña (2013), an outcome of process of coding, categorization, and analysis; this did not merely consist of ‘coding for themes’, with some significant data passages identified as ‘key moments’ (Sullivan, 2012, cited in Saldaña, 2013, p. 16). Rather, the pre-coding process started at O<sub>1</sub> and continued with initial coding and (re)categorization as the data was transcribed (Saldaña, 2013, p. 20). As a result, the codes were not static but served as questions for further investigation and

assumptions to be challenged (Saldaña, 2013, pp. 21–22). Pre-coding thus contributed to the partly emergent nature of the MMR design (Schoonenboom & Johnson, 2017).

### **Fieldwork analysis**

Both analytic memos and intensive and extensive analysis are associated with grounded theory methods (Glaser & Strauss, 2009; Silverman, 2019). We could not take for granted that existing theories would sufficiently describe the details of integrating ALT into teaching and learning activities. Since ALT technologies are emergent and have been so little researched in primary education, we were inspired by the emic perspective associated with grounded theory and constructivist perspectives and thus aimed to understand the teachers' viewpoints. The field notes were distilled based on patterns and contrasts in the teachers' ways of talking about and discussing ALT. The field notes showed that they had individual 'profiles' regarding how they talked about and 'framed' ALT. Although they expressed a great deal of agreement about the aim of their classroom management (they referred to topics like motivation, learning, sense of competence, and belonging), they also partly disagreed about what they perceived ALT would contribute. The first analyses of the field notes gave the impression that the teachers emphasized and prioritized the different goals for classroom management differently, which in turn inspired an assumption that their individual priorities and judgment influenced the way ALT was integrated and experienced. To put it briefly: Each teacher appeared to have an individual mental model about what was important to enhance motivation, learning, and a good learning environment; accordingly, each had individual expectations of how and why using ALT could lead to benefits and challenges in that interaction. The field notes thus informed the classroom observations and semi-structured interviews about certain tendencies for further exploration.

### **Classroom Observation Analysis**

The classroom observation notes were analysed according to five types of actions teachers take to facilitate learning in their classroom, based on Hickey & Schafer (2006): *Engagement, curriculum, relationships, development, and discipline*. The categories *integration of ALT* and *teacher emphasis* were added based on the findings

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reported in Study 2, where the pupils expressed contradictory experiences regarding whether the ALT was logically connected with other academic activities. The findings were organized in a tabular overview (Table 2 in Article 3) and are deliberately descriptive and recognizable from classroom contexts, to illustrate how various real-life teaching contexts and instructional formats add variation to teacher and pupil behaviour.

### **Semi-Structured Interview Analysis**

As noted above, the initial questions during the semi-structured interviews were thematic but open and free of theoretical terms to avoid leading the answers of the teachers. Their own answers were followed up, and they were invited to elaborate. This resulted in each transcribed interview having its own internal contextual logic, even though they all touched on the same topics. In order to systematize the teachers' reasoning and experiences, the interviews were therefore first analysed based on the following categories: *General attitudes towards use of ICT in teaching and learning; initial thoughts on ALT; ALT experiences (advantages and disadvantages); use of dashboard data in own practice; dashboard data vs. own perception of pupils; and experience of school culture* (the findings are reported in Table 3 in Article 3). Like the classroom observation data, the findings were deliberately descriptive to illustrate real-life differences in the teachers' reasoning.

### **Mixed Analysis**

In the mixed analysis, the integration of ALT was perceived as integrating technology knowledge (TK) in pedagogical knowledge (PK) and content knowledge (CK). The findings from the fieldwork and classroom observations informed the analysis of the semi-structured interviews about each teacher as participant in the shared culture (observed through fieldwork) and each teacher's classroom practice (as indicated by classroom observation).

### 3.4 Validity, Transferability, and Ethics Across the Studies

Development of pragmatic knowledge is the study's aim. Being able to understand and explain the challenges and benefits teachers face in their 1:1 classroom management practices is important knowledge for teacher education and further research. The real-life intervention in Studies 2 and 3 reflects a realistic introduction of new technology and provides opportunities for systematic investigations of what happens when such technology is introduced. The design of Studies 2 and 3 can be criticized for systematically investigating only one technology and replicating the intervention design when applying different forms of technologies and tools could have contributed to further developing findings and inferences. But the strength of examining only one technology is that teachers' and pupils' experiences with that particular technology is thoroughly investigated, with contextual factors coming to the fore.

Since the Study 1 data were collected prior to the current project, it was necessary to read up on the instrumentation, interview guide, and conceptual framework that formed the basis of the SMIL study as a whole. The operationalization of survey questions and interview guides reflected axiological, ontological, and epistemological assumptions, and not having contributed to the development of the survey, interview guides, or data collection created a distance from the reality described. This is especially evident when working with qualitative data, which is not merely *collected* but *produced* in a collaboration between researcher and respondent. Working with pre-collected data contributed to an awareness of the connection between context, instrumentation, participants, analysis, and the interpretation of findings, while co-authoring in a mixed team (e.g., B. Johnson & Christensen, 2017) and relying on co-authors for internal and external validation of interpretations and claims increased the validity and reliability of all three studies.

The use of mixed methods in Studies 2 and 3 enhances the ecological validity of the study, especially regarding contextual classroom management. The samples of the two studies are overlapping, the methods explore the context from different

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perspectives and viewpoints, and the research questions of the studies interact with each other. Despite being identified as information-rich, the case school sample of Studies 2 and 3 was also considered sufficiently representative for the transferability of inferences to occur. Teddlie and Yu (2008, pp. 206–209) describe one of the similarities of purposive and probability sampling as a concern over issues of generalizability to an external context (also known as transferability or external validity), in addition to providing valid contexts in line with the research question. The overall sampling process of the teacher and pupil participants was not individual but based on groups that occurred naturally within the community and could thus be described as cluster sampling (Teddlie & Yu, 2008, p. 201). However, the sampling of pupils for the focus group interviews aimed for representativeness in gender and mathematical competence. On the purposive-mixed-probability sampling continuum (Teddlie & Yu, 2008, p. 209), the sampling could thus be described as qualitative-mixed (Zone B). The sample in Study 1, on the other hand, does not overlap with the sample in Studies 2 and 3. While this could be considered a weakness of the overall study, it is a fairly widely accepted mixed methods practice to apply sequential designs to different samples, and since Study 1 explores conceptual rather than contextual classroom management perspectives, this is less problematic than if the samples in Studies 2 and 3 were divergent.

According to Onwuegbuzie and Johnson (2008), the *fundamental principle of mixed research* is that the research conducted will ideally combine quantitative and qualitative approaches that have complementary strengths and nonoverlapping weaknesses. Effective use of this principle is a major source of justification for MR, and in this project the fundamental principle is guided by the aims, purposes, and overarching research question of the dissertation. Understanding and explaining the 1:1 classroom practices of teachers is both a conceptual and a contextual task.

Both classroom management and digital competence are highly complex concepts which include integrating other skills and competencies, so investigating the relationship between them is a complicated task. In the quantitative instrumentation in Study 1, classroom management was operationalized through student-teacher



relationships and teaching control, while digital competence was operationalized through elementary ICT skills, basic ICT skills, didactic ICT competence, digital learning strategies, and digital bildung. When teachers' completed the survey, they self-reported on how they perceived their digital competence and their classroom management abilities, so we could not take for granted that their perceived level of competence and abilities reflected their actual skills. However, the quantitative results still indicated a relationship meriting further exploration. Integrating the qualitative and quantitative findings thus expanded our understanding not only of the registered relationship between digital competence and classroom management but also on how teachers perceived each of the two terms.

In Study 2, learning, motivation, and the learning environment were quantitatively investigated before and after the intervention. The statistical analysis revealed an increase in registered learning, a decrease in perceived learning, and an increase in amotivation. If we had applied a control group for comparison and a more controlled design (e.g., procedural ways of integrating ALT in classroom management practices) the validity and reliability for generalizability could have been higher. However, the aim of the study was not to evaluate the outcomes of applying the technology in a controlled environment; rather, it was to explore what happens when ALT is applied in a real-life context with a focus on ecological validity in order to better understand the complexity of the challenges and benefits that teachers face in their contextual classroom management practices.

The real-life context and ecological validity consequently had a high priority and focus, and group interviews contributed additional data. The widespread opposition to ALT expressed by the fifth graders and the feeling of being controlled by the program and getting stuck in frustration spirals expressed by a few pupils may not have been registered without the use of qualitative methods. Contradictory findings are sometimes described as a limitation of MMR, but as noted by B. Johnson & Christensen (2017), it is also 'a very important strength because with the use of a single approach, the researcher would be blind to the different ways the phenomenon can be understood' (p. 448). By combining qualitative and quantitative methods in

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Study 2, we became aware of new ways of understanding ALT technology which contrasted and partly contradicted the initial theoretical underpinning of the intervention, namely that struggling learners would benefit most from the intervention, a view that is in line with Roschelle et al. (2016).

Similar perspectives also apply to Study 3. By combining fieldwork, classroom observation, and semi-structured interviews qualitative data were produced which partly validated but also expanded and partly contrasted with one another. The use of fewer methods could have made it easier to draw a conclusion more clearly.

Interview and fieldwork data without classroom observation, for example, could have strengthened the impression that the teachers' practice was relatively similar, given the way they explained and discussed their practice during their everyday conversations and formal and informal meetings, as the fieldwork indicated. But the classroom observation data expanded the understanding by showing that teachers' classroom practices varied to a greater extent than the preliminary analysis indicated, even though they used similar terms to explain their practices. The mixed methods approach to the investigated context thus enabled multiple points of integration (Greene et al., 1989) and probes across methods (Merriam & Tisdell, 2016). In line with the pluralist (dialectic) pragmatist stance, contradictory, complementary and supportive findings are all embraced and elaborated in the articles. This is not considered a limitation; rather, it is in line with the axiology of the study, reflecting the multi-faceted complexity of classroom management in ICT learning environments.

All three studies were approved by NSD (Appendices 3 and 5) and informed consent (Appendix 6) was obtained from the respondents and, where appropriate (pupils at the upper primary level), their parents. In line with the assessment of the NSD, informed and active consent from the participants was repeatedly emphasized throughout Studies 2 and 3. However, attending school is not an optional activity, and real-life interventions and associated data collection therefore have ethical implications beyond the normal strictures of formal informed consent (Merriam & Tisdell, 2016). The methodological work on Study 2 (and partly Study 3) thereby

demonstrated the close link between ethics and validity in real-life research designs. The researcher must not abuse the trust of parents, pupils, or teachers. Real-life designs which involve the everyday life of teachers and pupils require researchers to understand the school's inner life and to be sensitive to context, all without 'going native'. The intervention must not cause harm to pupils or teachers or to the relationship between them.

In a real-life interventional study design, not all challenges can be predicted, and one must be flexible and make thoughtful methodical and ethical adjustments and decisions on very short notice (B. Johnson & Christensen, 2017). Not all pupils were participated in the study, due to a lack of consenting consent or to special needs. This meant we could not use video or sound recording in the classroom observations. Additionally, the researcher could not have direct access to pupil activity data in the ALT technology applied. A specific ethical challenge that occurred during the intervention was when a pupil (without parental consent) wanted to participate in the semi-structured focus group interview. In collaboration with the relevant teacher, this specific situation was easily resolved, but the situation in itself fuelled an awareness of the ethical dimension of research designs involving young people with their own opinions and eagerness to participate over against parents who would not consent to participation. The one-case bounded system sample of Studies 2 and 3 implies a somewhat different perspective on what anonymity means than would be found in a large multiple case scale study such as Study 1. Parents, teachers, and pupils at the case school were informed about the research project due to the principle of informed consent, and contextual information in the dissemination of findings could thus make pupils and teachers recognizable to others in the local community. Contributing a sufficient amount of information to substantiate findings, results, and inferences in the dissemination of the research in the articles while at the same time protecting the anonymity of the pupils and teachers has been, and continues to be, a delicate balancing act. Having to withhold some contextual information for the sake of anonymity also affects the reader's ability to assess reliability, validity, and

transferability issues. This places an extra ethical responsibility on researchers to be transparent whenever possible and not abuse the reader's confidence.

Data collected from the use of several quantitative or qualitative methods in single-case mixed methods designs also enables researchers to 'profile' individuals to a greater extent than in large sample designs or designs that use fewer methods. This informs further analyses and the interpretation of findings and helps increase the ecological and inner validity and reliability. One example is the time registration feature of MSØ, which provided real-time insight regarding the coherence between expected and reported time use and actual time use, in line with, for example, Rawson et al. (2017). However, researchers also have to be careful in how to use this information. In the same way that contextual information can influence anonymity, profiling through combining and integrating datasets can also have an effect in that regard. In Study 3 we had to be especially careful to portray the teachers without identifying them and therefore had to avoid references to gender, age, years of experience, and so on. It could also have been possible to assemble and re-analyse more data to gather more information on the pupils who struggled the most (in Study 2) or even compare groups of pupils based on their registered levels of competence. However, we did not consider this to be either fruitful or ethically justifiable given the project's intention and informed consent requirements. The large sample design of Study 1 did not provide the same opportunity for profiling individuals, as the findings from the interviews cannot be combined with other quantitative or qualitative data sources to the same extent as in Studies 2 and 3.

Emergent adjustments in the study design were both related to findings from preliminary analysis and to ethical considerations that arose along the way. Since some of the pupils could not participate in the study (due to special needs or a lack of consent), it was important to collaborate with the teachers to find good solutions that did not create a visible and stigmatizing distinction between pupils who could participate and those who could not.

## 4. Article Findings

### 4.1 Article 1

Moltudal, S., Krumsvik, R., Jones, L., Eikeland, O. J., & Johnson, B. (2019). The relationship between teachers' perceived classroom management abilities and their professional digital competence. *Designs for Learning, 11*(1), 80–98.

<https://doi.org/10.16993/df.128>

The purpose of this article was to explore the relationship between classroom management, student-teacher relationships, and professional digital competence when ICT is used from different perspectives. The qualitative analysis (n = 30) showed that pupils, school owners, and school leaders expected teachers to model and facilitate learning with ICT but that the teachers themselves seemed to be variously equipped for such a task. The findings also revealed that the different stakeholders articulated their expectations in a variety of ways, implying a tension between the controlling and relational/pedagogical approaches to classroom management. The quantitative analysis (n = 2,579) indicated that teachers' digital competence seemed to predict their perceived classroom management abilities when ICT was used.

The integrated results (QUAL+quan) imply that teachers' individual understandings of ICT and its role in teaching and learning practices could help explain the statistical relationship between digital competence and classroom management. Some teachers aimed to integrate ICT in their pre-computer practices, relying on crime control and strict rules to control pupils' use of the computers. Other teachers emphasized sensible over strict rules and advocated for the need for teachers to think differently and develop new teaching and learning practices.

Findings from this study suggest that different levels of professional digital competence among teachers appear to have created a gap between classroom management understanding and practice when ICT is used.

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## 4.2 Article 2

Moltudal, S., Høydal, K., & Krumsvik, R. J. (2020). Glimpses into real-life introduction of adaptive learning technology: A mixed methods research approach to personalised pupil learning. *Designs for Learning*, 12(1), 13–28.  
<https://doi.org/10.16993/dfl.138>

The purpose of this article was to explore how the systematic introduction of ALT would influence pupils' learning and motivation during a four-week real-life intervention. The upper primary pupils performed 15 minutes a day (60 minutes a week) of an ALT activity: homework in mathematics. Their teachers were otherwise free to implement ALT in their practices just as they would have in real life. The intervention was observed both qualitatively and quantitatively. The quantitative survey ( $n = 43$ ) instrumentation consisted of validated self-determination theory and perceived learning and competence items and a mathematics test (in line with the national curriculum). The qualitative observation consisted of classroom observation ( $n = 3 \times 2$ ) and focus group interviews with pupils ( $n_1 = 3, n_2 = 3, n_3 = 3$ ).

The integrated and mixed (QUAL+quan) analysis showed that ALT generally could help facilitate basic learning across classroom practices and that most pupils perceived ALT tasks to be fun and varied. However, the results also revealed that the aim of flow and motivation in the ALT activities could be replaced by spirals of frustration and amotivation. Pupils who perceived their competence as low were explicitly critical of the ALT program, and the transformed quantitative learning outcome data revealed that some of the pupils with low registered competence scored even lower on the mathematics test after the intervention than they had before.

The article thus concluded that ALT should be carefully introduced and that teachers should be aware of the potential for pupils to become stuck in frustration spirals.

### 4.3 Article 3

Moltudal, S., Høydal, K., & Krumsvik, R. J. (Submitted). Adaptive learning technology and learning analytics in primary education: Implications for teacher professional knowledge and classroom management. *Frontiers in Education*.

The purpose of this study was to explore how upper primary teachers (n = 3) systematically introducing ALT to their pupils (n =43) would influence their classroom management practices and professional knowledge. The pre-intervention and intervention phases were observed via fieldwork, classroom observation, and semi-structured interviews.

A two-pronged attitude towards the program was expressed by all three teachers. They appreciated the personalization and mapping potential of the program. However, they were also, to varying degrees, uncertain about the value of the activity data and how that data could and should be used. They also expressed that they, in their future practices, would not use the program as much as it is supposed to be used in order to be sufficiently calibrated and personalized. The integrated results demonstrated how the perceived and relatively shared collective understanding of teachers could be practiced differently in each classroom according to specific contexts. Each of the teachers perceived affordances in the ALT and LA and activity data differently, based on their overall classroom practice and their integration of professional knowledge bases (i.e., TPACK).

The findings indicated that integrated LA and ALT tools could be incorporated into different classroom practices in various ways, implying that they might no longer be self-adjusting or produce sufficient activity data for the dashboard visuals (e.g., colour coding) to reflect the real competencies of pupils. The teachers' restrictive attitude could be interpreted as an expression of their scepticism about outsourcing educational assessments and judgment to a self-driven and automated system that only partially overlaps with their shared and individual educational knowledge bases, values, and beliefs.

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## 5. Discussion

In this section of the thesis, I discuss the dissertation's overall research question: How can we understand and explain the challenges and opportunities primary and secondary teachers are facing in their 1:1 (ICT) classroom management practices? The discussion is based on the findings derived from the three articles and the six related sub-questions. I will also relate the findings to existing knowledge in the field and discuss some methodological strengths and weaknesses of the thesis as a whole. Finally, I offer my conclusions before presenting the implications of the thesis in terms of practice, policy, theory, method, and further research.

### **Tensions in ICT Classroom Management**

This doctoral thesis shows that individual teachers have different practices for leading learning processes and practicing classroom management when ICT is used – and when it is not used. In Article 1, we see this from a general perspective; the teachers' conceptual understanding of classroom management is addressed, and the findings are based on large-scale qualitative and quantitative data material. The findings show tensions between a 'crime control' approach to classroom management on the one hand and a more comprehensive pedagogical approach to leading learning processes and classroom management on the other. Similar findings have been previously demonstrated in pre-computer classroom settings (Bullough & Richardson, 2015; Haerens et al., 2016; Hickey & Schafer, 2006; Reeve, 2016) and have also been addressed as a challenge in ICT learning environments (Cakir & Yildirim, 2013; Korpershoek et al., 2016). The research questions, design, and sampling of Article 1 enabled an integrated discussion of the perceived relationship between classroom management and digital competence. Process descriptions regarding the school's everyday inner life and how – or even if – this 'tension' unfolds in practice in the classroom were thus left out. We do, however, identify that such a tension exists among teachers and other school stakeholders. According to existing knowledge, tension in matters of ICT could be rooted in teachers' established reasoning processes (Heitink et al., 2017), their well-established knowledge domains (Sutherland et al., 2004), and their using ICT for their own personal convenience (Gray et al., 2005) or



as a strategy for everyday survival (Shin, 2015). Integrating ICT into professional practice through professional development is time-consuming and complex (Lim et al., 2003; Wang et al., 2014), and successful implementation requires teachers to challenge and reflect upon their own practice in relation to how pupils learn (Heitink et al., 2017; Yoon et al., 2005).

### **Digital Competence and Classroom Management**

Article 1 examines teachers' conceptual understanding of digital competence; we find that teachers who perceive their digital competence as high experience a greater ability for classroom management than teachers with low digital competence, and we argue that this correlation is due to the ability to actively facilitate ICT learning alignment with the teachers' pedagogical values and beliefs. The high number of respondents also indicated that the results seemed relatively representative of the Norwegian context, especially at the upper secondary level. Studies across methods, disciplines, and educational levels indicate similar relationships (e.g., Korpershoek et al., 2016; Otrell-Cass et al., 2012; Roussinos & Jimoyiannis, 2019), and we perceive our finding as a valuable large-scale contribution to the existing knowledge.

In Article 3, we investigate the relationship between contextual classroom management and digital competence from another point of view at the upper primary level. The findings are based on small-scale and multimethod data. Fieldwork before and during the intervention, classroom observation, and semi-structured interviews provided a fairly good overview of the integrating processes as they unfolded in their natural context over time and, according to the fundamental principle of mixed methods, Article 3 can be said to supplement to some extent the findings in Article 1. However, merging complementary findings between Article 1 and 3 is not unproblematic. Upper secondary school has a somewhat different structure and context than upper primary school. In the former, the pupils are older, the teachers generally tend to have more advanced education in their subjects, the academic requirements for the pupils are more demanding, and the pupils receive grades, which Norwegian primary pupils do not. We must therefore only merge findings and make inferences the three studies reflexively and with caution. However, classroom

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management is, in general, context-specific (Doyle, 2006), and making inferences across contexts is thus a part of the field regardless of whether the researcher is conscious of it. A teacher, irrespective of level, must somehow integrate subject content, pedagogy, and technology within a specific context if he or she is to actively work on didactic ICT use, digital learning strategies, and digital bildung (Krumsvik, 2014a ; Mishra, 2019; Rosenberg & Koehler, 2015).

An interesting finding across the studies was that none of the data in Articles 2 and 3 suggested a crime control approach to the leadership of learning processes and classroom management, as was found in Article 1. The case school had few – but clear rules – for tablet use, and the pupils said that they mainly respected and understood the rules. The results from the SDT survey also indicated that all three learning environments were mainly characterized by relatedness and a sense of autonomy, both before and after the intervention. However, a methodological implication of the purposeful sampling might be a reason why we did not find crime control attitudes or practices. The school was selected because of its long experience with the general use of ICT, and it is therefore natural to assume that the participating teachers had sufficient digital competence to model and facilitate its good use, which our findings from both the fieldwork and interviews suggest. In addition, they have the same (local) rule framework policy across levels. Another reason could be that upper primary teachers generally emphasize structure, modelling, and sequencing to a greater extent than upper secondary teachers. One can also argue that the Article 1 data were older than the Study 2 and 3 data and attribute the results to a general digital maturation at the school. However, it is also important to keep in mind that 1:1 access was introduced much earlier in upper secondary schools than in upper primary schools.

### **Characteristics of 1:1 Learning Environments**

Based on the findings across the three articles, we have little reason to believe that learning environments with 1:1 access are more similar to each other than environments without 1:1 access. What we do know, however, is that the 1:1 learning environment by definition means that all learners have access to tablets or computers,

which provides infrastructure and a latent potential for far more methodological and pedagogical possibilities to facilitate learning than a learning environment without such access. One could argue that a shared characteristic of 1:1 learning environments is that they have an *inherent potential* for additional choices and a higher degree of complexity than learning environments without 1:1 access. A greater number of options implies that teachers must make more choices, unless they consciously or unconsciously choose to distance themselves from the available options. We therefore emphasize the importance of the 1:1 definition.

The findings from Article 1 indicate that the scope of ICT use varies greatly; the Article 2 and 3 findings also indicate that this use varies, but the observed learning activities were mainly analogue in nature. The findings across the articles have thus fuelled some new questions: When are learning environments with 1:1 access to technology to be considered technology-rich? Are such environments technology-rich only while ICT is used or all the time? Should we include only the active use of technology in the definition of technology-rich learning environments, or should it also include the latent potential for use? These questions may instinctively feel like semantic niceties, but they have important theoretical, methodological, practical, and policy implications.

A related key finding of this thesis is that teachers who aim to motivate each pupil must balance learners' diverse and sometimes conflicting needs when planning learning activities and selecting and applying technology. This finding is in line with the general framework of SDT (e.g., Liu et al., 2016; Ryan & Deci, 2000b). The teachers in Article 3 were keenly aware that their pupils' academic knowledge and skills varied, so they appreciated the built-in real-time mapping function of MSØ, which they believed or at least hoped could contribute to various forms of adjustment, adaptation, and facilitation, even outside the program. The teachers reported that the dashboard data gave them the opportunity to help pupils who strived the most. However, they also pointed out that the time pressures of everyday school life are high and that, in reality, they have far less time for such support and follow-up than they would like and perceive pupils to need. The qualitative findings from Article 2

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also show that the pupils who strive the most pay a high price for their teachers' use of activity data for facilitation purposes. ALT aims to keep learners in a state of flow (Gallego-Durán et al., 2018), but the findings in this thesis show that this is not always the case. This finding was also a priority when we shared the research results with the school for the further development of its local practices, as is in line with DBR intentions.

Pupils who strive can become stuck in frustration spirals and feel increasingly incompetent if they are not able to perform their assigned activities and not understand the timely hints provided by the ALT. According to SDT, struggling learners will be particularly vulnerable to such spirals of frustration (Liu et al., 2016). However, one should be careful when using this finding as an argument to avoid the use of ALT. Pupils who struggle might experience similar feelings of frustration and low motivation regardless of the technologies and tools they use (e.g., Mota et al., 2016). However, the program's adaptive function also makes it less fruitful to get help from teachers or parents while performing the relevant tasks, as the program algorithms will perceive the pupil's competence as increased and begin setting more difficult tasks. Teachers should therefore be aware of the relational component of classroom management when adaptive technology is used and maintain a fruitful balance regarding the scope of its use.

### **Interlinked Affordances in Cutting-Edge Technology**

The findings from Article 1 show that teachers have different degrees of digital competence and different abilities and desires to facilitate learning with the use of ICT in terms of finding and using educational potential in technology (affordances for learning). Similar findings are repeatedly demonstrated in existing knowledge (Gray et al., 2005; Shin, 2015; Sutherland et al., 2004; Wasson & Hansen, 2014). However, the Article 3 findings may indicate that being able to find and use the pedagogical potential of a given technology does not necessarily mean that a given teacher wants to make use of it. Despite the fact that the teachers in Article 3 described the main features of ALT functions similarly, they did not necessarily agree on whether it affords learning in line with the preferences of individual teachers. An affordance that

is in line with one teacher's preferences may conflict with another teacher's preferences (e.g., Kretschmann, 2015; Savage, 2005; Sutherland et al., 2004). Article 3 (and, to some degree, Article 2) demonstrate how affordances in learning systems such as adaptive technology could be linked and dependent on another. The adaptiveness, analytics, and activity data of the MSØ depend on the sufficient use of the program. Consequently, less intensive use will make these key features less precise or even imprecise. The choice of whether or not to use such systems and of the scope of any such use has direct implications for educational priorities and time use and thus also ethical and pedagogical implications (Knight and Buckingham Shum, 2017; Slade & Prinsloo, 2013).

The findings across the articles indicated that teachers' choices and preferences for the use of technology are rooted in their understanding of how a given technology works and how it can be used pedagogically. Different types of software and digital tools afford an ever-growing variety of potential uses (Tamim et al., 2015). However, choosing between technologies and, thus, perceived and real affordances has implications for how technology supports learning and how it could be integrated into a holistic learning design, which can have both analogue and digital components. In Article 3, this perspective was particularly evident, as the teachers explained how they perceived the advantages and disadvantages of MSØ. They linked their understanding and interpretation of ALT affordances to their own views on subject matters, what pupils should learn, and how pupils should learn, and they were explicitly uncertain whether or to what extent they would use MSØ after the intervention. This was not because they did not know how MSØ works; rather, they questioned the overall value of the program in light of their own priorities for their pupils' learning activities.

### **Purposeful Actions in Complex Learning Environments**

According to the findings of this doctoral thesis, we can understand and explain the challenges and opportunities teachers are facing in their 1:1 ICT classroom management practices in light of the term 'purposeful actions'. Although teachers might understand, accept, and embrace the role of facilitator of learning, they

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interpret and practice this role in different ways. Even culture-sharing teachers who generally seem to agree on how the teacher role should be practiced differ in their perceptions about whether a management strategy or action is purposeful at any given moment, due to their different learning environments. These are perspectives in line with the TPACK framework in general (Koehler & Mishra, 2009), its emphasis on context (Mishra, 2019; Rosenberg & Koehler, 2015), and the existing understanding of knowledge base integration (Jordan, 2011; Otrell-Cass et al., 2012; Roussinos & Jimoyiannis, 2019).

Leading learning processes and practicing classroom management are in themselves complex tasks that require knowledge of subjects, technologies, pedagogy, and pupil motivation and learning (Emmer & Sabornie, 2015; Evertson & Weinstein, 2006; Liu et al., 2016). However, they are also matters of understanding the complexity of the context (Rosenberg & Koehler, 2015). Learning environments with 1:1 access to technology have latent potential for variation in multiple ways, and classroom management might be understood as orchestrating this potential (Breeze, 2009) and being 'in sync' with pupils (Reeve, 2016). However, when student-centred activities, frequent transitions between activities, and parallel activities for different learners characterize the classroom context, the complexity increases. It might be tempting for some teachers to rely on prescriptive strategies, automated systems, and standardized actions and strategies to reduce complexity and simplify decision-making processes. However, this thesis has repeatedly demonstrated that the core pedagogical competence cannot be outsourced to any tool, regardless of its perceived or real affordances. Adaptive learning systems can help facilitate learning by sequencing and personalizing learning material and curricula and by providing the teacher access to data regarding the learner's activity and progression, which can also be used for facilitation beyond the program. However, considering that control approaches to classroom management exist in schools, we also find reason to warn that the mapping of activity data could be used to control pupils.

The teacher must still be the one to identify the extent to which a tool or a technology is useful in a comprehensive approach to teaching and learning. From this

perspective, the question of whether a 1:1 access learning environment is a 1:1 learning environment all the time or only when technology is being used is especially important and thought-provoking. On the one hand, it can be argued that teachers should be critical regarding the scope of overall screen usage and that it may be appropriate to set clear boundaries for when pupils should use technology. On the other hand, such an attitude could hinder a seamless integration of technology in which every learner uses technology, whether digital or analogue, adapted to their needs within a student-active learning environment. In principle, nothing prevents pupils from working on the same subject at the same time in different ways through different technologies within the same learning environment, based on their level of competence, what motivates them, and whether they prefer to work alone or with others.

