# Digitization in School Leadership and Educational Governance

## Examples from Policy and Practice

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Thesis submitted for the degree of Philosophiae Doctor

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Faculty of Educational Sciences
UNIVERSITY OF OSLO

2022

*Series of dissertations submitted to the*
*Faculty of Educational Sciences, University of Oslo*
No. 354

ISSN 1501-8962



Print production: Graphics Center, University of Oslo.

## Acknowledgements

I would first like to thank the Department of Teacher Education and School Research (ILS) at the Faculty of Educational Sciences, University of Oslo, under previous Department Head Rita Hvistendahl and current Department Head Dijana Tiplic, for fully funding my position as a PhD candidate. I have truly enjoyed being part of ILS and could not have chosen a better place to earn my PhD!

Special thanks to every school and school leader who participated in my project. Thank you for trusting me with your time and knowledge. Your contribution was significant. I hope you learned as much from participating as I learned from my time interviewing you.

Thank you to my main supervisor, Professor Emerita Eli Ottesen. You have always been deeply engaged with my project, and I am happy that I have shared my PhD experience so closely with you. You have surprised me many times with the knowledge you possess and the authority with which you carry yourself. My only hope is that I will follow some of your footsteps in the kind but critical way you approach research. Thank you also to my co-supervisor, Professor Gerry Mac Ruairc, who has provided very positive support throughout my project. I appreciate your optimistic feedback, which made me feel confident in my work. My two supervisors have been invaluable. Thank you!

I have had the pleasure of being part of the research group CLEG and the professional group in Educational Leadership at the Department. Many times, members of these groups have served as extra supervisors who have read my texts, given valuable feedback, and encouraged me both professionally and personally. Thank you Jorunn Møller, Berit Karseth, Kirsten Sivesind, Ann Elisabeth Gunnulfsen, Ruth Jensen, Jeffrey Hall, Hedvig Neerland Abrahamsen, Guri Skedsmo, Tor Colbjørnsen, Heidi Kleveland, Kristin Helstad, Judith Novak, Eivind Larsen, Hilde Madsø Jacobsen, Silje Kristin Gloppen, Anne Gry Fadum Carlsen, Anniken Hotvedt Sundby, Kjersti Løken Ødegaard, Siv Marit Stavem, Chanwoong Baek, and Simona Bernotaite. A special thank you to Berit, head of CLEG, for your careful reading of my texts and for your cooperation in other projects as well. Thank you Jorunn for introducing me to your vast network and also for being a fun office partner. Thank you, Jeff, for lending me your office during my final months. Thank you Kirsten, who encouraged me to apply for the PhD position—I would not have been here without you!

During the course of the project, I also had the pleasure of gathering and taking part in a study circle in sociomaterial theory and methodology with other research fellows at the Faculty. Thank you Kenneth Pettersen, Simona Bernotaite, Siv Marit Stavem, Christopher Sadorge and Isabel Brandenberger for the experience. I hope we can continue our work with sociomaterial approaches together and that we continue our relaxed but also ambitious reflections on how things, such as tables, have a voice.

During the early spring of 2020, I had the opportunity to be a visiting scholar at the Autonomous University of Barcelona. Thank you to Associate Professor Antoni Verger, who facilitated my visit and embraced my research interests within the Reformed group. Thank you also to Marjolein Camphuijsen, who helped me with small and big things during those few weeks. Although my research stay ended abruptly due to the pandemic, I am very grateful that I had the chance to meet you and learn from being in a research environment outside my own institution.

I have also been fortunate to share my research with other external researchers. Senior Researcher Paolo Landri, who served as my midway reader, provided me with important feedback on my work, and I truly enjoyed our conversations. Thank you also to Paolo (and Roberto, Emiliano, Danilo) for being part of the organizing committee of the Summer School in European Education Studies (SUSEES), where I participated in 2019. SUSEES marked a very important stage in my PhD, where I got the chance to meet many like-minded and gifted PhD candidates. I am grateful for my fellow participants in the summer school. A special thank you goes to Lanze Vanermen, whom I first met there and have had regular Skype conversations about our article manuscripts and life in general throughout our projects.

Thank you to Associate Professor Nelli Piattoeva, who served as my final external reader. You acted with integrity, and your careful reading (and extensive notes) is something I will take with me far beyond my PhD. Thank you also for our cooperation in the NOS-HS network on governance, data and time, where I first had the pleasure of meeting you. A big thanks as well to the rest of this network, and especially Miriam Madsen, with whom I have also shared many interesting conversations concerning my PhD work, and otherwise.

Thank you to everyone, near and far, who has shared their knowledge with me or given me practical, technical and sometimes emotional help: Viviana Daza, Sofie Bastiansen, Junyi Yang, Andrés Araos, Cliona Murray, Gavin Murphy, Mathias Decuypere, Ingrid Beiler, Maria Birch Rokoguniwai, Thea Westergaard, Gard Braskerud and Nora Braskerud. Thank you to the Teaching and Learning Video Lab in the Department, who helped me with guidance and equipment for data collection. A big thank you to Torgeir Christiansen for help with this and to Kenneth Nymoen for answering my technical questions (related and unrelated to the thesis). Thank you also to my colleagues at Inland Norway University of Applied Sciences, who offered me a place to write during some very stressful weeks in the spring of 2022.

I would also like to thank the anonymous reviewers of my articles. The peer review process is at times emotionally and timely draining, but it is nevertheless one of the most important aspects of learning to become a researcher. Thank you for assessing my work critically and for teaching me the value of good feedback. I have saved some of your review comments, and I tend to go back to them quite regularly. Thank you!

Lastly, I would like to thank my family and friends for their immense support throughout the project. A special thanks, and a warm hug to my mother, Solfrid, who has opened her home to me for writing on several occasions the last few years. Large parts of my thesis were written on her terrace, which bears evidence of all the places I have taken this thesis and situations where I have prioritized writing it. Thank you therefore, to everyone who has given me the space to write and think.

This thesis is dedicated to my younger self and to all the endeavors that led me to be here today – I am very proud!

Ida Martinez Lunde

Oslo, June 2022

## Summary

This PhD thesis investigates how digitization unfolds in school leadership and educational governance by interrogating examples from policy and practice. The project centers on the premise that digitized school leadership and educational governance have certain relational effects at the school level produced by a complex interplay between different governing actors. The main aim is to examine school leaders' practices with digital technologies in Irish and Norwegian schools and to explore their effects in school leadership and educational governance.

The study draws on two sites: Irish secondary schools and Norwegian lower secondary schools. These comprised three schools from each site, and 25 informants (principals and middle management) participated in semi-structured interviews. Datasets also include national policy documents (three from each site), screen recordings from the interviews, and interviews with digital platforms facilitated by analyzing screen prints in Nvivo. The overarching analytical and methodological approach draws from Actor-Network Theory (ANT).

This thesis has three empirical articles. In Article I, we unfolded governmental ambitions to digitalize school leadership and teaching practices in key policy documents in Ireland and Norway. Drawing from policy assemblage (Savage, 2019) and visual network analysis (Decuypere, 2019), we found that digital actors have the potential to steer education to enhance multiple governance mechanisms at once, such as assessment and evaluation. For school leaders and teachers, we found that the Irish policy documents portrayed rather analog formats of digitization, suggesting time-consuming and manual labor for school practitioners. The Norwegian documents portrayed more automated solutions, which suggested challenging ethical and juridical considerations from school leaders and teachers.

Article II investigated how school leaders' subjectivities emerged in interactions with a school management system (SMS). The article draws from interviews conducted in three Irish schools (including screen recordings), as well as interviews performed with the SMS in Nvivo. The article theorizes subjectivity by drawing from ANT and shows how school leaders and the SMS act on each other in ways that allow school leader subjectivity to emerge in a processual manner, whereas digital elements from the platform work as highly specific 'subjectifiers.'

In Article III, I unfolded anticipation in Norwegian school leaders' interactions with two learning analytic platforms (LAPs). I also aimed to problematize a chronological understanding of time and anticipation in digitized practices by drawing on ANT. This article analyzes interview material from three Norwegian schools (including screen recordings and screen prints). The findings show how time and anticipation emerged on the premise of the LAPs, albeit with fluid and multiple presentations. The LAPs served as actors who problematized the uncertain and offered possibilities for action that encouraged school leaders to act in the present. At the same time, school leaders adapted the LAPs to their own practice.

In sum, the thesis demonstrates how new actors are now involved in educational matters, which poses consequences for how we think about agency, governing structures and new leadership practices. In other words, this thesis shows how digitized practices open up new spaces for governing and leading education.

## Sammendrag

Denne PhD avhandlingen undersøker hvordan bruk av data og økt digitalisering ('digitization') utspiller seg i skoleledelse og styring i utdanning, ved å bruke eksempler fra policy og praksis. Prosjektet tar utgangspunkt i at fenomenet utgjør visse relasjonelle effekter på skolenivå, som kommer til uttrykk gjennom et komplekst samspill mellom ulike styringsaktører. Hovedmålet er å undersøke skolelederes praksis med digitale teknologier i irske og norske skoler, og å utforske dets effekter i styring og ledelse av skolen.

Avhandlingen har to studiesettinger: irske ungdoms-og-videregående skoler, og norske ungdomsskoler. Inkludert er tre skoler fra hver setting, og totalt 25 informanter (rektorer og mellomledere) deltok i semi-strukturerte intervjuer. Andre datasett inkluderer: nasjonale policydokumenter (tre fra hver setting), skjermopptak fra intervjuene og intervjuer med digitale plattformer. Det overordnede analytiske og metodiske perspektivet bygger på Aktør-Nettverks Teori (ANT).

Avhandlingen har tre empiriske artikler. I Artikkel I undersøkte vi nasjonale ambisjoner om å digitalisere skoleledelse og undervisningspraksis i sentrale utdanningspolitiske dokumenter fra Irland og Norge. Vi brukte perspektivene policy assemblage (Savage, 2019) og visuell nettverksanalyse (Decuypere, 2019). Funnene viser at digitale aktører har potensiale til å styre utdanning ved å forsterke flere styringsmekanismer samtidig, slik som vurdering og evaluering. For skoleledere og lærere, fant vi at de irske dokumentene skildret analoge formater av digitalisering, noe som tyder på tidkrevende og manuelt arbeid innad i skoler. De norske dokumentene skildret mer automatiserte løsninger, som antydet utfordrende etiske og juridiske hensyn for skoleledere og lærere.

Artikkel II undersøker hvordan skoleledere som subjekt, og deres egenskaper som formes gjennom subjektiveringsprosesser, oppstår i interaksjoner med en læringsplattform. Artikkelen bygger på intervjuer utført på tre irske skoler (inkludert skjermopptak), samt intervjuer utført med læringsplattformen. Artikkelen teoretiserer subjektivering ved å bygge på ANT begreper, og viser hvordan skoleledere og plattformen former hverandre på en prosessuell måte. Digitale elementer innad i plattformen fungerte som spesifikke aktører som formet skolelederen.

I Artikkel III undersøkte jeg hvordan forventningsstyring kommer til uttrykk i norske skolelederes interaksjon med to læringsanalyseplattformer. Jeg problematiserte også en kronologisk forståelse av tid og forventning i digitale praksiser ved å bygge på begreper fra ANT. Artikkelen analyserer intervjumateriale fra tre norske skoler (inkludert skjermopptak og skjermbilder). Funnene viser hvordan tid og forventning oppstår på premissene til læringsanalyseplattformene, med til dels flytende og skiftende presentasjoner. Plattformene fungerte som problematiserende aktører, som også tilbød løsninger og sikret at skolelederne handlet i nåtid. Samtidig tilpasset skolelederne bruk av plattformene til egen praksis.

Avhandlingen demonstrerer hvordan nye aktører involveres i utdanning og skole, og hvilke konsekvenser det har for hvordan vi definerer hva som er en aktør, hvordan vi forstår styring og ny ledelsespraksis. Oppsummert viser avhandlingen hvordan digitale praksiser åpner opp nye rom for å styre og lede utdanning.

# Part I: Extended Abstract

## Figures



## Tables

## Part II: Articles

Article I: Lunde, I. M., & Ottesen, E. (2020). Digital technologies in policy assemblages in Ireland and Norway: A visual network analysis. *European Educational Research Journal*, ahead of print, https://doi.org/10.1177/1474904120972291

Status: Published.

Article II: Lunde, I. M. (2021). Emergent school leader subjectivities in digitized practices: The case of VSware. *International Journal of Leadership in Education*, ahead of print https://doi.org/10.1080/13603124.2021.2000034

Status: Published.

Article III: Lunde, I. M. (in review). Learning analytics as modes of anticipation: enacting time in actor-networks. *Scandinavian Journal of Educational Research*.

Status: Submitted after second round of revisions May 20th, 2022.

# Part I

# Extended Abstract

# 1. Introduction

Digital technologies that collect and visualize school data have become integral to the organization of teaching and learning. School leaders are expected to analyze these data to identify the necessary areas of organizational improvement and for the purposes of school development (Ottesen, 2018). This digitization trend involves policy and governance, its technologies and materializations in practice, and a shift toward the digitalization of leadership practices (Niesche & Heffernan, 2020). This shift also suggests a new logic of governance in education, where new technologies and data-driven practices are emphasized to develop new insights for policymaking and practice (Williamson, 2017) and have been conceptualized as digital education governance (Landri, 2018; Ozga, 2016; Williamson, 2016). Digital education governance refers to kinds of datafication and digitization that work to govern education systems and school practices (Williamson, 2017). 'Datafication' is the transformation of educational aspects into quantifiable information for purposes of measurement and calculation, and 'digitization' refers to the digital systems that facilitate the regulation of data collection into practice (Williamson, 2017). The role of digital technologies in contemporary education is illustrated in my PhD project, with examples from policy and practice, and with a special emphasis on school leadership and educational governance.

## 1.1. Research Aim

The main aim of this PhD project is to examine school leaders' practices with digital technologies in Irish and Norwegian schools and to explore their effects in school leadership and educational governance.

The main aim of the PhD project informs three separate but connected articles. The first article is concerned with how Irish and Norwegian policy documents frame and put forward governmental ambitions for school leaders' and teachers' use of digital technologies. In this initial phase of the project, 'digital technologies' are used more widely to refer to any digital technology that school leaders and teachers are expected to use in data-driven practices. The expectations are presented as visual networks of potential interactions and practices between digital technologies, school leaders, teachers and other actors. The second article draws on empirical data from three secondary schools in Ireland. Here, digital technologies refer to one specific software, as I examine the Irish school management system VSware in school leaders' practice. The article is concerned with how school leaders and VSware emerge conjointly as school leaders' subjectivities come into being in the relations that form between VSware, school leaders and actors that were both internal and external to the schools. The third article draws on empirical data from three lower secondary schools in Norway. The article investigates the learning analytics platforms' Conexus Engage and Insight in modes of anticipation that produced various notions of time as school leaders interacted with the platform. Therefore, 'digital technologies' refer to learning analytic platforms in the third article. I take a broad view of what constitutes school leadership, and 'school leaders,' therefore, refers to all of those

holding official leadership positions within schools, including principals and middle management.