PfDK and Fagfornytelsen imply that varied, inclusive, and adapted learning environments are, to some extent, desirable, but managing and leading such highly complex learning environments places great demands on teachers' pedagogical core competence, digital competence, and ability to integrate a variety of analogue and digital tools in their suite of purposeful actions and strategies. This doctoral thesis therefore proposes that the challenges and opportunities that teachers face in their 1:1 (ICT) classroom management practices are not only based on the pedagogical use of technology in itself but are also closely linked to overarching policies for change and the latent potential for complexity. Leading frequent transitions between varied activities and technologies requires flexibility and an ability to identify whether an action or strategy is purposeful at any given time, within a certain context and whether it supports learning or not. Some teachers thrive in learning environments characterized by a high degree of complexity and have the ability and competence to lead learning processes in which frequent transitions and the varied use of different technologies are key ingredients. Other teachers may experience such a learning environment as overwhelming, and they will not experience the ability and competence to lead and manage frequent transitions and varied activities in the same

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way. Beginning teachers can be particularly vulnerable when it comes to leading and managing high-complexity learning environments.

### **Implications for Theory and Research**

Knowledge-based teaching and practices are important guidelines in teacher education programs and schools in general. However, translating fragmented research findings into a comprehensive professional practice will be an ongoing process for both teacher educators and teachers. Meta-analyses tend to conclude that educational technology has a moderately positive impact on learning (Cheung & Slavin, 2012, 2013; Rosen & Salomon, 2007; Sung et al., 2016; Tamim et al., 2011, 2015), but they have also demonstrated that quasi-experimental small-scale research on the effects of educational technology tend to find larger effects than ‘real’ experiments and large-scale studies (Cheung & Slavin, 2012, p. 211). Although meta-analyses seek to provide clear answers to what works in education, they also reveal that concepts that deal with efficiency and learning are ambiguous, which problematizes the determination of goals for effective learning (Rosen & Salomon, 2007). Such studies also compare different conditions across contexts and findings and must therefore be interpreted with caution (Tamim et al., 2011). Meta-analyses can thus provide important overviews and information on whether interventions appear to have a general effect, but they also lack contextual knowledge that can be important when translating research findings into practice. The current study contributes to the field by systematically exploring how real-life integration of educational technology could be influenced by teachers’ digital competence and by their contextual classroom management practices.

According to Lai and Bower (2019), studies addressing educational technology often use a combination of quantitative and qualitative methodologies, but they rarely apply mixed methods (MR) approaches. Throughout this thesis, I have demonstrated how MMR can contribute thick descriptions and pragmatic knowledge. The inferences are consequently contextual and cannot be generalized, but they bring together several dimensions and aspects of classroom management that can be transferred – reflexively and carefully – to similar contexts. I would argue that an important



strength of MR in educational research is its ability to combine emic and etic viewpoints and reasoning, thus reflecting the complexity of the educational real-life context (e.g., Mishra, 2019; Rosenberg & Koehler, 2015). MMR findings and results are seldom coincident; rather, they can be both divergent and contradictory and provide few unambiguous answers. Here, I cite Article 2 as a relevant example. It deals explicitly with statistical minority-majority issues by pointing out that although most pupils benefit from using adaptive technology, the situation is actually quite the opposite for a few of them. For teachers who want to translate research into practice, such nuances can be vital knowledge. The emic viewpoints of the pupils can also contribute contextual knowledge about how this type of technology can best be implemented and what pitfalls should be avoided. An important methodological implication of this thesis is therefore that various methodological approaches to educational research should be perceived as mutually complementary instead of being ranked in an order that purports to determine some being more valuable than others.

Throughout the thesis, contextual classroom management has been understood as purposeful actions and strategies, and an important contribution of the study is that some teachers see challenges where others see opportunities. Teachers' different understandings of what comprises purposeful actions and strategies seem to be rooted in their digital competence, but where do we go from there? As noted in Article 1, it is paradoxical that a certain level of digital competence is needed to understand why digital competence is important. This is a major challenge for teachers who have low digital competence and are less able (or even unable) to integrate technology into their purposeful actions, strategies, and comprehensive pedagogical practices.

However, it is also difficult for school leaders and school owners to understand how to manage teachers who are not digitally competent. The transition to the 1:1 learning environment and the implementation of Fagfornyelsen makes it urgent to identify workable solutions for comprehensive professional development that integrates the use of ICT. The experiences from Studies 2 and 3 and the findings from the review give us reason to recommend small-scale interventional studies or action research in local contexts as a starting point for professional development. Such studies provide

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an opportunity to start where teachers are and mediate and support their desired development, in line with the local context and teachers' perceived needs. Such studies also provide the research community with valuable insights into the continuously developing field of practice, which can further inform large-scale programs for professional development and teacher education programs in general.

### **Implications for Practice**

An obvious implication from the findings of this thesis is that teacher education programs have an extensive responsibility to prepare pre-service and beginning teachers for the flexible and complex classroom management and teacher role that the educational policy framework expects them to handle. Student teachers and beginning teachers appear to be generally positive and prepared to integrate technology into their teaching and learning activities (Fook et al., 2011; Gao et al., 2011; Geeraerts et al., 2018; Jordan, 2011; Sime & Priestley, 2005). However, leading and managing highly complex 1:1 learning environments requires more than basic digital skills (Røkenes & Krumsvik, 2016). Even if teacher education programs already use a number of approaches to ICT training (Røkenes & Krumsvik, 2014), it appears to be increasingly important that this training be integrated into professional development as a whole, so that both pre- and in-service teachers can benefit. The findings of this study imply that teacher education programs should aim to focus on classroom management as contextual practices, preparing prospective teachers for identifying and making use of actions and strategies they actively consider purposeful in a given context.

We also find reason to address the tension between teachers who thrive in high-complexity learning environments and those who do not, since this tension implies that school leaders, school owners, and teachers themselves have to manage a balance between individual and collective teacher autonomy. Some teachers request collective and standardized rules, rituals, strategies, and actions for classroom management and learning practices (especially in 1:1 learning environments), while others believe that teachers must be free to make their own choices. It can be difficult for school owners and principals to balance such fundamentally different and contrasting needs and

requests. We therefore encourage school leaders to use the professional community of teachers to discuss *purposeful* strategies and actions for practice in line with pedagogy and the new curricula instead of discussing the extent to which rules and rituals should be standardized and applied to all. The intention of this recommendation is not to warn against rules and routines. Rules, routines, and procedures do not need to be controlling and standardizing, and they can help create and maintain structure in pupils' learning lives. The intention is rather to encourage a focus on rules, routines, actions, and strategies that is grounded in purposefulness and supports teachers' pedagogical practices and pupils' learning, as opposed to being grounded in controlling behaviour.

We also suggest that teachers learn from one another. Learning across generations and practices can fuel new perspectives and contribute to an increased understanding of the experiences, challenges, and knowledge of others (Gao et al., 2011; Geeraerts et al., 2018). The development of professional practice is not merely about change; it is also about identifying and refining what already works (Robinson, 2018).

Innovative teaching and learning methods, including the use of ICT, do not always work as intended (e.g., Abulibdeh, 2013); nor are traditional teaching and learning methods necessarily less efficient than more innovative ones. We suggest that teachers should be encouraged to discuss, verbalize, and justify their pedagogical practices to demonstrate the purposefulness of their choices, strategies, and actions. Discussions and reflections revolving around the purposeful actions of teachers could help mediate professional development in complex learning environments.

Teachers' choices and use of tools affects pupils' learning. Investments in technology have implications for teachers' choice of teaching methods, and, in the Norwegian context, teachers have a legal right to use teaching and learning methods that accord with their professional autonomy. This thesis therefore encourages school owners, school leaders, and authorities to discuss the investment in technologies and teaching materials with the teachers intended to use them.

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### **Implications for Policy**

The framework for the new reform (including PfdK) has broad political support and implies a new comprehensive and complex teacher role. If teachers are expected to lead and manage highly complex learning environments and processes in which the use of technology is integrated, they must have the time and resources needed to continually develop their teaching and classroom management role at both the pre- and in-service phases. Discussions about measuring and ranking pupils' basic skills, competence, and learning have characterized Norwegian school policy for the past 20 years and reflect both ideological perspectives and political sympathies.

Implementing new educational policies takes time, and one implication of the findings of this study is that teachers and schools will need time to adjust to new policies in line with the new curricular reform and the PfdK framework. It is not our intention to advise against emphasizing and measuring pupils' basic competence, as through the use of national tests; the intention is rather to suggest that the findings and results should be interpreted in light of the extensive changes the Norwegian educational community is undergoing and that caution should be exercised in drawing hasty conclusions. Basic competence is a prerequisite for further learning and for pupils' ability to master their lives, and it is therefore important to monitor the long-term effects of educational development and changes. However, we still suggest that politicians be patient during the transition phase and not use potential short-term changes in measured learning outcomes for political gain or propose 'broken narratives'.

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# Article 1





## RESEARCH

# The Relationship Between Teachers' Perceived Classroom Management Abilities and Their Professional Digital Competence

Experiences from Upper Secondary Classrooms. A Qualitative Driven Mixed Method Study

Synnøve Moltudal\*, Rune Krumsvik†, Lise Jones‡, Ole Johan Eikeland‡ and Burke Johnson§

The aim of this study was to examine teachers' professional digital competence and classroom management experiences with a qualitatively driven Mixed Method Design. The qualitative part of the study is based on interviews, focus groups, observations and quasi statistics. The first part of the study aims to examine these qualitative experiences and associations with a quantitative survey (N = 2579). The quantitative data examines the strength of the associations and the qualitative data show the nature of those associations with regard to upper secondary teachers' professional digital competence and their classroom management abilities in ICT dense classroom environments. The SMIL-study was conducted in seven counties in Norway from 2012 to 2013. The qualitative part with observational data were analyzed in relation to the other qualitative data (interviews and focus groups) and then in relation to the quantitative part of the study. This part shows how teachers, school owners, school leaders and students perceived a relationship between teachers' professional digital competence and their classroom management. The quantitative is related to the qualitative part and presents statistical regression analyses indicating that teachers' individual professional digital competence predicted their classroom management abilities. The conclusion of the paper suggests that teachers' professional digital competence and classroom management abilities are closely attached to each other in technology rich classrooms settings. The SMIL-study contributes to a broader understanding of teachers' professional digital competence in the digitized school.

**Keywords:** Professional digital competence; upper secondary school; teachers; classroom management; Mixed Method Research

## Introduction

Despite heavy investments by national and local authorities to make the latest educational technologies available at education facilities internationally and in Norway, there has been a lack of uptake in teachers' utilization of such technologies both in Norway (Krumsvik et al. 2013) and internationally (Cuban, Kirkpatrick & Peck, 2001; Tamim et al. 2011; OECD 2015; Escueta, Quan, Nickow & Oreopoulos 2017). One of the reasons for this situation is mentioned in the PISA study, *Students, Computers and Learning*, which reveals that: "(...) we have not yet become good enough at the kind of pedagogies that make the most of technology" (OECD 2015, p. 5). At the same time research into computer literacy and educational use of Information and Communication Technology (ICT) has exploded in recent

years, but there is less documented research into how new technologies influence general classroom management. Classroom management means how teachers manage to create a good learning climate in classroom settings and facilitate both academic and social-emotional learning among the students (Evertson & Weinstein 2006). In such classrooms contexts teachers' fear of losing authority and control over their classrooms, has notably been pointed out as a challenge in ICT-related classroom management matters (Bolick & Bartels 2015, Bolick & Cooper 2006). Despite being suggested as especially prominent in ICT environments, opportunities and challenges for teachers to create and maintain fruitful learning environments have been discussed and researched for decades (Brophy 2006). Teachers' professional practice, their relations with their students and matters regarding authority are thus at the core of classroom management issues in general. This might give reason to believe that computers and other technologies not only initiate new challenges and opportunities for classroom management, but could also reawaken more general matters by challenging the traditional and culturally internalized ways in which they have

\* Volda University College, NO

† University of Bergen, NO

‡ Eikeland Research and Teaching, NO

§ University of South-Alabama, US

Corresponding author: Rune Krumsvik ([rune.krumsvik@uib.no](mailto:rune.krumsvik@uib.no))

been dealt with throughout the years. The relationship between ICT and classroom management might thus be complex and intricate, implying structural, cultural, pedagogical and social perspectives on teachers' professional practice and student learning outcomes.

Examples from classroom research suggest that some teachers have been 'frontrunners' in the use of educational technology due to their own digital competence and ability to identify and make use of its pedagogical potential beyond the ability of a normal teacher (Wasson & Hansen 2014). They seem to possess a high level of digital competence, which influences their ability and willingness to implement ICT more or less seamlessly in their own teaching and learning practices, assessment practices, administrative workflow and thus also in their classroom management practices (Wasson & Hansen 2014). However, more research is needed into the relationship between teachers' professional digital competence and their classroom management, and the SMIL-study presented in this article aims to fill some of this gap in the research field. Such research-based knowledge on whether, how and why teachers' professional digital competence is related to their classroom management practices may give us more insight into ICT classroom complexity.

The SMIL<sup>1</sup> study is the largest ICT study carried out in upper secondary schools in Norway. It involved 17,529 students and 2,477 teachers, as well as school owners, school leaders and representatives from student councils and the Norwegian Student Organization. This mixed-methods study was conducted from 2012 to 2013 in seven counties in Norway with a (1:1)<sup>2</sup> technology density in all classrooms. Some of the rationale for the study was to examine ICT and learning outcome both qualitatively and quantitatively, and based on the assumptions that: "At times we aim to explore and discover, and at other times we aim to test and confirm" (Hesse-Biber & Johnson 2016, p. 46). The qualitative part has a multilevel perspective and aims to examine how school leaders (macro level), teachers (meso level) and student representatives (micro level) describe the relationship between teachers' professional digital competence, student-teacher relations and their classroom management practices. This multilevel perspective aims to capture a more holistic understanding of such phenomenon addressed in this study. The quantitative part examines if the qualitative relationships holds beyond the local setting and the strength of these relationships. The main objective of this paper is therefore firstly to explore teachers' experiences with classroom management and professional digital competence in technology rich classrooms and secondly to examine (test) the relationship between teachers' classroom management and their professional digital competence. In this paper, we will focus mainly on the qualitative data followed up by quantitative data from SMIL in a QUAL-quan-design (qualitative driven sequential design, Schoonenboom & Johnson 2017).

The research questions examined are:

RQ1. How do teachers, school leaders and student representatives describe the relationship between

teachers' professional digital competence, student-teacher relations and their classroom management practices?

RQ2. Is there a statistical relationship between upper secondary teachers' professional digital competence and their classroom management?

RQ3. How can one explain the observed relationship between upper secondary teachers' professional digital competence and their classroom management practices?

### Our Mixed Methods Philosophical Paradigm

We relied on *dialectical pluralism* (DP) (Johnson, 2015) in multiple places in this research study as we attempted to listen to and dialogue with multiple theories, conceptual frameworks, paradigms and participant perspectives. As a philosophical theory, DP justifies the interaction and dynamic combining of differences into new wholes. DP requires deep understanding of the different positions and search for balances and new syntheses. DP tends to use a "both-and" logic (i.e. parts of both theories might be useful) rather than an "either-or logic" (where one must only use either theory A or theory B). In a mixed-methods research study, one often interacts with different theories, ontologies, epistemologies, axiologies, methods, methodologies and so forth, and the research team must carefully consider the differences and construct thoughtful and useful syntheses (Johnson 2015). On this basis, we applied an exploratory, sequentially mixed-methods design (Creswell & Clark, 2011; Fetters, Curry and Creswell 2013). The coherence between the quantitative –and the qualitative findings in the study can be described as *expansion* where the quantitative data show the strength of associations and the qualitative findings show the nature of those associations (Fetters et al. 2013).

### Conceptual Framework

Despite being suggested as the variable with the most impact on student learning outcomes (Marzano, Marzano & Pickering 2003), skills associated with classroom management are mostly studied and disseminated within specific separate curricula areas (Morine-Dershimer 2006). Identifying and comprehensively understanding the field of classroom management is thus a complicated task (Evertson & Weinstein 2006, Wubbels 2011, Emmer & Sabornie 2015, Postholm 2013) and the ICT perspective adds new layers of complexity to matters of classroom management (Bolick & Bartels 2015). Nevertheless, teachers and school leaders worldwide are currently struggling with how to deal with the fact that students are living digital lives, constantly communicating with others, even while in class. On-line access to a world of information, knowledge, entertainment and communication may enrich and enhance student learning processes, but such access may also serve as new venues for non-academic activities, either supplementing or replacing the old ones. Sana, Weston and Cepeda (2012) found that such non-academic activities as "(...) multitasking on a laptop poses a significant distraction to both users and fellow students

and can be detrimental to comprehension of lecture content" (p. 24).

Although the field of educational computer technology has been extensively researched during the last two decades, it is difficult to find peer reviewed empirical research documenting how the introduction of technology and ICT affects classroom management directly (Bolick & Bartels 2015, Bolick & Cooper 2006), especially in upper secondary education. One can find some studies dealing with this relationship indirectly and we also find some authors who use other terms than classroom management. E.g. a commonly used term is *classroom orchestration*, which seems to highlight the complexity of teaching in today's digitized classroom. However, only a few studies from lower secondary school represent what seems to be the pervasive challenge across school levels and subjects: Classroom management in ICT environments requires (and may over time contribute to) a form of teacher resiliency that enables changes in pre-computer classroom strategies and pedagogy (Nielsen, Miller, & Hoban 2015), but teachers tend to stick to known and established teaching methods, despite being aware of the benefits of using ICT (Kretschmann 2015). Such a structure can contribute to a self-reinforcing spiral of preservation of old and familiar practices. It thus seems paradoxical that digital competence and overarching matters of ICT are often dealt with as a separate unit, not fully integrated into ongoing discussions about teachers' professional development and issues concerning classroom management in general. In this paper, we aim to explore this structure, theoretically and empirically. By illuminating mainly qualitative experiences and descriptions, but also quantitative relations, we contribute to a deeper understanding of the challenges that teachers face in managing their ICT classrooms.

We will further elaborate on our understanding of the two main concepts discussed in this paper, classroom management and digital competence, and thus show how they theoretically may be mutually interwoven (and related to other variables). By doing this we also imply that skills and competences related to teachers' professional digital competence and classroom management may be partly overlapping. In the results section, we first present some key findings from the qualitative analysis, exploring the complexity that arises as matters of classroom management and matters of digital competence merge in technology-dense classroom environments in upper secondary schools. Secondly, we present statistical analyses, suggesting a quantitative relationship between upper secondary teachers' professional digital competence and their classroom management. In the integrated results section, we aim to outline some core findings on how the different stakeholders and their perspectives contribute to inform the research questions.

### ***Classroom management: From behavioral to relational approaches***

Classroom management has a broad impact on student learning outcomes and is a developing and pluralistic field of inquiry that has been influenced by the shifting traditions of general educational research throughout history

(Evertson & Weinstein 2006, Brophy 2006). When introduced in 2006, the *Handbook of Classroom Management: Research, Practice, and Contemporary Issues* extensively reviewed and mapped out research associated with classroom management and filled an existing knowledge gap (Wubbels 2011). Drawing on the work of Kounin (1970), Brophy (1988, 1989), Doyle (1986) and Watson & Ecken (2003), classroom management was defined as "*the actions teachers take to create an environment that supports and facilitates both academic and social-emotional learning*" (Evertson & Weinstein 2006). This definition marked a shift by stating that *how* a teacher achieves order is as important as *whether* a teacher achieves order, and that classroom management not only seeks to establish and sustain order for the purpose of meaningful academic learning, it also aims to enhance students' social and moral growth (Nucci 2006, Fallona & Richardson 2006). The second edition of *Handbook of Classroom Management* (Emmer & Sabornie (Ed.) 2015) further contributed to the field of classroom management by reviewing additional and new research and elaborating on the complexity of classroom management issues by identifying how strongly they are interlinked with other matters (both instructional and non-instructional) relating to teacher professional practices.

Behavioral approaches have been closely associated with classroom management throughout the history of education, but even as well-researched tools, they can be used either skillfully or clumsily (Landrum & Kauffman 2006). According to Landrum & Kauffman, skillful use of behavioral tools should thus be based on knowledge of the principles that make them work, thereby supporting autonomy instead of forming a controlling and frustrating classroom environment. Positive behavioral approaches, such as reward, could potentially enhance emotion and on-task behavior, but can also affect the long-term inner motivation of students (Reeve 2006). Awareness of the limitations regarding behavioral approaches has contributed to a paradigm shift in favor of approaches that emphasize self-regulation and trusting, caring relationships between teachers and students. Following dialectical pluralism, we believe that both of these paradigms/perspectives contain some truth value and both can help educational practice. When put into dialogue, both of the above-mentioned perspectives contribute to the understanding of educational matters as complex. For example, they pinpoint how even extensively researched approaches and methods may have unforeseen short-term and long-term consequences in new or even slightly altered contexts.

Brophy (2006) advocates that classroom management is not an end in itself, but a means for creating and maintaining any given optimal learning environment. He thus implies that understanding the contextual nature of classroom management is an important skill for a teacher, and he further emphasizes how classroom management must be perceived in close relation to student socialization in addition to disciplinary interventions. Ecological approaches to educational research are much in line with dialectical pluralism and view classrooms as tangible dynamic ecologies, without which there would be

no classroom in classroom study or classroom teaching (Doyle 2006). Wubbels et al. (2015) note that the behavior of teachers and students mutually influence each other. In a meta-analysis of more than 100 studies, Marzano et al. (2003) found that the quality of teacher-student relations is the keystone for all other aspects of classroom management. Elias & Schwab (2006) argue that social and emotional learning and effective classroom management are two sides of the same coin as students' self-control and responsibility are the ultimate goals of education. They advocate the teachers' responsibility to provide students with useful tools to enable students to build their own future. Gettinger & Kohler (2006) adds to this understanding by advocating that classroom management requires a sophisticated insight into what students need in order to understand the academic content, and that teachers must be able to connect curricula content to the experiences and backgrounds of diverse learners. Equity in society will be mirrored in schools, as morality in social relations is situation-specific and not fixed for good. Classroom management must thus be in tune with the real world and debate and dialogue related issues in the classroom (and outside) (Brantlinger & Danforth 2006). Bear (2015) proposes to integrate the ecological, behavioral and social-emotional learning perspectives of classroom management into an authoritative discipline approach. Studying classroom management in specific discourses, focusing on specific areas and curriculum, thus enriches general educational research. However, it also narrows the dissemination of such research because it tends to be published in books or forums that focus on the separate curricula area (Morine-Dersheimer 2006).

### ***Teaching and learning as cultural and social processes***

Socio-cultural approaches to teaching and learning view classrooms as unique communities with their own core characteristics, where learning is related to the use of specific artifacts and tools. Such approaches entail a paradigm shift from teacher authority and control to shared control and responsibility, inspired by the thoughts of Dewey (Watson & Brattistich 2006, Schwab & Elias 2015). Given that teaching and learning are cultural processes, they must include and reflect diversity (Gay 2006) and, within the socio-cultural approach, the creation of inclusive and supportive classroom environments is a cornerstone of teachers' pedagogical repertoire (Lothan 2006). Active learning methods, such as project-based learning, regards teachers as guides and facilitators, and Mergendoller, Markham, Ravitz & Larmer (2006) explain how a successful project brings students and teachers together as partners and enhances students' metacognitive reflection. However, such perspectives make the five aspects of classroom management (engagement, curriculum, relationships, development and discipline) and the principles that follow them less clear (Hickey & Schafer 2006). Brophy (2006) elaborates on similar perspectives, noting how a shift from a (passive) teacher-centered classroom to an (active) student-centered classroom has instructional and managerial implications. He suggests that it has become increasingly important to identify intended student learn-

ing outcomes first, and to design learning activities (and reflectively acknowledge what specific activities imply about desired student roles) thereafter. The learning process benefits from stating clear expectations and helping students understand what to do and why (autonomy support). Such goal-oriented teaching and learning activities imply deliberate pedagogical reflection on the choice of educational tools, and how such tools are implemented in teaching, learning and assessment methods. However, most research on managing secondary school classrooms is conducted in the fields of special education and school psychology, which focus on disruptive and acting-out adolescents. Emmer & Gerwels (2006) thus call for more knowledge on how to manage the classroom environment in secondary schools to enhance students' academic and social learning. In summary, one can say that dynamic classroom management requires a comprehensive and profound educational reflexivity that enables teachers to flexibly facilitate student academic and social learning processes based on specific needs in specific contexts.

However, studies of teacher personal characteristics have revealed that teachers who remain in their job tend to maintain higher levels of self-efficacy and positive emotions, despite agreeing with teachers who leave their job because of the challenges of classroom management and teaching (Hong 2012, Bullough, Jr. & Richardson 2015). Such findings contribute to the understanding of a general relationship between teachers' skills and competencies and their ability to manage their classroom successfully. Other studies indicate that assumptions teachers hold about students shape their classroom management judgments and practices, and that in-service teachers generally focus on rule-setting, enforcement and "crime control" (Bullough, Jr. & Richardson 2015). Hoy & Weinstein (2006) identify contrasting views on what constitutes good classroom management: Students identify caring relationships and mutual respect as fundamental for social and academic development, whilst teachers generally believe that such relationships and respect must be earned in advance. Such contrasting views may lead to a downward spiral of mistrust (Sheets & Gay 1996). However, many traditional classroom practices are teacher-centered and favor direct instruction methods. Such practices might hold certain assumptions about the interplay between teacher authority and student behavior, which might not be sufficient nor expedient in the face of contemporary issues relating to educational use of ICT.

### ***Teacher roles and competencies in the ICT environment***

In recent decades, several researchers and academics have addressed issues relating to educational use of computers and other technologies. Both theoretical and empirical contributions have revolved around the influences that such tools could (or should) have on students' social, moral and academic learning outcomes. Important contributions on the concepts of computer literacy, media literacy, digital literacy and digital competence have been made since the 1990s. The teacher's role as a facilitator who must contextualize the use of ICT tools is strongly emphasized in the ICT field, which implicitly connects

digital competence to classroom management. However, there is general agreement that the effective use of technology in teaching and learning practices is aligned with the general paradigm shift towards socio-cultural constructivist behavior and student-centered methods (Säljö 1999). Teachers who fear loss of control may experience such a paradigm shift as destabilizing and threatening (Bolick & Bartels 2015, Hickey & Schafer 2006, Brophy 2006); taking the perspective of dialectical pluralism and rejecting an either-or perspective, one can be informed by both of these paradigms. In both pre-service and in-service teacher training, there seems to be a general lack of awareness of the dynamics, vitality and diversity of classroom management (Evertson & Weinstein 2006). The concept of classroom management seems to be out of fashion, and academics and researchers tend to prefer phrases that elucidate the aims of classroom management rather than its techniques (Wubbels 2011). Standardized and internalized classroom management understandings are thus often adapted to a teacher-centered practice, associated with behavior management and sets of rules. However, the introduction of ICT tools in teaching and learning activities challenges the premises on which institutionalized solutions to behavioral issues are built. Ultimately it even challenges what really constitutes concepts such as classroom environment, learning, inclusion, relationships and behavioral issues as technologies offer additional (digital) venues and thus possibilities and limitations for managing teaching and learning activities. It would be interesting to further explore what might happen when a layer of ICT complexity is added to a static "crime-control" pre-understanding of classroom management.

Several different positions and studies, dealing with digital competence and ICT in teaching and learning, share the assumption that teachers' professional digital competence is more complex than digital competence in other occupations and among average citizens. It is therefore important to be aware of the complexity of professional digital competence and its relation to teachers' self-efficacy. According to Krumsvik, "Digital competence is the individual teacher's proficiency in using ICT in school with good pedagogical judgement, and his/her awareness of its implications for learning strategies and the digital Bildung of pupils" (Krumsvik, 2012, p. 466). A recent study from Krumsvik et al. (2016) shows that demographic, personal and professional characteristics, such as a teacher's age, work experience, gender, screen time and ICT education predict teachers' levels of professional digital competence in upper secondary school to a certain degree.

Based on the national curriculum in Norway (LK06) (Kunnskapsdepartementet 2006), we can generally say that teachers need *generic digital competence* when they are mastering general skills and knowledge of educational technology in the digital learning environment; they need *subject didactic digital competence* when they apply their digital competence to subjects; and, finally, they need *professional digital competence* which includes (but is not limited to) elements that occur outside the teachers' teaching but are simultaneously within the teaching profession. A national framework for teachers' professional digital competence

(PfdK) in school was implemented in 2017 (Center for ICT in Education) and in the general plans for all kinds of Norwegian teacher education. National educational authorities also expect PfdK to influence all aspects of teachers' professional development (in-service training) in the future and is already offered as 5–10 ECTS in-service courses in many municipalities and counties by the school owners.

However, these are very general descriptions and there seems to be a gap between the arena of formulation and the arena of realization when it comes to this issue, due to stakeholders having different interpretations of digital competence. Teachers therefore often perceive ICT and educational technology differently than intended in the policy documents. In the SMIL study, we explored the arena of realization through multiple lenses (dialectical pluralism and mixed-methods research) by mapping out qualitative and quantitative relationships between teachers' professional digital competence and their classroom management. The context examined in this paper is thus Norwegian, and it is important to bear in mind that different ICT policies in different countries influence our perception of how to define teachers' professional digital competence based on its connection to curricula. Similar awareness of context also applies to the understanding of classroom management. To enable international outcomes to be compared, the OECD report *Assessing the Effects of ICT in Education* (OECD, 2009) and its framework were used as a starting point in the SMIL study so that national (and maybe international) indicators for ICT use in school could be developed.

### Methodology

In this study we aimed to mainly explore and discover (qualitatively), and then test and confirm (quantitatively). The reason for this is to avoid the well known criticism against qualitative research where it is questioned if the inductive standpoint holds beyond the local setting. Therefore we also apply quantitative data to examine the qualitative relationships statistically (Hesse-Biber & Johnson 2015). In this way we examined if the quantitative data show the strength of associations and if the qualitative findings show the nature of those associations. To achieve this we decided to use an QUAL-quan (qualitative driven sequential design, Schoonenboom & Johnson 2017) which means that it is a qualitative dominant Mixed Method study. More concrete it is an exploratory, sequentially mixed-methods design for this study to be able to answer the research questions (Creswell & Clark, 2011; Fetters, Curry and Creswell 2013). This type of research design implies a linking of the different qualitative and quantitative elements in the design and in the analyses, so that they will supplement one another and provide a more holistic idea of the research area. More specifically, the *sequential design* means that the different phases build on each other and "In an exploratory sequential design, the researcher first collects and analyzes qualitative data, and these findings inform subsequent quantitative data collection" (Fetters et al. 2013, p. 2136). This implies a form of integration through methods, applying *Integration through building* which "occurs when results



from one data collection procedure informs the data collection approach of the other procedure, the latter building on the former. Items for inclusion in a survey are built upon previously collected qualitative data that generate hypotheses or identify constructs or language used by research participants" (Fetters et al. 2013, p. 7) which this study applied. Furthermore, we carried out an integration at the interpretation and reporting level, applying *narrative* where both qualitative and quantitative results are reported in the same article in different sections through the *contiguous approach* (Fetters et al. 2013). The coherence between the qualitative and quantitative findings are mainly based on *confirmation* and partly on *expansion* in this article (Fetters et al. 2013).

### Participants

We selected the interview participants, focus group participants and teachers and students for classrooms observations based on *purposeful selection* (Maxwell 2005) and included 30 school owners, school leaders, county politicians, teachers and the student organization from all public upper secondary schools in the seven counties in the Eastern Norway County Network. The online survey was completed by the 2579 teachers in the Eastern Norway County Network where the quasi-statistics (Maxwell 2005) in this study is related to the qualitative part, and the regression analysis is related to the quantitative part.

### Instrumentation

In this paper, the focus is on teachers' experiences with the relationship between classroom management and teachers' individual professional digital competence. To enable us to evaluate these relationships, we needed to develop a number of indicator areas of the schools' contribution (e.g. teachers' competence, learning climate, etc.) and indicator definitions, as Pelgrum (2009) implied above, and teachers' individual professional digital competence is one such indicator area and indicator definition. Following analyses of relevant policy documents and literature reviews, six indicator areas were considered significant. These were primarily based on recommendations from the framework created by Kikis, Scheuermann and Villalba (2009), which can be found in the above-mentioned OECD report. Previous research findings and suggestions from our employer, Norwegian Association of Local and Regional Authorities (KS), were also important when developing the indicator areas.

The six indicator areas of the school contribution are *implementation strategies, access to PCs, curriculum and competence improvement, infrastructure to support learning, degree of ICT use in teaching and educational ICT activities* (pupils). In the SMIL study, all six indicators areas were explored with a number of relevant groups. In this paper, however, we concentrate on teachers' experiences with classroom management and their individual digital competence. Indicator definitions were developed based on the indicator areas identified. These were rooted in well-established, distinguished theory, and the mixed-methods design that was utilized in the wider study ensured that we also maintained a broad empirical foundation. The

indicator definitions were then used when developing the instruments for collecting information. They were divided into operationalized indicator definitions, which means that they could potentially be used again when monitoring similar phenomena in the future.

In the wider SMIL study, both qualitative and quantitative data were collected and analyzed. The data were collected in sequences, and one of the important goals of the SMIL study was to place equal emphasis on both types of data and combine them in the analyses (Johnson 2015).

### Qualitative Instrumentation

The qualitative part of the study is based on interviews, focus groups, observations and quasi statistics.

More specifically, the informants were asked demographic questions and questions from six categories based on the framework of Kikis, Scheuermann & Villalba (2009), which aimed to outline a holistic perspective of the use of ICT in the upper secondary schools in the study. These categories were 1) implementation strategies, 2) resources, 3) curricula and in-service training, 4) infrastructure for learning support, 5) teaching, and 6) learning. We focus in this paper on indicator 3, 5 and 6. These are in line with the focus in the research questions of the paper and to answer the qualitative part of the research questions, interview-guides, focus-group guides and observation-schemes were developed as well as quasi statistics applied (Maxwell 2005). This kind of methodical triangulation was applied to enhance the internal validity of the qualitative part of the study as underlined by Merriam and Tisdell (2016): "With regard to use of multiple methods of data collection, for example, what someone tells you in an interview can be checked against what you observe on site or what you read about in documents relevant to the phenomenon of interest (Merriam and Tisdell, 2016, s. 245). Below we will describe this in more detail.

### Observational data

While these observational data examined the nature of teachers' experiences and associations, the quantitative data examined the eventually strengths of associations attached to the research questions. Therefore, "Observational data represent a firsthand encounter with the phenomenon of interest rather than a secondhand account of the world obtained in an interview" (Merriam & Tisdell 2016, p. 137). The observational data in this paper is based on 10 classrooms observations (120 minutes each) in the subjects Norwegian, English and Mathematics over 2 weeks among pupils in 1<sup>st</sup> grade in upper secondary school (16–17 years old). In addition we had 6 classrooms observations (180 minutes each) in the subject Natural Sciences over 8 weeks (2<sup>nd</sup> grade, 17–18 years old).

The observations were based on *Observer as participant* (Merriam & Tisdell, 2016) and also based on the framework from Kikis, Scheuermann and Villalba (2009). We applied extensive use of field notes in the observations based on the assumptions that "writing field notes is an onerous task, but field notes constitute the basis for data upon which the study is based: no field notes, no data" (Schensul & LeCompte, 2013, p. 20).

We followed Taylor and Bogdan (1984) suggestions for recalling data:

- Pay attention
- Shift from a “wide angle” to a “narrow angle” lens— that is, focusing “on a specific person, interaction, or activity, while mentally blocking out all the others” (p. 54)
- Look for key words in people’s remarks that will stand out later
- Concentrate on the first and last remarks in each conversation
- Mentally play back remarks and scenes during breaks in the talking or observing

The observational data were then analysed in relation to the other qualitative data and then in relation to the quantitative part of the study.

#### Semi-structured interviews and focus groups

We carried out a large amount (30) of interviews in this study and a research interview can be described as “A conversation with a structure and a purpose; it involves careful questioning and listening with the purpose of obtaining thoroughly tested knowledge” (Kvale 2007, glossary). The semi-structured interview guides (Kvale & Brinkmann, 2009) we developed for these research interviews were based on the Kikis, Scheuermann and Villalba’s (2009) framework and the research questions. This had seven sections, including demographic data, digital competence, approaches to digital educational resources and compliance between classroom management and digital competence. Some of the main findings relating to classroom management and digital competence are reported here as they are most relevant for the research questions and discussion in this paper. For a full description of all the results, see Krumsvik et al. (2013, 2016).

The same procedure were carried out also for the interview guides for the 3 focus groups interviews (Krueger & Casey 2009; Silverman 2009). Focus groups followed Krueger and Casey’s (2009) characteristics: “People who possess certain characteristics, provide qualitative data in a focused discussion to help understand the topic of interest” (p. 6). We carried out focus group interviews with the project group for the SMIL-project (90 minutes), vocational school teachers (90 minutes) and the student council at one school (90 minutes).

We carried out semi-structured interviews (30 minutes each) with 9 school owners, 3 county politicians, 1 county education manager, 1 representative from the national school organisation (KS), 8 school leaders, 7 teachers and 1 (45 min.) with the leader of the national student organization.

We carried out 3 focus group interviews (90 minutes each) with the project group of the study (3 teachers and 2 leaders), vocational study teachers (5 teachers) and the student council at one school (5 students). The reason combining teachers both from vocational program and teachers from academic programs in our focus group interviews, is based on the fact that the total amount of teachers in the survey part of SMIL-study (N = 2579)

showed that 48% came from vocational programs and 52% from academic programs. So that was the reason for having both vocational and academic teachers in the focus group interviews.

We transcribed the interview material ourselves and Merriam and Tisdell (2016) state: “There are great benefits to transcribing the interview yourself, not least of which is increasing your familiarity with your data” (p. 132). We analyzed the interviews based on Creswell’s (2013) data analysis spiral which underlines the need to “Immerse yourself in the details, trying to get a sense of the interview as a whole before breaking it into parts” (p. 183). And Merriam and Tisdell (2016) describe this in the following way: “Involves consolidating, reducing, and interpreting what people have said and what the researcher has seen and read – it is the process of making meaning” (p. 202).

We analyzed the interview data in line with Merriam & Tisdell (2016) recommendations where we applied Kvale & Brinkmann (2009) concept driven coding based on the aforementioned indicators (3 and 6) framework from Kikis, Scheuermann and Villalba (2009). We have further applied an abductive approach in the analysis which is based on “Categories are conceptual elements that “cover” or span many individual examples of the data you previously identified” (Merriam & Tisdell, 2016, p. 206) and related to theoretical lenses of the study, the quantitative part to the research questions.

This establish a good coherence between the qualitative and quantitative parts, items for inclusion in the quantitative survey were built upon these qualitative data.

#### Quantitative Instrumentation

The four-part survey questionnaire included digital competence, classroom management, approaches to digital educational resources and compliance between classroom management and digital competence, and demographics. Classroom management was further classified into two categories:

- 1) Student-teacher relations
- 2) Teaching control

The teachers’ professional digital competence part was further divided into five categories:

- 1) Elementary ICT,
- 2) Basic ICT skills,
- 3) Didactic ICT competence,
- 4) Digital learning strategies and
- 5) Digital Bildung (Krumsvik 2016).

The survey questions relating to teachers’ attitudes, opinions and views on classroom management and digital competence included 7-point rating scales. The anchors for digital competence ranged from (1) ‘no skills’ to (7) ‘very high skills’. The anchors for classroom management ranged from (1) ‘to no extent’ to (7) ‘to a very large extent’ (Krumsvik 2016).

The online questionnaire was first developed in 2012 in Bergen based on the goals of the education monitor, findings from previous research, the framework for the SMIL



project and indicator areas and definitions. This quantitative questionnaire was piloted by two researchers in four schools in the Eastern Norway County Network using 'live surveys' (Student Response System). Information was gathered from 153 teachers and 921 students in the pilot test. KS's project group and the SMIL project's scientific advisor also examined the questionnaire during the pilot phase. After the pilot phase was completed and the questionnaire adjusted, it was converted into an electronic survey<sup>3</sup> using the SurveyExact online questionnaire system.

The questionnaire items were checked for validity and reliability based on the pilot data. Eight of the questions on how teachers perceived their digital competence had high face validity. Exploratory factor analysis (using oblimin rotation) was then used on the resulting data to identify possible higher order factors that could be used to develop a digital competence index (Russell, 2002). The factor analysis was conducted using an oblimin rotation, which allows the factors to be correlated (Russell, 2002). The factor loadings are outlined in **Table 1** below.

Question 8 and question 10 load on both factors produced from the analysis (see **Table 1**). Hence, they must be interpreted according to the other variables loading on the two factors. Factor 1, as we see it, is the (an) indicator of teachers' individual professional digital competence; factor 2 indicates a contextually related competence scale that also included teachers' understanding of their own competence and skills.

Factor 1 statistically explains 48.5% of the variation. Six out of the eight variables analysed show loadings above the guidelines for identifying significant factors (Hair et al. 1998), and these were used to create an index representing the teachers' professional digital competency. Questions 12 and 13 were not included in the index due to their low factor loadings. Compared to the other questions, questions 12 and 13 are more related to how the teacher perceived others' (pupils' and colleagues') competence rather than their own digital competence.

Technically, the index is the arithmetical mean of the answers to the six questions included. A Cronbach's alpha value of .86 indicates that the internal consistency of the digital competence index was high.

In addition to the data from the teacher survey, quasi statistics from the student survey (N = 17529) in the SMIL study are applied in the discussion part of this paper for the purpose of methodological triangulation.

**Results**

In this paper, we present both the qualitative and the quantitative (interview data, focus group, observations, quasi statistics and survey data) because the research questions are aimed at teachers' experiences with the relationship between classroom management and teachers' individual professional digital competence.

**Qualitative results**

In this qualitative results section, we aim to explore how teachers, school leaders and students perceive and explain the interaction between teachers' professional digital competence, student-teacher relations and teachers' classroom management. The SMIL-semi structured interview guides contained questions on non-academic use of ICT, the overall scope of ICT, and classroom management. They thus provided data on classroom management matters, both explicitly and implicitly. These three categories were obtained during the qualitative analysis based on the broader concept-driven categories (Brinkmann 2013), on former research and Kikis, Scheuermann & Villalbas' (2009) framework.

**Non-academic use of ICT**

It seems that relatively many informant teachers believe that students are responsible for using the computers as intended. When asked about non-academic use of ICT, most informants preferred not to estimate exactly how much time they think students spend on non-academic computer content, but most of them agree to a certain

**Table 1:** Factor Loadings (Oblique Rotated) from the Principal Axis Factor Analysis (N = 2477).

Questions	Factor 1	Factor 2	Communalities
'How would you rate your <i>basic skills</i> when using digital tools in school?'	<b>.86</b>	.01	.76
'Based on the previous questions, how would you estimate your overall digital competence in relation to teaching?'	<b>.84</b>	.51	.78
'How would you rate your <i>elementary skills</i> when using digital tools in your leisure time?'	<b>.81</b>	-.02	.72
'How would you rate your skills within didactic ICT use?'	<b>.77</b>	.38	.63
'How would you estimate your competence to guide students' digital judgement related to their digital lifestyle within and outside of school?'	<b>.66</b>	.56	.58
'How would you rate your skills in guiding students in the use of digital learning strategies?'	<b>.62</b>	.57	.55
'Based on the previous questions, how would you estimate the students' overall digital competence within school subjects?'	.27	.75	.57
'To what extent do you believe the teachers at your school are good role models for the students' curricular ICT use in education?'	.13	.74	.56
<b>Eigenvalue:</b>	3.9	1.3	

degree that students using ICT for other things than they are supposed to is a challenge:

*"More than half of my students are abusing the trust. It is a bit (...) I may be a bit naive (...) but more than half of the students use the laptops for other than intended purposes" (LF32)*

*"I do not have an overview all the time (...) it is a bit hard to say when they are working on their assignments (tasks), so they may be doing other things in addition to the school-related work. They probably do. Say 20–25%." (LF61)*

A third teacher (LF51) remarked that non-academic use of ICT varies between subjects. The teacher reported relatively extensive non-academic use when students are supposed to be using their computers to take notes during natural science class. While for another subject (geography), the teacher believes that students almost exclusively use their computers for academic purposes. This teacher pointed to student age and entertainment addiction as reasons for non-academic use of computers. The teacher further explained:

*"(...) You have this group of students who spend most of their time on Facebook and so on, and when I told them NOT to do that, they had to take it out somewhere else, and then they take it out through chats (...) so they kind of make themselves addicted to the non-academic aspect in class as well".*

This quote is interpreted as though the teacher views students' use of social media and entertainment content as a direct reason for not being attentive in class.

The school leaders mainly confirmed that teachers (without specifying whether they were many, some or few) complain about students having access to mobile phones and their computers, and several of the teachers and school leaders stated Facebook as a distraction. However, it is worth noting that not all informants agreed that non-academic use of ICT is a specific challenge or that Facebook is a distraction. One school leader (SLF11) and one teacher (LF41) provided a contrasting perspective on social media, pointing out that Facebook can be useful for teaching, learning, information and communication purposes. The teacher said:

*"(...) If someone is wondering about something, rather than just asking the teacher, they may ask other students in class or other people with knowledge of the specific area" (LF41).*

The extent to which teachers recognize computers as artefacts of learning may be seen in relation to teaching and learning practices in general, and whether the individual teacher's practice aligns with and is related to the use of ICT. One school owner (SEF3B) pointed out that a teacher who only ever lectures to a small degree will benefit from the use of ICT.

The student organization representative (EO) also pointed to teachers' classroom practices as a main reason

for non-academic use of computers. The EO said that the organization has not explicitly worked on measures aimed at reducing non-academic activity, but suggested that the organization implicitly stretches towards reducing non-academic use of ICT tools by efforts aimed to enhance pedagogical use of ICT:

*"There is a public debate, which probably also takes place in many teacher staffrooms, about whether or not to shut down Facebook access, which boundaries to establish for that, and I think this is something of a sidetrack to what it's all about. We need teachers to establish boundaries for how and when to use ICT, because today it is more likely that teachers get annoyed when students use Facebook."*

The EO wants the teachers to communicate guidelines for when and how ICT should be used rather than getting irritated and confrontational when they experience that the students are using it incorrectly.

The overall scope of ICT use in teaching and learning practices: Goal or means?

When asked about the scope of the use of ICT in teaching and learning, most informants agreed that this varies among teachers, schools and subject areas. School owners and school leaders tended to describe variation using arguments and explanations relating to teachers' professional digital competence and the paradigm shift towards student-centered methods. One school leader (SLF71) said:

*"I miss a greater curiosity, in a way, from the teachers. And it's not only teachers in their 60s who lack competency. People in their 40s also exhibit too little curiosity and their ICT competency might be very inadequate. (...) We are constantly considering whether to be stricter or to regularly offer new voluntary courses and so on, but such curiosity would, in a way, make them more self-driven and they would simply spend more time (on ICT). If you never use your PC for other things than simple searches and so on, you never improve your skills and knowledge. This is a bit of a struggle".*

Another school leader said that it is important to focus on the learning aspect, not ICT use in itself:

*"We are clear in our expectations towards teachers using ICT, and that students should benefit from their computers and that positive aspects of student and classroom computers should be adopted" (SLF51).*

The leader further explained how he/she considers himself/herself to be a "computer freak", yet still spoke about how he/she sees the computer as the one educational tool school could do without and still achieve similar learning outcomes. This is an interesting paradox. The leader added:

*"It seems like quite a few politicians and other key people are more focused on ICT use than the actual learning".*

Although the two leaders asserted different arguments, they pointed to similar underlying issues: Use of computers in itself is not the ultimate goal. It should be a means to support learning processes. One school owner expressed similar views and said:

*"The public debate about ICT is on the wrong track if you think that computers in themselves lead to more and better learning. It would be very valuable to make the connection to (teachers) beliefs about learning and students, and what characterizes the successful teacher and what characterizes the teacher who fails" (SEF3B).*

Two school owners differed in their answers on teachers' use of ICT: One school owner (SEF4) said he/she is afraid that demanding a good "analogue" teacher to use ICT might transform a good teacher into a bad one. Whereas the other school owner (SEF3B) claimed that bad teaching with ICT simply uncovers a teacher's poor pedagogic practice, and that the use of ICT just makes poor practice more visible. This school owner said that good teachers will manage to adapt to changes and continually adjust their practices.

The informant teachers themselves described varying experiences related to practices and scope of use. One teacher said:

*"It (the computer) becomes a distraction during the lecture and you often lose eye contact with the students. They sit and ... it is not the same anymore. There is so much more going on with the computer than what happens in front of the classroom and on the blackboard. This makes many (teachers) prefer that the computer stays in the backpack and that students take notes like we did when we were in school" (LF71).*

This teacher misses his/her relationship with the students and finds technology a distraction. It also indicates that the teacher identifies with a teacher-centered traditional (pre-computer) practice. This teacher's experience contrasts with the teacher (LF41) who described the students' use of social media as an integral part of the learning process. To metaphorically rephrase: While the first teacher (LF71) described students' ICT use as "students disappearing out of reach into a black hole", the other teacher (LF41) acknowledges and encourages what is going on in "the black hole" as a desired part of the learning process. The gap between the two explanations helps highlight an important aspect of the relationship between classroom management and digital competence, namely teachers' ability and willingness to facilitate digital learning communication. In a dialectical pluralism perspective, the two different views on students' ICT use is not necessarily a question about who is more right in their assumptions.

#### Classroom management

The informants agreed across groups that classroom management is important when ICT is used, but viewpoints, perspectives and arguments varied. The teacher informants mostly agreed when asked explicitly if they believe there is a relationship between low classroom management ability and a high degree of non-academic use of ICT. Two teachers explained their viewpoints:

*"(...) If the teacher doesn't care what students do, they will do whatever they want" (LF32)*

*"Only in the sense that if you don't have rules for how the computer should be used it will slip (...), and if you don't have a good connection, and students paying attention in class, (...) then it certainly will be non-academic use. I believe that classroom management is essential to keep students away from non-academic use" (LF21).*

The answers (besides LF21 pointing at rules) provided little information on *how* the teachers think classroom management can prevent non-academic use of ICT. The lack of suggested strategies and "how-tos" might mean that the teachers find such strategies to be self-explanatory. It seems that teachers are not fully able to reflect upon and verbalize the "how-tos" of managing the use of ICT, even if they view it as generally important. If so, one might further wonder whether teachers experience or feel (consciously or unconsciously) that they are being given a responsibility which they are not capable of handling. However, the quasi statistics showed that most informant teachers (5/7) only believed, to some degree, that there is a relationship between teachers' classroom management and their digital competence. Only one teacher graded the relationship between digital competence and classroom management as true to a large extent. Bearing in mind the description of non-academic use of ICT as a challenge, the agreement upon the necessity of classroom management and the quantitative relationship between digital competence and classroom management, this finding might be seen as somewhat surprising. One of the teachers elaborated on his/her answer:

*"To some degree, I would say. Because ... I mean, it has to do with being where the students are, and they are digitally competent and if we are left behind we kind of lose grip on them. So, to some degree I would say that there is a relationship." (LF61).*

This quote is interesting because it points directly to the core of student-teacher relation issues, also raised by the EO. By using the phrase "being where the students are", this teacher seems to emphasize the importance of understanding the relationship between student learning and their use of ICT. But what do the students say about this issue? In the student survey (N = 17529) of the SMIL study 55.7% of the students claim that the teachers' classroom management influences student learning outcomes with ICT to a high degree (Krumsvik et al. 2013).

When asked about beliefs regarding the relationship between teachers' professional digital competence and rule-based ICT practices, one informant teacher (LF21) said:

*"I cannot see that less digitally competent teachers have less rules for how to use the computer in the classroom".*

The teacher added that a digital competent teacher might, to a greater extent, make use of technical support systems for classroom management. Another teacher (LF61) provided a somewhat different perspective:

*"In order to make sensible rules, we must know what it is all about".*

The teacher added:

*"Given that ICT is part of the job, as it is, it is also a part of our job to be updated. Then it becomes easier to have reasonable and clearly defined framework too".*

The viewpoints of the two teachers emphasize the importance of rules and/or frameworks for use. However, their explanations on how and why digital competence matters for rule-setting are partly contradictory. The first teacher believes that teachers who are less digitally competent also have rules, and perceives a high level of digital competence more as a precondition to make use of technical support systems for management. The other teacher regards high levels of digital competence as necessary for establishing rules that are sensible and up-to-date. This implies that rules may be less sensible and outdated.

However, teachers are not alone in developing and practicing their classroom management understanding. Even if school leaders and school owners acknowledged that non-academic use of ICT is a challenge for teachers, most of them seemed to expect that teachers should be able to handle such challenges. Nevertheless, they had partly different solutions. Some of the leaders and school owners mentioned strict rules as a solution, whilst others would rather avoid such measures and believed that teachers should use more relation-based strategies to reduce non-academic use of ICT. School leaders used two partly overlapping phrases to communicate their expectations of teachers' classroom management: teachers are expected to *control* students' use of ICT and teachers are expected to *lead* students' use of ICT. The use of the two words may mean the same thing, but, bearing in mind that these informants are leaders and administrators by profession, it is also possible to interpret the words as consciously chosen and indicating contrasting attitudes toward the nature of classroom management (crime control vs. relational). As previously mentioned, many of the school leaders and school owners tended to explain teachers' diverse and contrasting ICT practices using arguments related to pedagogical understanding and digital competence. However, as with the teachers themselves, school

leaders and school owners also tended to be very general in their descriptions of how they expect teachers to practice classroom management and facilitate learning in an ICT environment.

The student organization representative (EO) suggested three main reasons for the extensive non-academic use of ICT: 1) poor student-teacher communication about how to use ICT, 2) deficient pedagogical use, and 3) teachers are not good at communicating their expectations to students. The participant described teachers' classroom management in a broader way than the other informants, emphasizing student-teacher relations. The participant suggested that teachers should maintain an ongoing dialogue with their students educational use of ICT, saying that dialogues could revolve around teaching and learning activities, involving students in planning, implementation and evaluation of learning processes including the use of ICT. The EO was sceptical about focusing exclusively on discipline and rule-based classroom management, and said:

*"(...) I find the public debate on classroom management rather weird (...) because it revolves around (...) well, one speaks about how there should be more discipline in school as a kind of slogan for good classroom management and I think that is a bit hollow and conveys associations to a teacher role which I don't find positive for student learning".*

The EO added:

*"(...) If you're a teacher who is able to see and hear the students, who is clear and at the same time has a good dialogue with the students all the way, then I think you're a good classroom manager".*

#### Descriptive statistics (quasi statistics)

In line with Maxwell (2005, 2010) and Becker (1970) we apply quasi statistics as part of the qualitative data in this study for to a certain degree validate the claims above in verbal form since the items in the survey are generated from the qualitative data. Becker states that it is important to make explicit the quasi-statistical basis of their conclusions in qualitative research. Therefore, we present some simple descriptive statistics below attached to the qualitative parts of the research questions.

The results for the teachers' self-reported data relating to the seven elements of classroom management, on an adjectival Likert scale with seven response options from 'to no extent' (1) to 'to a very high extent' (7) is presented in the following **Figure 1**.

The results for the teachers' self-reported data relating to the five elements of the digital competence model, on an adjectival Likert scale with seven response options from 'no skills' (1) to 'very good skills' (7) is presented in the following **Figure 2**.

Even if this quasi statistics is based on numbers and not text, it adds a layer to the methodical triangulation of semi-structured interviews, focus groups, and observations in the qualitative result part.

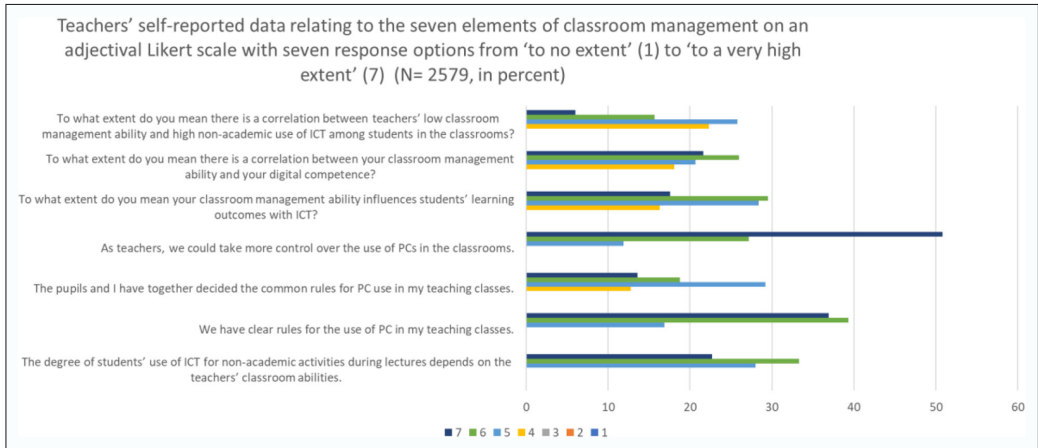


Figure 1: Teachers' self-reported data relating to the seven elements of classroom management (N = 2579).

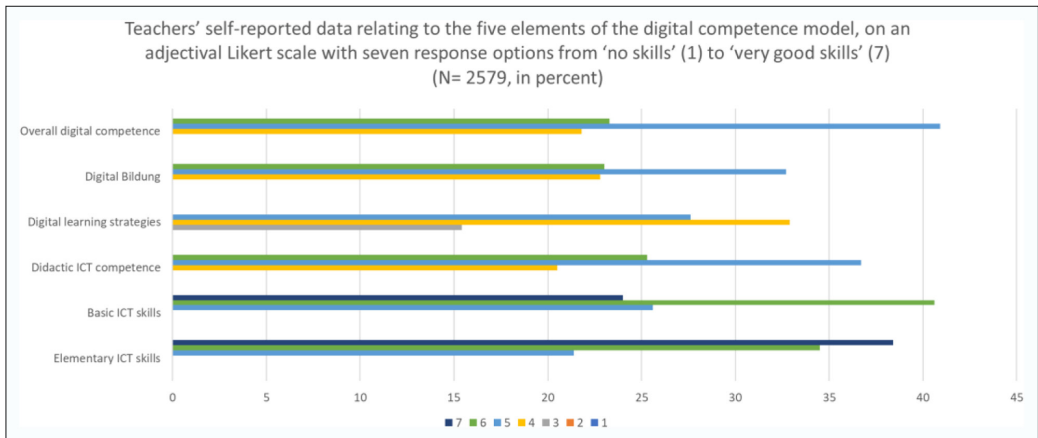


Figure 2: Teachers' self-reported data relating to the five elements of the digital competence model (N = 2579).

**Quantitative results**

So far, we have seen from the qualitative part of the study that both teachers, school leaders, students representatives and others perceives that there is some kind of relationship between teachers' professional digital competence and their classroom management abilities. However, the qualitative analysis only explores the nature of these associations in relatively a small sample of participants. The qualitative analyses alone therefore provide limited evidence as to how and why digital competence predicts classroom management ability in larger populations. The next part will examine this issue.

**Regression analysis**

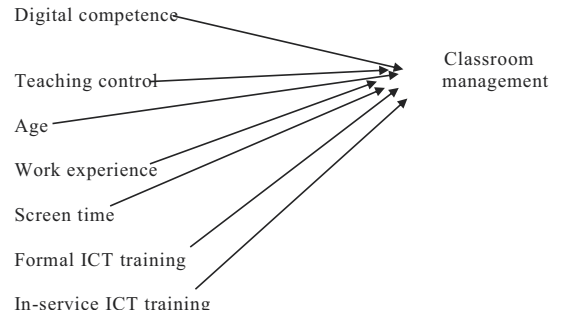
Because the sample size was large (2579 teachers), we used a more conservative significance level of .001 for the quantitative analyses.

A digital index covering six questions was developed. This was statistically analyzed and compared to a number

of factors in order to explore whether there was a relationship between demographic, personal and professional characteristics and teachers' professional digital competence (see Krumsvik et al. 2016).

Ordinary least square regression was used in estimation of the regression coefficients. In the first regression analysis (Table 2), teachers' classroom management (dependent variable) was regressed on the following independent or predictor variables: teachers' professional digital competence, their teaching control, work experience in years, age, daily screen time activity and whether they have ICT qualifications (both formal and in-service). Four independent variables that were statistically significant predictors were digital competence, screen time, work experience and teaching control. The strongest predictor of classroom management was teachers' self-reported professional digital competence (beta = 0.34). The other three statistically significant predictors had smaller relationships with classroom management: the beta for screen time was 0.10, the

**Table 2:** Regression analysis results of teachers' reported ability for classroom management (dependent variable) predicted by professional digital competence, teaching control, age, work experience, screen time and ICT qualifications (formal and in-service).



Predictor Variables	Classroom management	
	B	Beta
Digital competence	0.43*	0.34
Screen time	0.08*	0.10
Work experience	-0.07*	-0.07
Teaching control	0.05*	0.10
Age	0.02	0.03
Formal ICT training	0.01	0.01
In-service ICT training	0.04	0.02
R <sup>2</sup> (adj.)	0.175	

Note: \*  $p < .001$ .

beta for teaching control was also 0.10, and the smallest significant predictor beta was  $-0.07$ . The full set of predictor variables accounted for 17.5 percent of the variance in classroom management.