As such, all three articles contribute to the main research aim by exploring school leaders' digital practice as policy expectations for practice in Article I and the unfolding of school leaders' digital practice in Articles II and III. All three articles contribute to exploring the different effects of digitization in school leadership and educational governance by conceptualizing three main effects in the three articles (see Chapter 3).

### 1.2. Datafication and Digitization in Education

The significance of digital technologies in contemporary education is often discussed in terms of teaching and learning (i.e., Blikstad-Balas & Klette, 2020; Chaudron et al., 2018; Roulston et al., 2019). Such investigations explore critical discussions of teaching methods and one-to-one devices in the classroom by addressing issues of instruction. However, a substantial proportion of digital technologies in schools are managerial in nature (Selwyn, 2011), and the growing interest in data use strengthens the use of these technologies for processual development in schools. At the leadership level, there are school management systems (SMS) that are used for staff time-tabling and for the registration of student attendance and record-keeping. Other types of digital systems include learning analytic platforms (LAPs) that are designed to provide school leaders with large quantities of student data to inform on student and school performance. We now also see an increased interest in merging these two types of systems, providing school leaders and teachers with one space for typical administrative tasks, such as time-tabling and staff communication, as well as connecting to educational standards and data analytics (see, for instance, the new Conexus Skooler).

For school leaders, the use of such digital technologies implies an increased political interest in leading through evidence. Evidence in education stems from several educational reforms from the 2000s and onwards in industrialized countries, emphasizing the use of evidence through data (Gunnulfsen & Møller, 2021; Hornskov et al., 2016; Krejsler & Moos, 2021). This 'best practice' transition in education has aimed to identify correlations between educational elements to demonstrate what works, such as the works of Hattie (Krejsler & Moos, 2021). There has especially been an interest in exploring these discussions, irrespective of context, to bring forward a 'one size fits all' mentality that strengthens the validity of objective numbers (Steiner-Khamsi, 2013). Within school leadership research, functionalist approaches have largely promoted the transition to best practice and effectiveness by interrogating the specific outcomes and outputs of leadership and identifying questions of efficiency (Courtney et al., 2021). The main goal of using evidence in schools has also been to strengthen education quality through issues of learning outcomes and students' wellbeing. Data and evidence, as such, have been an issue for both teaching and quality development in schools at different governing levels (Hornskov et al., 2016). As an implication, school leaders now deal with various forms of data (attendance, behavior, performance) to uphold ambitions of standardization, quality and accountability, suggesting a strengthened influence from New Public Management (NPM) ideas. Digital technologies make these educational goals possible by drawing on automation

and machine learning and translating educational issues, such as school development, into digital practices (Williamson, 2017).

These trends in education have been influenced by a variety of actors who have not traditionally taken a leading role in educational matters. Examples include supra-national organizations (i.e., the Organisation for Economic Cooperation and Development [OECD], the European Union [EU], the World Bank), Edu-business (i.e., Pearson), and now also increasingly EdTech companies (Gunnulfsen & Møller, 2021; Williamson, 2017). The use of data and digital technologies has also affected school leaders' roles and their approach to leadership development (Gunnulfsen & Møller, 2021). The importance of school leadership in contemporary (digital) education is therefore twofold; it implies that school leaders are one of the 'core pillars' in bringing forward schools that are embedded in evidence-based reforms (Niesche & Heffernan, 2020) and that data is now a main 'ingredient' in educational leadership in relation to a vast number of leadership tasks and activities (Landri & Gorur, 2021).

The context in which school leaders are becoming important 'data-managers' is part of developments in educational governance. Simultaneous to the rise of data in schools, governance has been rearranged from being solely based within central governments to becoming fluid and distributed tasks between the public and private spheres (Ozga et al., 2011; Williamson, 2017). This is a form of steering from a distance, where schools, school leaders and teachers are encouraged to engage in self-evaluations alongside national governance mechanisms, such as external inspections and national testing (Ozga, 2009; Ozga & Grek, 2012). Digital technologies, the governments and businesses that produce them, and the school leaders who interact with them can therefore be said to be part of networked practices that distribute governance across micro and macro levels (Ozga et al., 2011). Digitizing education, therefore, encompasses a political and ideological transition toward intensifying the role of school leaders in relational practices that give them dual roles (in-house leaders and forming connections to other governing actors in education). Moreover, these governance instruments (in the form of digital technologies and policy encouragements) suggest that there is a performative side to these practices and the actors partaking in such practices. This implies that humans, as well as non-human (digital) technologies, connect to each other to enact particular activities of leadership and management by engaging with issues of governance. The 'other governing actors' that school leaders engage with daily are therefore often actors presented in digital form. This PhD project centers on the premise that digital technologies for school leadership and educational governance are increasingly important topics for investigation through approaches that allow the entangled realities of digitization to be unfolded and shown. It puts forward a need to investigate the phenomenon as transparently as possible to shed light on examples from policy and practice that highlight day-to-day scenarios of digital technologies in schools and to shed light on the roles of those enacting digitized activities. The upcoming sections will continue this introductory section by contextualizing educational–political developments in digitizing Irish and Norwegian education.

### 1.3. Digitizing Irish Education

There are three main school types in Irish secondary education: voluntary secondary schools, which are (privately) owned and managed by the Catholic Church; community schools, which are run by education and training boards (ETB); and community/comprehensive schools, which are typically under the patronage of a religious order or bishop (Liddy et al., 2019; Skerritt & Salokangas, 2020). Some schools are enrolled in the Delivering Equality of Opportunity in Schools (DEIS) program, which supports schools in areas with a high percentage of disadvantaged students. The different school types all teach the national curriculum.

Largely influenced by NPM and a decline in Irish results in the Programme for International Student Assessment (PISA), the 1990s and 2000s represented various changes to school quality assurance through political and legislative means in Ireland (O'Doherty, 2014). This included a clarification of roles in the education sector through managerialism, accountability and local autonomy, and whole school development plans were formally mandated (Bowe et al., 2017; Hislop, 2013; McNamara et al., 2020). School inspections were coupled with school self-evaluation (SSE) and were made mandatory in 2012 (Department of Education and Skills, 2012a). This change to school evaluation was an attempt to combine external inspections with internal evaluations, which also involved parent and student surveys and the monitoring of literacy and numeracy strategies (Department of Education and Skills, 2017; McNamara et al., 2020; O'Brien et al., 2019). Standardized tests were implemented in English and mathematics at the primary level, while post-primary schools have yet to start this process although it was announced a decade ago (Department of Education and Skills, 2012b). Despite some aspects of NPM gaining foothold in Irish education, these are characterized by lower-stakes and soft forms of governance in comparison to its neighboring country, England (Hogan, 2019). There are, however, perceptions among school leaders that such changes have caused an increased interest in numbers and 'ticking boxes' (Mac Ruairc, 2020), which puts leadership at center stage in quality assurance.

Simultaneously, the 1990s and 2000s saw a digital revolution in Irish society (Department of Education and Science, 1997). Through several digitalization phases in schools, the use of ICT has gone from concerns of integration and infrastructure to learner-centered strategies that are highly coupled with curriculum and assessment (McGarr & Johnston, 2019). Some examples are the complete digitalization of (interactive) curricula and the Digital Strategy for Schools 2015–2020 (which is currently being renewed), where digital technologies are thought to strengthen formative and summative assessment (Department of Education and Skills, 2015a). In this sense, digitalization supports other policy initiatives and the ongoing assessment reform at post-primary levels, offering a method to manage and measure those aspects of the New Junior Cycle (lower secondary) curriculum that pose significant challenges to traditional assessment methods. The strong link between digitalization and evidence-based practice suggests that these have been gradually coupled and grown side-by-side, at least on a policy level.

However, these developments in quality assurance have been subject to negotiation between the government and teacher unions. Teacher unions have a significant influence on Irish education and have caused several industrial disputes throughout the 2000s. In particular, the disputes surrounding the Framework for Junior Cycle 2012 are worth highlighting. The

framework aimed to introduce school-based assessment, as well as generic skills, short courses and learning outcomes at the lower secondary level (Department of Education and Skills, 2012c). There was substantial resistance to changes in assessment, which led to a renewed Framework for Junior Cycle in 2015 (Department of Education and Skills, 2015b; MacPhail et al., 2018). While some of the ideas in the framework have been implemented, the developments have moved slowly, and resistance is an ongoing issue.

### 1.4. Digitizing Norwegian Education

Norwegian schools are grounded in democratic values and the welfare state. Most schools in Norway are public and are managed by municipal boards and municipal superintendents (primary and lower secondary schools) and county boards with district leaders (upper secondary schools). Privatization has not gained root in the Norwegian context, mostly because free school choice exists only in larger cities and private companies are juridically restricted from profiting (Gunnulfsen & Møller, 2021).

Sparked by the first PISA results, the national reform 'The Knowledge Promotion' (LK06) was implemented in 2006 with a competency-based curriculum (Skedsmo, 2009). Simultaneously, the National Quality Assessment System (NQAS) was introduced. The NQAS is comprised of national tests in Norwegian, English and Mathematics at grades 5, 8 and 9, mapping tests (typically numeracy and literacy), student, parent and teacher surveys, end-of-school examinations, and end-of-year grades in secondary schools. The aim of the NQAS is twofold: to increase the quality of schools and to enable national authorities' insight into educational output (Skedsmo, 2009). Except for a short break in national testing in 2006 (after massive critiques from teachers, school leaders and students), the NQAS has persisted and continues to expand. Recently, the Value-Added-Indicator (VAI) was introduced—a statistical tool for assessing schools' contributions to student achievement (Directorate for Education and Training, 2020). Based on historically tracked performance results and cross-sectional indicators, such as family background, the VAI is intended to predict completion rates for each student and shed light on schools' contribution to this work.

The NQAS exemplifies some NPM features; it promotes evidence-based practice, expectations to use data extensively, and a shift from input-oriented policy to output-oriented policy (Skedsmo, 2009). The increased expectations to use data in both policy and practice saw the rise of several websites and platforms, offering all or some of the datasets in one place (Caspersen et al., 2017). This includes the webpage Skoleporten, which was recently replaced by 'Statistikk' (statistics), a separate branch on the Directorate's webpage that encompasses statistical data from the NQAS through 'analysis boards,' where one can filter the data and make comparisons across schools and municipalities. In addition, several platforms have been developed between private providers and the Directorate that offer similar solutions. The data from the NQAS, either in the form of numbers or visualizations, are used in result meetings between municipalities/counties and leadership teams at schools. Result meetings are a new practice that has been established on the background of the NQAS and are typically designed for school leaders and local authorities to regularly discuss schools' results, how the results can be used for school development, and how the results can inform teaching and learning

(Mausethagen et al., 2018). These result meetings exemplify one approach in which school leadership teams, particularly principals, are placed at the center of learning and efficacy through the NQAS. Other examples include a growing focus on students' wellbeing through, for instance, the Education Act, which works to hold schools juridically accountable for issues, such as bullying and general wellbeing (Education Act, 1998, §9A).

By materializing the NQAS into vast forms of data collection through digital means, digitalization trends have expanded side-by-side steering mechanisms in Norwegian education. While the early 2000s were characterized by securing access and ICT infrastructure in Norwegian schools (Ottesen, 2013), digitalization has gradually affected several areas of the NQAS, such as assisting data collection through different forms of learning analytics, an area that is expected to expand rapidly in Norwegian education (Ministry of Education and Research, 2020). In addition, other examples of digitization include the national curricula 'Fagfornyelsen' (LK20) in interactive and digital form, as well as the increased use of one-to-one devices in schools that offer a plethora of adaptive solutions to data analytics.

This extended abstract draws from empirical data from these two sites, and the articles present them somewhat differently: the two sites are presented together in Article I and separately in Articles II (Irish schools) and III (Norwegian schools). I have not aimed to make comparisons across contexts, nor to make use of comparative methodologies in the three articles or in this extended abstract. This has been done to have more flexibility in what and who to investigate at each site, as well as in the topics covered in the articles. Simple comparisons of findings can, however, be found in that the two sites illuminate how digitization trends unfold in similar and different ways. For the rationale and further explanations of the empirical sites, see Chapter 4.1.

### 1.5. Outline of the Extended Abstract

This PhD thesis has two main parts: part one is the extended abstract, and part two consists of the three articles. The extended abstract is divided into seven chapters aiming to connect the three articles together empirically, theoretically and methodologically. Chapter 2 continues the introduction to the field of datafication and digitization in school leadership and governance by positioning this project in a literature review. Chapter 3 outlines the analytical framework of the project as a whole by discussing the overarching concepts that I utilized. I also briefly discuss the limitations of the analytical approach. Chapter 4 presents the research design, data material and data analysis methods, as well as some reflections on research credibility and ethical protocols. Chapter 5 synthetizes the main empirical findings, as well as the theoretical and methodological points in this project, and I further discuss these with a discussion of contributions in Chapter 6. In Chapter 7, I briefly summarize the thesis, point to some implications for school leaders and policymakers, and make suggestions for future research. All chapters are meant to supplement and connect the articles. At times, I have written this extended abstract in close connection with the articles, and I refer to important concepts and methodologies within the articles throughout this text. Readers can therefore benefit from reading the articles before continuing this extended abstract or follow the guides in this text, where I refer to exact places in the articles. The articles are referred to in the order in which they were written:

Article I: Lunde, I. M., & Ottesen, E. (2020). Digital technologies in policy assemblages in Ireland and Norway: A visual network analysis. *European Educational Research Journal*, ahead of print, https://doi.org/10.1177/1474904120972291

Article II: Lunde, I. M. (2021). Emergent school leader subjectivities in digitized practices: The case of VSware. *International Journal of Leadership in Education*, ahead of print https://doi.org/10.1080/13603124.2021.2000034

Article III: Lunde, I. M. (in review). Learning analytics as modes of anticipation: enacting time in actor-networks. *Scandinavian Journal of Educational Research*.

## 2. State of the Field

The main aim of this literature review is to situate the study within the broader context of digitization in education by creating an overview of existing research (Grant & Booth, 2009). The overview goes more in-depth than the reviews presented in the three articles; nevertheless, it is not meant to be exhaustive. I present the main strains in the research on digitization by highlighting the methodology and findings. I searched for literature in Google Scholar and ERIC. I included only peer-reviewed work (journal articles, scientific reports, scientific books and chapters of scientific books) from 2005 onwards, and I limited the search to include languages I understand (Norwegian, English and Spanish). Search words included school leader/principal/headmaster, education/school, and digital/digitalization/ICT/data. Except for one reference (Lupton, 2018), all included studies were fully or partly empirical. In addition to the systematic literature search, I used the snowball method by skimming reference lists of articles and books that were already included in the overview (Randolph, 2009).