Student-teacher relations was the dependent variable in the second analysis (Table 3). It included the same independent variables as in the previous analysis. The following independent variables were statistically significant predictors: digital competence, teaching control, and age. The strongest predictor of student-teacher relations was teachers' professional digital competence (beta = 0.39); the second strongest predictor was teaching control (beta = 0.31); and the third strongest predictor was teachers' age (beta = 0.16). None of the other independent variables contributed significantly to the student-teacher relation prediction. The full set of independent variables accounted for 31.2 percent of the variance in student-teacher relations.

### Integrated Results

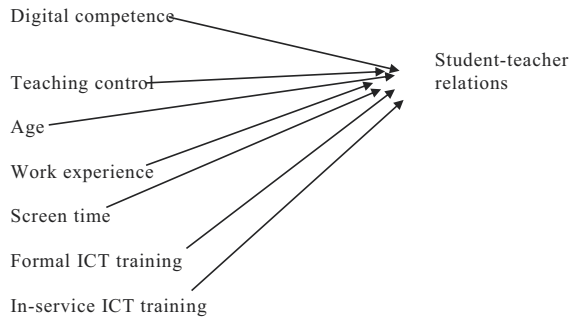
The first research question was:

*How do teachers, school leaders and student representatives describe the relationship between teachers' professional digital competence, student-teacher relations and their classroom management practices?*

The qualitative analysis indicated that teachers generally believed that classroom management is important when ICT is used. However, views regarding the importance of digital competence seemed to vary. This was expressed through statements about classroom management explicitly, and through statements relating to more general questions on educational use of ICT and non-academic use of ICT. Teachers seemed to experience and interpret ICT usage differently, even if the situations and examples they described from their classroom experiences seemed to have common traits. They described different expectations for their students' use of computers and they described somewhat contrasting views about facilitating, modelling and regulating students' use. Statements by school owners and school leaders also seemed to support the fact that teachers experience and interpret ICT usage differently. However, these participant groups emphasized that teachers' professional digital competence explains the variation, and most of them said that teachers should develop their practices and skills to enable them to cope with ICT challenges in the classroom. Statements by the student organization representative seemed to support the fact that teachers' expectations and practices vary. On the one hand, the participant provided examples of teachers who succeed in using ICT in teaching and learning activities. On the other hand, the



**Table 3:** Regression analysis results of student-teacher relations (dependent variable) predicted by digital competence, teaching control, age, work experience, screen time and ICT qualifications (formal and in-service).



Predictor Variables	Student-teacher relations	
	B	Beta
Digital competence	0.50*	0.39
Teaching control	0.15*	0.31
Age	0.10*	0.16
Work experience	-0.04	-0.04
Screen time	-0.02	-0.03
Formal ICT training	0.02	0.02
In-service ICT training	0.09	0.03
R <sup>2</sup> (adj.)	0.312	

Note: \* p < .001.

participant pointed to poor student-teacher communications about expectations and lack of pedagogical use of ICT as the main reasons for non-academic activity. The EO therefore emphasized the importance of trusting student-teacher relations and suggested that both teachers and students would benefit from discussing ICT in a teaching and learning context.

The second research question was:

*Is there a statistical relationship between upper secondary teachers' professional digital competence and their classroom management?*

The statistical analysis indicates that secondary teachers' professional digital competence predicted their perceived classroom management abilities and student-teacher relations. However, the analysis provided limited information on how and why digital competence, classroom management and student-teacher relations seemed to be somehow interwoven.

The third research question was:

*How can one explain the observed relationship between upper secondary teachers' professional digital competence and their classroom management practices?*

The integration of the quantitative and the qualitative analysis indicates a complex and mutual relationship between teachers' professional digital competence, their relations with their students and their classroom management abilities. The qualitative descriptions demonstrated that various teachers integrate digital competence in their overall professional understanding and classroom practices in quite different ways. The gap between perceived experiences pinpoints how a teacher's understanding of ICT and its place in teaching and learning activities can help explain the relationship between digital competence and classroom management. It is also valuable to question whether different teachers might describe similar use of computers differently. If so, it might also be hard for students to distinguish between what is desired use and not, hence, what they are expected and supposed to use their computers for. Whilst some teachers aimed to integrate the computer into pre-computer practices, other teachers emphasized the need to think differently and develop new teaching and learning practices. Professional digital competence seemed to predict teachers' overall willingness and ability to facilitate learning processes with ICT. We thus suggest that variations in professional digital competence can help explain the variations in what teachers perceive pedagogical use of ICT to be, teachers' conceptual understanding of classroom management in general

and how they practice their understanding in ICT-dense learning environments.

### Discussion

Awareness of the importance of pedagogical use and contextualization of ICT and computers seems to be key to the mutual interplay between professional digital competence and classroom management. If one compares information from school owners, school leaders, teachers, the student organization representative and students, it seems that teachers who are willing and able to deliberately integrate and model the use of ICT in learning processes (teachers who are digitally competent) are better equipped to communicate educational purposes and clear expectations about ICT use in different contexts (classroom management). This enables the digitally competent teacher to be flexible in his/her management of the classroom environment, evaluating and adjusting on-going use. Teachers who are either not willing or not able (or both) to deliberately implement ICT into teaching and learning activities will probably have problems communicating educational purposes and expectations, and would therefore have to depend more on strict rules and "crime-control" when ICT is used. However, crime-control practice might be particularly challenging for teachers who, in a pre-computer classroom, emphasized and practiced relational classroom management. Teachers, school owners and school leaders who stress the crime-control aspect of classroom management might thus unintentionally undermine the pedagogical reflection needed to flexibly facilitate learning with ICT. Using a both-and logic, we suggest that both these practices can be moderately combined in practice.

Data from the interviews suggest that some teachers (and school leaders) label general classroom management issues as more or less infrastructural ICT issues rather than pedagogical issues. One teacher viewed students' addictiveness to social media and entertainment content as the main reason for classroom chatter. Some teachers commented that unstructured students do not seem to tackle access to technology (implying that they should not have access to computers), and often use their computers for non-academic purposes. However, the underlying assumption for both these views is that there was no (or less) chatter or inattentive students before computers were introduced into classrooms and daily school life.

Smartphones and computers provide access to a world of entertainment and communication, and students need to experience and learn the importance of using these tools in ways that facilitate their academic, social and moral learning. However, if teachers disagree amongst themselves on how students should use their laptops and what they should use them for, and are unable to clearly communicate their expectations, how can they expect the students to know what they are supposed to use their laptops for? Modelling and explaining the correct way to use ICT are thus important management skills in ICT-dense classroom environments. However, what happens in practice seems to vary. Teachers who expect their students to use computers as simple typing machines or notebooks in

a teacher-centered learning environment tended to identify, experience or/and expect non-academic use of ICT amongst students as an explicit challenge. Data from the study also suggest that teachers worry that students know more about ICT than they do. Some teachers fear their authority is being threatened, which might be especially relevant for teachers who are unable to advocate their ICT policies. Such and similar findings indicate that ICT and computers are not actively integrated into the specific teachers' professional role and their pedagogical design.

These different and partly contrasting views on classroom management and the scope and use of ICT in the classroom seem to revolve around the core question: Who is responsible for the use of ICT in the classroom, the teachers or the students? The general pattern of the qualitative results appears to be that school owners, school leaders and the student representative consider the teachers as responsible for facilitating learning processes with ICT. However, teachers seem to be variously equipped for such a task. Although teachers apparently accept this responsibility, something seems to be moving beneath the surface: Quite a few of the teachers seemed to blame the students for not using the computers correctly for academic purposes. Teachers who blame their students seem to be experiencing a feeling of powerlessness and stress related to the use of ICT in their classrooms. Findings indicate that some teachers do not know how to connect with the students when ICT is used, and that they perceive computers as disturbing elements that have somewhat alienated them from their professional role. Static, stress and fear-driven focus on managing an ICT classroom may end up as a self-reinforced spiral of mistrust if students and teachers continually and mutually suspect each other's judgements. Findings from the study also suggest that such spirals exist. Some teachers seem to assume that non-academic use often takes place despite them admitting not to have a good understanding of what students are using their laptops for.

The qualitative data also revealed that the EO and some teachers, school leaders and school owners emphasize a need to think differently about teaching and learning in the ICT environment. They outline how teachers should model and support proper use of ICT through student-teacher communication and pedagogical facilitation, and they seem to doubt that strict rules and crime control is a suitable measure for reducing non-academic use of ICT.

Individual informants (across groups) who described digital competence as important use phrases like "the teachers must be able to understand what it is all about". This wording indicates that the specific informants believe that they have understood something they experience that many others do not understand. One example is the teacher who advocated sensible rules rather than strict rules. Another example is the teacher who emphasized the importance of "being where the students are". Such statements are consistent with the theoretical perspective of the relationship between ICT usage and classroom management, which introduce digital competence as a mind-set beyond technical skills. Overall, findings from



the study point to what appears to be a challenging paradox: A teacher must have a certain level of digital competence to understand how and why digital competence influences classroom management and teachers' ability to facilitate learning processes when ICT is used. This paradox may seem quite insignificant in a micro context, if one focuses on the individual teacher. However, the qualitative analyses indicate that different levels of digital competence among teachers has led to different professional understandings and classroom practices. In a broader context and over time, this might contribute to structural uncertainty and thus widen the gap between practices. This gap between the "frontrunners" (Wasson & Hansen 2014) and the "laggers" (Rogers 2003) can give some input to our understanding of why there has been a lack of uptake in teachers' utilization of digital technologies both in Norway (Krumsvik et al. 2013) and internationally (Cuban, Kirkpatrick & Peck, 2001; Tamim et al. 2011; OECD 2015; Escueta, Quan, Nickow & Oreopoulos 2017).

### Suggestions for future research

Together, the quantitative and qualitative findings from the SMIL study suggest that classroom management in upper secondary schools should entail pedagogical knowledge on how to create and maintain diverse learning environments to facilitate students' learning processes, especially when ICT is used. The qualitative descriptions indicate that some teachers do not include technology and digital communication platforms in their understanding of the learning environment and the learning processes they are supposed to facilitate, whilst others do. The seemingly unanimous common understanding that classroom management is important when ICT is used can thus prove to cover up different perceptions of what it really means to manage an ICT environment.

Ultimately, further research is needed into how digitally competent classroom managers facilitate learning processes, and to present a framework proposal for integrating digital competence and classroom management. We also suggest further research into how pre-service and in-service teacher training could successfully integrate professional digital competence in classroom management skills and professional development.

And the implications for practice from this study is to bridge the gap between the "frontrunners" and "laggers" by systematic focus towards professional digital competence and class management in teacher education as well as in in-service teacher training. In this way teachers might become gradually good enough with the kind of pedagogies that make the most of technology (OECD 2015).

### Methodological imitations

The digital competence index and the elements of classroom management in this study are based on teachers' self-ratings, which might be a limitation of the study.

### Notes

<sup>1</sup> Sammenhengene Mellom IKT-bruk og Læringsutbytte (the relationship between ICT use and learning outcomes).

<sup>2</sup> Students in all Norwegian upper secondary schools are provided with one laptop each.

<sup>3</sup> Available from the first author upon request.

### Ethics and Consent

This research project has been approved by the Norwegian Centre for Research Data (NSD) and all the counties and schools participating in the SMIL-study.

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### Competing Interests

The authors have no competing interests to declare.

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## **Article 2**



## RESEARCH

# Glimpses Into Real-Life Introduction of Adaptive Learning Technology: A Mixed Methods Research Approach to Personalised Pupil Learning

Synnøve Moltudal\*, Kjetil Høydal\* and Rune Johan Krumsvik†

Adaptive Learning Technologies (ALT) and Learning Analytics (LA) are expected to contribute to the customisation and personalisation of pupil learning by continually calibrating and adjusting pupils' learning activities towards their skill and competence levels. The overall aim of the study presented in this paper was to obtain a comprehensive understanding of how a systematic implementation of ALT influenced the learning outcomes, learning environment and motivation of 10- to 12-year-old pupils (grades 5–7 in Norwegian education) in mathematics, and the paper explores the following research question: How do systematic use of adaptive learning technology influence pupils' learning and motivation? In this small-scale, Mixed Methods Research (MMR) study, a real-life introduction of adaptive technology was initiated and explored. Fifteen minutes of ALT homework each day or a total amount of 60 minutes a week, was applied to streamline individual volume training and root learning and thus free up time for practical mathematics and deep learning at school. The pupils' level of competence, learning, motivation and basic psychological needs were measured quantitatively before and after the four-week intervention, and the intervention was observed qualitatively. The findings of the study indicate that use of ALT can help streamline volume training and root learning, and thus free up time for practical mathematics and deep learning at the upper primary level ( $ES = 0.39$ ,  $P = 0.001$ ). However, the study also indicates a interwoven relationship between learning, motivation and volume training that teachers should be aware of when using ALT. Particular attention should be paid when pupils learn new mathematical concepts.

**Keywords:** adaptive learning technology; self-determination theory; classroom management; mixed methods research

## Introduction and background

In the last couple of years, various types of learning analytics (LA) and adaptive learning technologies (ALT) have been made available for educational purposes (Lang et al., 2017). Such technologies have the potential to personalise and increase the volume of student activity and to provide continuous feedback. In addition, the technology provides teachers with empirically generated data about student activity, level of competence and progress in learning. Its inherent potential is promising and could support and improve metacognition and self-regulated learning (Knight & Buckingham Shum, 2017; Pardo et al., 2017; Winne, 2017) which is in line with requirements in the new Norwegian reform "Fagfornyelsen" (to be introduced into Norwegian education in the fall of 2020). We know a little about how LA and ALT technology is contextualised and introduced in post-secondary education (Krumsvik

& Rokenes, 2016). Predicative models have been used in small-scale studies by some pilot universities and have produced encouraging results (Campbell et al., 2007). The ALT explored in this paper, Multi Smart Øving (MSØ) (Gyldendal, n.d.), is already used extensively in Norwegian primary schools. MSØ is developed in collaboration with Knewton and is thus built on the Knewton platform. However, we know little about how MSØ and similar ALT-technologies are implemented in primary educational practice in real life in Scandinavia (Norway). Knowledge about how adaptive technology influences pupils' learning and motivation in real life is thus important.

This paper reports on findings from a Design-Based Research (DBR) project called Learning and Teaching with Adaptive Learning Technology (LaT-ALT). LaT-ALT was a partly planned and partly emergent mixed methods study (Schoonenboom & Johnson, 2017) in which each phase of the study informed the next. The study had an interdisciplinary profile at the intersection of pedagogy and media science, and its overall aim was to iteratively initiate, evaluate, adjust and improve the use of ALT within a local school context. Findings from the LaT-ALT project

\* Volda University College, NO

† University of Bergen, NO

Corresponding author: Synnøve Moltudal ([moltudal@hivolda.no](mailto:moltudal@hivolda.no))



could contribute to the body of educational research by exploring how systematic use of ALT in homework and at school influenced pupils' learning outcome, learning process, motivation and learning environment. During the four week intervention of the study, where systematic use of ALT was introduced in real-life practice, qualitative data was produced (during the intervention) and quantitative data was collected (pre-/post-intervention). These data form the empirical basis of this paper. The study was positioned within the logic of Mixed Methods Research (MMR) (Johnson & Christensen, 2017; Johnson et al., 2007) and Dialectical Pluralism (DP) (Johnson, 2017).

### Research questions

The following MMR question is investigated in this paper:

How do systematic use of adaptive learning technology influence pupils' learning and motivation?

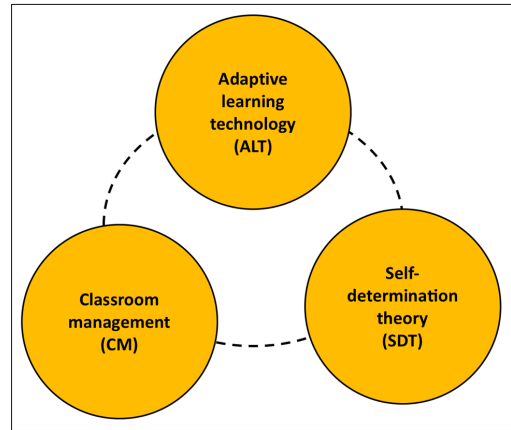
By exploring this research question, we aim to contribute to knowledge-based implementation and contextualisation of ALT in primary schools.

### Conceptual framework

The MMR framework of this study builds on an ecological approach to teaching and learning, in which the introduction of the systematic use of ALT is considered to be a new element that could intentionally improve teaching and learning, but also could affect established learning environments and contexts in unforeseen ways. The study thus aim to address complexity, and the power of mixed methods research is its ability to deal with diversity and divergence (Schoonenboom & Johnson, 2017). In line with previous research on the educational use of digital tools and technology enhanced learning, this study assumes that the successful implementation of learning technology is a mutual interaction that includes, but is not necessarily limited to, 1) the inherent advantages and disadvantages of the specific technology being used, 2) the teacher's ability and willingness to facilitate learning, and 3) the pupils' motivation for learning. The actual operationalisation of these three aspects in the study are made concrete through the following concepts: Classroom Management, Self-Determination Theory and ALT (see **Figure 1**).

#### Classroom management

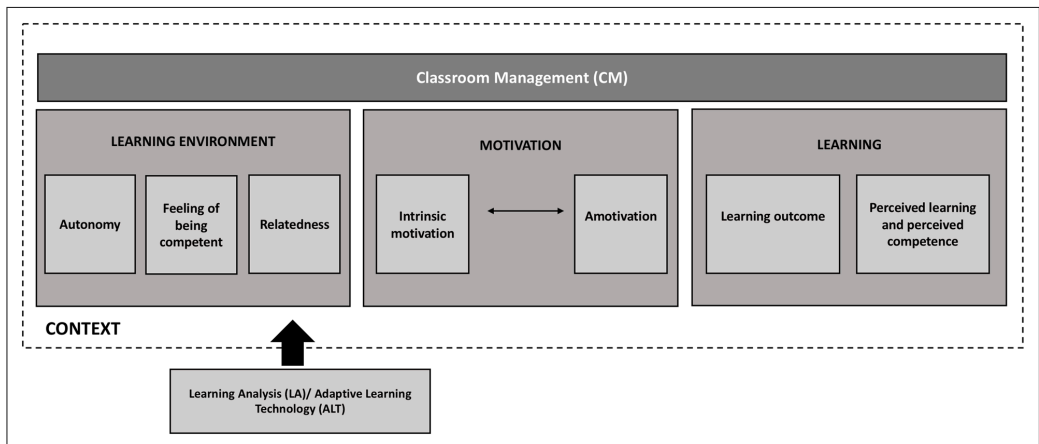
Classroom management (CM) is defined as "the actions teachers take to create an environment that supports and facilitates both academic and social-emotional learning" (Evertson & Weinstein, 2006, p. 4). CM is not an end in and of itself, but a means to create and maintain any given optimal learning environment (Brophy, 2006; Doyle, 2006). Behavioural approaches have been closely associated with CM and can be used clumsily (by forming a controlling and frustrating classroom environment) or skilfully (by supporting autonomy; Landrum & Kauffman, 2006). Awareness of the limitations regarding behavioural approaches has contributed to a paradigm shift in favour of approaches that emphasise self-regulation and trusting, caring relationships between teachers and pupils.



**Figure 1:** Conceptual framework: The mutual interaction between adaptive learning technology (ALT), classroom management (CM) and self-determination theory (SDT).

Nevertheless, standardised and internalised understandings in CM are often adapted to a teacher-centred practice, associated with behaviour management and sets of rules (Emmer & Sabornie, 2015; Evertson & Weinstein, 2006). The effective use of technology in teaching and learning practices is, however, aligned with the general paradigm shift towards pupil-centred methods. Such approaches entail a paradigm shift from the teacher's authority and control to shared control and responsibility (Schwab & Elias, 2015; Watson & Brattstich, 2006).

The shift from a (passive) teacher-centred classroom environment to an (active) pupil-centred classroom environment has instructional and managerial implications; it has become increasingly important to identify the intended pupil learning outcomes first, and to design learning activities and reflectively acknowledge what specific activities imply about desired pupil roles thereafter (Brophy, 2006). The learning process benefits from stating clear expectations and helping pupils understand what to do and why; in other words, to support autonomy. This paradigm shift makes some teachers fear a loss of control in their classrooms (Bolick & Barthels, 2015; Brophy, 2006; Hickey & Schafer, 2006). Some studies indicate that assumptions teachers hold about pupils shape their CM judgements and practices, and that teachers tend to focus on rule-setting, enforcement and "crime control" (Bullough & Richardson, 2015). CM provides the LaT-ALT-study with a framework for identifying and addressing the facilitation of learning in different contexts and learning ecologies. The operationalisation of CM in LaT-ALT is implemented in line with the overall mindset of Evertson and Weinstein (2006) and Emmer and Sabornie (2015). As illustrated in **Figure 2**, the core of CM is considered to be the facilitation of learning, maintaining or enhancing positive motivation and creating and maintaining an optimal learning environment. The overall aim of the LaT-ALT-project was to explore what happens when the logic of LA and ALT is introduced in the existing real-life (RL)-context.



**Figure 2:** The LaT-ALT operationalising of the conceptual framework.

### **Self-determination theory**

The mapping of the pupils' learning environment and motivation (Figure 2) uses self-determination theory (SDT) as a theoretical lens in the LaT-ALT study. SDT's basic psychological needs (autonomy, relatedness and the feeling of competence) are generally seen as essential indicators of a productive learning environment (Evertson & Weinstein, 2006). In addition, motivation is considered to be the moving force of any action or behaviour (Ryan & Deci, 2000b; Ryan & Deci, 2000a). SDT suggests that a pupil can be motivated to a greater or lesser degree and be driven by various forms of motivation (Ryan & Deci, 2000a). SDT distinguishes between different types of motivation based on the reasons or goals that give rise to the action (Deci & Ryan, 2004; Deci & Ryan, 2016; Ryan & Deci, 2000a; Ryan & Deci, 2000b). The distinction between intrinsic and extrinsic motivations has for decades influenced motivational research both inside and outside of the educational field.

*Intrinsic motivation* is defined as the doing of an activity for its inherent satisfaction rather than for some other and separable consequence and refers to performing a task or an activity because one finds it enjoyable, interesting or fun in and of itself. Intrinsic motivation is linked to high-quality learning and creativity, and is considered a natural wellspring of achievement and learning that can be either catalysed or undermined by parent and teacher practices (Ryan & Deci, 2000a; Ryan et al., 1994).

*Extrinsic motivation* is defined as the doing of an activity for a reward or another separable consequence and seems to be a more complex and ambiguous term. Operant theory maintains that all behaviours are motivated by some sort of reward, and thus contradicts the very existence of intrinsic motivation (Ryan & Deci, 2000b). However, the SDT's model in "A taxonomy of human motivation" (Ryan & Deci, 2000a) displays different types of extrinsic motivation on a continuum between the contrasting concepts of intrinsic motivation and amotivation, indicating that some extrinsic motivations are related to intrinsic motivation whilst others are related to amotivation. *Amotivation*

is described as the lack of intentionality and sense of personal involvement, and results from not valuing an activity, not feeling competent to do it, or not believing it will yield a desired outcome (Ryan & Deci, 2000a; Deci & Ryan, 2004). The taxonomy additionally distinguishes between regulatory styles based on their associated processes and perceived locus of causality (IPLOC). SDT and the taxonomy of motivations thus provides the study with a framework for identifying and describing factors that undermine or enhance internalised (positive) forms of motivation.

### **Learning analytics and adaptive learning technology**

"There is a pressing need to review the extent to which conventional theories are applicable to ICT-infused learning contexts" (Liu et al., 2016, p. 6). However, an underlying challenge is that technologies have spread so fast that formal research has trouble keeping up with real-life practices (Koh, 2016). In recent years, a new type of technological educational tool has been developed and thus gained attention. We know this technology as Learning Analytics (LA) and Adaptive Learning Technology (ALT). We find relatively few studies that combine ALT with homework as part of the intervention and that follow teachers' everyday practices. However, Roschelle, Feng, Murphy, and Mason (2016) studied 2850 mathematics pupils who used adaptive learning software and homework as central parts of the intervention. They observed an increase in the pupils' scores on an end-of-the-year standardised mathematics assessment as compared to a control group that continued with existing homework practices. Pupils with low prior mathematics achievement benefited most from this intervention. Compared to other areas of educational technology, there is still relatively little research on adaptive learning in elementary schools, both internationally and in Norway, and we need more research on how this can be attached to deeply entrenched structures in teachers' everyday practices and to pupils' homework. LA focuses on adaptive learning by tracing and analysing pupils' learning activities to understand and optimise

learning outcome in different learning environments and contexts (Blakelock & Smith, 2006; Lang et al., 2017). But what are LA and ALT?

Learning analytics is a term that refers to the use of digital data for analysis and feedback that generates actionable insights to improve learning. LA feedback can be used in two ways: 1) to improve the personal learning power of individuals and teams in self-regulating the flow of information and data in the process of value creation; and 2) to respond more accurately to the learning needs of others (Crick, 2017, p. 291). The use of data and models can predict pupil progress and performance, and thus provide pupils and/or learning facilitators with the ability to act on that information (Winne, 2017). Different ALT-technologies are of various qualities, have different affordances, and will thus have different impacts on pupils and teachers – and the interaction between them. In the LaT-ALT study ALT and LA are combined in the Multi Smart Øving (MSØ) software, as the software uses ALT for personalising/automating student activity tasks and has an inherent LA-access for teachers (Gyldendal, n.d.). MSØ is a practice program for root learning in basic mathematics, hence it aims to increase the volume of drills. It is not intended for practical mathematics and processes associated with deep learning. ALT could thus partly automate or support the teacher's tasks of mapping the pupils' activities, skill development and competencies and providing them with tasks and activities individually tailored to their needs. However, introducing learning analytics and adaptive learning into education has ethical and pedagogical implications (Bergner, 2017; Hoppe, 2017; Prinsloo & Slade, 2017). Winne (2017) points to the balance between accuracy and generalisation when describing a learner's ipsative development as a challenge, noticing that two learning signatures will never match completely: "The field of learning analytics will benefit from frequent consideration of this challenge" (Winne, 2017, p. 248). In this article we aim to address the real-life pedagogical challenges and implications of introducing ALT systematically in primary education. **Figure 3** roughly

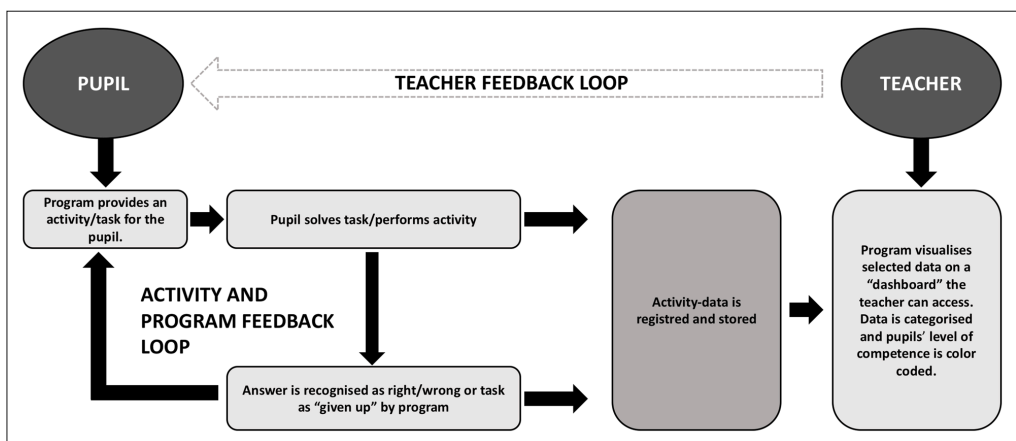
illustrates the process workflow of the ALT that was used during the intervention (MSØ).

The dark grey circles illustrate the active engagement of pupils and teachers in the program interface. The light grey boxes illustrate steps (processes) that are visible to pupils and/or teachers. The dark grey box represents the processes that are not visible to either pupils or teachers, but acts as the link between the two interfaces. The light grey box connected to the pupil is only viewable in the pupil interface during the activity process, and the light grey box connected to the teacher is only viewable in the teacher interface. The technology can help to facilitate learning on at least two levels, in line with Crick (2017). The first level is called the *activity and program feedback loop*. This is the automated process where the program selects tasks and activities from a database, tentatively adapted to the pupil's competence level at any given time. The pupils are provided with immediate (summative) feedback on whether the answer is right or wrong and are given stars and/or diamonds by MSØ when they have reached certain levels within the program. Both pupils and their teachers are provided an overview of the amount of time the pupils have spent in the program, right and wrong answers and how many tasks they have given up on. The second level may be called the *teacher feedback loop*. This is a non-automated process (hence the dotted arrow) by which the teacher can actively use the empirical data from the dashboard to support their facilitation of learning as a supplement to the program feedback loop or outside the program. Teacher feedback could thus be summative, formative or both.

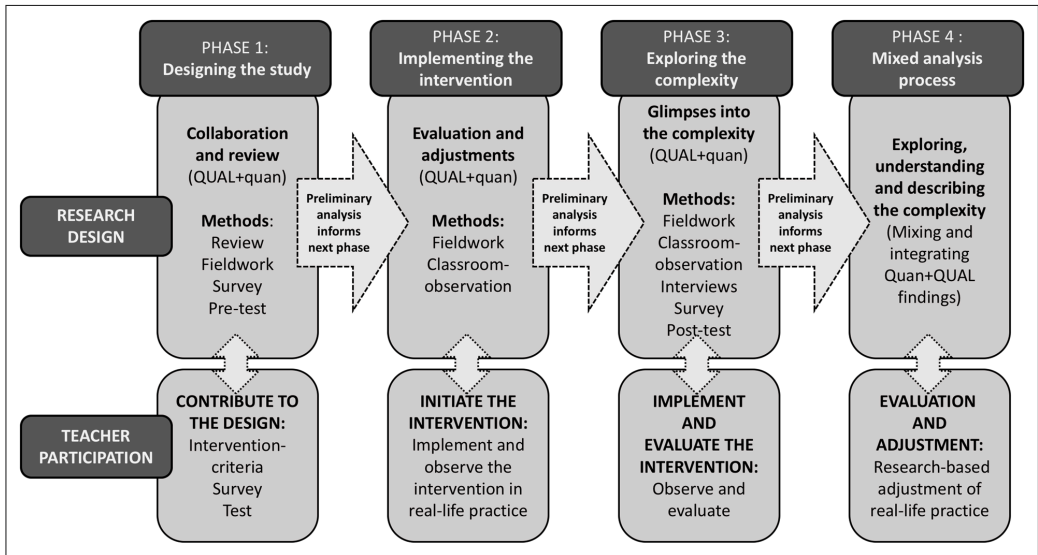
## Methods and material

### *The design of the study*

The data on which this article builds were produced and collected through a MMR study, conducted in the last half of 2017. The LaT-ALT project as a whole (**Figure 4**) was based on a principle associated with Design-Based Research (DBR): That practitioners and researchers work together to produce meaningful change in the context



**Figure 3:** A visual summary of adaptive learning technology.



**Figure 4:** The DBR/MMR design of the study (including teacher participation).

of real-life (Brown, 1992; The Design-Based Research Collective, 2003). The overall project design aimed to bridge the gap between theory and practice, by implementing an intervention in a real-life context, as opposed to a controlled laboratory context (Brown, 1992). Design-based research focus on advancing theory grounded in naturalistic contexts (Barab & Squire, 2004), and the design of the intervention is considered a key feature of the quality and result of the research project (Anderson & Shattuck, 2012). Putting a first version of the intervention design into the world (in this case a Norwegian upper primary context) to see how it works is the first step of a progressive refinement (Collins et al., 2004). The MMR-design of the study may be described as a partly planned and partly emergent design (Schoonenboom & Johnson, 2017), where some parts of the design was planned in advance whilst others emerged, informed by the teacher-researcher collaboration and preliminary (quan and qual) findings. The quan-qual integration was therefore both convergent and interactive (Fetters et al., 2013). Systematic observation of the intervention should enable the researchers to explore what consequences systematic use of ALT could have for 1) pupils' learning, competence and motivation (pupil perspective), 2) teachers practices and professional role (teacher perspective), and thus be able to provide a DP approach to the 3) interaction between pupil learning and motivation and teacher practices when ALT is being used (Johnson, 2017; Schoonenboom & Johnson, 2017; Johnson & Christensen, 2017).

In line with the research questions that drives this paper we presents findings from phase 2 and 3, including pre-test data collected at the end of phase 1 and post-test data collected at the end of phase 3. The further description of the phases (as presented in **Figure 4**) thus emphasises the methodologies, data collection and data analyses related to learning and motivation during the real-life intervention.

#### Phase 1: Designing the study and the intervention

The study was designed over a period of four months. The school leaders and teachers involved had begun preparing for the new content curricula reform "Fagfornyelsen", which e.g. emphasize deep learning within and across subjects. Since time is generally a limited resource in school, they wanted to find good solutions to ensure time for deep learning processes while also providing pupils with basic mathematics knowledge. The study was thus designed to initiate, evaluate and adjust the first step of a desired change in the case school's existing practice: To free up time for practical mathematics and deep learning in mathematics through effectively streamlining and personalising basic mathematical understanding using ALT. The case school's teachers were (in line with the guidelines of the new reform) committed to safeguarding the pupils' curiosity, creativity and need to explore; teachers were thus explicitly unwilling to compromise the pupils' motivation for learning.

Long term commitment to interventions have a series of practical and ethical implications for pupils and teachers involved, and proposals for the design and intervention criteria were thus iteratively drafted by the researchers and adjusted in collaboration with the participating teachers ( $N = 3$ ). The *intervention period* was set to 4 weeks and the *intervention criteria* were few, but real-life oriented: All pupils ( $N = 43$ ) should have their own tablet with access to the MSØ software. Pupils should do volume training tasks in the software a minimum of 15 minutes per day or 60 minutes per week as homework. The teachers were otherwise free to implement the use of the program in their own practice. However, the vendor advices against using the program more than 60 minutes pr. week, and also against helping the pupils because it will affect the adaptiveness of the program providing pupils with difficult tasks beyond their level of competence (Gyldendal, n.d.).

The pupils and teachers involved had used the program (unsystematically) earlier, and thus had a basic knowledge of its use. To establish a baseline start-up, all use of the program was stopped in the last 3 weeks prior to the intervention. At the beginning of the intervention during the transition between phase 1 and phase 2, a pre-test was conducted to collect data about the pupils' motivation, basic psychological needs, perceived learning and perceived competence (the survey) and the pupils' baseline knowledge about the theme (fraction and percentage) for the intervention period (the mathematics test). The survey questions were derived from validated items in self-determination (27 items), perceived learning (4 items) and competence (4 items) and adapted to the pupils' context and age. Thus, experienced learning had only 4 items, but one of the questions was a reversed control question for comparison. Language and meaning content in the survey was developed over a period of several weeks. The participating teachers and experienced professionals in quantitative methodology was consulted during this period. The survey was also piloted during the development phase, and the researchers were actively conscious of monitoring for misconceptions during the pre-test.

The mathematics test consisted of 11 tasks and activities and was made by the teachers involved according to the following criteria: 1–3: Easy tasks far below national curriculum, 4–6: Towards national curriculum, 7–9: In line with national curriculum, 10–11: Tasks beyond national curriculum.

#### Phase 2 and 3: Observation during the intervention

During the first two weeks, the intervention was observed qualitatively (Fangen, 2004; Merriam & Tisdell, 2016; Tjora, 2017) through participating in fieldwork (5 working days) and classroom observations (2 × 45–60 minutes in each class). The data from the survey and the mathematics test were preliminary analysed beforehand and formed an understanding of the pupils' starting point. The aim was both to understand how the teachers implemented the intervention in their practice and how the pupils responded. The findings of this work also contributed to a revision of the interview guides. During the last two weeks, the intervention was observed through participating in fieldwork (4 working days) and through semi-structured interviews (Kvale & Brinkmann, 2009) and focus group interviews (Merriam & Tisdell, 2016). The aim of the interviews was to challenge and validate the preliminary understanding and to gain deeper insights into the complexity of implementing ALT.

The interview guides were based on both theoretical categories from phase 1 and preliminary findings and analyses from phase 2. Contextual and descriptive questions were deliberately asked in the beginning of the interviews, while more evaluative and validating/contrasting questions were asked later on. Active listening and second questions were also emphasised during the interviews (Kvale & Brinkmann, 2009).

DP is considered a process philosophy for dialoguing with difference, which entail an underlying assumption that much of reality is plural and dynamic rather than

singular and static (Johnson, 2017; Johnson & Stefurak, 2013). The study aimed to go beyond narrow measures (Collins et al., 2004, p. 18), and the axiology of the study therefore imply pupils life-world experiences and perceptions as valuable perspectives. Since we know little about how upper primary pupils experience working with ALT (within a LA-system), the emic viewpoint of the pupils was considered to be an important epistemological contribution (Johnson & Christensen, 2017, p. 306). Pupil interviews would voice the pupils and bring their reasoning into the understanding how ALT affects their learning and motivation, from their point of view. The pupil interviews were carried out as focus group interviews. Three pupils from each of the participating classes (N1:3, N2:3 and N3:3) were asked questions about learning, their learning environment, the use of technology in general and the use of adaptive technology specifically. Group interviews were preferred over individual interviews in an effort to understand the lifeworld of the pupils better, to balance out the power asymmetry associated with the research interview, and to avoid a therapeutic turn of the interviews (in line with the informed consent) (Kvale & Brinkmann, 2009). The pupil interviews lasted a total of 132 minutes.

#### Phase 4: Mixed analysis process – the integration of results

The analysis work in phase 4 was done step-by-step (Figure 5). The quantitative data were statistically analysed to comparatively explore if the pupils' learning outcomes, perceived learning, competence and motivation had changed during the intervention. The qualitative analyses contributed complementary information (voiced by the pupils themselves) regarding how they experienced the use of ALT during the intervention. Integrating the two perspectives served two purposes: 1) to offer the practitioners at the case school multiple perspectives on how their pupils experienced the ALT and thus to enable them to improve their facilitation of learning, and 2) to contribute to further research on ALT by suggesting some theoretical implications for further research (e.g. Collins et al., 2004).

#### Ethical considerations

The study was designed in collaboration with the teachers and school leaders involved, and was approved by the Norwegian Centre for Research Data (NSD). Informed consent was obtained by parents and pupils prior to the intervention. In line with the assessment of the NSD, informed and active consent from the participants was repeatedly emphasised throughout the project (Johnson & Christensen, 2017, p. 135–136). However, real-life interventions and connected data collection have ethical implications beyond formal approval and informed consent, as school is not an optional activity in itself (Merriam & Tisdell, 2016). Since some of the pupils should not attend (due to special needs or not consenting), it was important to additionally collaborate with the teachers to find good solutions that did not create a visible and stigmatizing distinction between the pupils who would participate and the pupils who would not partici-



pate. To avoid collecting personal data from pupils who were not to participate (without refusing those pupils to do their homework) researchers could e.g. not obtain direct prints of student activity in MSØ. Instead, the teachers and the researchers had updating conversations (weekly) about the pupils' scope of activity and their academic progress based on the teacher dashboard view. It was also decided to hand out the test and survey on paper to ensure the anonymity of the participating pupils. The design of the encrypted data collection tools (which the researchers had access to) was not considered to be sufficiently adaptable to the pupils' age and needs. Although the school and teachers participated in the design of the study, they should not have access to the pupils' responses and personal information in line with the informed consent. Therefore, it was considered important to take precautions possible to avoid information leak (Johnson & Christensen, 2017).

**Analysis and results**

**Quantitative analysis and results**

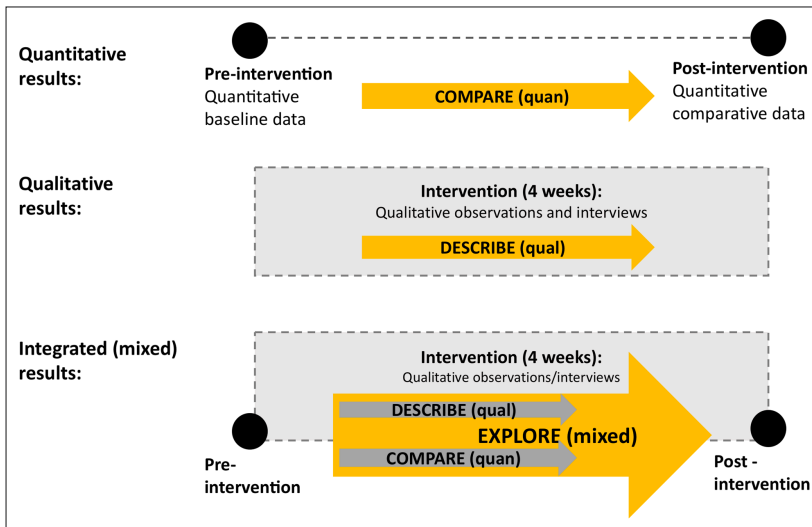
We performed a statistical analysis with SPSS 19 (Statistical Package for Social Science, Chicago, USA). All table values are expressed as a mean ± standard deviation (SD). Changes within groups from pre- to post-test, were determined by the paired sample T-test. A two-tailed  $p < 0.05$  was accepted as statistically significant for all tests. To investigate the magnitude of the effect in the case within each group and between groups, the effect size (ES) was calculated in the form of Cohen's d (Cumming, 2012) for

primary outcome variables. We used the web-based Practical Meta-analysis Effect Size Calculator<sup>1</sup> (Lipsey & Wilson, 2001) to calculate Cohen's d. An ES of 0.2 is regarded as small, 0.5 as medium and 0.8 as large (Cumming, 2012).

The registered learning improved moderately from pre-intervention to post-intervention (ES 0.39,  $P = 0.001$ ; **Table 1**). However, there seems to be a decrease in perceived learning. The perceived learning (reversed control question) shows a moderate to large decrease (ES 0.86,  $P = 0.004$ ; **Table 2**). Intrinsic motivation, identified and external regulation do not change, but there is a moderate increase in amotivation from pre- to post-intervention (ES 0.4,  $P = 0.039$ ; **Table 3**). No changes are revealed in basic psychological needs (**Table 4**).

**Qualitative analysis and results**

The focus group interviews were transcribed in the original language (Norwegian). In order to preserve the pupils' diverse and complex experiences and opinions, the category-based analysis had a step-by-step deductive-inductive approach (Schoonenboom & Johnson, 2017; Tjora, 2017). The transcribed interviews were first analysed by categories related to learning, competence and motivation to look for clear patterns. Second, they were compressed through a multitude of lifeworld-based subcategories derived from the pupils' own perspectives. These subcategories were subsequently sorted into the following overall categories: 1) contextual factors, 2) the use of technology in general, 3) ALT and 4) learning, competence and motivation.



**Figure 5:** Step-by-step analyses and integration of results in phase 4.

**Table 1:** Registered learning (overall results pre-test/post-test in mathematics). Scoring of the test as previously described in the methods section.

Level	Pre-intervention	Post-intervention	Difference	95% CI	ES	P-value
Total (N = 40)	6.13 (2.69)	7.18 (2.72)	1.05 (1.83)	0.466, 1.63	0.39	0.001**

**Table 2:** Perceived learning and competence Likert scale 1–5: 1 = Strongly disagree, 5 = Strongly agree.

Variable	Pre-test	Post-test	Difference	95% CI	ES	P-value
Perceived competence	3.90 (0.63)	3.91 (0.61)	0.008 (0.56)	−0.19, 0.17	0.01	0.926
Perceived learning	3.62 (0.84)	3.34 (0.83)	−0.28 (1.08)	−0.7, 0.62	0.33	0.116
Perceived learning (reversed question)	2.15 (1.14)	2.93 (1.12)	0.78 (1.58)	−1.28, −0.27	0.68	0.004**

**Table 3:** Motivation Likert scale 1–5: 1 = Strongly disagree, 5 = Strongly agree.

Variable	Pre-test	Post-test	Difference	95% CI	ES	P-value
Intrinsic motivation	3.62 (0.88)	3.48 (0.89)	−0.14 (0.63)	−0.06, 0.33	0.15	0.173
Identified regulation	4.25 (0.58)	4.15 (0.61)	−0.10 (0.63)	−0.10, 0.30	0.16	0.298
External regulation	2.84 (0.61)	2.89 (0.59)	0.04 (0.46)	−0.19, 0.10	0.07	0.556
Amotivation	1.68 (0.59)	1.93 (0.65)	0.24 (0.72)	−0.47, −0.01	0.4	0.039*

**Table 4:** Basic psychological needs Likert scale 1–5: 1 = Strongly disagree, 5 = Strongly agree.

Variable	Pre-test	Post-test	Difference	95% CI	ES	P-value
Autonomy	3.69 (0.62)	3.75 (0.61)	0.06 (0.51)	−0.22, 0.10	0.09	0.450
Relatedness	4.46 (0.59)	4.43 (0.57)	−0.02 (0.52)	−0.14, 0.19	0.03	0.766
Competence	3.73 (0.52)	3.85 (0.61)	0.12 (0.57)	−0.30, 0.06	0.28	0.186

To provide an emic (inside out) insight into the pupils reasoning and voice about how learning with ALT relates to their everyday practice in school, we will first show some selected passages from the focus group interviews. Descriptive quotations were translated into English and slightly adjusted linguistically and grammatically to keep their original content meaning. The names of the pupils are fictional.

**Integration between homework and classroom practice when adaptive technology is used**

All the participating pupils (N = 9) described the ALT program in similar ways: as a task and activity-generator in which a right answer was supposed to provide them with harder tasks and a wrong answer was supposed to provide them with easier tasks.

- It is a website where you can solve math tasks. And if you get the answer right you will get harder tasks, and if you get the answer wrong you will get easier tasks. (Jon, seventh grade)

**Could you describe a typical mathematics class? What do you do then?**

- We are working in our book or in the ALT program, really. (Kristian, seventh grade)
- We come in, do tasks from the book, and then we get a break and walk up to a light pole and back. And then we do tasks in the ALT program or something like that. Or just continue with the book. (Jon, seventh grade)

**What do you do if there is something you don't understand or can't do?**

- We ask the teacher or the pupil sitting next to us. (Kristian, seventh grade)

**Do you work alone or in groups?**

- Alone. (Astrid, seventh grade)
- Mostly alone. But sometimes we collaborate. (Kristian, seventh grade)

The seventh-grade pupils thus described an individual volume training classroom practice, and framed the ALT homework as more or less an extension of this practice.

- We draft our answer in our writing books if the task is difficult. And there are assignments where you are supposed to write what you think is correct without getting things wrong. Kind of. (Kristian, seventh grade)
- At school we have to use our writing book, but at home I do it all in my head. (Jon, seventh grade)

**You don't feel the need to draft your answer?**

- No. (Jon, seventh grade)

The fieldwork and classroom observation identified the sixth-grade classroom as varying between group and individual practice. The pupils also described the practice as a combined one, which varied between collaborative practical mathematics and individual volume training in the ALT program.

**What do you typically do during math classes?**

- Multi Smart. (Svein, sixth grade)
- We have used it for quite some time. For me, that is fun. (Tove, sixth grade)

**Do you work alone or together during class?**

- Actually, we work mostly together. (Tove, sixth grade)  
[The pupils further described a project they were working on in groups during the intervention.]

- Otherwise, it is a bit individual. (Svein, sixth grade)
- Yes, we do tasks alone. (Tove, sixth grade)
- What do you think about working on the same (ALT) program, but on different levels and on different challenges?**
- I think it is okay because ... well, it is okay to do harder tasks if you need it. (Knut, sixth grade)
- It is ... like ... adjusted to *you*. Personally. How *you* handle the tasks. (Tove, sixth grade)
- And it is much easier to know how long you have been doing tasks because of the time. (Knut, sixth grade)

Even if the two classroom practices were different, a common trait shared by the sixth and seven graders was that they did not particularly distinguish between homework and schoolwork. Their answers throughout the interviews indicated an intertwined practice where some parts of the work were done at school whilst other parts were done at home. They did not fully enjoy all aspects of doing neither their homework or their schoolwork, but they seemed to accept and value both as part of their learning process. This point becomes particularly visible when compared to the fifth-grade pupils' answers to the same question about their classroom practice.

**Could you describe a typical mathematics class? What do you do?**

- The teacher gives us an assignment and asks us to do it. (Ingrid, fifth grade)
- The teacher first explains by using other examples, so we understand. And then we understand that the assignment [we are supposed to work on] is somewhat different, but that we are supposed to do it the same way. But we don't get that in Multi Smart. We just have to try to explain it to ourselves. And we can't do that, because we don't know how to. (Kari, fifth grade)

This response is representative of how the fifth-grade pupils framed the use of the ALT program throughout the interview. Despite repeated attempts to keep the first part of the interview on a descriptive level, the pupils responded to most questions by attaching some sort of criticism about the ALT program. They were especially and explicitly critical towards using ALT as homework. The fieldwork and classroom observation had identified the fifth-grade classroom as mostly group-oriented, where collaborative problem-solving was a key ingredient. However, the fifth-grade pupils also did some ALT tasks at school when they had time to spare. The previous classroom observation carried no obvious indications of strong negative emotions such as frustration, and the pervasive critical rhetoric of the fifth-grade pupils' interview was thus somewhat surprising.

It was an overall aim of the interviews to understand whether and how the ALT mediated volume training at home, and how this volume training corresponded to the general classroom practice during the intervention. Although the participating teachers shared common visions of active, motivated pupils who engaged in deep learning, these visions were operationalised through different practices in each of the classrooms. Informed by previous fieldwork and classroom observations, it was thus an aim for the researchers to understand how the logic of ALT corresponded to the dominant learning practices in each classroom and each learning environment (as previously illustrated in **Figure 2**). The main findings from analysing the student interviews in relation to the integration of MSØ homework and classroom practices during the intervention can be visually presented in the following way in **Figure 6**.

The figure aims to represent whether or not the pupils perceived an integration of ALT homework in their classroom practice. There seem to be contrasting views of the

Coding:	5th grade	6th grade	7th grade
Segmenting and coding	Often overlapping and co-occurring codes	Little overlapping and co-occurring codes	Little overlapping and co-occurring codes
Main classroom practice (CP) during intervention	Group (and some individual) assignments. Help from teacher/other pupils when needed.	Group (and some individual) assignments. Help from teacher/other pupils when needed.	Individual assignments and help from teacher when needed.
Homework (HW) during intervention	MSØ assignments. Is generally referred to as negative.	MSØ assignments. Is generally referred to as positive.	MSØ assignments. Is generally referred to as positive.
General experience of integration between CP and HW	Described as two incoherent practices.	HW described as an extension of CP.	HW described as an extension of CP.

**Figure 6:** Integration between homework and classroom practice when adaptive technology is used.



sixth- and seventh-grade pupils on the one hand and the fifth-grade pupils on the other. The fifth grade pupils were especially and explicitly critical towards using ALT as homework, beyond the (critical) viewpoints of the sixth and seven grade pupils. Even in short text passages, there were many overlapping codes in the fifth-grade interview. When they talked about classroom practice, they made a point of criticizing MSØ for not offering help and support as the teacher does in the classroom. And when they talked about the homework, they pointed out what they missed and wish the program could offer. This partially divergent perception between pupils thus inspired a new question: Why did the sixth- and seventh-grade pupils seem to accept and value volume training in MSØ more than the fifth graders did?

**Competence, learning and motivation when adaptive technology is used**

From a SDT perspective, the frustration of the fifth grade pupils might be associated with a lack of internally regulated motivation for learning (Ryan & Deci, 2000b). The motivational category in the analysis of the interviews may thus provide deeper insight regarding the contrasting views of the sixth- and seventh-grade pupils on the one hand and the fifth-grade pupils on the other. The motivational categories for analysing the qualitative data were derived from SDT’s taxonomy of human motivation (Deci & Ryan, 2014; Ryan & Deci, 2000a) as illustrated in **Figure 7**.

ALT factors that were interpreted as undermining or enhancing pupils’ internally regulated motivation are summarised in **Table 5**. To provide an emic insight into the pupils reasoning and voice about how learning with ALT influence their learning, motivation and feeling of competence, we will additionally show some selected passages from the focus group interviews below **Table 5**. The selected quotations exemplify how the pupils talked

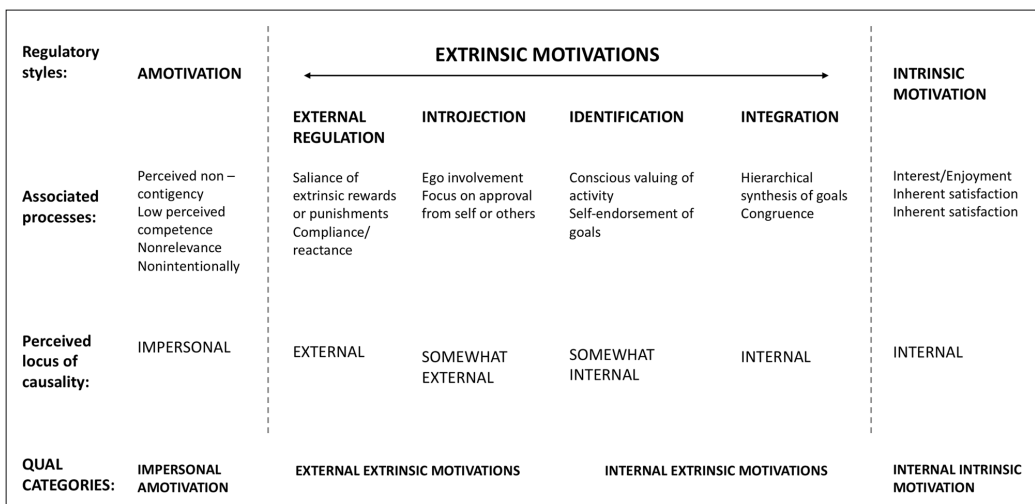
about mathematics, learning and ALT, and how their experiences were interpreted within the framework of SDT (**Figure 7**).

When asked explicitly whether they liked working in the program the sixth- and seventh-graders were generally relatively positive. However, they also raised some objections:

- It is okay. (Jon, seventh grade)  
**If you were to compare it to the book, for instance, do you like it better?**
- I think... I like the book better. But I like both, really. (Kristian, seventh grade)
- I kind of think the book is better. At least if we have homework. Because when we are working in the program, we have to do 15 minutes no matter what. But if we use the book, we might complete the homework sooner if we work fast. Because we usually have like 5 assignments [in the book], and that doesn’t take 15 minutes. (Jon, seventh grade)

Some of the pupils noted that the program did not reward slow work either. For example, David, a fifth-grade pupil, figured out how to solve a difficult task, but the time ran out before he was allowed a second try.

- I had been thinking for five minutes, trying to figure it out. How the task could be solved. Because I had never solved that kind of task before. So I was thinking for a long time. How to do it. When I finally figured it out and pressed the button, it was wrong. I had been thinking about it for a really long time, and finally figured out how to do it. (David, fifth grade)  
**What did you feel then? When you had spent so much time?**
- I thought it was stupid. (David, fifth grade)



**Figure 7:** Qualitative categories derived from “The taxonomy of human motivation” (Deci & Ryan, 2014; Ryan & Deci, 2000a).

**Table 5:** ALT and factors that increase or decrease internal forms of motivation (pupil perspective).

PERCEIVED LEVEL OF COMPETENCE	REASONS WHY THEY LIKED ADAPTIVE LEARNING Increasing motivational factors	REASONS WHY THEY DID NOT LIKE ADAPTIVE LEARNING Decreasing motivational factors
<b>Pupils who described themselves as “not very good” in mathematics</b>	Explicitly did not like it.	Expressed greater resistance towards ALT than other tools and methods. Did not feel that the technology contributed what they wanted or needed (and expected). Expressed an unmet need for human support and help. Disliked the measurement, comparison and control aspect, especially regarding the time control and number of tries available. <b>AMOTIVATION and EXTERNAL REGULATION</b>
<b>Pupils who described themselves as “ok” in mathematics</b>	Experienced that the technology generally met their needs and provided variation and exciting activities. Provided clear and structured framework for activity. <b>INTERNAL REGULATION</b>	Disliked the measurement, comparison and control aspect, especially regarding time. Did not trust/understand the integrated clock. Expressed lack of human presence and judgement. <b>EXTERNAL REGULATION</b>
<b>Pupils who described themselves as “good/very good” in mathematics</b>	Experienced that the technology generally met their needs and provided variation and exciting activities. Enjoyed math activities regardless of method and learning recourses. <b>INTERNAL REGULATION/INTRINSIC MOTIVATION</b>	Disliked the measurement, comparison and control aspect, especially regarding time control. Experienced the technology as limiting in a number of ways. Expressed lack of human presence and judgement. (NB: One pupil explicitly did not like ALT at all.) <b>EXTERNAL REGULATION</b>

Issues regarding the time control were both initiated and elaborated on by all the interviewed pupils. Two perspectives were mainly identified as problematic: 1) counting the minutes instead of the tasks did not reward either effective or thorough work, and 2) they did not entirely trust the time control in itself.

- And the time... It registers how much time you spend on your homework. But the time is not exact. And you might work on a really hard task, and think and write and struggle, trying to figure it out... (David, fifth grade)
- And draft an answer. (Ingrid, fifth grade)
- Yes, and draft an answer. And the time goes so slowly. And you have to get the right answer for the clock to tick. Time is time. One minute is one minute. But not there. One minute there might be three in reality. (David, fifth grade)

Another issue brought up by the pupils was how long it would take for the program algorithms to understand the pupils' level of competence, and thus provide them with the right activity.

#### **Do you like to work in the program?**

- Yes. (Knut, sixth grade)
- Yes, but it can be boring sometimes. Because, it's like, you get one task right, and you might get that same task for 15 or 20 more minutes. The exact same kind of task. Before they understand that you know it. That you get it. (Tove, sixth grade)
- Yes, but you have to do it several times for the robot to read how much you know. You have to do quite a few tasks. This one time I was supposed to measure land, on a field, and I could not do that task. But I kept on getting it. Again and again. And one time I did it. And I haven't gotten it since. (Knut, sixth grade)

- Yes, if you have given up many times or gotten the answer wrong many times you get it again and again. So you will be able to do it. (Tove, sixth grade)
- The robot wants to show you that you have to try again and again. Practice makes perfect. (Knut, sixth grade)

As previously mentioned, the fifth graders stated from the beginning of the interview that they did not like the program and the adaptive technology, especially as homework. However, they expressed their resistance differently. Kari emphasised that she was not good in math and that she didn't like doing math tasks in general. Her descriptions bear some indications of the program reinforcing her feeling of amotivation and incompetence.

- It says, “figure this out,” but often you don't know what to do. So you could ask your parents or others, who knows this stuff, so they can explain. But if your parents stay at work for a long time you just sit there. Not knowing what to do. (Kari, fifth grade)

David, on the other hand, described himself as both liking math and being quite good at it, but he critiqued how the program continually displayed data about their working process.

- One thing that upsets me is this thing about “how many did you get wrong”? And “how many times have you quit a task”? I don't find that very pleasant. It would have been much better if they focused on what you did right. Not how many you did wrong. [...] Math is one of my favourite subjects. I really like math. I like learning new things in math. But when it comes to the program, I don't find it very smart. (David, fifth grade)

The math pre-test further informed the observation that pupils demonstrated varied levels of skills and competence. It was thus important to gain insight into how pupils experienced working on math activities, both in general and in the program.

– I like best the kind of mathematics ... [stops and rephrases] ... like, easy tasks. I don't really like math, but I still have to do it. So, what I like best is kind of fun and simple tasks like plus and minus. Yes. (Kari, fifth grade)

– It is like she is saying [points to Kari]: Fun tasks are fun. And I think it is great that we also have some fun tasks in math as well. Not just multiplication and stuff. (Ingrid, fifth grade)

**Could you tell me what you mean by fun tasks?**

– Well, I kind of like almost all tasks. The only ones I don't like are the really difficult ones. But I like colouring this and that many squares in this and that colour. And placing Fibon [sic] on the number line, for example. That is fun, because you have to figure out where the ball should hit. (Ingrid, fifth grade)

**Like when it has a consequence? You don't just do the activity, but it makes something else happen?**

– Yes! (Ingrid, fifth grade)

– I like difficult math. When there is a challenge. A lot of the math we are doing now is too simple. We solve the tasks too quickly, sometimes. (David, fifth grade)

### Integrated (mixed) results and discussion

Every mixed methods research study has at least one point of integration (Schoonenboom & Johnson, 2017), and we have so far dealt with the emergent integration of methods (e.g. how one phase informed the next, and thus contributed to probes across methods Merriam & Tisdell, 2016; Creswell, 2019). Our quantitative findings show that learning in mathematics improved from pre- to post-intervention ( $ES = 0.39$ ,  $P = 0.001$ ; **Table 1**). This indicates that the pupils increased their competence in mathematics during the intervention. However, we have also shown qualitatively that pupils describe the integration of the ALT program in different ways (**Figure 7** and **Table 5**) and that there was a quantitatively registered decrease in perceived learning (**Table 2**) and an increase in amotivation (**Table 3**). In this section we will further integrate results from the study and discuss them in relation to the research question: How do systematic use of adaptive learning technology influence pupils' learning and motivation? In this part of the article we will further integrate quantitative and qualitative findings and discuss them in the light of the theoretical framework. The pupils participating in the LaT-ALT study were generally driven by internally regulated motivations whilst doing math activities, both before and after the intervention (**Table 3**). The case school's learning environment was described by the participating teachers as supportive of autonomy (Landrum & Kauffman, 2006) and in line with the paradigm shift from teacher authority and control to shared control and responsibility (Schwab & Elias, 2015; Watson & Brattstich, 2006). At the end of the intervention, however, a mod-

erate increase in amotivation was registered (**Table 3**). Amotivation was generally low both before and after the intervention, so this finding alone should not be too strongly emphasised. The qualitative analysis, however, shows a relatively large gap in the pupils' motivation for learning when using ALT. Most pupils describe adaptive learning as a fun and varied way of learning mathematics, as long as they didn't spend too much time in the program interface. The intervention criteria of 60 minutes a week corresponded with advice from the vendor, and seems to be a time frame that should not be exceeded. Even though all the pupils pointed to elements of the program they did not appreciate, most of them were still generally positive towards using it both at home and in school. For most pupils, the program seems to contribute to volume training in line with internally regulated (positive) motivation. They especially emphasised the varied activities as something they enjoyed, and said that the volume training was easier when they did not have to write full answers or draft their calculations.