In the leadership literature, one often finds categorizations of various leadership classifications, such as instructional leadership and transformational leadership, leaning toward examples of best practices and pertaining to functionalist approaches (Bush, 2013; Leithwood et al., 1999; Rhodes & Brundrett, 2010; Robinson et al., 2009). As briefly mentioned in the introduction, these functionalist approaches tend to endorse a one-size-fits-all view of reality, where a positivist and objective reality is believed to be feasible (Courtney et al., 2021). My stand, however, is that school leadership, educational governance, and digital practices in particular are recognized by their particularities pertaining to the diverse and manifold ways in which they emerge. Therefore, my aim was not to universalize or to study what leadership or governance is. For these reasons, I chose not to review the literature on leadership classifications. I view leadership and governance in this project as a practice that emerges within interactions between different actors, and I was interested in reviewing literature that shows how digitization is made into being in policy and practice. In another research strain, we find studies that use critical approaches to study issues of accountability and power relations in school leadership and educational governance (i.e., Ball, 1994; Courtney et al., 2021; Grek, 2009; Gunter, 2011; Niesche, 2013; Niesche & Heffernan, 2020). The latter research strain has tended to discuss the implications of datafication, such as governing through numbers, but its interrelation with digital technologies is in the beginning stages. Because of the lack of attention devoted to digital technologies in the school leadership literature, I also engaged with literature from other fields

that have advanced their interrogation of digital practices conceptually and empirically. This includes educational policy research and studies focused more generally on the digitization (and platformization) of education. The latter research strain is known for its investigations of digital elements, such as data and visualizations, to inform larger discussions of how educational institutions come to govern or be governed. Together, the literature on educational policy, digitization and (critical) school leadership all inform three overarching categories in this review: i) the governance by numbers literature, ii) the politics of digitization and iii) digitization in schools. This study is thus positioned in the overlap of these bodies of literature, and the categories have been separated to make it comprehensible to the reader but should be read as categories and literature of the phenomenon that are imbricated.

### 2.1. Governance by Numbers—From Datafication to Digitization

In recent decades, educational systems have produced governance practices that draw from numerical data of teaching and learning achievements. This trend is linked to national and international assessment and evaluation initiatives. While the use of numbers is not entirely new (statistical information has persisted for years and years), governing through them is relatively new in modern schools (Williamson, 2017). This phenomenon has become a key focus in educational research (Ozga, 2008). Many studies deal with the effect that numbers, as data, have on national educational policy, as well as on an international level. For instance, Grek (2009) examined the role of the OECD and PISA's effect on educational policy at the national (Finland, Germany and the UK) and European levels. The paper draws from interview data from key policy actors in the three country cases and from the European Commission, in addition to documentary data. The article concludes that PISA is constant in the three national systems (although with some local differences) in Europe, and beyond, through indirect steering, where the PISA data is used to incorporate and justify change. Similar findings can be found in other national contexts, such as in the US, Japan, New Zealand, Ireland, Switzerland, France, Portugal and Scandinavian countries (Egelund, 2008; Karseth & Sivesind, 2010; Martens et al., 2010; Martens & Niemann, 2013; Pons, 2011; Takayama, 2008).

Focusing on data use as national testing in Norway, Mausethagen (2013) identified tensions between internal (teachers' professional practice) and external (national testing) practices. Through observations and interviews with teachers and school leaders, she found that teachers, were less convinced to use the national test results, as the data seemed to steer their priorities for teaching and planning. However, school leaders seem to comply with such regulations. Gunnulfsen (2017) showed that the political intention behind national testing in Norway (that is, improving school quality) was 'lost in translation,' as school leaders and teachers in her study focused on discussing achievement levels and comparing the results, rather than drawing on pedagogical practices. In Ireland, Skerritt et al. (2021) found that school leaders work as narrators to translate and implement data practices related to school self-evaluation but that teachers tended to be 'receivers' of the policy with minimal adaptation. Both examples illuminate ongoing processes of assessment and evaluation that move between internal and external levels that necessitate the data practices to be enacted by a wide range of actors. In a higher-stakes setting, Koyama's (2015) study showed how No Child Left Behind (NCLB) links New York City schools together through the collection and comparison of standardized test

results. The article draws upon ethnographic data collected over a five-year period and reveals the various actors that are brought together in such operations, including market-based actors that produce and legitimize their own interventions through data-driven activities. The author argued that local policy actors and schools were reduced to data centers through extensive private–public intervention that helped schools comply with the NCLB accountability policy but that replaced important pedagogical tenets in teaching and learning.

Brøgger and Staunæs (2016) examined how data work as a subjectivizing technology in higher education. This includes the notion of affect and how educational practitioners come to feel data in 'their own body' (Brøgger & Staunæs, 2016, p. 238) as they feel pressured to push forward standardized practices desired by an external party (rather than stemming from their own desires and needs). In this sense, data can exert peer pressure when implemented in practice and may shape, change or force the becoming of certain educational subjectivities, such as low- or high-performing school systems. This is also a way of examining how educational practitioners emerge into their professional tasks by establishing, merging or changing their role in data practices with other actors involved.

Descending from the bulk of research presented in this part, attention has been given in recent years to the digital initiatives, tools and platforms that enable and effectuate governance by numbers (cf. Lupton, 2018; Piattoeva, 2015; Williamson, 2016a). Datafication (the transformation of governing aspects, such as assessment, into data) is now widely organized by digital means. The remaining part of the review will therefore center on digitization and how these trends strengthen the aforementioned consequences of data use in a fast-paced and real-time manner.

### 2.2. The Politics of Digitization—Moving across Established Boundaries of Time and Space

Drawing from examinations of the authority and potential for steering education through data, some studies have examined how computers, platforms and data analytics enact specific spaces between the local, the global and the transnational. At the European level, websites have become important enablers of data distribution transnationally and potentially globally (Lawn & Grek, 2009). Decuypere (2016) performed a diagrammatic analysis of two EU websites: the European Commission's Directorate Education and Culture website and the Open Education Europa website. By analyzing the relations between the textual and the visual on the websites, Decuypere (2016) unfolded the websites as policy spaces and spaces of action. Specifically, the findings showed how the websites enact different types of 'Europe' and European education; it is 'a uniform geographical entity,' a collection of numbers and a loosely coupled gathering of EU national member states, all depending on the intentions of the diagrams (p. 867).

Other studies have inquired into how digitization policies travel across sectors, as well as national borders (Hartong, 2018; Player-Koro et al., 2018; Williamson et al., 2018). For instance, Williamson et al. (2018) did a comparative analysis of policies that have prompted new computer programming practices in English, Swedish and Australian schools. Drawing on 'policy mobility' (cf. Gulson et al., 2017), the authors identified strategic partnerships between governmental institutions and individuals, think tanks, non-profit organizations, philanthropic

organizations, and commercial companies, such as Google, all working to promote computer programming to schools across the three geographical contexts. This further exemplifies the soft privatization of education, whereas the digitization of standardization and measurement is one of the most important drivers in marketizing contemporary education (Cone & Brøgger, 2020; Pettersson et al., 2017). The cross-sectoral and cross-national politics of digitization suggest that traditional spaces such as 'Europe,' 'England,' 'Google' and 'school' emerge as networked places and are reconfigured constantly as the boundaries of such entities become more and more blurred (Decuypere, 2021; Lawn, 2009). Space thus gains new meaning in digital practices.

There are also studies that interrogate how technological advancements are imbued with temporal capabilities (Segerholm, 2020; Wajcmann & Dodd, 2017). Some have written about acceleration, such as Sellar and Cole (2017). In their article, they interrogated the relationship between data analytics, capital and time and argued that education now increasingly produces time as 'capitalist profit' (p. 45), accelerated through feedback loops between data analytics, professional development, and commercial technology providers. Others, such as Webb et al. (2020), have examined how learning analytics is used to anticipate educational futures and argue that anticipation through learning analytics is produced by chronologies, habits and memories, which help accelerate how time is enacted by educational subjects. In another study, Williamson (2016) explored how learning analytics' produce 'real-time' educational policy instruments that connect the past, the present, and especially the future in new ways. Specifically, Williamson (2016) examines learning analytics platforms produced by Pearson and Knewton. This is an important contribution to understanding how educational futures are algorithmically tracked and customized for each student. Such practices may produce students as 'micro-centers' of anticipation, where probable predictions and future-tense practices demand action in the present (Williamson, 2016). There is a sense of the past and the future as temporalities that are made governable in the present, rather than a linear presentation of time. It also suggests that governance is produced within the schools rather than at a distance, also contributing to the discussions above on digital space-making. Time, similar to space, gains other meanings in digital practices.

A few studies have examined how space and time are closely linked in digital practices, creating certain time-spaces. For instance, Decuypere and Simons (2020) drew upon two EU policy documents, Opening up Education (OuE) and Digital Education Action Plan (DEAP), to examine how the learner comes to be fabricated through digital education and its instruments (i.e., platforms) in specific presentations of time and space. They found that time in OuE and DEAP is fabricated through notions of innovation that delinearize time by seizing opportunities in the present. The future, through foresight and scenarios, is therefore the result of potential within the present. Consequently, space is no longer bounded to specific localized places or institutions, such as schools. Platforms, spaces where students can enter and exit as needed, may therefore emerge as holding a key position in teaching and learning, and schools 'reside in their ability to operate as platforms themselves' (Decuypere and Simons, 2020, p. 648). Likewise, Sheail (2017) explored shifting time-spaces by drawing on interview data from students attending a digital university and found that the digital university allows students to be 'simultaneously situated' (p. 58) in translocal and transtemporal form, where learning is

produced in multiple locations and times simultaneously. Space and time thus emerge as intertwined and networked in digital practices.

Notably, what most studies presented in this part have in common is that their analysis is built on the level of policy, the digital technologies or both. They also suggested that digital initiatives and tools hold certain performative characteristics. However, the politics of digitization may stretch far beyond policy and platform into school practice and professional decision making (Hartong, 2016). The upcoming section will therefore present studies done at the school level in terms of school administration and leadership.

### 2.3. Digitization in Schools—School Leaders' Mundane Practices

Despite the governing trends described above and several exploratory essays that argue digital technologies need to be investigated in practice (i.e., Boyd & Crawford, 2012; Fenwick & Edwards, 2016), there are limited studies that inquire into its consequences at the school level. In addition, existing research in schools is often conducted on a classroom level where digital skills, digital literacy, teacher integration and student responses have been especially emphasized (i.e., Blikstad-Balas & Klette, 2020; Chaudron et al., 2018; Correro & Real, 2014; Roulston et al., 2019; Sheffield et al., 2018).

Selwyn's work on the use of digital technology in school leadership, management and administration is an exception. In a study of 12 English schools where 277 informants were interviewed, Selwyn (2011) found that institutional technologies, i.e., school management systems, enforced existing school hierarchies and reflected leadership concerns of effectiveness and school quality. Such practices made use of visible data, often in the form of traffic light systems, which invoked self-surveillance in schools, including the monitoring of teachers' work. Similarly, in an empirical study of two secondary schools in Australia with site visits and 10 in-depth interviews, Selwyn et al. (2015) found that 'tracking red data' dominated the schools' data work, rather than increasing knowledge for school leaders and teachers. The study also showed how school leaders and middle managers deal with internal mediation work by generating reports and aggregating data on behalf of teachers. In another study, Selwyn (2016) argued that data work in two Australian schools was attributed to various routinized activities of accountability, thus enforcing well-established power relations between governments and schools.

In a small case study, Ottesen (2018) studied the Point-of-View (PoV) tool through interviews with school principals in three Norwegian schools. The PoV, an analysis tool used by schools to gather evidence and support the work in the NQAS, was examined by tracking 'the connections that develop between the tool, the schools' practices and other entities' (p. 183). Several actors—humans and things—were brought into the PoV process. The principal's role, Ottesen argued, was to 'convince' the staff that the goals defined through PoV were acceptable, although these, at times, seemed to reinforce existing governance mechanisms rather than address the needs of the local schools. In an Italian context, Taglietti (2020) examined how the Italian policy National Plan for Digital Schools (PNSD) was enacted by school leaders in daily situations. By shadowing the school leaders in an assemblage ethnography (cf. Baker & McGuirk, 2017), the author unfolds several leadership subjectivities that emerged in the digital

practices: the school leader as a software shopper, data-entry operator, bureaucratic worker and project designer. The study also showed how the digital processes gave space to some forces (digitalization as strengthening bureaucratic improvement, human skills and intervention of educational futures) and marginalized others. Building on these findings, Landri and Taglietti (2021) found that Italian school leadership, thanks to digitization, now emerges as a hybrid production that simultaneously gives leaders a dual presence; the school leader can be 'there' with a digital avatar without being physically present (p. 127). This means that while digital elements work in ways that can produce school leaders, they also give leaders the opportunity to present themselves in several ways.

These findings suggest that school leaders relationally negotiate their own roles and others' governing roles with a vast number of actors. These stretch from digital elements to humans in various positions linked to schools, such as municipal superintendents. They also suggest that the same actors negotiate with school leaders, implying that the way we think about agency and governing in education necessitates inquiries that offer other methods of studying who gain authority in educational practice.

### 2.4. Contribution to Existing Research

Together, the research presented here gives an indication of how digital initiatives, websites, platforms and data move between governing levels and how it dives into school practice and school leader subjectivity. It has shown an initial interest in researching data and numbers towards contending the strong relationship between data and digital technologies and its complex entanglements in governing education. Some studies presented here examine the performative and governing aspects of digital technologies at the policy and platform levels, suggesting that digital elements may hold agential characteristics (i.e., Decuypere & Simons, 2020). However, these findings should be treated as *potential* and do not necessarily report on evidence from schools. There is a research gap in interrogating the unfolding of digitization at the school level and in the leadership of schools. Moreover, there is also a contextual research gap, as most of the studies on digitization have been carried out outside of Ireland and Norway. Digitization is broadly understood as bounded to its particularities rather than expressed through rationales of generalization (Hartong, 2022). Consequently, earlier studies from other contexts will not necessarily speak for what is happening in Irish and Norwegian schools. This thesis seeks to fill these gaps by unfolding school leaders' digitized practices in Irish and Norwegian schools, examining the complex presentations of heterogeneous actors, subjectivities, places and times in these practices, and following the train-of-thought on how digitized practices incorporate actors in different ways, where both humans and non-human things have the potential to partake and give meaning to action (Latour, 2005). Chapters 3 and 4 will show how this project has been designed analytically and methodologically to study this phenomenon.

## 3. Actor-Network Theory

In this chapter, I will discuss how I utilized actor-network theory (ANT) in my project by highlighting ANT's ontological underpinnings. The terms employed in the articles are described within these larger discussions, including network effect, heterogeneity, relationality,

emergence, actor, enactment, multiplicity, fluidity and subjectivation. The argument I make in this chapter is that ANT offers important insights into how digitization poses certain effects in educational practice that have implications for school leaders' mundane work life and educational governance. I also discuss selected critiques and limitations of ANT directly connected to the main themes in the three articles and how I have addressed these issues in my project.

### 3.1. Introduction to ANT

ANT stems from poststructuralism and postmodernism and is largely associated with the works of scholars in science and technology studies (STS) and sociology, such as Bruno Latour, Michel Callon, Madeleine Akrich, Annemarie Mol and John Law. Some scholars refer to ANT as material-semiotic or 'a disparate family of material-semiotic tools' (Law, 2009, p. 2). The focus is on the sociomaterial by decentering human intention and perception. Things such as texts and tools have the potential to be symmetrical to humans (Law, 2004), which suggests that there are other relevant factors in studying leadership practice in addition to school leaders themselves. As the studies presented in the previous literature review show, digital practices emerge as highly connected activities with a range of actors. Against this backdrop, I utilized ANT to show how digital activities unfold, connect and encourage school leaders to engage in governing practices in relation to numerous actors. There is no a priori in ANT, as it seeks to study that which emerges in practice. ANT's 'practice comes first' ontology negates traditional sociological dualisms, such as subject–object and human–non-human. This positions the approach in an overlap between individualism and structuralism, although leaning toward the former as action forms its ontological reality. ANT is a relational approach and posits that nothing exists outside of the shifting relations that may or may not coalesce in networks (Fenwick & Edwards, 2012). Therefore, I chose to investigate digitization empirically, and the focus remained on describing what the relations enact, rather than on explaining why the activity is happening. What the relations enact is always in connection to other humans and non-humans, and enactment is therefore understood as the interplay within these relations and what makes an actor an actor (Fenwick & Edwards, 2012).

ANT scholars reject ANT as an overarching theoretical approach. The various advancements in ANT studies that span from early-ANT to after-ANT, or using ANT as a 'companion,' demonstrate that ANT is not a uniform theory (Blok et al., 2020; Law, 1999; Law & Hassard, 1999). Similar to its own ontological underpinnings, it is fluid, often moving and changing. I used ANT in this project as a sensitivity and analytical lens to 'sense and draw (nearer to) a phenomenon' (Fenwick & Edwards, 2012, p. 8). The objective was to unfold policy expectations and practice.

### 3.2. Network Effects

The overarching view in ANT is that the world and everything in it (people, locations, time, computer programs, etc.) are relational effects (Fenwick et al., 2011; Law, 1992). Therefore, the term 'network effects,' or simply 'effect,' does not relate to a causal relationship but is used to understand exactly how things come together, manage to stay together and allow each other

to be made into being. Thus, how digitization unfolds in school leadership and educational governance can be understood as the effects of a network that produces several repercussions in the forms of agency, subjectivities, policies, routines and responsibilities, among others. In all three articles, I was interested in showing the various effects digitization poses on school leadership practice and governance, and the questions I asked are centered around two main themes: to track the relations that are enacted (or expected to be enacted in Article I) and to examine what effects the relations (may) perform. The main objective of the following sections is to show how I applied ANT sensitivities in my project by framing them as network effects and to show how these sensitivities shed light on how digital practices emerge as a complex phenomenon that 'does' something in school leadership and educational governance. In the forthcoming section, I therefore present the three main network effects that I examined in my project.

### 3.2.1. The Network in ANT

The network in ANT is comprised of actors and relations. Actors in ANT refer to any given entity that gives meaning to or performs an action in relation to other actors (Latour, 2005). This assumption is called heterogeneity and can suggest three things. First, it takes a broad view of what constitutes performative characteristics. Anything that gives meaning to an action relationally is considered an actor (Latour, 2005). Second, agency is not rooted in human intentions or perceptions, nor is it a result of top-down or bottom-up forces. ANT's ontology therefore attempts to undo the agency–structure dualism by viewing action as 'a node, a knot, and a conglomerate of many surprising sets of agencies' (Latour, 2005, p. 44). Third, it suggests that every activity and actor is heterogeneous and sociomaterial. When a school leader engages with numerical data, the action of collecting, visualizing and analyzing is sociomaterial because it invites the leader, numbers, colors, graphs, student subjectivities and organizational routines to the practice. However, the actors, such as numbers, are also sociomaterial, as the data is both plastic (in the sense of it being a *thing*) and a presentation of social processes, such as student performance. Whether an actor is abstract or not (such as routines or pedagogical ideas) is, according to Law and Singleton (2005), less important if its characteristics have been materialized and made visible through its relational features.

Highly connected to heterogeneity is relationality, or semiotic relationality (cf. Law, 2009). This notion implies that everything exists in relation to other actors. They take fluid forms and can change as new actions and actors are performed in the network (Law, 2009). The various relations in a network come together in a processual manner where relations and actors are always attaching, detaching, arranging and rearranging the various compositions of practice. These minute negotiations show how the actor-networks are always in a state of emergence (Fenwick & Edwards, 2012). Thus, emergence in ANT builds on the ontological premise that practice or action always comes first. In this sense, the network (and everything in it) does not exist before it is performed, and its characteristics are constantly emerging and changing according to the relations that are formed. If networks do not exist before they are performed, neither do the entities as agentic actors. This can, for instance, be a classroom, where policies, teaching methods and books enact the classroom. The classroom is thus a network that gathers various things and intellectual procedures, but it is also an actor that may produce students,

forms of learning, communication and miscommunication. In this sense, an actor is also always a network, hence the term 'actor-network,' and their properties and identities are formed within the configurations (Law, 1992). The network and the actors that have been enrolled in it are therefore also effects in themselves that are produced by relations and interactions (Fenwick & Edwards, 2012).

I have applied concepts of what constitutes an actor-network explicitly in Article I, where I draw from Savage's (2019) notion of policy assemblage. The three subcategories of policy assemblage and my use of them are described in Article I. Here, I briefly discuss how the analysis sheds light on the first network effect: the network itself. In the first article, I closely examined how things and activities, such as student reports, self-evaluation, learning analytics and school development, have the potential to become performative. Here, the term 'actor-network' is apparent, as the networks were expected to be composed of several agencies by having the potential to perform evaluative practices *and* to relationally perform objects into being agentic and possibly obtain a strategic position in the assemblage. In this sense, the actor-networks were potential effects made possible by the particular compositions of the expected relations between heterogeneous actors.

Furthermore, all three articles use the notions of heterogeneity, relationality and emergence as an analytical backdrop. In Articles II and III, the network was used as a starting point to discuss extending effects. This relates to what Latour (1996a) calls the dissolving of the micro–macro distinction in ANT, where the network can never be bigger than another, but it can be 'longer and more intensely connected' (p. 371). The fact that a network is *long* builds on a flat ontology and implies two things. On the one hand, it implies that studying what happens in practice, as I have done in Articles II and III, can inform on following the actors across space and time and show how they may be highly connected. Such a procedure makes no assumption of micro and macro, top or bottom, but implies that the network may go from individual to collective and back (Latour, 1996a). This can inform on extending effects beyond the particularities of the network, such as subjectivation and time. On the other hand, it implies a common critique in ANT that networks may be infinite (Miettinen, 1999). Callon (1999) argued that if anything is to be performed, there needs to be a boundary drawn between which actors one considers and, consequently, which actors are left out. This notion is called externality and refers to the various actors that become invisible when one 'cuts' the network (Callon, 1999; Strathern, 1996).

Such network cuts were done in all three articles, although most explicitly presented in Article I. In conversation with the co-author in the first article, I decided to cut the network by considering only the direct sphere of school leaders and teachers (according to the research questions), while simultaneously building on what was evident in the policy texts. For instance, inspectorates and local school boards might develop an interest in the decisions and documentations that are generated by the actor-networks identified in Article I. However, the texts did not directly identify that such actors were to take part in the activities and were thus left out of the networks. I used similar techniques for cutting the networks in Articles II and III; I did not assume that any actors would be enrolled in the practices; I only coded actors that were explicitly identified in the interviews and the data from the platforms. By drawing a line through these specific points, some actors were consequently not highlighted in the three articles.

The ‘cutting of the network’ (Strathern, 1996) further implies that my research was enacted in specific ways. First, it relates to the notion that every actor-network is constantly emerging. Critics of ANT argue that presentations of actor-networks in research are far more stable than the relations they seek to illuminate (Mutch, 2013). Ideally, an ANT study would show how the actor-networks change from second to second and how they expand in never-ending relations. However, this fluidity (how actor-networks move) and flatness poses considerable analytical challenges and necessitates the ‘cutting’ of networks to show how minute relations unfold (Fenwick & Edwards, 2012). I framed the analyses in all three articles in ways that would show the momentary unfolding of digitization, rather than generalizations. For instance, in the first article, I frame the analysis as ‘snapshots’ of governmental ambitions to steer digitalization in schools. In the second article, scenes of practice were utilized to capture how the compositions unfolded and changed between the three scenes. In the third article, I used Mol’s (2002) notion of multiplicity to unfold how anticipation emerged in various ways and thus had multiple presentations: as colors, as numbers, and as actions—to mention some. These techniques showed momentary stabilizations of practice while simultaneously allowing the fluidity of the same practices to be shown.

Second, it entails that I have, to a certain extent, framed practice through visible networks. This can lead to the reproduction of the informants’ and my own views of reality (Hassard et al., 1999). It is important in terms of accounting for the non-humans but also for the various consequences externality poses to ANT. To produce accounts of the non-humans (without positioning them above humans and thus ‘break’ the symmetry), I performed explicit ‘interviews’ with VSware in Article II and implicit interviews with Conexus Insight and Engage as a first step of the analysis in Article III (see 4.2.3), while also following these non-humans ‘live’ in the descriptions of practice as the school leaders interacted with the platforms during the interviews. However, issues of externality, which are created as a consequence of cutting the network, tend to be harder to accommodate (Fenwick, 2012). Nevertheless, instead of thinking of the ‘outsiders’ as becoming marginalized or left out of the network, it requires other ways of thinking about time and space and to recognize that actors and relations exist inside, outside and alongside the networks (Hetherington & Law, 2000).

### 3.2.2. Time and Space in ANT

ANT’s flat ontology puts forward some network properties that break with notions of distance and proximity. Rather than using terms such as surfaces or spheres, ANT requires thinking in terms of *multiple* networks and through possibly infinite connections. Latour (1996a) introduces three network properties that are common to all networks in this regard: far/close, small scale/large scale and inside/outside. First, thinking in terms of networks allows one to get rid of the dualisms of global/local and distance/proximity. Actors that may be geographically far apart may appear closer when their connections are analyzed. For instance, in Article II, the Child and Family Agency (TUSLA) became part of the schools by connecting through VSware despite it being geographically distant (some leaders did not relate to ‘where’ TUSLA resided other than ‘in’ VSware). Second, the small scale/large scale dissolves the micro–macro dualism. Here, Latour argues that the world is not organized as having a ‘top’ or ‘bottom,’ nor should researchers assume it has. Connections are what count. ANT thus discards spatial conceptions

of far/close and big/small. Third, a network does not necessarily have an 'outside' (after a cut has been made) because all networks have the potential to expand, connect and/or mutate.

I have not explicitly commented on space in depth in the articles. However, there are major references to space in all three articles that are presented relatively implicitly. In Article I, space is presented through regions within the networks. Here, 'space' is conceptualized through clusters of actors and relations that each make up regions of (intended) practice. Regions point to areas of the network with concentrations of possible interactions between actors, and I used Visual Network Analysis (VNA) to visualize this notion. In ANT, the boundaries between regions can be drawn but only as an effect or a product of the relations (Latour, 1984). In other words, networks can generate regions, and their boundaries can be neat or overlapping depending on how the relations unfold. When coding and analyzing the networks in Article I, contextual information was important. It allowed a closer analysis of the activities in which the actors were expected to participate, and based on that, we were able to identify the regions. However, it quickly became evident that some regions were difficult to distinguish and presented major overlaps. These overlaps were conceptualized as infrastructures with boundary actors that connected practices together (see Article I). This implies that as an effect, regions emerged with some neat divisions and others that were overlapping. These were spaces of practices that school leaders and teachers potentially had to navigate.

In Articles II and III, space was conceptualized differently (and more implicitly). First, space became the platforms themselves, VSware, Conexus Insight and Engage, as more or less situated practices. Similarly to what Decuypere and Simons (2020) and Sheail (2017) found, Articles II and III showed that space is not bounded to a physical place but connected through digital means. Second, Articles II and III presented space through ANT's flat ontology; actors connected through the platforms in ways that allowed them to be drawn nearer to the schools and the school leaders. Some examples include parents, social workers, the Child and Family Agency, and the police (Article II), as well as other schools, old and new school improvement projects, and municipal superintendents (Article III). In Article III specifically, space divisions between private providers and governmental co-operations (Conexus) became blurred. In addition, Articles II and III showed that the platforms moved back and forth between governing levels (i.e., from principal to municipality and back to students). In this sense, space follows the fluid logic of relations and emergence.

The way space comes to show in the articles exemplifies the far/close and small scale/large scale notions of Latour (1996a). These notions of space do not necessarily point to chronological events. Therefore, regarding Latour's (1996a) third point, I highlight how time plays a significant role in situating networks. When the networks expand, they expand because the actors expand their connections to other actors. As already discussed, this can bring geographically distant actors closer together and break the far/close dualism. In addition, it suggests that actors can connect with other actors across time. The network can span backwards in time or connect to places and things that will take place in the future. In this sense, the networks are situated at different points in time.

However, while networks can expand, they can also connect and coexist because actors can be part of several networks at the same time (Decuypere, 2019a). Therefore, the far/close dualism

is also flattened through time in ANT. On the one hand, this means that networks can be situated and exclude everything 'outside.' On the other hand, as the notion of multiplicity (Mol, 2002) and fluidity (Mol & Law, 1994) suggests, networks exist across time *and* alongside each other. Thus, there is no outside or inside of the networks. One place cannot be clearly distinguished from another (Mol & Law, 1994), and the present and future do not necessarily exist separately. Instead, ANT challenges practice to think of enactments as multiple realities that may or may not connect. The network cuts (and consequently the spatial and temporal boundaries) I made were methodologically necessary, as they allowed me to highlight certain actors and actions by making them comprehensible to the readers. Nevertheless, the actors that do not become visible in the analyses can still exist; they are waiting to be framed and have their actions traced (Callon, 1999). They are not outsiders to the networks; they are there for others to unfold.

I explicitly addressed time in Article III. In this article, I viewed time as an implicit presentation of anticipation. I conceptualized time (and anticipation) as a network effect by using two ANT sensitivities: fluidity (how actor-networks move) and multiplicity (relational compositions that exist over time and are juxtaposed). First, the networks connected to actors from the past, present and future. These presentations of time also emerged conjointly in the present and not always chronologically. Time becomes fluid (Mol & Law, 1994). The future was especially powerful, as it encouraged school leaders to perform a series of activities. Second, time (and anticipation) emerged multiply; through colored and numerical data, result meetings, and leadership actions, among others (Mol, 2002). Fluidity and multiplicity were useful notions to use as they resonated well with the complex movements of digital technologies and showed how time was a result of the particular interactions in practice that prompted these to anticipate the future (Fenwick & Edwards, 2012; Hassan, 2017). In this sense, anticipation can be defined as 'the palpable effect of the speculative future on the present' (Adams et al., 2009, p. 247), where time is its main component. Moreover, the networks were contingent on time. As the actors interacted and connected, their actions depended on momentary performances. The actions and actors changed as their temporary connections changed. In this sense, time was generated as a network effect *and* as a premise of how networks work as the activities were contingent on time (and space).

Time is implicitly presented in Articles I and II. In Article I, time connects to the notion of regions, especially the overlaps that may create infrastructures and boundary actors. The characteristic of boundary actors having the ability to take part in and connect several practices *at once* implies that time can be juxtaposed (Decuypere, 2019a; Mol, 2002). In Article II, while time is not the main effect I examine, the interactions between VSware and school leaders in strategic work show that data from VSware extend over time to future whole-school projects (see Article II, p. 13). This suggests that the networks expanded and brought the future closer to the present. ANT's ontology, which suggests that time and space are networked, is thus particularly useful in conceptualizing how the politics of digitization (and its performances) move across spatial and temporal boundaries (cf. Chapter 2.2), also implying that educational governance can have the potential to draw nearer to schools and their day-to-day activities.