We still find a contrasting pattern among the fifth-grade pupils. Their critical attitudes to the adaptive learning tool were pervasive, but the argumentation was not unambiguous. The pupils point out that the modelling of solution alternatives is poor and that technical solutions are weak. This does not necessarily mean that they are right in their evaluations, but it is interpreted as indicating that pupils have high expectations of what the program can contribute to their learning processes. The fifth-grade pupils also said that the program's inherent summative feedback (stars and diamonds etc.) was being used by pupil peers in the classroom environment to compare themselves to others. Such easily comparable measures may, according to the taxonomy of human motivation (Ryan & Deci, 2000b) contribute to a more externally regulated (negative) motivation (or, ultimately, amotivation). The fifth-grade pupils generally indicated that the program controlled their homework and learning processes in a way they did not appreciate. This could be seen in light of ethical and pedagogical implications of ALT and LA (Prinsloo & Slade, 2017; Bergner, 2017; Hoppe, 2017). The technology can give a precise overview of the pupils activities and thus be used to facilitate learning, but the overview can also be perceived as controlling by the pupils. The fifth graders described the logic of the program as a controlling and frustrating one (Landrum & Kauffman, 2006). A key question in this context is why the fifth grade pupils expressed a more externally oriented and thus negative motivation when using ALT than the sixth and seventh grade pupils did? One piece of this complex puzzle may be found in the learning outcome data. Data transformation (Johnson & Christensen, 2017) allows us to view the learning outcomes from another point of view, and through transforming the (pre/post) mathematics results it can be shown that the average progress is more complex than **Table 1** implies at first glance (as illustrated in **Figure 8**).

When the pupils' level of competence before and after the intervention is color-coded (in line with the taxonomy of the mathematical test), we see that a large proportion of

pupils (most prominently in seventh grade) demonstrated competence at or beyond the national curriculum level after the intervention. These pupils increased the average level of competence registered. The figure additionally shows that some pupils already had demonstrated a high level of competence before the intervention, and that even more pupils demonstrated a high level of competence after the intervention. However, in fifth grade there were more pupils who demonstrated a competence far below the curriculum level after the intervention than before. These pupils thus demonstrated lower competence after the intervention than before. According to SDT, lower registered competence might interact with other SDT-variables connected to learning (Deci & Ryan, 2004). As a single result, this decrease in learning outcomes can be explained in various ways. The same can be said about the criticism the pupils communicated through the qualitative interview. But together (and combined) the two results constitute an indicator that the intervention cannot be said to have been entirely successful in the fifth-grade learning environment. Systematic introduction of ALT seems to have had some sort of negative influence on the fifth-grade pupils.

Another piece of the puzzle might be found if we compare the class-level results (Figure 8). If the results are read horizontally (from fifth grade to seventh grade), we can see the contours of progress throughout the class levels (even if they are not strictly coherent). The circles become increasingly (dark) green. The national curriculum in Norway (KL06) is not specifically attached to a certain grade level, but identify competence aims after the second grade, fourth grade, seventh grade etc. The fifth graders in the LaT-ALT study can therefore be said to be beginners in a new mathematical learning cycle that the sixth-grade pupils are in the middle of, and the seventh-grade pupils are about to end. From this perspective, it makes sense that the fifth-grade pupils are calling for clearer modelling and explanations, and are criticising the program for giving them too little time to think. The teachers collaborated

to adapt both their teaching and the math test to a level of competence appropriate to the pupils' class level and age (known as the Knowledge Promotion Reform initiative), however, the individual pupil must still acquire a basic understanding of new words and key mathematical concepts. The acquisition of knowledge and understanding is an individual process that requires time and concentration and should maybe not be rushed through standardized time use. This is a central part of the learning process and the entrance to a learning cycle will thus be decisive for the pupil's perceived competence and motivation for further learning (Liu et al., 2016). A pupil who strives to understand basic thematic concepts will have difficulty seeing how the same concepts can have practical utility in activities. According to the taxonomy of human motivation (Ryan & Deci, 2000a) IPLOC will influence pupils' motivation for learning. Pupils who feel competent and able to do their assigned activities will most likely experience emotions associated with internally regulated motivation. On the other hand, pupils who feel less competent and unable to do their assigned activities will most likely experience emotions associated with externally regulated motivation or amotivation. This point does not only apply to ALT. However, the participating pupils were aware of the inherent potential of the technology, and thus expected more from ALT than from more traditional tools such as books.

According to Mathison (1988), the importance of triangulation is not limited to validating findings. She also emphasises the value of elaborating convergence, contradiction and inconsistency in mixed methods results and findings. An important methodological implication of the LaT-ALT study is that the quantitatively observed progress in learning outcomes mainly converges with, but also partly contradicts, the lifeworld experiences of the participating pupils. This inconsistency is visible in the transformed data (Figure 8), in the qualitative material (Figure 6 and Table 5) and in the statistical analysis

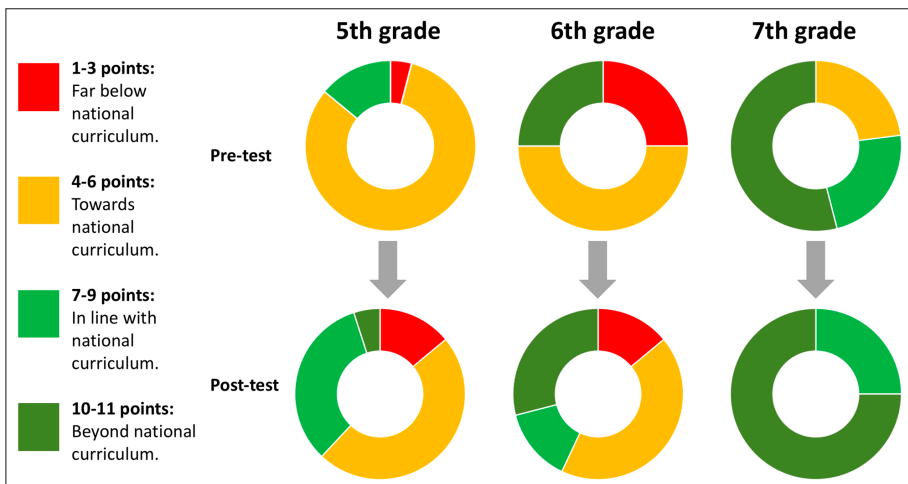


Figure 8: Pupils' levels of competence before and after the intervention.

(Tables 2 and 3). One can thus say that the use of ALT could potentially help streamline volume training and root learning, and thus free up time for practical mathematics and deep learning in line with Fagfornlysen. However, the use of ALT also seems to have some associated challenges, especially related to pupils who struggle to grasp new mathematical concepts. This partially contradicts previous findings (Roschelle et al., 2016). Winne (2017, p. 248) notes that it is statistically very unlikely any two learners' data signatures perfectly match when emphasising how ALT and LA must balance between accuracy and generalisation. This challenge applies particularly to primary school pupils who have to learn and understand basic principles while at the same time do volume training. The very intention of ALT-mediated volume training is to create personalised challenges in the pupils' flow zone, between boredom and anxiety (Gallego-Durán et al., 2018). Feelings of competence and a sense of autonomy are important factors that generate variability in feelings of flow and intrinsic motivation. Individuals must experience both perceived competence (self-efficacy) and the activity to be autonomous and self-determined and for intrinsic motivation to be maintained or enhanced (Ryan & Deci, 2000b). If the volume training is not sufficiently personalised, or if the pupils are not sufficiently prepared to enter the ALT activity loop, it might lead to a volume of frustration (as opposed to a volume of training/learning), decreasing the pupils inherent motivation for learning. The fifth-grade pupils' interview bore indications of the pupils wanting to progress in their learning process, but experiencing that MSØ did not help them understand as they had anticipated:

– You get things wrong, but you don't know what is right if you are home alone. So maybe it could show you the explanation? Before or after? And then you could try a bit for yourself as well. But there are too few tries. I think you ought to have more than three tries. Even if you have just one tiny error, everything is wrong. [...] They use difficult words in the tasks you are supposed to work on. (Kari, fifth grade)

### Conclusion

The LaT-ALT study shows that the use of ALT can help streamline volume training and root learning, and thus free up time for practical mathematics and deep learning. ALT can contribute to student learning outcomes at an average level ( $ES = 0,39$ ,  $P = 0,001$ ), across different classroom practices. ALT could also positively motivate pupils by offering varied and customised learning activities and tasks. However, the relationship between learning, motivation and volume training when ALT is systematically introduced seems to be intertwined. This relationship becomes especially apparent in the group of pupils who were meeting new mathematical concepts for the first time during the intervention. Pupils who had previous knowledge of the mathematical concepts expressed an aligned connection between school activities and volume training at home, while the pupils who were at the beginning of a new learning cycle expressed a greater degree of

colliding logics between the volume training at home and the learning activities at school. We suggest that teachers should be aware of the difference between externally regulated motivation and internally regulated motivation when integrating ALT in their practice. The study thus concludes that ALT-mediated volume training should be carefully introduced if pupils do not have sufficient basic knowledge in key mathematical concepts. Although the program is supposed to be individualised and self-adjusting, it is crucial that teachers monitor the pupils' use and mastery to avoid pupils being stuck in frustration spirals.

The LaT-ALT study is a small-scale study and more research is needed. We especially encourage research investigating the interplay between the learning of new concepts and volume training in adaptive learning programs.

### Limitations

The lack of a control-group and the real-life design of the study makes it hard to determine to what extent the tool itself directly affected the quantitative results.

### Note

<sup>1</sup> <https://www.campbellcollaboration.org/escalc/html/EffectSizeCalculator-SMD1.php>.

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### Competing Interests

The authors have no competing interests to declare.

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# **Article 3**





## Appendix 1: Review iterations

An overview of review rounds during the project (including courses which provided relevant literature). The overview is not complete and exhaustive, but it provides some transparency to the scope and selection of references and sources.			
Round of review (year)	Aim of review:	Included sources:	Relevant findings and perspectives:
Spring 15 Spring 16 Spring 16 Fall 16			
	Theory of science, methods and ethics <sup>1</sup> , (University of Bergen) 8 credits		
	Structural terms for professional practice <sup>2</sup> , (Volda University College) 5 credits		
	Theory of Science <sup>3</sup> , (Volda University College) 5 credits		
	Literature review at Ph.D level (WNGERII/Univeristy of Bergen) 3 credits		
1 (2015-2016)	Positioning of the project as a whole.  Formulating preliminary research question(s).	Personal archive of books, grey literature and peer reviewed articles.  <b>Search strings in library databases:</b> <b>ICT AND “CLASSROOM MANAGEMENT” AND “DIGITAL COMPETENCE” AND “CLASSROOM MANAGEMENT”</b>  Unsystematic searches for key phrases and relevant concepts.  <b>Added:</b>  <b>Chapter:</b> about CM and ICT: Bolick, & Barthels. (2015). <i>Handbook of classroom management</i> (E. T. Emmer & E. J. Sabornie, Eds.; Second edition).  <b>Chapter:</b> about CM and ICT: Bolick, & Cooper. (2006). <i>Handbook of classroom management: Research, practice, and contemporary issues</i> (C. M. Evertson & C. S. Weinstein, Eds.).  <b>Book:</b> Krumsvik (2014). <i>Klasseledelse i den digitale skolen</i> .  <b>Report:</b> Krumsvik et. al. (2011). <i>The Rogaland study</i> . <b>Report:</b> Krumsvik et. al. (2013). <i>The SMIL study</i>	Matters of ICT and classroom management tends to be dealt with as a separate unit, isolated from the ecology and context in which it plays out in real life practices.  The overall aim of the study will thus be to explore classroom management and use of ICT within its dynamic real-life context.
2 (2016-2017)	<b>Conceptual framework for article 1</b>  Formulating research question(s).	Personal archive of books, grey literature and peer reviewed articles. Including previously added items from round 1.  <b>Added:</b>  <b>Book:</b> Emmer & Sarbornier (2015). <i>Handbook of classroom management</i> . Second edition). Routledge, Taylor & Francis Group.  <b>Book:</b> Evertson and Weinstein (2006). <i>Handbook</i>	Create a framework for discussing the relationship between teachers professional digital competence and their classroom management. Synthesize CM and DC-literature.

<sup>1</sup> PS901Forskningsdesign, metode, etikk og vitenskapsteori

<sup>2</sup> DRHS900 Strukturelle vilkår for profesjonsutøving

<sup>3</sup> DRHS902 Vitenskapsteori og etikk

		<p><i>of classroom management: Research, practice, and contemporary issues.</i> Lawrence Erlbaum Associates.</p> <p><b>Journal articles</b> on mixed methods, MMR, triangulation and Dialectical Pluralism.</p> <p><b>Books</b> on quan- and qual- methods.</p>	
<b>Spring 17 Fall 17</b>	Professional theory, practice and professional ethics <sup>4</sup> , (Volda University College) 5 credits Design-based Research and Case Studies, (University of Oslo) 1 credit		
<b>3 (2016- 2017)</b>	<p>Designing the Lat-ALT-study</p> <p>Formulating aims, purposes and RQs.</p>	<p>Personal archive of books, grey literature and peer reviewed articles. Including previously added items from round 1 and 2.</p> <p>Unsystematic searches for key phrases and relevant concepts.</p> <p><b>Added:</b> <b>Journal article:</b> Roschelle et. al (2016). Online Mathematics Homework Increases Student Achievement. <b>Journal articles</b> on SDT, adaptive learning technology, learning analytics, quasi statistics, DBR, case studies and more on MMR. <b>Books</b> on quasi experimental research and</p>	<p>Understand implications of ALT and LA. Understand motivation and how to measure it.</p> <p>Understand the limitations and strengths of DBR and interventions in RL contexts.</p>
<b>Spring 18</b>	Mixed Method Research, (WNGERII/University of Bergen) 1 credit		
<b>4 (2018- 2019)</b>	<p><b>Conceptual framework for article 2</b></p> <p>Refine aims, purposes and RQs.</p> <p><b>Conceptual framework for article 3</b></p> <p>Refine aims, purposes and RQs.</p>	<p>Personal archive of books, grey literature and peer reviewed articles. Including previously added items from round 1-3.</p> <p><b>Search strings in library databases:</b> Unsystematic searches for key phrases and relevant concepts.</p> <p><b>Added:</b> <b>Book:</b> C. Lang, G. Siemens, A. Wise, &amp; D. Gasevic (Eds.)(2017). Handbook of Learning Analytics. <b>Book:</b> W. C. Liu, J. C. K. Wang, &amp; R. M. Ryan (Eds.) (2016). Building Autonomous Learners. Springer Singapore. <b>Books</b> on mixed research paradigms and methods.</p>	<p>Understand the interaction between DBR and MMR.</p> <p>Explore pupil data in light of ALT, LA and SDT literature.</p> <p>Explore teacher data in light of CM, CD, SDT and LA/ALT literature.</p>
<b>Fall 19 Fall 19</b>	Writing the synopsis in a doctoral thesis, (WNGERII/University of Bergen) 1 credit The use of theory in educational research, (WNGERII/University of Bergen) 1 credit		
<b>5 (2019- 2020)</b>	<p>Writing the thesis and refine overall aims, purposes and RQs.</p>	<p>Personal archive of books, grey literature and peer reviewed articles. Including previously added items from round 1-4</p> <p><b>Search string:</b> <b>ICT AND "CLASSROOM MANAGEMENT"</b> Unsystematic searches for key phrases and relevant concepts.</p>	<p>Position the overall coherence of the study within recent research literature.</p>
<b>2015-2020</b>	The total scope of included references are found in the thesis reference list, and in the reference lists of each article.		

<sup>4</sup> DRHS904 Profesjonsteori, skjønnutøvelse og profesjonsetikk

## Appendix 2: References excluded from the search strings.

Total amount of excluded references: 14 of 53 = 36 (36) articles for review

	Source:	Reason(s) for exclusion:
1	Ramírez, E., Clemente, M., Recamán, A. et al. (2017). Planning and Doing in Professional Teaching Practice. A Study with Early Childhood Education Teachers Working with ICT (3–6 years). <i>Early Childhood Educ J</i> 45,	Kindergarten/pre-school level
2	Lakarnchua, O. & Wasanasomsithi, P. (2013) What is said and what is done: EFL Student Writers' Perceptions of Peer Feedback. <i>The Turkish Online Journal of Distance Education</i> . 14 (4)	Dead link despite open access policy.
3	Bdiwi, R., De Runz, C., Faiz, S., Cherif, A. (2019). Smart Learning Environment: Teacher's Role in Assessing Classroom Attention. <i>Research in Learning Technology</i> . 27	Higher education without (sufficient) relevance for teacher training.
4	Nikolopoulou, K. & Gialamas, V. (2015). ICT and Play in Preschool: Early Childhood Teachers' Beliefs and Confidence. <i>International Journal of Early Years Education</i> . 23.	Kindergarten/pre-school level
5	Mereku, D. & Mereku, C. (2015). Congruence between the Intended, Implemented, and Attained ICT Curricula in Sub-Saharan Africa. <i>Canadian Journal of Science, Mathematics and Technology Education</i> . 15.	Not able to access article according to criteria
6	Using Information and Communication Technology (ICT) to Enhance Language Teaching & Learning: An Interview with Dr. A. Gumawang Jati	Considered not relevant. Interview (even if peer-reviewed article was criteria).
7	Dintoe, S. (2018). Educational Technology Adopters: A Case Study in University of Botswana. <i>International Journal of Education and Development using Information and Communication Technology</i> . 14 (1)	Higher education without (sufficient) relevance for teacher training.
8	Schrad, M. (2010). In Defense of the Populist Lecture. <i>Political Science &amp; Politics</i> . 43(4).	Higher education without (sufficient) relevance for teacher training.
9	Trentin, G. (2008). TEL and University Teaching: Different Approaches for Different Purposes. <i>International Journal on E-Learning</i> . 7(1)	Higher education without (sufficient) relevance for teacher training.
10	McLoughlin, C. (2011). Leading Pedagogical Change with Innovative Web Tools and Social Media. <i>International Journal of Adult Vocational Education and Technology</i> . 2(1)	Higher education without (sufficient) relevance for teacher training.
11	Nomdo, G. (2004). Collaborating Within the "Risk Zone": A Critical Reflection. <i>Active Learning in Higher Education the Journal of the Institute for Learning and Teaching</i> . 5 (3).	Higher education without (sufficient) relevance for teacher training.
12	Jordan, K. (2008). "But It Doesn't Count, Sir"-A Conversation about Using Electronic Discussion in VCE English. <i>English in Australia</i> . 43 (2)	Forbidden access directly from link. Not found in Oria (forbidden suggested as reason).
13	Marengo, A. & Marengo, V. (2005). Measuring the Economic Benefits of E-Learning: A Proposal for a New Index for Academic Environments. <i>Journal of Information Technology Education</i> . 4	Higher education without (sufficient) relevance for teacher training.
14	Cinkara, E. (2018). Analysis of EFL Teachers' Use of Digital Components: Evidence from Self-Report and Classroom Observation. <i>Eurasian Journal of Educational Research</i> . 74	Higher education without (sufficient) relevance for teacher training.

## Appendix 3: Study 1 - Project evaluation and approval from NSD.

Rune Johan Krumsvik  
Institutt for pedagogikk  
Universitetet i Bergen  
Christies gate 13  
5020 BERGEN

Harald Hårfagres gate 29  
N-5007 Bergen  
Norway  
Tel. +47-55 58 21 17  
Fac. +47-55 58 96 50  
rs@nsd.uib.no  
www.nsd.uib.no  
Org.nr. 985 321 884

Vår dato: 05.09.2012

Vår ref:31287 / 3 / MSS

Deres dato:

Deres ref:

### TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 31.08.2012. Meldingen gjelder prosjektet:

31287 *Sammenbengen mellom IKT-bruk og læringsutbytte i videregående opplæring*

*Behandlingsansvarlig* *Universitetet i Bergen, ved institusjonens øverste leder*  
*Daglig ansvarlig* *Rune Johan Krumsvik*

Personvernombudet har vurdert prosjektet og finner at behandlingen av personopplysninger er meldepliktig i henhold til personopplysningsloven § 31. Behandlingen tilfredsstiller kravene i personopplysningsloven.

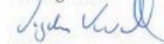
Personvernombudets vurdering forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, eventuelle kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, [http://www.nsd.uib.no/personvern/forsk\\_stud/skjema.html](http://www.nsd.uib.no/personvern/forsk_stud/skjema.html). Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, <http://pvo.nsd.no/prosjekt>.

Personvernombudet vil ved prosjektets avslutning, 01.04.2014, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen



Vigdis Namtvedt Kvalheim

  
Marie Strand Schildmann

Marie Strand Schildmann tlf: 55 58 31 52  
Vedlegg: Prosjektvurdering

## Appendix 4: Study 1 - Summary of interview guide.

### Intervjuguide lærer (interview guide teacher):

Bakgrunn

- Alder
- Stilling
- Hvor lenge har du vært i denne jobben (som lærer i vgs.)?
- Hvilken kjennskap har du til nasjonale- og fylkesvise styringsdokument på IKT-området (stormiddels-liten)
- Hvor mye egen erfaring har du med pedagogisk bruk av IKT i undervisningen (mye-middelsliten).

[Not relevant categories are removed, but are available in the report. Link is provided at the end of appendix 4.]

Undervisning

Grad av IKT-bruk • Hvordan vurderer du som lærer graden av IKT implementering til faglig bruk hos din skole i den generelle skolehverdagen (svært god, god, lite god) • Hvordan vurderer du som lærer omfanget av den pedagogiske IKT-bruken inne i klasserommene hos deres skole (svært stort omfang, stor omfang, lite omfang) • Hvordan vurderer du som lærer omfanget av lærerne sin pedagogiske IKT-bruk i selve undervisningen i klasserommene hos deres skole (svært stort omfang, stor omfang, lite omfang) • I hvor stor grad har du som lærer lagt til rette for elevers faglige bruk av IKT i undervisningen i hverdagspraksis på en skala fra 1-8 o 1-2. Er dette i en tidlig begynnende fase hos deg? (Emerging) o 3-4. Er dette i en fase hvor det kommet noe lengre hos deg? (Applying) o 5-6. Er den i en fase hvor den er godt integrert hos i undervisningen din? (Integrating) o 7-8. Er den i en fase hvor den faglige IKT-bruken har transformert undervisningen din? (Transforming) • Har du andre kommentarer/tilføyelser til dette temaet?

Læring

Grad av IKT-relaterte aktiviteter

- I hvor stor grad bruker elevene IKT (generelt) i ditt/dine fag på din skole? (svært mye, mye, lite) o Kan du anslå en fordeling mellom hvor mye av denne IKT-bruken er skolefaglig orientert og hvor mye er utenomfaglig orientert inne i klasserommene i din undervisning? (10%, 20%, osv.)
- I hvilken grad mener du at IKT fremmer læring i din klasseromsundervisning? (svært mye, mye, lite) o Kan du utdype ditt svar her?
- I hvor stor grad legger du som lærer til rette for faglig bruk av IKT for elevene i hjemmene? (svært mye, mye, lite) o Kan du gi eksempel på dette? o Kan du anslå en fordeling mellom hvor mye av denne IKT-bruken er skolefaglig orientert og hvor mye er utenomfaglig orientert i hjemmene for dine elever? (10%, 20%, osv.)
- I hvor stor grad har du som lærer lagt til rette for læringsfremmende IKT-bruk i undervisningen din i hverdagspraksisen på en skala fra 1-8 o 1-2. Er dette i en tidlig begynnende fase i din undervisning? (Emerging) KS FoU-rapport – Sammenhengen

mellom IKT-bruk og læringsutbytte i videregående opplæring 324 o 3-4. Er dette i en fase hvor det kommet noe lengre i din undervisning? (Applying) o 5-6. Er den i en fase hvor den er godt integrert i din undervisning? (Integrating) o 7-8. Er den i en fase hvor den læringsfremmende IKT-bruken har transformert undervisningen din?

(Transforming)

- Har du andre kommentarer/tilføyelser til dette temaet?
- I hvilken grad mener du lærerens evne til klasseledelse spiller inn på elevenes læringsutbytte med IKT? (i stor grad, i noen grad, middels, i liten grad, i svært liten grad). Har du andre kommentarer/tilføyelser til dette temaet?
- I hvilken grad mener du lærerens digitale kompetanse spiller inn på elevenes læringsutbytte med IKT? (i stor grad, i noen grad, middels, i liten grad, i svært liten grad). Har du andre kommentarer/tilføyelser til dette temaet?
  - I hvilken grad mener du at det er en sammenheng mellom lærerens evne til klasseledelse og hans digitale kompetanse? (i stor grad, i noen grad, middels, i liten grad, i svært liten grad). Har du andre kommentarer/tilføyelser til dette temaet?
  - I hvilken grad mener du at det er en sammenheng mellom høy digitale kompetanse (lærer) og regler for elevens PC-bruk i klasserommene? (i stor grad, i noen grad, middels, i liten grad, i svært liten grad). Har du andre kommentarer/tilføyelser til dette temaet?
  - I hvilken grad mener du at det er en sammenheng mellom lav evne til klasseledelse (lærer) og høy (graden av) utenomfaglige IKT-bruk i klasserommene blant elevene? (i stor grad, i noen grad, middels, i liten grad, i svært liten grad). Har du andre kommentarer/tilføyelser til dette temaet?

Additional information is available in the end report from SMIL:

[https://www.iktogskole.no/wp-content/uploads/2014/05/Sluttrapport\\_SMIL.pdf](https://www.iktogskole.no/wp-content/uploads/2014/05/Sluttrapport_SMIL.pdf)

## Appendix 5: Studies 2 and 3 - Project evaluation and approval from NSD.



Synnøve Moltudal  
postboks 500  
6101 VOLDA

Vår dato: 13.11.2017

Vår ref: 56246 / 3 / PEG

Deres dato:

Deres ref:

### Vurdering fra NSD Personvernombudet for forskning § 31

Personvernombudet for forskning viser til meldeskjema mottatt 27.09.2017 for prosjektet:

56246	<i>Klasseleing og bruk av digitale verktøy</i>
<i>Behandlingsansvarlig</i>	<i>Universitetet i Bergen, ved institusjonens øverste leder</i>
<i>Daglig ansvarlig</i>	<i>Synnøve Moltudal</i>

#### Vurdering

Etter gjennomgang av opplysningene i meldeskjemaet og øvrig dokumentasjon finner vi at prosjektet er meldepliktig og at personopplysningene som blir samlet inn i dette prosjektet er regulert av personopplysningsloven § 31. På den neste siden er vår vurdering av prosjektopplegget slik det er meldt til oss. Du kan nå gå i gang med å behandle personopplysninger.

#### Vilkår for vår anbefaling

Vår anbefaling forutsetter at du gjennomfører prosjektet i tråd med:

- opplysningene gitt i meldeskjemaet og øvrig dokumentasjon
- vår prosjektvurdering, se side 2
- eventuell korrespondanse med oss

Vi forutsetter at du ikke innhenter sensitive personopplysninger.

#### Meld fra hvis du gjør vesentlige endringer i prosjektet

Dersom prosjektet endrer seg, kan det være nødvendig å sende inn endringsmelding. På våre nettsider finner du svar på hvilke [endringer](#) du må melde, samt endringskjema.

#### Opplysninger om prosjektet blir lagt ut på våre nettsider og i Meldingsarkivet

Vi har lagt ut opplysninger om prosjektet på nettsidene våre. Alle våre institusjoner har også tilgang til egne prosjekter i [Meldingsarkivet](#).

#### Vi tar kontakt om status for behandling av personopplysninger ved prosjektslutt

Ved prosjektslutt 01.06.2020 vil vi ta kontakt for å avklare status for behandlingen av

*Dokumentet er elektronisk produsert og godkjent ved NSDs rutiner for elektronisk godkjenning.*



personopplysninger.

Se våre nettsider eller ta kontakt dersom du har spørsmål. Vi ønsker lykke til med prosjektet!

Marianne Høgetveit Myhren

Pernille Ekornerud Grøndal

Kontaktperson: Pernille Ekornerud Grøndal tlf: 55 58 36 41 / [pernille.grondal@nsd.no](mailto:pernille.grondal@nsd.no)

Vedlegg: Prosjektvurdering

# Personvernombudet for forskning



## Prosjektvurdering - Kommentar

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Prosjektnr: 56246

Utvalget består av elever fra tre klassetrinn, samt de respektive lærerne. Utvalget rekrutteres gjennom skolen. Forskeren søker om de nødvendige godkjenninger fra skolen til å gjennomføre prosjektet.

Utvalget informeres skriftlig og muntlig om prosjektet og samtykker til deltakelse. Informasjonsskrivet er godt utformet.

Det innhentes samtykke fra foreldre for at elevene skal kunne delta i prosjektet. Merk at når barn skal delta aktivt, er delttagelsen alltid frivillig for barnet, selv om de foresatte samtykker. Barnet bør få alderstilpasset informasjon om prosjektet, og det må sørges for at de forstår at deltakelse er frivillig og at de når som helst kan trekke seg dersom de ønsker det.

I følge prosjektmeldingen skal det gjennomføres observasjon i skole. Dersom det skal registreres personopplysninger under observasjon i skole skal det gis informasjon og innhentes samtykke fra dem som observeres. Ved lydopptak under observasjon i skole må dere sørge for et alternativ opplegg for barn som ikke skal delta i prosjektet. Dette fordi barna skal kunne delta i sine vanlige aktiviteter uten at det registreres personopplysninger om dem til forskning.

Personvernombudet legger til grunn at forsker etterfølger Universitetet i Bergen sine interne rutiner for datasikkerhet.

Forventet prosjektslutt er 01.06.2020. Ifølge prosjektmeldingen skal innsamlede opplysninger da anonymiseres. Anonymisering innebærer å bearbeide datamaterialet slik at ingen enkeltpersoner kan gjenkjennes. Det gjøres ved å:

- slette direkte personopplysninger (som navn/koblingsnøkkel)
- slette/omskrive indirekte personopplysninger (identifiserende sammenstilling av bakgrunnsopplysninger som f.eks. bosted/arbeidssted, alder og kjønn)
- slette digitale lydopptak

## **Appendix 6: Studies 2 and 3 - Information letter/informed consent.**

### **Informasjon om deltaking i forskingsprosjektet:**

#### ***”Klasseleiing/læringsleiing og digitale verkøy”***

##### **Bakgrunn og føremål**

Digitale verkøy vert stadig meir brukt i skulen (både nasjonalt og internasjonalt), men det er framleis lite forskning som systematisk undersøker korleis slike verkøy blir brukte og korleis lærarar og elevar opplever bruken. Forskingsprosjektet ”Klasseleiing/Læringsleiing og digitale verkøy” har som føremål å sjå nærare på kva for innverknad bruken av nettbrett og digitale verkøy i skulen har på elevane si læring og lærarane si klasseleiing/læringsleiing. Prosjektet vert gjennomført som eit doktorgradsprosjekt, i samarbeid mellom Universitetet i Bergen og Høgskulen i Volda.

Forskingsprosjektet er godkjent av leiinga ved [REDACTED] og vert gjennomført i samarbeid med lærarane ved skulen. I første omgang er det lærarar og elevar på 5.-7. trinn ved skulen som vert inviterte til å delta i dette forskingsprosjektet. Datainnsamlinga vil hovudsakleg gå føre seg [REDACTED], men det kan bli aktuelt med forlenging av tidsperioden ved behov. De vil i så fall få informasjon om dette.

##### **Kva innebærer deltaking i studien?**

Datamaterialet til studien vil bli henta inn gjennom ulike former for forskingsmetodar. Døme på slike metodar er observasjon av læringsarbeidet som går føre seg i klasserommet, spørjeundersøking (elevar), intervju (lærarar) og fokusgruppesamtale (nokre utvalde elevar som sjølve ønsker å delta). Intervju og samtalar vil bli tatt opp på lydband (og sletta i etterkant av datainnsamlinga), medan spørjeundersøkinga vil bli gjennomført på papir. Gjennom studien ønsker forskarane å finne ut meir om korleis elevar og lærarar opplever bruken av digitale verkøy, og korleis bruken påverkar lærarane sitt arbeid og elevane si læring. Spørsmåla vi stiller i både spørjeundersøking, intervju og fokusgruppesamtalar vil altså vere direkte knytte til denne tematikken. Det er viktig å understreke at forskarane ikkje samlar inn sensitive opplysningar om enkeltelevar og deira privatliv.

##### **Kva skjer med informasjonen om deltakarane i studien?**

Alle personopplysningar vil bli behandla konfidensielt, og alle elevar og lærarar vil bli anonymisert ved formidling av resultat frå studien. Det vil altså ikkje vere mogleg å kjenne att enkeltelevar eller enkeltlærarar. Under arbeidet med studien vil berre prosjektansvarleg/PhD-stipendiat Synnøve Moltudal og professor Rune Johan Krumsvik v/ Universitetet i Bergen ha tilgang til identifiserande

opplysningar om deltakarane. Informasjon om deltakarane vil bli lagra separat frå lyd-opptak og svar på spørjeskjema, og all informasjon vil bli fullstendig anonymisert (også for forskarane) ved prosjektslutt (seinast våren 2020).

### **Frivillig deltaking**

Det er frivillig å delta i studien, og ein kan når som helst trekke samtykket utan å oppgi nokon grunn. Dersom ein trekker seg vil alle opplysningar bli anonymiserte, og det vil ikkje få nokon konsekvensar for vidare forhold til skulen. Dersom du har spørsmål til studien, ta kontakt med prosjektleiar Synnøve Moltudal, Avdeling for Mediefag, Høgskulen i Volda.

E-post: [moltudal@hivolda.no](mailto:moltudal@hivolda.no)

Telefon 47751943.

Studien er meldt til Personvernombudet for forskning, NSD - Norsk senter for forskningsdata AS.

----- Klipp her og ta med svarslippen tilbake til skulen

### **Samtykke til deltaking i studien**

Vi har mottatt informasjon om studien, og er villig/ikkje villig (stryk det som ikkje passar) til å delta

-----  
(Signert av elev, føresett, dato)

## Appendix 7: Study 2 - Examples from the SDT-survey.

Namn: \_\_\_\_\_

Klassetrinn: \_\_\_\_\_

**Korleis har du det på skulen? Kryss av på det svaret som stemmer best.**

<b>Spørsmål 1) Eg kan gjere ting eg har lyst til å gjere på skulen.</b>				
Stemmer ikkje i det heile tatt	Stemmer dårleg	Stemmer sånn passe	Stemmer godt	Stemmer heilt nøyaktig

<b>Spørsmål 2) Eg kan sjølv velje korleis eg skal løyse oppgåvene mine på skulen.</b>				
Stemmer ikkje i det heile tatt	Stemmer dårleg	Stemmer sånn passe	Stemmer godt	Stemmer heilt nøyaktig

<b>Spørsmål 3) Eg kan vere meg sjølv på skulen.</b>				
Stemmer ikkje i det heile tatt	Stemmer dårleg	Stemmer sånn passe	Stemmer godt	Stemmer heilt nøyaktig

<b>Spørsmål 4) Eg gjer ting som er interessante på skulen.</b>				
Stemmer ikkje i det heile tatt	Stemmer dårleg	Stemmer sånn passe	Stemmer godt	Stemmer heilt nøyaktig

<b>Spørsmål 5) På skulen min bryr vi oss om kvarandre.</b>				
Stemmer ikkje i det heile tatt	Stemmer dårleg	Stemmer sånn passe	Stemmer godt	Stemmer heilt nøyaktig

<b>Spørsmål 6) Eg likar dei eg er saman med på skulen.</b>				
Stemmer ikkje i det heile tatt	Stemmer dårleg	Stemmer sånn passe	Stemmer godt	Stemmer heilt nøyaktig

<b>Spørsmål 7) Eg har både vennar og lærarar på skulen som vil at eg skal ha det bra.</b>				
Stemmer ikkje i det heile tatt	Stemmer dårleg	Stemmer sånn passe	Stemmer godt	Stemmer heilt nøyaktig

**Spørsmål 8) Eg har det bra saman med dei andre elevane på skulen.**

Stemmer ikkje i det heile tatt	Stemmer dårleg	Stemmer sånn passe	Stemmer godt	Stemmer heilt nøyaktig
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**Spørsmål 9) På skulen har eg god sjølvtilitt.**

Stemmer ikkje i det heile tatt	Stemmer dårleg	Stemmer sånn passe	Stemmer godt	Stemmer heilt nøyaktig
--------------------------------	----------------	--------------------	--------------	------------------------

**Spørsmål 10) På skulen får eg til det eg prøver på.**

Stemmer ikkje i det heile tatt	Stemmer dårleg	Stemmer sånn passe	Stemmer godt	Stemmer heilt nøyaktig
--------------------------------	----------------	--------------------	--------------	------------------------

**Spørsmål 11) Eg får til vanskelege ting på skulen.**

Stemmer ikkje i det heile tatt	Stemmer dårleg	Stemmer sånn passe	Stemmer godt	Stemmer heilt nøyaktig
--------------------------------	----------------	--------------------	--------------	------------------------

Kva tenker du om faget matematikk (matte)?

**Spørsmål 12) Eg synest matematikk er interessant.**

Stemmer ikkje i det heile tatt	Stemmer dårleg	Stemmer sånn passe	Stemmer godt	Stemmer heilt nøyaktig
--------------------------------	----------------	--------------------	--------------	------------------------

**Spørsmål 13) Det er viktig å kunne matematikk.**

Stemmer ikkje i det heile tatt	Stemmer dårleg	Stemmer sånn passe	Stemmer godt	Stemmer heilt nøyaktig
--------------------------------	----------------	--------------------	--------------	------------------------

**Spørsmål 14) Andre personar forventar at eg skal like matematikk.**

Stemmer ikkje i det heile tatt	Stemmer dårleg	Stemmer sånn passe	Stemmer godt	Stemmer heilt nøyaktig
--------------------------------	----------------	--------------------	--------------	------------------------

## Appendix 8: Study 2 - Examples from the development-/transparency document.

Basic Psychological Need Satisfaction (and Frustration) Scale

Competence satisfaction: items 5, 11, 17, 23

<b>Originalformulering</b>	I feel confident that I can do things well.
<b>Første oversetting (BM)</b>	Jeg føler meg trygg på at jeg kan få til ting.
<b>Tilpassing til målgruppa</b>	Jeg føler meg trygg på at jeg kan få til ting på skolen Spørsmål 9) Eg trur på meg sjølv og trur at eg greier ting når eg er på skulen
<b>Endeleg spørsmål</b>	<b>Spørsmål 9) På skulen har eg god sjølvtilitt.</b>
<b>Kommentarar til spørsmålet</b>	Eg var heilt fram til dagen for pretest usikker på om eg skulle bruke formuleringa "trur på meg sjølv" eller "sjølvtilitt". I tenkespråket har nok "trur på meg sjølv" meir presise konnotasjonar, men då eg såg formuleringa skriftleg (i skjemaet) framstod meininga som veldig abstrakt. Den kunne fort bli tolka inn i eit sanning/løgn-perspektiv. Fall difor ned på "sjølvtilitt" grunna utstrakt bruk av omgrepet i populærkulturen. <u>Under pretest:</u> På femte trinn var det ein elev som spurte kva sjølvtilitt betyr. Eg omsette då til "trur eg kan få til ting" til henne, og ho kryssa umiddelbart av på eit svar.

<b>Originalformulering</b>	I feel capable at what I do.
<b>Første oversetting (BM)</b>	Jeg føler at jeg får til ting jeg gjør.
<b>Tilpassing til målgruppa</b>	Jeg føler at jeg får til ting jeg gjør på skolen Spørsmål 10) På skulen får eg til det eg prøver på
<b>Endeleg spørsmål</b>	<b>Spørsmål 10) På skulen får eg til det eg prøver på.</b>
<b>Kommentarar til spørsmålet</b>	<u>Under pretest:</u> Ingen spørsmål.

<b>Originalformulering</b>	I feel competent to achieve my goals.
<b>Første oversetting (BM)</b>	Jeg føler at jeg kan nå mine egne mål.
<b>Tilpassing til målgruppa</b>	Jeg føler at jeg kan nå mine egne mål på skolen Spørsmål 11) Eg får til det eg vil på skulen
<b>Endeleg spørsmål</b>	<b>Spørsmål 11) Eg får til vanskelege ting på skulen.</b>
<b>Kommentarar til spørsmålet</b>	Vanskelig å tilpasse eit så abstrakt spørsmål til målgruppa utan at det blei for likt neste item/spørsmål. Valgte difor å slå saman dei to i det endelege spørjeskjemaet.

<b>Originalformulering</b>	I feel I can successfully complete difficult tasks.
<b>Første oversetting (BM)</b>	Jeg føler at jeg kan få til vanskelige ting.
<b>Tilpassing til målgruppa</b>	Jeg føler at jeg kan få til vanskelige ting på skolen Spørsmål 12) Eg får til vanskelige ting på skulen
<b>Endeleg spørsmål</b>	<b>Spørsmål 11) Eg får til vanskelege ting på skulen.</b>
<b>Kommentarar til spørsmålet</b>	<u>Under pretest:</u> Ingen spørsmål.

## The Situational Motivation Scale (SIMS)<sup>5</sup>

Why are you currently engaged in this activity?

<i>Intrinsic motivation</i>	
<b>Originalformulering</b>	Because I think that this activity is interesting
<b>Første oversetting (BM)</b>	Fordi jeg synest det er interessant
<b>Tilpassing til målgruppa</b>	Jeg gjør matematikk fordi jeg synes faget er interessant Spørsmål 13 <sup>6</sup> ) Eg synest matematikk er interessant
<b>Endeleg spørsmål</b>	<b>Spørsmål 12) Eg synest matematikk er interessant.</b>
<b>Kommentarar til spørsmålet</b>	<u>Under pretest:</u> Ingen spørsmål.

<i>Identified regulation</i>	
<b>Originalformulering</b>	Because I am doing it for my own good
<b>Første oversetting (BM)</b>	Fordi det er bra for meg
<b>Tilpassing til målgruppa</b>	Jeg gjør matematikk fordi det er bra for meg Spørsmål 14) Det er viktig å kunne matematikk
<b>Endeleg spørsmål</b>	<b>Spørsmål 13) Det er viktig å kunne matematikk.</b>
<b>Kommentarar til spørsmålet</b>	<u>Under pretest:</u> Ingen spørsmål.

<i>External regulation</i>	
<b>Originalformulering</b>	Because I am supposed to do it
<b>Første oversetting (BM)</b>	Fordi det er forventet av meg/Fordi det er meningen jeg skal gjøre det
<b>Tilpassing til målgruppa</b>	Jeg gjør matematikk fordi andre forventer det av meg Spørsmål 15) Andre forventar at eg skal like matematikk
<b>Endeleg spørsmål</b>	<b>Spørsmål 14) Andre personar forventar at eg skal like matematikk.</b>
<b>Kommentarar til spørsmålet</b>	“Andre personar” er ei vanskeleg operasjonisering, og eg kan nok kritisera for å vere for lite konkret konkret. Men hensikta med å opne opp slik var å kunne fange opp eventuelle kjensler eleven måtte ha av at nokon utanfor eleven sjølv (uavhengig av kven det er) legg forventningar på barnet sine skuldrer. Om eleven opplever ei slik kjensle vil formuleringa opne opp for å få den registrert, uavhengig av kvar den kjensla kjem frå. Min argumentasjon er at ei meir spesifikk formulering som ”foreldra mine”, ”lærararen min” el.l. ville kunne utelukke andre moglege kjelder til opplevde forventningar. <u>Under pretest:</u> På femte trinn fekk eg eit spørsmål om kva eg meinte med ”andre personar”. Om eg meinte andre elevar eller lærarane. Eg svarte at det kan vere både andre elevar, lærarar eller foreldre. ”Det er uansett ingen som forventar det,” var svaret eg fekk tilbake.

<sup>5</sup> Codification key: Intrinsic motivation: Items 1, 5, 9, 13; Identified regulation: Items 2, 6, 10, 14; External regulation: Items 3, 7, 11, 15; Amotivation: Items 4, 8, 12, 16.

<sup>6</sup> På grunn av at eg kutta ut eit spørsmål vil nummereringa vere usynkronisert resten av dokumentet.



<i>Amotivation</i>	
<b>Originalformulering</b>	There may be good reasons to do this activity, but personally I don't see any
<b>Første oversetting (BM)</b>	Det skal visstnok vere viktig, men jeg klarer ikke å forstå hva som er så viktig.
<b>Tilpassing til målgruppa</b>	Det finnes sikkert gode grunner til å gjøre matematikk, men personlig ser jeg ingen gode grunner Spørsmål 16) Eg skjønner ikkje kvifor eg skal lære matematikk
<b>Endeleg spørsmål</b>	<b>Spørsmål 15) Eg skjønner ikkje kvifor eg skal lære matematikk.</b>
<b>Kommentarar til spørsmålet</b>	<u>Under pretest:</u> Ingen spørsmål.

## Appendix 9: Studies 2 and 3 - Interview guides (pupils and teachers).

Norwegian	English (translated)
<b>Intervjuguide elevar (fokusgruppe)</b>	<b>Interview guide pupils (focus group)</b>
<p><b>Om eiga klasse og læringsmiljø.</b> -Oppfølgingsspørsmål spelar vidare på deira svar.</p> <p><b>Generelle haldningar til- og tankar rundt bruk av nettbrett i skulen.</b> (omfang av bruk, reglar, korleis dei blir brukt o.l.) -Oppfølgingsspørsmål spelar vidare på deira svar.</p> <p><b>Typisk matematikk-time: Kva gjer dei då?</b> -Oppfølgingsspørsmål spelar vidare på deira svar.</p> <p><b>Kva opplever dei at læraren er oppteken av i matematikk?</b> -Oppfølgingsspørsmål spelar vidare på deira svar.</p> <p><b>Kva er MSØ? (Vil ha dei til å skildre med egne ord)</b> -Oppfølgingsspørsmål spelar vidare på deira svar.</p> <p><b>Korleis arbeider dei med MSØ?</b> -Oppfølgingsspørsmål spelar vidare på deira svar.</p> <p><b>Kva synest dei om MSØ?</b> -Oppfølgingsspørsmål spelar vidare på deira svar.</p> <p><b>Kartlegge matematikk-preferanser:</b> Korleis ser de føre dykk den perfekte matematikk-time? -Oppfølgingsspørsmål spelar vidare på deira svar.</p> <p>Noko de vil legge til?</p>	<p><b>About own class and learning environment</b> -Follow up questions based on their answers.</p> <p><b>Thoughts about use of tablets in school</b> (scope of use, rules, how they are used etc.) -Follow up questions based on their answers.</p> <p><b>Typical mathematics class. What do they do then?</b> -Follow up questions based on their answers.</p> <p><b>What is their teacher concerned with regarding mathematics?</b> -Follow up questions based on their answers.</p> <p><b>What is MSØ? (Want them to describe using their own words)</b> -Follow up questions based on their answers.</p> <p><b>How do they work on MSØ?</b> -Follow up questions based on their answers.</p> <p><b>How do they perceive MSØ?</b> -Follow up questions based on their answers.</p> <p><b>Map out preferences in mathematics:</b> How do you envision the perfect math class? (Follow up questions based on their answers)</p> <p>Something you would like to add?</p>

<b>Norwegian</b>	<b>English (translated)</b>
<b>Intervjuguide teachers (individual)</b>	<b>Interview guide teachers (individual)</b>
Motivasjon for å ville bli lærar: Kvifor og korleis (og kor lang erfaring)? (Oppfølgingsspørsmål?)	Motivation for becoming a teacher: Why and how (and how long experience)? (Follow up questions)
Om eiga lærarrolle: Vediar, fokus, haldningar o.l. (Oppfølgingsspørsmål?)	About own teacher role: Values, focus, attitudes etc. (Follow up questions)
Opplevd endring i eiga lærarrolla over tid (evt. kvifor og korleis)? (Oppfølgingsspørsmål?)	Perceived change in own teacher role over time (how and why)? (Follow up questions)
Generelle haldningar til bruk av IKT i skulen (Oppfølgingsspørsmål?)	General attitudes towards use of ICT in education (Follow up questions)
Haldningar til MSØ (Oppfølgingsspørsmål?)	Attitudes towards MSØ? (Follow up questions)
Erfaringar med MSØ (Oppfølgingsspørsmål?)	Experiences with MSØ (Follow up questions)
Kobling mellom MSØ og eigen praksis (Oppfølgingsspørsmål?)	Links between MSØ and own practice (Follow up questions)
Oppleving av fagleg og sosialt miljø i klassen? Mål for fagleg og sosialt miljø i klassen? (Oppfølgingsspørsmål?)	How do you perceive the academic and social learning environment in class? Aims for academic and social learning environment? (Follow up questions)
Om kulturen på skulen når det gjeld skuleutvikling (inkludert bruk av IKT). (Oppfølgingsspørsmål?)	School culture regarding school development (including use of ICT). (Follow up questions)
Noko du vil legge til?	Something you would like to add?

## Appendix 10: Studies 2 and 3 – Fieldnote- and observation templates.

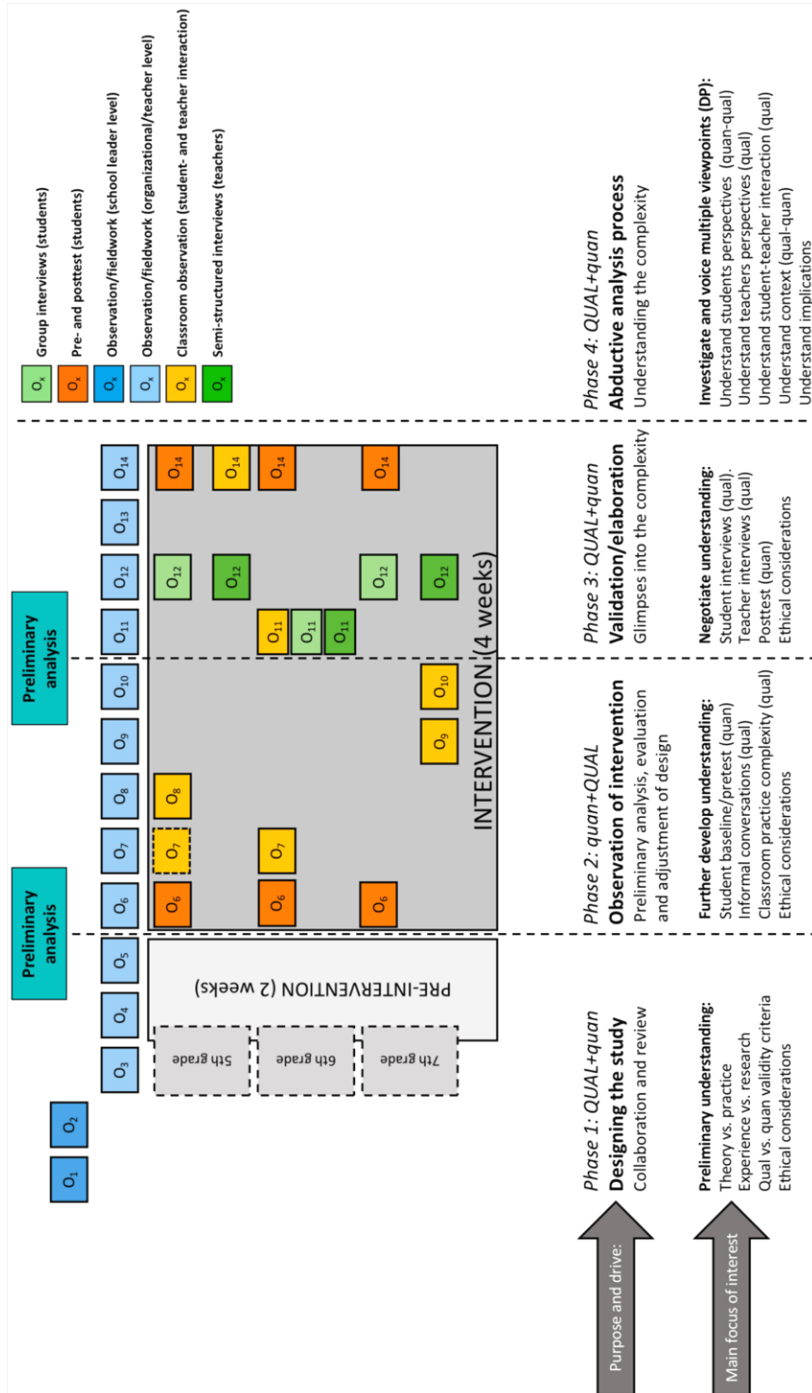
Feltarbeid (fieldwork)	
Dato (date):	
Stad (place):	
Deltakarer (participants):	
Forskarrolle (researcher role):	[expanding text box]
Situasjon (situation):	
Metodologiske perspektiv (methodological issues):	
Tema (topic):	[expanding text box]
Stikkord/kategoriar: (Keywords/categories):	[expanding text box]
Mine førebelse funn og tolkingar (preliminary findings/interpretations):	[expanding text box]
Noko som overraska meg (did something surprise me)?	[expanding text box]
Ting å ta med seg vidare/utforske (topics for further investigation):	[expanding text box]
Supplerande analyser i ettertid (supplemental analysis afterwards):	
Other things: [expanding text box]	

Klasseromsobservasjon (classroom observations):	
Kronologisk skildring av økta (Chronological description of the class):	[expanding text box]
Transkriberte snapshots (transcribed snapshots):	
Kva såg eg etter (what was I looking for)?	[expanding text box]
Kva såg eg – kva betyr dette (What did I see and what could this mean)?	[expanding text box]
Ting å ta med vidare (Things to further investigate):	[expanding text box]

Observasjonar knytt til semi-strukturerte intervju (Observations during semi structured interviews)				
Datapunkt: (Observation)	Lengde/tid: (Time)	Trinnlærer: (Who)	Særskilt fokus: (Particular focus)	Ta med vidare i analysen: (Notes for further analysis)
[expanding text box]				

Fokusgruppeobservasjonar (Observations during focus group interviews)				
Datapunkt: (Observation)	Lengde/tid: (Time)	Trinn: (Level)	Særskilt fokus: (Particular focus)	Hovudfunn etter første runde (Main findings noticed during interview:)
[expanding text box]				

# Appendix 11: Studies 2 and 3 – Visual log summary



**Doctoral Theses at The Faculty of Psychology,**  
**University of Bergen**

<b>1980</b>	Allen, Hugh M., Dr. philos.	Parent-offspring interactions in willow grouse ( <i>Lagopus L. Lagopus</i> ).
<b>1981</b>	Myhrer, Trond, Dr. philos.	Behavioral Studies after selective disruption of hippocampal inputs in albino rats.
<b>1982</b>	Svebak, Sven, Dr. philos.	The significance of motivation for task-induced tonic physiological changes.
<b>1983</b>	Myhre, Grete, Dr. philos.	The Biopsychology of behavior in captive Willow ptarmigan.
	Eide, Rolf, Dr. philos.	PSYCHOSOCIAL FACTORS AND INDICES OF HEALTH RISKS. The relationship of psychosocial conditions to subjective complaints, arterial blood pressure, serum cholesterol, serum triglycerides and urinary catecholamines in middle aged populations in Western Norway.
	Værnes, Ragnar J., Dr. philos.	Neuropsychological effects of diving.
<b>1984</b>	Kolstad, Arnulf, Dr. philos.	Til diskusjonen om sammenhengen mellom sosiale forhold og psykiske strukturer. En epidemiologisk undersøkelse blant barn og unge.
	Løberg, Tor, Dr. philos.	Neuropsychological assessment in alcohol dependence.
<b>1985</b>	Hellesnes, Tore, Dr. philos.	Læring og problemløsning. En studie av den perseptuelle analysens betydning for verbal læring.
	Håland, Wenche, Dr. philos.	Psykoterapi: relasjon, utviklingsprosess og effekt.
<b>1986</b>	Hagtvatn, Knut A., Dr. philos.	The construct of test anxiety: Conceptual and methodological issues.
	Jellestad, Finn K., Dr. philos.	Effects of neuron specific amygdala lesions on fear-motivated behavior in rats.
<b>1987</b>	Aarø, Leif E., Dr. philos.	Health behaviour and socioeconomic Status. A survey among the adult population in Norway.
	Underlid, Kjell, Dr. philos.	Arbeidsløse i psykososialt perspektiv.
	Laberg, Jon C., Dr. philos.	Expectancy and classical conditioning in alcoholics' craving.
	Vollmer, Fred, Dr. philos.	Essays on explanation in psychology.
	Ellertsen, Bjørn, Dr. philos.	Migraine and tension headache: Psychophysiology, personality and therapy.
<b>1988</b>	Kaufmann, Astrid, Dr. philos.	Antisocial atferd hos ungdom. En studie av psykologiske determinanter.

	Mykletun, Reidar J., Dr. philos.	Teacher stress: personality, work-load and health.
	Havik, Odd E., Dr. philos.	After the myocardial infarction: A medical and psychological study with special emphasis on perceived illness.
<b>1989</b>	Bråten, Stein, Dr. philos.	Menneskedyaden. En teoretisk tese om sinnets dialogiske natur med informasjons- og utviklingspsykologiske implikasjoner sammenholdt med utvalgte spedbarnsstudier.
	Wold, Bente, Dr. psychol.	Lifestyles and physical activity. A theoretical and empirical analysis of socialization among children and adolescents.
<b>1990</b>	Flaten, Magne A., Dr. psychol.	The role of habituation and learning in reflex modification.
<b>1991</b>	Alsaker, Françoise D., Dr. philos.	Global negative self-evaluations in early adolescence.
	Kraft, Pål, Dr. philos.	AIDS prevention in Norway. Empirical studies on diffusion of knowledge, public opinion, and sexual behaviour.
	Endresen, Inger M., Dr. philos.	Psychoimmunological stress markers in working life.
	Faleide, Asbjørn O., Dr. philos.	Asthma and allergy in childhood. Psychosocial and psychotherapeutic problems.
<b>1992</b>	Dalen, Knut, Dr. philos.	Hemispheric asymmetry and the Dual-Task Paradigm: An experimental approach.
	Bø, Inge B., Dr. philos.	Ungdoms sosiale økologi. En undersøkelse av 14-16 åringers sosiale nettverk.
	Nivison, Mary E., Dr. philos.	The relationship between noise as an experimental and environmental stressor, physiological changes and psychological factors.
	Torgersen, Anne M., Dr. philos.	Genetic and environmental influence on temperamental behaviour. A longitudinal study of twins from infancy to adolescence.
<b>1993</b>	Larsen, Svein, Dr. philos.	Cultural background and problem drinking.
	Nordhus, Inger Hilde, Dr. philos.	Family caregiving. A community psychological study with special emphasis on clinical interventions.
	Thuen, Frode, Dr. psychol.	Accident-related behaviour among children and young adolescents: Prediction and prevention.
	Solheim, Ragnar, Dr. philos.	Spesifikke lærevansker. Diskrepanskriteriet anvendt i seleksjonsmetodikk.
	Johnsen, Bjørn Helge, Dr. psychol.	Brain asymmetry and facial emotional expressions: Conditioning experiments.
<b>1994</b>	Tønnessen, Finn E., Dr. philos.	The etiology of Dyslexia.
	Kvale, Gerd, Dr. psychol.	Psychological factors in anticipatory nausea and vomiting in cancer chemotherapy.