A limitation posed by thinking time and, especially space, through ANT is that while the move away from dualisms brings forward the multiplicity of networks, it does not always account for

the same multiplicity inside the networks (Mol & Law, 1994). An example of this can be found in Article I, in which actors who performed similar activities were grouped together in regions. This was a matter of how far we were able to unpack the actors and relations to avoid black boxing (Latour, 1987). To a certain extent, we unpacked actors to avoid such a notion (i.e., not coding an actor as 'big data' but as 'learning analytics' and 'adaptive algorithms'), but we still relied on what was explicit in the texts to do so. While learning analytics and adaptive algorithms are actors that both produce big data, the way they perform certain activities and at which points in time and space they perform these activities may technically be very different. In this sense, the VNA's in Article I presented relatively stable spaces. The differences inside the networks were accounted for in more depth in Articles II and III, as the scenes of practice (Article II) and modes of anticipation (Article III) showed that the relations inside the networks changed and were restructured across time and space. At the same time, these differences shed light on how the heterogeneous actors' characteristics merged and differed as they were formed within the relations. I will address this issue in the upcoming section.

### 3.2.3. The Subject and Subjectivation in ANT

The notion of the subject, and its concomitant notions of subjectivity and subjectivation, are linked to various sociological approaches, such as the Durkheimian tradition (individualism), the Weberian tradition (inter-subjectivity) and methodological holism, such as Foucault's political subject (Cremonesi et al., 2016; Hollis, 1994; Rebughini, 2014). In ANT, subjectivation is not as explicitly addressed as in these other approaches; rather, it follows some of the main premises of the network. Therefore, in my project, I used 'subject' in the same meaning as 'actor,' which has the potential to become performative by the ontological premises of heterogeneity, relationality and emergence. The subject/object dualism has collapsed; every actor has the potential to be both the subject and the object, social and material. In this sense, the subject is plural, heterogenous and relational, and differences are seen as positive and productive (Colebrook, 2004). Subjectivation in ANT thus follows a processual logic as action comes first, then the actors' characteristics as possible subject–object hybrids (Latour, 1987). This builds on the premise that everything in the network, including the actors, is the effect of the network. The subject in ANT is decentered from being an ontological figure with inherent abilities; instead, practice and interactions become the ontological focus (Moser, 2003; Rebughini, 2014).

The collapsed subject/object (or human/non-human) dualism does not mean that the school leaders and the digital technologies are the same or that their characteristics are the same. They may emerge together, but the way they emerge may be different. Colebrook (2002) discussed negative and positive differences (similar discussions can also be found in Callon, 1999, and Mol, 2002). A negative difference is that which separates one thing from another, such as subject from object, active from passive or inside from outside. The previous discussions on how to unfold time and space in ANT can therefore also be applied in the case of subjectivation; rather than fixed divisions, positive differences are a multiplicity of subjectivities that are affected and affect others, and the way these are unfolded depends on time and space (Colebrook, 2002). Following the logic of differences *inside* the network (Mol & Law, 1994), studying the process of subjectivation can account for these differences within the actor-

networks by exploring how actors act on each other (for instance, school leaders and VSware in Article II).

I utilized the ANT approach to subjectivity and subjectivation explicitly in Article II. When doing the analysis in this article, I found that the clearest effect was how the school leader's subjectivities were formed and formed others when interacting with VSware. I built on the main premises of ANT (heterogeneity, relationality and materiality) to show how school leaders and VSware emerged in sociomaterial practices. By drawing on Latour's (2005) notion of plug-ins ('subjectifiers'), I unfolded how the interactions attached to the school leaders and activated them in their leadership roles and duties. Moreover, it was evident that the school leaders and VSware formed each other. For instance, in scene two (Article II, pp. 14–15), school leaders utilized an edit button to add behavior categories that reflected their schools' priorities. Here, the school leaders acted upon VSware by changing its inherent scripts (going from monitoring behavior to monitoring aspects, such as numeracy), while the edit button acted upon the school leaders by encouraging them to evaluate their school's quality. The edit button became a very important 'plug-in' that showed the horizontal way two actors acted upon each other simultaneously, although how they acted on each other was different.

My argument is that ANT can serve to move away from reductionist tendencies (such as those found in other postmodern approaches), where the subject has little autonomy because of structural notions, such as 'society' (Latour, 2005). In ANT, all actors have the potential to exert autonomy and, as such, are not 'trapped' subjects. Using ANT to study subjectivation is also a way of overcoming anti-anthropocentric notions, which have been emphasized in the school leadership literature (see, for instance, Niesche, 2013; Niesche and Heffernan, 2020; Sugrue, 2015). However, some critics would argue that ANT's notions of emergence where each actor, relation and network only show (and exist in) minute negotiations is so particular that it makes it difficult to account for subjectivity as an internalized practice (Collin, 2014; Mutch, 2013). As a result, human intentions, beliefs and emotions gain limited space in ANT (Morgan-Thomas, 2018; Reckwitz, 2012). To this Latour (2005) reflects:

> You don't have to imagine a 'wholesale' human having intentionality, making rational calculations, feeling responsible for his sins, or agonizing over his mortal soul. Rather, you realize that to obtain 'complete' human actors, you have to *compose* them out of many successive *layers*, each of which is empirically distinct from the next (p. 207, italics are original).

Nevertheless, examining subjectivation through ANT entails accounting for enactment rather than intentions and rational choices (see Chapter 4.2.2 to see how I designed the data collection to account for practice).

Articles I and III do not focus on subjectivation; however, the two articles refer to its main essence in two ways. First, all articles follow the main premises of the network and what constitutes an actor (Latour, 2005). This means that all three articles follow the horizontal subject–object and can be exemplified by the way material actors (primarily digital) have the potential to become performative and how the humans (school leaders) act and are acted upon in practice. These notions also suggest that all actors enrolled in the networks can be sociomaterial in themselves and thus show the collapsed subject–object dualism (i.e., the Junior

Profile of Achievement in Article I becomes nearly an extension of the students). Second, Article III comments on 'risk subjects' that emerge out of the interactions between the school leaders and the Conexus' platforms (Adams et al., 2009). These are student subjectivities that arise as the leaders interrogate visualized data to ensure quality development where a traffic light system alerts at-risk students (both for general skills and wellbeing). Although not explicitly addressed, student subjectivities can also be found in Article II, as a similar traffic light system was used to identify 'Top Offenders' within student groups (see scene one, Article II). This signals how actors and subjectivities can be formed in the interaction between two actors (here, school leaders and the platforms) as a form of extension of the network (Latour, 1996a). In other words, digitization poses consequences for a wide range of actors and their subjectivities.

ANT's flat ontology has somewhat eliminated epistemological questions, as the transition to performativity places less importance on human knowledge. How to research sociomaterial practice has gained some attention (i.e., Orlikowski & Scott, 2015); however, ANT privileges nominalism and questions of what is real and how reality may be achieved are favored (i.e., Mulcahy, 2012). On the one hand, this has prompted ANT critics to reintroduce the subject as a kind of 'residual humanism' where the ontological equality of humans and non-humans are taken back, and instead of centering the two equally, they rather talk about being 'moderated by' or 'linked to' each other (Schatzki, 2002, 2019; Morgan-Thomas, 2018). On the other hand, efforts to address these criticisms invite researchers to think about their own subjectivities and their own research as multiple and heterogeneous (Ferreira, 2020; Latour, 2004; Mol, 2002). To me, this meant first and foremost to view my own research through multiplicity as a result of a multitude of research practices, doctoral protocols and sociomaterial formalities, and to show how the research has been produced (see Chapter 4.4. for further unpacking of these issues).

### 3.3. Applying ANT to Study School Leadership and Educational Governance

Together, the various network effects studied in my project (the network, time and space, subjectivity) suggest that digitized school leadership and educational governance emerge in a complex interplay between digital technologies, people and various governing practices. As such, school leadership and educational governance in itself can be said to emerge as an effect of digitization, where school leaders interact with and mediate their positions with new (digital) actors that each bring new expertise and forms of agency in educational practices. For educational governance, this also suggests distributed ways of governing educational institutions, as well as their individuals.

It might seem paradoxical to draw on ANT to analyze leaders' practices, given ANT's decentering of the human. It would, however, be undesirable to privilege material and abstract things over humans, also in ANT. There are some references to leadership and ANT in the literature, such as Law's (1994) work on scientific laboratories in which multiple realities of organizational leadership were examined. In a more recent work, Landri (2021) showed how schools are fluid spaces where school governance emerges as 'regional and networked places' (p. 95) through, for instance, policy, and argued that school leadership unfolds in a processual

form. Furthermore, he argued (building on the works of Kamp, 2018) that an actor that is highly connected through both social and material means becomes a leader and that leadership in itself can have fluid presentations. In this sense, ANT can show how school leaders' characteristics unfold in multiple ways: as surveiller, as team-builder, as data-operator, and school leadership as contingent, connected and so on. More importantly, however, ANT gives important insights into how digital technologies have effects on school leaders and their practice, as well as it is useful in interrogating how school leaders negotiate with the digital technologies and thus act *back* on the material actors.

For governance, ANT can show how contemporary aims of governance are fabricated and enacted at the school level (Landri, 2018). Often, such investigations inform on issues of power by showing who or what gains powerful roles in the network (Fenwick & Edwards, 2012). I explicitly conceptualized this in Article I as a relationally composed effect in which some actors gain an important position in policy assemblages. These were the boundary actors. In the other two articles, other actors gained powerful roles (see Chapter 4.3.2), and governance could, on the one hand, be interpreted as explorations of how heterogeneous actors act on each other in practice (which has sometimes proven asymmetrical in my research). On the other hand, I investigated issues of governance through ANT by showing how digital technologies and policy expectations for digital technologies in schools materialize governance mechanisms, such as quality assessment, accountability and evaluation (Landri & Gorur, 2021). Sometimes these have been presentations of government-mandated tests and surveys, but at other times, these have been presentations of commercial and market-based actors that show how governance in education is now redistributed from a central government to private providers (Ozga et al., 2011; Williamson, 2017). ANT discussions of governing actors can therefore also be found implicitly in Articles II and III by considering digital technologies as concrete technologies that enable steering at the school level (Asdal & Reinertsen, 2020). The examples I discussed in policy and practice are thus used as scenarios of educational governance in which school leaders and digitization are emphasized.

In my project, I utilized ANT to draw attention to how school leaders work with and on digital technologies and how the same materials work with and on them. ANT's flat ontology is therefore first and foremost expressed through the collapsed dualisms of subject/object, far/close and inside/outside. This means that I do not understand school leadership as a personal attribute but as timely and horizontally situated, contingent on the attachments and interactions with which they merge in practice. School leadership and educational governance can therefore be understood as never-ending or complete, a collective that is constantly shaping practice (Landri & Taglietti, 2021). The imbedded multiplicity in my use of ANT also highlights the complex day-to-day activities that school leaders navigate, where tensions between multiple practices may arise, such as balancing quality assessment and students' wellbeing.

This chapter has explored the various effects that digitized practices can have on school leaders and educational governance through discussions of how and when I applied ANT sensitivities in my project. These effects have also shown how digitization is complex; the premises of actor-networks in digital practices and their effects are not performed separately, but as this chapter has shown, they are highly entangled. My job has been to unfold these, and each article focuses

mainly on one main effect (Article I, the network; Article II, subjectivation; Article III, time). At the same time, all three articles necessarily touched upon several effects, as ANT shows that educational (digital) practice is connected and does not exist in isolation. In this chapter, I have highlighted ANT sensitivities deployed in the articles, as well as limitations and critiques, by discussing what counts as reality in ANT (ontology). I have also presented how ANT can be used to study school leaders and governance in digital practices. In Chapter 4, I will show how I have further operationalized ANT in my project.

# 4. Methodology

In this chapter, I present how I designed my project. I discuss the research design, the data collection process and the data analysis, as well as issues concerning research credibility and research ethics. The entire chapter connects the different methodological considerations to the underlying ontological premises of ANT, while also drawing on criteria for qualitative research in general.

## 4.1. Case Study

Case studies in education aim to explore the complexity of a phenomenon that often considers specific units of analysis, such as individuals, groups of individuals, organizations or locations (Creswell, 2013; Yin, 2014). The cases are bounded in place and/or time and can explore a bounded system (one case) or multiple bounded systems (multiple cases/sites). While my project builds on the case study design and shares some similarities with traditional case studies, such as an interest in exploring how a complex phenomenon takes place through specific units of analysis, the way I have approached the case and sites differs somewhat from traditional bounded cases in case study design.

In ANT, case studies have been used to unfold specific scientific procedures and cross-sectoral projects, such as Latour and Woolgar's (2013) study of laboratories, Mol's (2002) study of atherosclerosis, and Callon's (1984) study of scallops and fishermen in St. Brieuc Bay. Whereas traditional case studies separate the units of analysis (and the case) from everything around it, ANT does not talk about the pre-determined boundaries of space and time. Mol (2002) follows atherosclerosis, where atherosclerosis 'goes' through multiple sites, enactments and presentations, which eventually leads to some enactments and sites being highlighted. In the case of Latour and Woolgar (2013), the laboratory is the case of interest, but it is not treated in isolation from the world around it, meaning that connections can be traced outside of the 'bounded' laboratory. Separating cases through ANT are therefore made by network cuts, but as I argued in Chapter 3, everything around such cuts still has the potential to connect to the network, leaving the case study design in ANT to be less bounded.

### 4.1.1. Case, Sites and Units of Analysis

The case in my project is digitization in school leadership and educational governance. Whether boundaries/network cuts are made prior to or after empirical work, all case studies need to make some choices regarding where to look for how certain processes and practices unfold. For me,

this meant choosing specific sites that would allow me to unfold the phenomenon and trace connections across individuals, places and activities. Initially, I wanted to treat each school that participated in my project as a separate site, however, after data collection I decided to merge these together (see further explanation below), and thus, there are two sites in my project explored by different datasets and units of analysis.

The two sites in my project are Irish secondary schools and Norwegian lower secondary schools. The selected sites and the school-level criteria were chosen for three reasons. The first reason centers on the manifoldness of digitized practices in education. Capturing the different moments and variations of digitization across multiple sites, while still acknowledging the standardizing power of such practices, is one of the main goals of studying digitization in education (Hartong, 2022). Having different sites also supports the heterogeneity and multiplicity underlying ANT research. Second, the choice to set the sites in two different countries also builds on my own personal research experience. I had previously carried out research in Irish secondary schools, where I had observed extensive use of the VSware software. While I could not go in depth into digitization issues in that project, I built on some of its findings to develop my current PhD project. Moreover, being a Norwegian citizen and having carried out my undergraduate (teaching degree) and master's degree (comparative and international education) in Norwegian institutions, as well as having worked in Norwegian lower and upper secondary schools, I had native and professional insight into Norwegian education. The contextual research gap that the literature review showed also strengthened the choice of Irish and Norwegian schools. The third rationale builds on which grade levels to focus on. This was somewhat decided for me based on how the education system works in these countries. In Ireland, lower secondary (junior cycle) and upper secondary (senior cycle) are offered as 'post-primary' or 'secondary education' together and, as such, are integrated. In Norway, school levels are divided into primary, lower secondary and upper secondary and, as such, are separated (although 'basic education' refers to both primary and lower secondary education). Moreover, the choice to focus on secondary education as a whole for the Irish schools and lower secondary education in the Norwegian schools also builds on deciding the units of analysis.