	Asbjørnsen, Arve E., Dr. psychol.	Structural and dynamic factors in dichotic listening: An interactional model.
	Bru, Edvin, Dr. philos.	The role of psychological factors in neck, shoulder and low back pain among female hospital staff.
	Braathen, Eli T., Dr. psychol.	Prediction of excellence and discontinuation in different types of sport: The significance of motivation and EMG.
	Johannessen, Birte F., Dr. philos.	Det flytende kjønnnet. Om lederskap, politikk og identitet.
<b>1995</b>	Sam, David L., Dr. psychol.	Acculturation of young immigrants in Norway: A psychological and socio-cultural adaptation.
	Bjaalid, Inger-Kristin, Dr. philos.	Component processes in word recognition.
	Martinsen, Øyvind, Dr. philos.	Cognitive style and insight.
	Nordby, Helge, Dr. philos.	Processing of auditory deviant events: Mismatch negativity of event-related brain potentials.
	Raaheim, Arild, Dr. philos.	Health perception and health behaviour, theoretical considerations, empirical studies, and practical implications.
	Seltzer, Wencke J., Dr. philos.	Studies of Psychocultural Approach to Families in Therapy.
	Brun, Wibecke, Dr. philos.	Subjective conceptions of uncertainty and risk.
	Aas, Henrik N., Dr. psychol.	Alcohol expectancies and socialization: Adolescents learning to drink.
	Bjørkly, Stål, Dr. psychol.	Diagnosis and prediction of intra-institutional aggressive behaviour in psychotic patients
<b>1996</b>	Anderssen, Norman, Dr. psychol.	Physical activity of young people in a health perspective: Stability, change and social influences.
	Sandal, Gro Mjeldheim, Dr. psychol.	Coping in extreme environments: The role of personality.
	Strumse, Einar, Dr. philos.	The psychology of aesthetics: explaining visual preferences for agrarian landscapes in Western Norway.
	Hestad, Knut, Dr. philos.	Neuropsychological deficits in HIV-1 infection.
	Lugoe, L.Wycliffe, Dr. philos.	Prediction of Tanzanian students' HIV risk and preventive behaviours
	Sandvik, B. Gunnhild, Dr. philos.	Fra distriktsjordmor til institusjonsjordmor. Fremveksten av en profesjon og en profesjonsutdanning
	Lie, Gro Therese, Dr. psychol.	The disease that dares not speak its name: Studies on factors of importance for coping with HIV/AIDS in Northern Tanzania
	Øygard, Lisbet, Dr. philos.	Health behaviors among young adults. A psychological and sociological approach
	Stormark, Kjell Morten, Dr. psychol.	Emotional modulation of selective attention: Experimental and clinical evidence.

	Einarsen, Ståle, Dr. psychol.	Bullying and harassment at work: epidemiological and psychosocial aspects.
<b>1997</b>	Knivsberg, Ann-Mari, Dr. philos.	Behavioural abnormalities and childhood psychopathology: Urinary peptide patterns as a potential tool in diagnosis and remediation.
	Eide, Arne H., Dr. philos.	Adolescent drug use in Zimbabwe. Cultural orientation in a global-local perspective and use of psychoactive substances among secondary school students.
	Sørensen, Marit, Dr. philos.	The psychology of initiating and maintaining exercise and diet behaviour.
	Skjæveland, Oddvar, Dr. psychol.	Relationships between spatial-physical neighborhood attributes and social relations among neighbors.
	Zewdie, Teka, Dr. philos.	Mother-child relational patterns in Ethiopia. Issues of developmental theories and intervention programs.
	Wilhelmsen, Britt Unni, Dr. philos.	Development and evaluation of two educational programmes designed to prevent alcohol use among adolescents.
	Manger, Terje, Dr. philos.	Gender differences in mathematical achievement among Norwegian elementary school students.
<b>1998</b>	Lindstrøm, Torill Christine, Dr. philos.	«Good Grief»: Adapting to Bereavement.
<b>V</b>	Skogstad, Anders, Dr. philos.	Effects of leadership behaviour on job satisfaction, health and efficiency.
	Haldorsen, Ellen M. Håland, Dr. psychol.	Return to work in low back pain patients.
	Besemer, Susan P., Dr. philos.	Creative Product Analysis: The Search for a Valid Model for Understanding Creativity in Products.
<b>H</b>	Winje, Dagfinn, Dr. psychol.	Psychological adjustment after severe trauma. A longitudinal study of adults' and children's posttraumatic reactions and coping after the bus accident in Måbødalen, Norway 1988.
	Vosburg, Suzanne K., Dr. philos.	The effects of mood on creative problem solving.
	Eriksen, Hege R., Dr. philos.	Stress and coping: Does it really matter for subjective health complaints?
	Jakobsen, Reidar, Dr. psychol.	Empiriske studier av kunnskap og holdninger om hiv/aids og den normative seksuelle utvikling i ungdomsårene.
<b>1999</b>	Mikkelsen, Aslaug, Dr. philos.	Effects of learning opportunities and learning climate on occupational health.
<b>V</b>	Samdal, Oddrun, Dr. philos.	The school environment as a risk or resource for students' health-related behaviours and subjective well-being.
	Friestad, Christine, Dr. philos.	Social psychological approaches to smoking.
	Ekeland, Tor-Johan, Dr. philos.	Meining som medisin. Ein analyse av placebofenomenet og implikasjonar for terapi og terapeutiske teoriar.

<b>H</b>	Saban, Sara, Dr. psychol.	Brain Asymmetry and Attention: Classical Conditioning Experiments.
	Carlsten, Carl Thomas, Dr. philos.	God lesing – God læring. En aksjonsrettet studie av undervisning i fagtekstlesing.
	Dundas, Ingrid, Dr. psychol.	Functional and dysfunctional closeness. Family interaction and children's adjustment.
	Engen, Liv, Dr. philos.	Kartlegging av leseferdighet på småskoletrinnet og vurdering av faktorer som kan være av betydning for optimal leseutvikling.
<b>2000 V</b>	Hovland, Ole Johan, Dr. philos.	Transforming a self-preserving "alarm" reaction into a self-defeating emotional response: Toward an integrative approach to anxiety as a human phenomenon.
	Lillejord, Sølvi, Dr. philos.	Handlingsrasjonalitet og spesialundervisning. En analyse av aktørperspektiver.
	Sandell, Ove, Dr. philos.	Den varme kunnskapen.
	Oftedal, Marit Petersen, Dr. philos.	Diagnostisering av ordavkodingsvansker: En prosessanalytisk tilnæringsmåte.
<b>H</b>	Sandbak, Tone, Dr. psychol.	Alcohol consumption and preference in the rat: The significance of individual differences and relationships to stress pathology
	Eid, Jarle, Dr. psychol.	Early predictors of PTSD symptom reporting; The significance of contextual and individual factors.
<b>2001 V</b>	Skinstad, Anne Helene, Dr. philos.	Substance dependence and borderline personality disorders.
	Binder, Per-Einar, Dr. psychol.	Individet og den meningsbærende andre. En teoretisk undersøkelse av de mellommenneskelige forutsetningene for psykisk liv og utvikling med utgangspunkt i Donald Winnicotts teori.
	Roald, Ingvild K., Dr. philos.	Building of concepts. A study of Physics concepts of Norwegian deaf students.
<b>H</b>	Fekadu, Zelalem W., Dr. philos.	Predicting contraceptive use and intention among a sample of adolescent girls. An application of the theory of planned behaviour in Ethiopian context.
	Melesse, Fantu, Dr. philos.	The more intelligent and sensitive child (MISC) mediational intervention in an Ethiopian context: An evaluation study.
	Råheim, Målfrid, Dr. philos.	Kvinneres kroppserfaring og livssammenheng. En fenomenologisk – hermeneutisk studie av friske kvinner og kvinner med kroniske muskelsmerter.
	Engelsen, Birthe Kari, Dr. psychol.	Measurement of the eating problem construct.
	Lau, Bjørn, Dr. philos.	Weight and eating concerns in adolescence.
<b>2002 V</b>	Ihlebak, Camilla, Dr. philos.	Epidemiological studies of subjective health complaints.

	Rosén, Gunnar O. R., Dr. philos.	The phantom limb experience. Models for understanding and treatment of pain with hypnosis.
	Høines, Marit Johnsen, Dr. philos.	Fleksible språkrom. Matematikklæring som tekstutvikling.
	Anthun, Roald Andor, Dr. philos.	School psychology service quality. Consumer appraisal, quality dimensions, and collaborative improvement potential
	Pallesen, Ståle, Dr. psychol.	Insomnia in the elderly. Epidemiology, psychological characteristics and treatment.
	Midthassel, Unni Vere, Dr. philos.	Teacher involvement in school development activity. A study of teachers in Norwegian compulsory schools
	Kallestad, Jan Helge, Dr. philos.	Teachers, schools and implementation of the Olweus Bullying Prevention Program.
<b>H</b>	Ofte, Sonja Helgesen, Dr. psychol.	Right-left discrimination in adults and children.
	Netland, Marit, Dr. psychol.	Exposure to political violence. The need to estimate our estimations.
	Diseth, Åge, Dr. psychol.	Approaches to learning: Validity and prediction of academic performance.
	Bjuland, Raymond, Dr. philos.	Problem solving in geometry. Reasoning processes of student teachers working in small groups: A dialogical approach.
<b>2003</b> <b>V</b>	Arefjord, Kjersti, Dr. psychol.	After the myocardial infarction – the wives' view. Short- and long-term adjustment in wives of myocardial infarction patients.
	Ingjaldsson, Jón Þorvaldur, Dr. psychol.	Unconscious Processes and Vagal Activity in Alcohol Dependency.
	Holden, Børge, Dr. philos.	Følger av atferdsanalytiske forklaringer for atferdsanalysens tilnærming til utforming av behandling.
	Holsen, Ingrid, Dr. philos.	Depressed mood from adolescence to 'emerging adulthood'. Course and longitudinal influences of body image and parent-adolescent relationship.
	Hammar, Åsa Karin, Dr. psychol.	Major depression and cognitive dysfunction- An experimental study of the cognitive effort hypothesis.
	Sprugevica, Ieva, Dr. philos.	The impact of enabling skills on early reading acquisition.
	Gabrielsen, Egil, Dr. philos.	LESE FOR LIVET. Lesekompetansen i den norske voksenbefolkningen sett i lys av visjonen om en enhetsskole.
<b>H</b>	Hansen, Anita Lill, Dr. psychol.	The influence of heart rate variability in the regulation of attentional and memory processes.
	Dyregrov, Kari, Dr. philos.	The loss of child by suicide, SIDS, and accidents: Consequences, needs and provisions of help.
<b>2004</b> <b>V</b>	Torsheim, Torbjørn, Dr. psychol.	Student role strain and subjective health complaints: Individual, contextual, and longitudinal perspectives.

	Haugland, Bente Storm Mowatt Dr. psychol.	Parental alcohol abuse. Family functioning and child adjustment.
	Milde, Anne Marita, Dr. psychol.	Ulcerative colitis and the role of stress. Animal studies of psychobiological factors in relationship to experimentally induced colitis.
	Stornes, Tor, Dr. philos.	Socio-moral behaviour in sport. An investigation of perceptions of sportpersonship in handball related to important factors of socio-moral influence.
	Mæhle, Magne, Dr. philos.	Re-inventing the child in family therapy: An investigation of the relevance and applicability of theory and research in child development for family therapy involving children.
	Kobbeltvedt, Therese, Dr. psychol.	Risk and feelings: A field approach.
<b>2004</b> <b>H</b>	Thomsen, Tormod, Dr. psychol.	Localization of attention in the brain.
	Løberg, Else-Marie, Dr. psychol.	Functional laterality and attention modulation in schizophrenia: Effects of clinical variables.
	Kyrkjebø, Jane Mikkelsen, Dr. philos.	Learning to improve: Integrating continuous quality improvement learning into nursing education.
	Laumann, Karin, Dr. psychol.	Restorative and stress-reducing effects of natural environments: Experiential, behavioural and cardiovascular indices.
	Holgersen, Helge, PhD	Mellom oss - Essay i relasjonell psykoanalyse.
<b>2005</b> <b>V</b>	Hetland, Hilde, Dr. psychol.	Leading to the extraordinary? Antecedents and outcomes of transformational leadership.
	Iversen, Anette Christine, Dr. philos.	Social differences in health behaviour: the motivational role of perceived control and coping.
<b>2005</b> <b>H</b>	Mathisen, Gro Ellen, PhD	Climates for creativity and innovation: Definitions, measurement, predictors and consequences.
	Sævi, Tone, Dr. philos.	Seeing disability pedagogically – The lived experience of disability in the pedagogical encounter.
	Wium, Nora, PhD	Intrapersonal factors, family and school norms: combined and interactive influence on adolescent smoking behaviour.
	Kanagaratnam, Pushpa, PhD	Subjective and objective correlates of Posttraumatic Stress in immigrants/refugees exposed to political violence.
	Larsen, Torill M. B. , PhD	Evaluating principals` and teachers` implementation of Second Step. A case study of four Norwegian primary schools.
	Bancila, Delia, PhD	Psychosocial stress and distress among Romanian adolescents and adults.
<b>2006</b> <b>V</b>	Hillestad, Torgeir Martin, Dr. philos.	Normalitet og avvik. Forutsetninger for et objektivt psykopatologisk avviksbegrep. En psykologisk, sosial, erkjennelsesteoretisk og teoriehistorisk framstilling.

	Nordanger, Dag Øystein, Dr. psychol.	Psychosocial discourses and responses to political violence in post-war Tigray, Ethiopia.
	Rimol, Lars Morten, PhD	Behavioral and fMRI studies of auditory laterality and speech sound processing.
	Krumsvik, Rune Johan, Dr. philos.	ICT in the school. ICT-initiated school development in lower secondary school.
	Norman, Elisabeth, Dr. psychol.	Gut feelings and unconscious thought: An exploration of fringe consciousness in implicit cognition.
	Israel, K Pravin, Dr. psychol.	Parent involvement in the mental health care of children and adolescents. Empirical studies from clinical care setting.
	Glasø, Lars, PhD	Affects and emotional regulation in leader-subordinate relationships.
	Knutsen, Ketil, Dr. philos.	HISTORIER UNGDOM LEVER – En studie av hvordan ungdommer bruker historie for å gjøre livet meningsfullt.
	Matthiesen, Stig Berge, PhD	Bullying at work. Antecedents and outcomes.
<b>2006</b>	Gramstad, Arne, PhD	Neuropsychological assessment of cognitive and emotional functioning in patients with epilepsy.
<b>H</b>	Bendixen, Mons, PhD	Antisocial behaviour in early adolescence: Methodological and substantive issues.
	Mrumbi, Khalifa Maulid, PhD	Parental illness and loss to HIV/AIDS as experienced by AIDS orphans aged between 12-17 years from Temeke District, Dar es Salaam, Tanzania: A study of the children's psychosocial health and coping responses.
	Hetland, Jørn, Dr. psychol.	The nature of subjective health complaints in adolescence: Dimensionality, stability, and psychosocial predictors
	Kakoko, Deodatus Conatus Vitalis, PhD	Voluntary HIV counselling and testing service uptake among primary school teachers in Mwanza, Tanzania: assessment of socio-demographic, psychosocial and socio-cognitive aspects
	Mykletun, Arnstein, Dr. psychol.	Mortality and work-related disability as long-term consequences of anxiety and depression: Historical cohort designs based on the HUNT-2 study
	Sivertsen, Børge, PhD	Insomnia in older adults. Consequences, assessment and treatment.
<b>2007</b>	Singhammer, John, Dr. philos.	Social conditions from before birth to early adulthood – the influence on health and health behaviour
<b>V</b>	Janvin, Carmen Ani Cristea, PhD	Cognitive impairment in patients with Parkinson's disease: profiles and implications for prognosis
	Braarud, Hanne Cecilie, Dr. psychol.	Infant regulation of distress: A longitudinal study of transactions between mothers and infants
	Tveito, Torill Helene, PhD	Sick Leave and Subjective Health Complaints

	Magnussen, Liv Heide, PhD	Returning disability pensioners with back pain to work
	Thuen, Elin Marie, Dr.philos.	Learning environment, students' coping styles and emotional and behavioural problems. A study of Norwegian secondary school students.
	Solberg, Ole Asbjørn, PhD	Peacekeeping warriors – A longitudinal study of Norwegian peacekeepers in Kosovo
<b>2007</b>	Søreide, Gunn Elisabeth, Dr.philos.	Narrative construction of teacher identity
<b>H</b>	Svensen, Erling, PhD	WORK & HEALTH. Cognitive Activation Theory of Stress applied in an organisational setting.
	Øverland, Simon Nygaard, PhD	Mental health and impairment in disability benefits. Studies applying linkages between health surveys and administrative registries.
	Eichele, Tom, PhD	Electrophysiological and Hemodynamic Correlates of Expectancy in Target Processing
	Børhaug, Kjetil, Dr.philos.	Oppseding til demokrati. Ein studie av politisk oppseding i norsk skule.
	Eikeland, Thorleif, Dr.philos.	Om å vokse opp på barnehjem og på sykehus. En undersøkelse av barnehjemsbarns opplevelser på barnehjem sammenholdt med sanatoriebarns beskrivelse av langvarige sykehusopphold – og et forsøk på forklaring.
	Wadel, Carl Cato, Dr.philos.	Medarbeidersamhandling og medarbeiderledelse i en lagbasert organisasjon
	Vinje, Hege Forbech, PhD	Thriving despite adversity: Job engagement and self-care among community nurses
	Noort, Maurits van den, PhD	Working memory capacity and foreign language acquisition
<b>2008</b>	Breivik, Kyrre, Dr.psychol.	The Adjustment of Children and Adolescents in Different Post-Divorce Family Structures. A Norwegian Study of Risks and Mechanisms.
<b>V</b>	Johnsen, Grethe E., PhD	Memory impairment in patients with posttraumatic stress disorder
	Sætrevik, Bjørn, PhD	Cognitive Control in Auditory Processing
	Carvalho, Susana Fonseca, PhD	Prevention of bullying in schools: an ecological model
<b>2008</b>	Brønnick, Kolbjørn Selvåg	Attentional dysfunction in dementia associated with Parkinson's disease.
<b>H</b>	Posserud, Maj-Britt Rocio	Epidemiology of autism spectrum disorders
	Haug, Ellen	Multilevel correlates of physical activity in the school setting
	Skjerve, Arvid	Assessing mild dementia – a study of brief cognitive tests.

	Kjønniksen, Lise	The association between adolescent experiences in physical activity and leisure time physical activity in adulthood: a ten year longitudinal study
	Gundersen, Hilde	The effects of alcohol and expectancy on brain function
	Omvik, Siri	Insomnia – a night and day problem
<b>2009 V</b>	Molde, Helge	Pathological gambling: prevalence, mechanisms and treatment outcome.
	Foss, Else	Den omsorgsfulle væremåte. En studie av voksnes væremåte i forhold til barn i barnehagen.
	Westrheim, Kariane	Education in a Political Context: A study of Knowledge Processes and Learning Sites in the PKK.
	Wehling, Eike	Cognitive and olfactory changes in aging
	Wangberg, Silje C.	Internet based interventions to support health behaviours: The role of self-efficacy.
	Nielsen, Morten B.	Methodological issues in research on workplace bullying. Operationalisations, measurements and samples.
	Sandu, Anca Larisa	MRI measures of brain volume and cortical complexity in clinical groups and during development.
	Guribye, Eugene	Refugees and mental health interventions
	Sørensen, Lin	Emotional problems in inattentive children – effects on cognitive control functions.
	Tjomsland, Hege E.	Health promotion with teachers. Evaluation of the Norwegian Network of Health Promoting Schools: Quantitative and qualitative analyses of predisposing, reinforcing and enabling conditions related to teacher participation and program sustainability.
	Helleve, Ingrid	Productive interactions in ICT supported communities of learners
<b>2009 H</b>	Skorpen, Aina Øye, Christine	Dagliglivet i en psykiatrisk institusjon: En analyse av miljøterapeutiske praksiser
	Andreassen, Cecilie Schou	WORKAHOLISM – Antecedents and Outcomes
	Stang, Ingun	Being in the same boat: An empowerment intervention in breast cancer self-help groups
	Sequeira, Sarah Dorothee Dos Santos	The effects of background noise on asymmetrical speech perception
	Kleiven, Jo, dr.philos.	The Lillehammer scales: Measuring common motives for vacation and leisure behavior
	Jónsdóttir, Guðrún	Dubito ergo sum? Ni jenter møter naturfaglig kunnskap.
	Hove, Oddbjørn	Mental health disorders in adults with intellectual disabilities - Methods of assessment and prevalence of mental health disorders and problem behaviour
	Wageningen, Heidi Karin van	The role of glutamate on brain function



	Bjørkvik, Jofrid	God nok? Selvaktelse og interpersonlig fungering hos pasienter innen psykisk helsevern: Forholdet til diagnoser, symptomer og behandlingsutbytte
	Andersson, Martin	A study of attention control in children and elderly using a forced-attention dichotic listening paradigm
	Almås, Aslaug Grov	Teachers in the Digital Network Society: Visions and Realities. A study of teachers' experiences with the use of ICT in teaching and learning.
	Ulvik, Marit	Lærerutdanning som danning? Tre stemmer i diskusjonen
<b>2010</b>	Skår, Randi	Læringsprosesser i sykepleieres profesjonsutøvelse. En studie av sykepleieres læringserfaringer.
<b>V</b>	Roald, Knut	Kvalitetsvurdering som organisasjonslæring mellom skole og skoleeigar
	Lunde, Linn-Heidi	Chronic pain in older adults. Consequences, assessment and treatment.
	Danielsen, Anne Grete	Perceived psychosocial support, students' self-reported academic initiative and perceived life satisfaction
	Hysing, Mari	Mental health in children with chronic illness
	Olsen, Olav Kjellevod	Are good leaders moral leaders? The relationship between effective military operational leadership and morals
	Riese, Hanne	Friendship and learning. Entrepreneurship education through mini-enterprises.
	Holthe, Asle	Evaluating the implementation of the Norwegian guidelines for healthy school meals: A case study involving three secondary schools
<b>H</b>	Hauge, Lars Johan	Environmental antecedents of workplace bullying: A multi-design approach
	Bjørkelo, Brita	Whistleblowing at work: Antecedents and consequences
	Reme, Silje Endresen	Common Complaints – Common Cure? Psychiatric comorbidity and predictors of treatment outcome in low back pain and irritable bowel syndrome
	Helland, Wenche Andersen	Communication difficulties in children identified with psychiatric problems
	Beneventi, Harald	Neuronal correlates of working memory in dyslexia
	Thygesen, Elin	Subjective health and coping in care-dependent old persons living at home
	Aanes, Mette Marthinussen	Poor social relationships as a threat to belongingness needs. Interpersonal stress and subjective health complaints: Mediating and moderating factors.
	Anker, Morten Gustav	Client directed outcome informed couple therapy

	Bull, Torill	Combining employment and child care: The subjective well-being of single women in Scandinavia and in Southern Europe
	Viiig, Nina Grieg	Tilrettelegging for læreres deltakelse i helsefremmende arbeid. En kvalitativ og kvantitativ analyse av sammenhengen mellom organisatoriske forhold og læreres deltakelse i utvikling og implementering av Europeisk Nettverk av Helsefremmende Skoler i Norge
	Wolff, Katharina	To know or not to know? Attitudes towards receiving genetic information among patients and the general public.
	Ogden, Terje, dr.philos.	Familiebasert behandling av alvorlige atferdsproblemer blant barn og ungdom. Evaluering og implementering av evidensbaserte behandlingsprogrammer i Norge.
	Solberg, Mona Elin	Self-reported bullying and victimisation at school: Prevalence, overlap and psychosocial adjustment.
<b>2011</b>	Bye, Hege Høivik	Self-presentation in job interviews. Individual and cultural differences in applicant self-presentation during job interviews and hiring managers' evaluation
<b>V</b>	Notelaers, Guy	Workplace bullying. A risk control perspective.
	Moltu, Christian	Being a therapist in difficult therapeutic impasses. A hermeneutic phenomenological analysis of skilled psychotherapists' experiences, needs, and strategies in difficult therapies ending well.
	Myrseth, Helga	Pathological Gambling - Treatment and Personality Factors
	Schanche, Elisabeth	From self-criticism to self-compassion. An empirical investigation of hypothesized change processes in the Affect Phobia Treatment Model of short-term dynamic psychotherapy for patients with Cluster C personality disorders.
	Våpenstad, Eystein Victor, dr.philos.	Det tempererte nærvær. En teoretisk undersøkelse av psykoterautens subjektivitet i psykoanalyse og psykoanalytisk psykoterapi.
	Haukebø, Kristin	Cognitive, behavioral and neural correlates of dental and intra-oral injection phobia. Results from one treatment and one fMRI study of randomized, controlled design.
	Harris, Anette	Adaptation and health in extreme and isolated environments. From 78°N to 75°S.
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	Melkevik, Ole Rogstad	Screen-based sedentary behaviours: pastimes for the poor, inactive and overweight? A cross-national survey of children and adolescents in 39 countries.
	Vøllestad, Jon	Mindfulness-based treatment for anxiety disorders. A quantitative review of the evidence, results from a randomized controlled trial, and a qualitative exploration of patient experiences.
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	Munkvold, Linda Helen	Oppositional Defiant Disorder: Informant discrepancies, gender differences, co-occurring mental health problems and neurocognitive function.
	Christiansen, Øivin	Når barn plasseres utenfor hjemmet: beslutninger, forløp og relasjoner. Under barnevernets (ved)tak.
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	Veseth, Marius	Recovery in bipolar disorder. A reflexive-collaborative exploration of the lived experiences of healing and growth when battling a severe mental illness
	Mæland, Silje	Sick leave for patients with severe subjective health complaints. Challenges in general practice.
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	Nordahl, Kristin Berg	Early Father-Child Interaction in a Father-Friendly Context: Gender Differences, Child Outcomes, and Protective Factors related to Fathers' Parenting Behaviors with One-year-olds
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	Halvorsen, Kirsti Vindal	Partnerskap i lærerutdanning, sett fra et økologisk perspektiv
	Solbue, Vibeke	Dialogen som visker ut kategorier. En studie av hvilke erfaringer innvandrerdommer og norskfødte med innvandrereforeldre har med videregående skole. Hva forteller ungdommenes erfaringer om videregående skoles håndtering av etniske ulikheter?
	Kvalevaag, Anne Lise	Fathers' mental health and child development. The predictive value of fathers' psychological distress during pregnancy for the social, emotional and behavioural development of their children
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	Hoff, Helge Andreas	Thinking about Symptoms of Psychopathy in Norway: Content Validation of the Comprehensive Assessment of Psychopathic Personality (CAPP) Model in a Norwegian Setting
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	Matanda, Dennis Juma	Child physical growth and care practices in Kenya: Evidence from Demographic and Health Surveys
	Amugsi, Dickson Abanimi	Child care practices, resources for care, and nutritional outcomes in Ghana: Findings from Demographic and Health Surveys
	Jakobsen, Hilde	The good beating: Social norms supporting men's partner violence in Tanzania
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	Bless, Josef Johann	The smartphone as a research tool in psychology. Assessment of language lateralization and training of auditory attention.
	Løvvik, Camilla Margrethe Sigvaldsen	Common mental disorders and work participation – the role of return-to-work expectations
	Lehmann, Stine	Mental Disorders in Foster Children: A Study of Prevalence, Comorbidity, and Risk Factors
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	Thun, Eirunn	Shift work: negative consequences and protective factors

	Hilt, Line Torbjørnsen	The borderlands of educational inclusion. Analyses of inclusion and exclusion processes for minority language students
	Havnen, Audun	Treatment of obsessive-compulsive disorder and the importance of assessing clinical effectiveness
	Slåtten, Hilde	Gay-related name-calling among young adolescents. Exploring the importance of the context.
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	Øyeflaten, Irene Larsen	Long-term sick leave and work rehabilitation. Prognostic factors for return to work.
	Henriksen, Roger Ekeberg	Social relationships, stress and infection risk in mother and child
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	Oanes, Camilla Jensen	Tilbakemelding i terapi. På hvilke måter opplever terapeuter at tilbakemeldingsprosedyrer kan virke inn på terapeutiske praksiser?
	Reknes, Iselin	Exposure to workplace bullying among nurses: Health outcomes and individual coping
	Chimhutu, Victor	Results-Based Financing (RBF) in the health sector of a low-income country. From agenda setting to implementation: The case of Tanzania
	Ness, Ingunn Johanne	The Room of Opportunity. Understanding how knowledge and ideas are constructed in multidisciplinary groups working with developing innovative ideas.
	Hollekim, Ragnhild	Contemporary discourses on children and parenting in Norway. An empirical study based on two cases.
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	Krane, Vibeke	Lærer-elev-relasjoner, elevers psykiske helse og frafall i videregående skole – en eksplorerende studie om samarbeid og den store betydningen av de små ting
	Søvik, Margaret Ljosnes	Evaluating the implementation of the Empowering Coaching™ program in Norway
	Tonheim, Milfrid	A troublesome transition: Social reintegration of girl soldiers returning ‘home’
	Senneseth, Mette	Improving social network support for partners facing spousal cancer while caring for minors. A randomized controlled trial.
	Urke, Helga Bjørnøy	Child health and child care of very young children in Bolivia, Colombia and Peru.
	Bakhturidze, George	Public Participation in Tobacco Control Policy-making in Georgia
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<b>2017 H</b>	Hagatun, Susanne	Internet-based cognitive-behavioural therapy for insomnia. A randomised controlled trial in Norway.
	Eichele, Heike	Electrophysiological Correlates of Performance Monitoring in Children with Tourette Syndrome. A developmental perspective.
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	Sandhåland, Hilde	Safety on board offshore vessels: A study of shipboard factors and situation awareness
	Blågestad, Tone Fidje	Less pain – better sleep and mood? Interrelatedness of pain, sleep and mood in total hip arthroplasty patients
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	Vedaa, Øystein	Shift work: The importance of sufficient time for rest between shifts.
	Steine, Iris Mulders	Predictors of symptoms outcomes among adult survivors of sexual abuse: The role of abuse characteristics, cumulative childhood maltreatment, genetic variants, and perceived social support.
	Høgheim, Sigve	Making math interesting: An experimental study of interventions to encourage interest in mathematics

<b>2018</b> <b>V</b>	Brevik, Erlend Joramo	Adult Attention Deficit Hyperactivity Disorder. Beyond the Core Symptoms of the Diagnostic and Statistical Manual of Mental Disorders.
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	Hagen, Egon	Cognitive and psychological functioning in patients with substance use disorder; from initial assessment to one-year recovery
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	Egelandsdal, Kjetil	Clickers and Formative Feedback at University Lectures. Exploring students and teachers' reception and use of feedback from clicker interventions.
	Torjussen, Lars Petter Storm	Foreningen av visdom og veltalenhet – utkast til en universitetsdidaktikk gjennom en kritikk og videreføring av Skjervheims pedagogiske filosofi på bakgrunn av Arendt og Foucault. <i>Eller hvorfor menneskelivet er mer som å spille fløyte enn å bygge et hus.</i>
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