While ANT studies do not put physical and temporal boundaries on their case study approach, they often choose specific actors to follow, which can be a pre-determined unit of analysis (Latour, 2005). Following actors entails choosing one or a few specific actors to follow within a network. The main actors I follow in my project were school leaders. In Article I, I decided to follow the ambitions for digitalization in a general sense and did not choose any specific digital technologies to follow. I learned from this analysis that the digital activities of school leaders can, in general, go in different directions. To untangle such practices, I therefore chose to follow school leaders in interactions with specific tools in the remaining two articles (rather than general digital practices); as such, these tools also became the main actors that I followed in my project. The 'followed actors' can be seen as a way of choosing units of analysis, and in the forthcoming, I use 'units of analysis' and 'followed actors' interchangeably. In Article I, the main actors were school leaders and teachers (see Chapter 4.2.1 for the rationale for why teachers were also followed). In Article II, the main actors I follow were school leaders and VSware. In Article III, the main actors I follow were school leaders, Insight and Engage. The

choice to follow the specific tool VSware in school leaders' practice builds on my previous research in Irish schools. Given that VSware is used across secondary education in Irish schools, I chose to focus on secondary education as a whole.

The choice to follow learning analytic platforms in Norwegian schools builds partly on the findings from Article I. Here, we found that one of the prominent policy expectations for digitalization in Norwegian schools was the use of learning analytics. The choice to focus on Conexus Engage and Insight specifically came after conversations with several teachers, school leaders and other educational professionals in my capacity as a former teacher and current lecturer in school leadership programs at the University of Oslo. The Conexus platforms were repeatedly mentioned as tools that were often used at the leadership and governance levels. Both Insight and Engage are offered on primary, lower secondary and upper secondary levels. After conversations with the company Conexus themselves, it became evident that the platforms were most commonly used at the primary and lower secondary levels. Later, by familiarizing myself with the tool through demo users, I saw that the databank in lower secondary schools would be greater than in primary schools and, as such, would present me with more examples from practice. In sum, the units of analysis in my project determined both what actors I followed in my project and the choices of school level at the two sites.

I collected various datasets within the two sites; policy documents, interviews with the leaders from six schools, and interviews with the platforms (see Chapter 4.2). I initially wanted to treat each school as a separate site. Within the Irish site, School A is a DEIS Catholic Voluntary Secondary School in an urban area, School B is an Educate Together School in a suburban area, and School C is a Catholic Voluntary Secondary School in a rural area. Within the Norwegian site, School A resides in a suburban area, School B is in an urban area and School C is in a rural area, all of which are plain lower secondary schools in three different municipalities. These included 13 informants across the three Irish schools and 12 informants from the three Norwegian schools (principals and middle leaders). The schools were chosen to observe variations in the data. Other criteria I had for the chosen schools were based on school levels and that the leadership teams used the platforms in one form or another in their mundane practices. However, after data collection, I found that the transcriptions reflected very similar enactments with VSware and Insight and Engage despite variations in school sizes and locations. Therefore, I chose not to treat the six schools as six different sites. In Articles II and III, I merged the schools in the analysis and presented interactions between the school leaders and the different platforms interchangeably between the schools. However, as I argued in Chapter 3, networks can expand in time and place when new actors and relations are formed. This means that while I followed the actors within the two sites, the actors also, to a certain extent, revealed other presentations of other actors, other times and other places. Examples are the external agencies identified in Article II and the various presentations of pasts and futures in Article III. In this regard, what was 'bounded' in my case studies is the phenomenon and, to a certain extent, the main actors that I follow (see Chapter 4.3.1 for more information on how I followed actors analytically). The sites were constant, but not bounded, in the sense that I traced connections that go beyond the physicality of the two sites by examining connections.

### 4.1.2. Comparable Perspective

Multiple case studies are often used with comparative methodologies. A qualitative comparative design aims to contrast two or more cases to understand social phenomena, leaving the comparison a goal in itself (Bryman, 2012; Ragin & Amoroso, 2011; Yin, 2014). When there are two countries representing the cases or sites, such comparisons often deal with how the phenomena are culturally specific and sometimes tending to historical comparisons over time (i.e., Vavrus & Bartlett, 2009; Vennebo & Ottesen, 2012; ). Comparative methodology can also be used to study multiple cases that are not specific to nations, such as different local sites (e.g., schools) (Bryman, 2012).

I used multiple sites in my project; however, I did not rely on comparative methodologies. The choice not to perform comparisons between the sites was made at the beginning of the project. Not choosing a comparative approach allowed me to be more flexible in what I examined at the different sites. This comes through in the choices of tools I examined: one learning management system in Irish schools and two learning analytic platforms in Norwegian schools. Without explicit comparisons, I chose two/three different types of tools, rather than studying the use of one main tool (or one main type of tool) across the sites. The choice not to contrast the schools within the two cases was, as I argued, a choice made after data collection.

This means that I did not approach the analysis by examining how each site has different (or similar) contextual conditions for digitization or by comparing how the units of analysis (the actors) move differently between sites. This poses some consequences for how I used national descriptors, or context, as an explanatory device in my analyses. ANT's goal is to 'show how' rather than 'explain why.' Its underlying assumption that objects do not require meaning in or exist because of a given context suggests that context is made in action (or through relations and interactions) (Woolgar & Leuzan, 2013). Explaining exactly why the relations unfold as they do regarding national context is therefore not the focus of this project. Instead, I wanted to examine how the phenomenon of digitized school leadership and governance unfolds and show some variations in sociomaterial practices and emergent effects. Variations can be found in the way the relations form and in what main effects the relations produce. In this sense, while there can be simple comparisons done between the findings in the two sites, I treated such comparisons as relationally produced and differences/similarities should therefore be read as a product of the traced relations, rather than as fixed methodological protocols (Bartlett & Vavrus, 2017). Hence, the findings show the uniqueness of certain digital practices by adding new insights to the phenomenon.

### 4.2. Data

I collected three datasets in my project: policy documents, interviews with school leaders in Irish and Norwegian schools, and interviews with the platforms. The data were attended to and collected during various periods. The policy documents were selected during the spring of 2019. The interview guides were piloted in a Norwegian lower secondary school in the early fall of 2019. Some minor changes were made to the guide afterwards and are described below. The interviews with Irish school leaders were conducted during the fall of 2019, and interviews with Norwegian school leaders took place during the fall and winter of 2019/2020. This means that all data collection finished before the spread of Covid-19 in Europe with its subsequent

lockdowns, and the data therefore presents digitalization in schools pre-pandemic. Overviews of the specific data sources can be found in all three articles, and they are summarized in Table 1. In the following sections, I provide explanations and justifications for the chosen datasets to supplement the rich methodological accounts in the three articles.

*Table 1: Overview of articles and data sources*

| Articles | Research Questions | Empirical data |
|---|---|---|
| **Article I**<br>Digital technologies in policy assemblages in Ireland and Norway: A visual network analysis | (i) How are actors assembled in key policy documents from Ireland and Norway to display governmental ambitions for the enhancement of digital technologies?<br>(ii) What imagined practices for teachers' and school leaders' use of digital technologies emerge from the composition of relationships between the actors in the policy assemblages, and what may these imply for educational governance? | Six policy documents (see Article 1) |
| **Article II**<br>Emergent school leader subjectivities in digitized practices: The case of VSware | (i) What are the relations that emerge within and between VSware, school leaders and other actors?<br>(ii) How do school leadership subjectivities emerge in the relations between VSware, school leaders and other actors? | Individual interviews with three school principals, group interviews with middle management across three secondary schools in Ireland, using screen/audio recordings. Interviews with VSware (see Article II for a full list of human informants) |
| **Article II**<br>Learning analytics as modes of anticipation: enacting time in actor-networks | (i) How do LAPs, in practice, enact anticipation?<br>(ii) How do school leaders act on these modes of anticipation? | Individual interviews with three school principals, group interviews with middle management across three lower secondary schools in Norway, using screen/audio recordings. Interviews with Engage and Insight<br>(see Article III for a full list of human informants) |

### 4.2.1. Policy Documents

The politics of digitization suggests that the use of digital technologies in schools is encouraged on a policy level. Studies such as Williamson et al. (2018) also show how the policy level seeks to steer education toward heightened quality assessment in schools by utilizing digital technologies. Given the national and international interest in enforcing and developing digital technologies in Irish and Norwegian schools (see Chapters 1.3 and 1.4), I chose to include policy documents as one data source in my project. These documents are presented in Article I and were accessed mainly through official government websites, such as gov.ie and regjeringen.no. They were purposively sampled; the documents had to explicitly address digitalization in schools. For the Irish documents, we found that there were very few official policy documents in general and even fewer targeting our focus. Consequently, we included the

policy documents that were available in the Irish database (three) and chose a similar number of policy documents for the Norwegian documents.

From an ANT point of view, the selection of policy documents naturally created a boundary for the networks; the documents included focused only or partly on digitalization at the school level, meaning that the selection and framing of the networks were focused on the digital work of school leaders and teachers. Teachers were added as an explicit interest in this part of the project because the documents rarely distinguished between the work of school leaders and teachers in their expectations of practice, suggesting that school leaders are frequently expected to partake in professional work in schools with teachers and vice versa. Policy documents have two main spheres: they entail an activity in that they enable certain actions, and they are relational in that they connect to a reality external to the documents themselves (Asdal & Reinertsen, 2020). We treated the policy documents as 'windows' into governmental strategies for digitizing education, and as such we analyzed what the potential for practice is by looking at who or what are 'defined *into* the text as the relevant objects and actors' (Asdal, 2015, italics are original). This meant that our interest lay in interrogating 'relevant characters' and assigned attributes by looking at who should do what and how (Woolgar & Lezaun, 2013). As ANT reminds us, however, networks emerge in practice, and policy outcomes are questions for practice (Baker & McGuirk, 2017). The policy documents as research data should therefore be considered potential for practice, as well as a methodological starting point that hinted toward types of tools and activities that could be relevant to 'follow' in practice (see Chapter 4.3.2). While I did not focus on specific policy enactments in Articles II and III, some of the policy documents analyzed in Article I resurfaced as actors in the other datasets below, such as The Framework for Junior Cycle (see Article II).

### 4.2.2. Interviews with School Leaders—Audio and Screen Recordings

A common struggle when following ANT methodology is to overly rely on human informants, which breaks with the main premises of the network (heterogeneity and relationality). While I chose to interview school leaders in my project, I employed 'specific tricks' (Latour, 2005) in how the interviews were designed to account for the school leaders, the digital and other actors that emerged from the analysis. This meant taking a step back from more commonly used interview techniques in qualitative (phenomenological) educational research (such as asking for perceptions or looking for how school leaders act upon digital technologies) and caring more about who is interacting and how the interaction takes place (Adams & Thompson, 2016). I designed semi-structured individual interviews with principals and group interviews with assistant principals and middle managers (see Appendices 1–4 for interview guides). The individual interviews had three main components, and the group interviews had four components.

First, I asked opening questions to ease the interview situation and get to know the schools. The interview questions here included questions about the leaders' positions and jobs at the school, reasons for using the platforms, and staff training when introducing the platforms. The questions in this first step were not intended to form part of the analysis and were merely used to familiarize myself and the school leaders with the school and interview context. Second, the

main part of the interviews consisted of questions that exemplified practice, and I used interview techniques common to ANT that encouraged the school leaders to narrate examples of the activities they performed with the platforms (Fenwick et al., 2011). These are techniques that make the interviews as certain *hearings* that follow the same flat ontology of ANT and use questions such as 'how,' 'with who or what,' 'what happened next,' and so on (Decuypere, 2019a). The interview guide was therefore designed in a way that would allow me to go where the how and who of the discussions went. I would point to examples of features in the platforms, ask them to describe situations when they used these, and probe for taken-for-granted actions that show how heterogeneity unfolds. During this part of the interviews, the school leaders were able to interact with the platforms using demo users (Conexus Insight and Engage) and screen prints (VSware) that were presented on a laptop and screened through a projector. This gave the digital platforms a voice to account for practice more symmetrically. In both cases, the school leaders were asked to focus on the features that they most commonly used in their day-to-day practice.

The use of the platforms was most successful during the group interviews in both cases and only partly used during the individual interviews, as principals tended to not engage directly with the platform (in total, two Irish principals voluntarily interacted with presentations of the platform, but none of the Norwegian principals did). I did not want to 'stage' practice, meaning that if the principals did not deliberately engage with the platforms, I did not force the situation. In these scenarios, I vividly described the features of the platforms for them to discuss instead. Both the demo user and the screen prints were interacted with similarly, although the demo user presented somewhat more interactive and lively examples. As a third step in the group interviews, I asked the school leaders to summarize the main examples of practice that had been discussed in the previous part. A typical example would be a leadership meeting in which someone had collected information from the platforms and brought to the meeting for discussion. I asked them to think specifically about some main questions: What data have you gathered and how? What type of data? Did you bring information from other sources? What kinds of sources and how? Who and what participates in these discussions? What happens after the meeting? These summaries were first intended to be a prepared case from practice, but after piloting the interview guide, I decided that a pre-given case would not necessarily accommodate the specific leadership practices in each school (and would definitely orchestrate practice). Instead, I decided to select an example from the school leaders' own narratives there and then (see Appendix 2 for an example). This exercise helped focus the analysis later on and pinpoint specific actors that emerged in the interactions between the school leaders and the platforms. As a last step, both the individual and group interviews had closing questions that focused on the limitations and possibilities within the platforms. Initially, these were meant to create a bridge toward an ending of the interview; however, some of the discussions arising here showed how the platforms were open or closed to the school leaders and were fruitful in connection to the third dataset, interviews with platforms (see Chapter 4.2.3).

All interviews were audio-recorded using the University of Oslo's Dictaphone app, which has GDPR clearance. The interviews that had presentations of the platforms present were also screen-recorded. Screen recording is a method that uses software on a computer or one-to-one device to record everything that is happening on the screen (Beiler et al., 2021; Geisler &

Slattery, 2007). I used the Captura software, which recorded both on-screen activity and sound, which meant I could connect the audio recordings with what was happening on the screen. I primarily wanted to use screen recordings for pragmatic and ethical reasons, to avoid challenges in access to schools and school leaders by using video recordings and to avoid issues of transferring video equipment across national borders. Audio and screen recordings would still allow me to map relations and interactions. However, as I familiarized myself with Captura, I realized that using these two recordings conjointly would provide a record of both the human accounts and the digital. The platforms emerged with several performative characteristics, and by using both recordings, I could clearly follow their interactions. These were also highly productive during the analysis, as I had visuals of which elements from the platforms were interacted with during specific points in the discussions. The audio and screen prints from all three platforms were transcribed in parallel and amounted to approximately 300 pages (see Appendix 5 for an example).

### 4.2.3. Interviews with Platforms—Screen Prints

While the interviews with the school leaders were designed to ensure a symmetrical approach, they relied more or less on anecdotes from the school leaders. I therefore also chose to analyze the platforms inherently by 'listening for the invitational quality of things' (Adams & Thompson, 2016, p. 40). When school leaders described practice, the platforms 'spoke' to them in different ways that signaled that the platforms were contributing to an activity (Latour, 2005). What that something was, differed based on the interaction. For instance, in Article II, the amber numbers in Figure 4 told one middle leader that the roll had been taken incorrectly and needed to be changed. The leader could choose to contact the teacher who had taken the roll to fix it; the leader could ask the principal to do it or simply fix it themselves so that the amber number would turn red or green (the leader chose to do the latter). In Article III, the anonymized data on the yearly student survey showed that some girls felt violated in school. The leadership team felt it was necessary to gather contextual information to try to understand who these girls were and whether they were already familiar with the problem. In either case, regardless of the leaders' responses, the platforms did something to practice that encouraged a set of actions from the leaders. In addition to how these actions unfolded in practice, there was an 'invitational quality' (Adams & Thompson, 2016) that was made possible by scripts and invitations to practice inherent to the platforms (Cabitza & Mattozzi, 2017; Mattozzi, 2010).

In the case of VSware, school leaders were asked to take screen prints, anonymize them and send them to me before the interviews. This was necessary because I did not have access to a demo user, and I needed to use them during the interviews. I was provided with a total of 15 screen prints from VSware. These included end-of-year reports, behavior reports, attendance and time-tabling. I selected seven of these to bring to the interviews based on two criteria. First, it had to be relevant to answer the overall research aim (time-tabling, for instance, did not seem relevant). Second, overlaps in the screen prints were removed (meaning that the schools had sent me similar screen prints of the same features). After the interviews, I selected four screen prints (see Article II) for further analysis. These were selected because the school leaders most frequently interacted with them during the interviews. In the case of Conexus Insight and Engage, I asked the school leaders to point to examples on the platforms during the interviews.

After the interviews were over, I watched the screen recordings and took screen prints of the features with which the school leaders interacted most during the discussions. This amounted to a total of 12 screen prints. After further consideration, I saw that there were overlaps in these screen prints as well, and from here, I cut them down to four screen prints, which included the front page of Insight and Engage, student reports, and visualized data.

All screen prints were imported to Nvivo and interviewed there (see Appendix 6 for examples). In Article II, I performed these interviews as an explicit part of the analysis, while in Article III, these interviews were used more implicitly and interwoven with the interviews with school leaders. I created nodes in Nvivo by marking parts of the screen prints as a form of coding. In both cases, I asked questions that would show what the platforms are encouraging the users to do and what it constrains them to do. In other words, I was interested in exploring the possibilities and limitations inscribed to the platforms and whether their elements enhanced or framed action in any way. This meant that while these interviews were carried out in isolation, I always asked questions that would show the platforms' ability to perform in relation to its users (the school leaders). These were later coupled with some of the school leaders' discussions on challenges and opportunities within the platforms (see Chapter 4.2.2).

## 4.3. Data Analysis

This section is meant to supplement the rich analytical descriptions in the articles, and will highlight main analytical steps that were used across the three articles.

### 4.3.1. Coding Relational Data

I designed the data collection to account for how relations between school leaders and digital technologies establish (or potentially establish in Article I) relations in practice, following ANT's premise of relationality (Law, 2009). The first step of the analysis in all three articles was, therefore, to code relations and actors that emerged in practice. I was especially drawn to Decuypere's (2019a) way of coding sociomaterial and relational data, and the forthcoming presentation of specific steps and procedures of coding stems from his work in bringing forward 'the relational composition of a particular practice under investigation' (Decuypere, 2019a, p. 2). He proposes attention to jotting down actors and relations between actors and adding contextual information that sheds light on how the relations were formed.

To code the relational data, I created structured coding schemes in Word, where I recorded how interactions were formed between actors. In the analysis of Article I, we began by writing down the actors. Here, it was essential for us to determine what we counted as actors, and we utilized Latour's (2005) broad definition, in that an actor is anything and anyone that contributes or gives meaning to an activity. We therefore paid specific attention to how the policy documents described action. For instance, entities explicitly addressed to effectuate school leaders' and teachers' work with assessment, such as performance data, were coded as actors because they were expected to contribute to (digital) assessment activities. However, we quickly found that performance data connected to other actors (not just school leaders and teachers), such as the Junior Cycle Profile of Achievement and School Self-Evaluation. These were then coded in

relation to the performance data. The actors and relations were coded in two different columns (see Appendix 7, for example), and we added descriptions from the policy documents in the third column. These descriptions worked both as evidence for how we identified actors and relations and to further build our analysis through visual networks (see Chapter 4.3.3).

The main idea of coding relational data as a first step in the analysis was followed in Articles II and III, and I utilized the same definition of 'actor' in all three articles. In Article II, the coding scheme for the interviews included a short description of the activity, an overview of actors, an overview of relations (and the specific action that connected the actors together), and additional contextual information taken from the interview transcripts and the screen prints from VSware (see Appendix 8). I previously coded relations between the elements on VSware by interviewing the software in Nvivo (see Appendix 6), where I coded how colors, icons, numbers and text connected to each other and to other actors 'outside' of VSware (as well as what actions the relations encouraged). Where appropriate, some of the VSware analysis was added to the coding book; sometimes this was done by simply pasting descriptions of relations between VSware elements, and at other times, I inserted the screen shots that showed the relations. I first created individual coding schemes for all three schools, but as I already argued, their enactments were very similar, and so their empirical data were later merged into one main coding scheme in Word.

In Article III, I created a coding scheme that included segments from interview transcriptions, descriptions of activity, overviews of relations and interactions and an extra column that commented on the type of time that was produced through the interactions (see Appendix 9). In this coding scheme, I did not add an individual column for the actors. Instead, I merged it in the 'relations/interactions' column. This partly shows how I adopted the coding scheme throughout the project to fit the main research questions in the articles, but it also shows my analytical development and ANT integration. In Article III, while understanding what and who can emerge to be an actor is an important premise, I did not want to have major discussions of what is considered as an actor (as I had done in Article II and Article I especially) but make the argument of time and anticipation more prominent. I therefore wished to take a step forward from discussions of heterogeneity and the subject/object dualism, and put the relational effect of time at the forefront. Moreover, as in Article II, I began by creating individual coding schemes for each school. As I found that their enactments were very similar, the data was transported into Nvivo to further develop the analysis (see Chapter 4.3.4).

Finally, the method of coding relational data in the three articles reflects the effects highlighted in each article. This means that the very first step of coding actors and relations is what determined what effects I wished to emphasize and, as such, reflects how I worked between inductive and deductive levels. The way of tracing the actors taps into the notion of 'following' the main actors described in Chapter 4.1.1. In the next section, I discuss some considerations and consequences of following the actors analytically.

### 4.3.2. Following and Unpacking the Main Actors

The main actors I follow in my project are described in Chapter 4.1.1. Choosing school leaders and specific tools as the main actors to follow meant that I followed their interactions. However,

following actors is not as straightforward as one would think, and the very act of tracing connections implies that other key actors will surface as other related connections come to the researchers' attention (Adams & Thompson, 2016; Elmholdt & Ratner, 2021). While the overarching actors I followed were school leaders, teachers and digital technologies in general in Article I, one learning management system in Article II, and two learning analytic platforms in Article III, there were other key actors that came to my attention during the analytical processes.

The first step when coding the data was to look for special interactions that caused something in the micro-practices to do something important in the network. These actors came to my attention in different ways. In Article I, some actors became significant because they could potentially take on multiple roles in the network. They could take on these roles by connecting multiple activities together and, as such, becoming somewhat of a hybrid. These were the boundary actors, i.e., learning analytics and performance data. In Article II, I looked closer at backgrounded actors of VSware rather than Vsware as a whole. This meant that I untangled VSware as an actor and chose to follow some of its elements in the interactions. I followed attendance data, behavior categories and behavior entries. One actor became a 'buzz of activity in the background' (Adams & Thompson, 2016), which made all other actors performative: the blue pencil button (the edit button). In the interaction between school leaders and attendance and behavior monitoring, the blue pencil button showed how mundane ways of working with software like VSware entangled activities of external reporting, in-house development, and staff training.

In Article III, I chose to disentangle Insight and Engage by looking at specific elements in the platforms. I looked at how school leaders interacted with visualized data, such as the results of the student survey, to address issues of school development. The actor(s) that was especially powerful in painting images of the future and that prompted school leaders to take actions in the present was the historical data feature that allowed the school leaders to choose results from various points in time for the same group of students. The school leaders interacted with bits of historical data in all the interviews and drew from examples of surveillance, identifying students in need of extra attention, and external accountability measures, such as result meetings with municipal superintendents. The way I approached to follow actors analytically can therefore be said to have three main considerations. First, I identified potential actors of interest (the main actors I followed). Second, I mapped other connections extending from the interactions between the initial actors of interest. Third, in some cases (Articles II and III), I further unpacked the digital actors to follow specific elements within them. This means that while there were some main actors in focus, I also had to trace their inherent and extending networks and their practices by attuning to the 'gatherings of actors in a specific practice or the sociality and connectedness around an object' (Adams & Thompson, 2016, p. 38).

### 4.3.3. Visual Network Analysis

In Article I, we drew from Visual Network Analysis (VNA) to visually present the relational compositions in the policy documents by visualizing network diagrams (Decuypere, 2019a; Venturini et al., 2016). In other words, we used VNA to visualize the analysis built on the

conceptualization of policy assemblage. VNA is a methodology developed within a 'relational turn' in qualitative research, which aims to create an integrated analysis of relational practice and the effects that are generated from these relations (Decuypere, 2019a; Latour et al., 2012). VNA thus builds on the same premises of ANT, such as relationality, emergence and the various network effects that may be generated. In ANT research, networks have tended to not be displayed visually, as is common in other types of network analyses, such as Social Network Analysis (Vicsek et al., 2016). VNA is therefore an attempt to visualize heterogeneous networks, and the focus is on flexible and descriptive methodologies (rather than on structure per se).

In Decuypere's (2019a) elaboration on VNA, analytical steps include the collection and coding of relational data, the making of visual network diagrams and analyzing the form of the networks. We have described in detail how we utilized VNA in Article I. Briefly put, we followed the main actors (school leaders and teachers) in the descriptions of digitalization at the school level in the policy documents. We accounted for heterogeneity by coding both human (blue nodes) and non-human actors (red nodes) and linked their expected interactions as a way of showing the composition of the networks. To analyze the form of the networks, we grouped actors that were expected to frequently interact with each other in regions of practice where certain actors caught our attention, as they could potentially merge practices together (boundary actors that resided in the overlaps). The overlaps of the regions were conceptualized as interfaces.

Attuning to some of the main concepts that I draw on in my study (heterogeneity, relationality, network effects, time/space), I chose to utilize VNA in my first article based on two rationales. First, the main aim of VNA matched my conceptual focus of policy assemblage (and ANT in general) and allowed our analysis to have productive theoretical and methodological discussions. It was thus fruitful for my project in a more general sense, as it allowed me to draw closer to ANT concepts and methodology by building some of the main analytical foundations in my project. It was a way of adding structure to my network analyses that followed specific methodological protocols and, as such, made the ANT concepts more tangible in my research. Article I is, in this sense, a building block in my project, empirically, theoretically and methodologically. Second, and more specifically within the boundaries of the first article, creating visual networks allowed us to lift the analysis of the policy documents to be more than textual analyses; visually presented, the digital ambitions show clear expectations for action, responsibility distribution (the boundary actors) and, to some extent, the expected level of digitization integration in the sites by focusing on the specific actions digital technologies have the potential to perform (Venturini, 2010).

VNA thus offers a way of presenting the composition of networks, as well as a way of analyzing the networks in terms of regions, interfaces and boundary actors. This is the interrogating side of VNA. Moreover, VNA also offers a narrative function (Decuypere, 2019a). Constructing particular stories of the networks was therefore the fourth and last step of our VNA analysis, but creating narratives was also used in Articles II and III, which the next section will briefly comment on.

### 4.3.4. Creating Narratives

After gaining an overview of a relational practice, ANT research is left with the task of showing what relations perform. This is often done by creating narratives that "reassemble and resemble the concrete, lived-though particulars of the eventing lifeworld" (Adams & Thompson, 2016, p. 30). The task is to weave together the human and non-human stories so that it not only presents the tracing of actors but also shows how they connect and provide evidence of the work they do in practice.

I used human accounts as starting points in Articles II and III, but I did not treat their accounts as uniform. Rather, I connected them to the other research data that I had collected and unfolded them conjointly. This meant that I shifted between first-hand accounts (quotations from the interviews), third-person narrations (my own) and the invitational quality of the digital that had emerged through my interviews with the digital tools. In Article II, I created the narratives by approaching the analysis in two ways. First, I created 'VSware narratives' by analyzing the inherent elements of VSware independently. I presented the screenshots in the text, and after tracing connections between elements, such as colors and numbers, I commented on what VSware could potentially 'do' in practice, stretching from creating autonomous leader subjectivities to encouraging practices of external reporting. Second, I proceeded to connect the VSware narratives with the leaders' accounts from the interviews. I did this by presenting three scenes of practice; each scene included segments from the interviews, explanations of the activities and descriptions of specific elements that were traced back to the previously presented screen shots. The focus remained on disentangling the connections between the school leaders and VSware and explaining what was happening within these connections. The narrated story in Article II was thus one that aimed to break down the subject/object dualism by showing how school leaders' subjectivities were formed through their direct and indirect interactions with VSware elements.

In Article III, instead of having Insight and Engage narratives separately, they were woven directly into the analytic text. When presenting the three modes of anticipation, I included quotations from the interviews and some screen prints from the platforms, while I also described the specific activities producing anticipation. The focus here remained on tracing connections across time specifically, while simultaneously commenting on what kinds of anticipation emerged from these cross-time relations. The analytical descriptions in Article III are, in this sense, a way of narrating non-linear and networked sorts of time by showing how the networks folded time through their actions.

The narrative accounts in Article I were somewhat different from those in Articles II and III, as they were built on policy documents rather than interview material. While we visualized the performative networks in Article I through VNAs, we also created certain narratives to accompany the visualizations. This was based on VNA's double function, an exploratory function that shows how networks are composed relationally, and a narrative function 'that allows to construct particular stories or anecdotes out of the formed networks' (Decuypere, 2019a, p. 85). We narrated the effects of the VNAs in two main ways. First, we narrated the network as an effect by itself by following actors and describing the central position of school

leaders, teachers and the digital boundary actors. Here, we narrated the story of how these actors bring different practices together and are potentially made into being together. Second, we described the possible consequences that the relational compositions may have for school leaders and teachers *in practice* and for educational governance. One can therefore think of the narrative accounts in Article I as stories of policy ambitions for practice that suggest they can have very specific consequences at the school level.

I viewed the narrations in the three articles as a way of working on the empirical data I had gathered. It was also a way of presenting the different network effects that emerged from the analyses. But these narrations do more than simply retell stories of actors, relations and effects. Narrations also 'do' and are themselves material actors that are a result of research practices, such as digital coding and interview techniques (Adams & Thompson, 2016). It is a way of doing research. In the upcoming section, I comment on how my ways of doing research speaks for practice, and specifically what the different digital software I used to analyze my data (Gephi, Captura, Nvivo) have implied for my research.

### 4.4. Studying Practice through Digital Methods

In ANT, reflexivity rests on the same ontology it promotes and an anti-anthropocentric notion where reflection and knowing are never done in isolation but a product of different forces coming together. This implies that from an ANT perspective, research is a contingent part of the continuous practice under investigation (Fenwick et al., 2011). Latour (1988) calls this 'infra-reflection' and suggests that researchers think in-between things, research protocols and agents. Against this backdrop, I want to briefly highlight my relationship with the methods I used in my project as an explicit reflective activity.

On the one hand, digital technologies are materials of practice (Law, 2009). They materialize certain forms of interactions, negotiations and ways of conforming to leadership tasks. They leave digital traces in terms of visualizations, inscriptions and reports. On the other hand, they encourage certain scientific methods and analytic procedures and prompted me to think about how I could investigate them to see their materializations (Ruppert et al., 2013). This means that while I, through my overall aim and the research questions in the articles, examined digital technologies in practice, I also developed some analytical steps and methods to analyze their effects that best suit the aims and questions in my project. These have partly rested on digital methods (Snee et al., 2016). To show how the tools I have unfolded have mobilized and shaped the analytical and methodological parts of my project, I provide some examples from the data analysis software I used to draw closer to the interactions between the school leaders and digital technologies.

To visualize the connections within the policy documents in the first article, we utilized Gephi to build the visuals of the networks. We began by inserting our relational data into the software. We then used an algorithm called ForceAtlas2 because it works to account for the form of the networks (i.e., regions) (Decuypere, 2019a; Jacomy et al., 2014). It ensures that nodes (actors) are connected directly or indirectly and that their proximity reflects how the actors are expected to interact. However, when activating the algorithm, we saw that the visualization it produced was not useful for our analysis. The nodes were positioned very close together and resembled

a cohesive ball rather than a network. From here, we therefore proceeded to code all connections manually (which we were able to do in the 'back room' of Gephi) and relied on our contextual information to place the nodes accordingly. The coloring of the networks was also done manually in Photoshop.

The first concern I had when designing the interviews for my project was to properly account for the digital actors. I wanted their voices to be heard. I originally wanted to use a GoPro camera to film the screens during the interviews. This would mean that the GoPro had to be installed so that it would only record what was happening on the screen (and audio). Although the camera would not film the informants, it could potentially seem intimidating to them, and there would be issues in safeguarding that no one jumped in-and-out of the camera lens. Eventually, I was able to explore the Captura software that could be installed on my laptop as a recording device. Captura made it possible to record the digital tools I examined and render them visible while simultaneously accounting for human voices. After the recordings, I had to find a way to analyze them properly. Thus, I transcribed the interviews in two columns (one with text and one with screen prints from the recordings), and I later transferred these data to code schemes made in Word and Nvivo (see Chapter 4.3.4). When working in Nvivo, I quickly saw that the 'clicking' mechanics of nodes and sub-nodes at times made me lose track of the connections the data had rendered visible. The connections that were visibly entangled in the recordings became fragmented and only loosely associated in Nvivo. Therefore, I chose to make coding schemes in Word as well, as these allowed me to have a better visual record of the connections and interactions that emerged from the data.

Together, the data collection and data analysis software were assembled into specific procedures that allowed me to examine digital technologies in both text and practice. They also showed how I negotiated with the software to fit my concerns and research aims, and thus how I, too, was assembled to make specific decisions in my project (Ruppert et al., 2013). In addition, the examples show two levels of using digital technologies in my project: i) 'natively digital' data generated from the digital tools (VSware, Engage and Insight) through screen recordings and screen prints, and ii) the digitalization of data collection and data analysis methods (Captura, Gephi, Nvivo, Photoshop, Word) (Rogers, 2009). In the forthcoming section, I reflect on the issues of research credibility in my project.

### 4.5. Research Credibility

In discussions of quality criteria in qualitative research, we often find references rooted in quantitative protocols, such as reliability and validity (Creswell, 2013). Others choose more flexible terms such as credibility, quality and validity in qualitative research (Silverman, 2017). In this section, I use terms from the latter tradition to discuss rigor and analytical trustworthiness in my project. Credibility and validity strategies are discussed in terms of five categories: reflexivity of research design, transparency of analytic claims, comprehensive and critical data analysis, validation through 'next turn,' and construct validity (Alvesson & Sköldberg, 2018; Bryman, 2012; Peräkylä, 2021; Silverman, 2017). I also briefly comment on triangulation (Silverman, 2017). These strategies are presented somewhat separately here but should be read

as strategies that connect to each other throughout my project to ensure overall research credibility. The section concludes with a discussion of limitations and generalizations.

When designing the different methods of the study, I focused on following an ANT ontology by staying true to its ontological premises. To secure a turn toward ANT in my project, I used an ANT language that resides in showing how (rather than explaining why), designing the data collection methods to uphold relational symmetry, placing the analysis at the level of enactment (instead of perceptions), and choosing analytical procedures that would show further evidence of human and non-human practices (Adams & Thompson, 2016; Decuypere 2019b; Fenwick & Edwards, 2012). These steps are characterized by reflections on how I could provide new insights to research school leaders and governance in digital environments and how I considered the methodological and analytical consequences of applying ANT to invoke these insights (Alvesson & Sköldberg, 2018). In Chapter 3, I have also reflected on how ANT is useful in answering my research questions, as well as its limitations. Further examples include the articulations of research questions in the three articles and reflecting on how my way of doing research has entailed working through digital methods and digitalizing the data collection/analysis. The latter example especially emphasizes how reflexivity can increase analytical credibility by establishing how I, as a researcher, have shaped the process and how the process has shaped (or assembled) itself and me (Alvesson & Sköldberg, 2018; Ruppert et al., 2013).

Analytical rigor is further emphasized in my project through the transparency of analytic claims and building a comprehensive and critical view of the data analysis (Peräkylä, 2021; Silverman, 2017). The transparency of analytic claims relates to whether others reading your research can trust in what is being reported (Peräkylä, 2021). I aimed to provide detailed descriptions of data collection and data analysis to give readers the opportunity to audit my findings (Guba & Lincoln, 1994; Lincoln & Guba, 2013). This includes the rationale behind choosing the specific article topics, research questions, analytical framework and data collection/analysis methods. I also ensured this transparency by providing excerpts from coding schemes in all three articles, quotes from interviews or segments from policy documents and screen prints from the platforms in the last two articles. In this extended abstract, I also detailed the steps of the systematic literature review for the project. In addition, I provided examples from the specific coding procedures, interview guides, ethical consent forms and other important documentation by attaching them to this extended abstract as appendices. To create a comprehensive and critical view of the data analysis, I aimed to prevent a misleading presentation of the phenomenon (Silverman, 2017). Some strategies I used in this regard included making sure I followed the same understanding of what an actor is in all three articles. This entailed considering all datasets to analyze exactly who or what contributed to an activity (Latour, 2005). I further followed ANT's 'practice comes first' ontology by working through inductive levels. Therefore, I did not presume that any specific effects would emerge from the networks I examined; rather, I traced relations and actors first, and then I let the data show what effects were most dominant. As such, I wanted the data to speak for the phenomenon alongside the theory.

Letting the data decide which network effects, and thus which sensitivities from ANT to focus on, also informs the validity strategy of validation through the 'next turn' (Peräkylä, 2021).

Validation through the 'next turn' entails pondering possible interpretations of the data (Peräkylä, 2021). Working inductively is one possible step, but other steps also include member checking and peer checking (Lincoln & Guba, 2013; Seale, 1999). I performed member checking by checking with the informants during the interviews that I understood (or interpreted) their stories from practice correctly. Peer checking included discussing possible interpretations with my supervisors and presenting work-in-progress drafts to colleagues, at PhD courses and seminars, and at national and international conferences. Construct validity also taps into this notion as the aim of this credibility strategy entails whether a construct, like a sensitivity, is accurately presented in the study (Bryman, 2012). To ensure construct validity in my project, I defined the sensitivities used in all three articles by relating them to the overall objectives of the project (Yin, 2018). I also identified previous studies that produced similar findings and, in doing so, identified the operational measures that match my conceptual focus (Yin, 2018). This was done to varying extents in all chapters in this extended abstract but is also included in shortened form in all three articles.

Triangulation of multiple data sources is a common credibility strategy in qualitative studies (Silverman, 2017). This is a form of triangulation that can strengthen the validity of the study from various angles. ANT works in another direction by basing the research on an actor or a few actors and working its way from there. In other words, there is an 'opposite triangulation' that follows the actor(s) and opens up for possible sites and data sources from some initial empirical material (Bleakley, 2012; Mol, 2002). In summary, validity through triangulation can be found in the varied data sources and ways of approaching the data that emerged from my research.

### 4.5.1. Limitations and Generalizations

The goal of qualitative case studies is to gain in-depth knowledge about the social world, give voice and advance theory (Ragin & Amoroso, 2011). My use of ANT to investigate the cases in my project implies an investigation of the particular minute negotiations that are under constant emergence (Fenwick & Edwards, 2012). I have 'zoomed-in' on a small number of practices, and in some cases, brackets of these practices (Nicolini, 2012). One of the main limitations in my study is, thus, the sample size in all my empirical data material. This implies that I report on 'snapshots' of practice that are not necessarily fit for generalizations. Nevertheless, a broader understanding of applicability to external contexts can be found in the notion of analytical generalizations (Kvale & Brinkmann, 2009).

Analytical generalizations can be used to extend theory empirically by making larger theoretical arguments through induction (Ragin & Amoroso, 2011). Case studies, which provide rich descriptions of a phenomenon, are especially appropriate for advancing such analytical generalizations (Ragin & Amoroso, 2011). I facilitated analytical generalizations by writing rich descriptions through the narrative analyses in all three articles. In these descriptions, I actively used the empirical data to show connections that I believe best illustrate ANT sensitivities. This includes a careful selection of sites and the 'snapshots' within these so that they clearly contribute to our understanding of digitized practices, such as human–digital

networks (all articles, but especially emphasized in Article I), school leader subjectivity (Article II), and time and anticipation (Article III).

Analytical generalizations can also be used to describe a projects' ability to invoke questions of what might unfold in other contexts (Kvale & Brinkmann, 2009). These should be treated as suggestive (Maxwell, 2012). As previously mentioned, context is not an explicit concern for ANT (actually, it has at times heavily contested context), as context is also made by relational performances that suggest a 'contemporary turn' (Asdal, 2012). ANT's approach to mapping actors and relations does also not aim to build a model that can be used across contexts (Vicsek et al., 2016). However, I attempted to balance the contextual elements of traditional case study approaches with ANT's ontology. In parts of Chapter 6.1., I discuss how my findings provide new insights into digitization in Irish and Norwegian schools. This should be understood as a way of thinking about context as something that is integral to the actions that I shed light on, rather than as external surroundings (Asdal, 2012). I wrote the findings as detailed as possible so that they could suggest further empirical work within and beyond my empirical contexts. Moreover, the similar enactments that I found across the Irish and Norwegian schools (despite their differences in size, location and school types) imply that there is consistency in my findings, thus strengthening the overall validity of the project. This consistency also suggests that my analytical tools can potentially be used and adapted to discuss the phenomenon at other sites (Kvale & Brinkmann, 2009).

Another limitation of this study involves the cutting of networks. I have discussed this in detail in Chapter 3 by showing how these cuts were analytically necessary and by drawing on arguments of multiplicity that acknowledge all networks and actors exist inside, outside and alongside each other (Hetherington & Law, 2000; Mol & Law, 1994; Mol; 2002). Here, I briefly highlight that, although these ways of thinking about the network bring forward a positive critique of ANT, there will always be some actors that do not become visible or less visible as the main actors that are followed (Hassard et al., 1999). This is also true of my project. At the same time, the ability to follow the actors you are intended to follow and thus continue to study what you are intended to study can also be said to strengthen the validity of the research (Silverman, 2017). Following actors was my way of limiting the scope of my project to fit with my research questions and pragmatic/timely frames of my PhD. An extensive investigation of actors, relations and practices would not have been possible with or without ANT and should therefore be considered as analytical cuts that are familiar to all qualitative research (Silverman, 2017). In the following section, I wrap up this chapter by discussing the ethical considerations in my project.

### 4.6. Ethical Considerations

Educational research in Norway reports to the Norwegian Center for Research Data (NSD) for ethical clearance. I submitted my application for approval to NSD in July 2019 before I started data collection (project number 582355). The application included information about my initial research aim, research questions, research design and interview guides. Part of the ethical guidelines I followed in my project included written consent from the informants. I developed a consent form according to the NSD's guidelines, which also conforms to the General Data

Protection Regulation (GDPR). I made two consent forms (see Appendices 10 and 11), one written in English for the Irish informants and one written in Norwegian for the Norwegian informants (the informants in the pilot interview were also given the Norwegian consent form). The consent forms cover information about the project, their rights, data collection method (screen and audio recordings), information on data storage, and contact information for myself (project leader), supervisors, the University of Oslo's data protection officer and NSD. Consent forms were sent to the schools electronically upon agreement to participate. When approaching the scheduled interviews, I sent them a reminder to read and sign the consent forms. The consent forms were collected in person when we met, and I repeated the information about the project and their rights. I stored the consent forms electronically on a secure server.

I designed the interviews to uphold ethical guidelines, considering the students and the informants themselves. The importance of upholding research ethics in connection to students builds on the tools that were examined in my project; they collected and stored student data and could, therefore, potentially be indirectly identified in the empirical data (NESH, 2021; Rose, 2012). In the Irish schools, I asked all informants to take screen prints from VSware and anonymize all student data. All informants complied with this and I was sent screen prints that did not have any identifying information about students. In some cases, I saw that the informants had forgotten to delete information about themselves, such as leaving their own names visible. I deleted these before the interviews started. In the Norwegian schools, I was able to use two demo users for Engage and Insight. This meant that all data were fictional, and I could proceed to use the platforms in the interviews without any further digital adjustments. In addition, I reminded all informants not to mention any student names or information that could identify their students before the interviews started. Despite my efforts to avoid recording student data during the interviews, there were two instances in which the school leaders mentioned students by first name. In these two cases, I deleted the names in the recordings immediately after the interviews were finished (both audio and Captura recordings), and I logged these changes (Rose, 2012).

The storage of research data is another ethical measure in my project. I developed a data management plan in cooperation with the IT office in my department before sending my application to NSD (later approved by them). This included the described measures taken before, during and after the interviews, as well as data storage (see Appendix 12). The type of data I collected is classified as 'yellow,' according to the NSD and data classification at the University of Oslo (University of Oslo, 2020). This means that my empirical data had limited disclosure of personal data but nevertheless had to be stored on a secure server. In addition, the data were stored separately from the anonymized data (transcriptions), and a scrambling key was kept (NESH, 2021). I was the only person with access to the data except for the three individual interviews from the Norwegian schools. For these interviews, I contracted someone to transcribe for me. In cooperation with the IT office and the data protection officer at the University of Oslo, I made a confidentiality declaration that the consultant signed (see Appendix 13). NSD was notified and approved of these changes to my project.

Lastly, I want to mention my proximity (or lack thereof) to the digital technologies examined in my project. I have worked as an independent researcher on this project, and I have not worked

in cooperation with any of the commercial companies behind VSware and Conexus Engage/Insight. I contacted VSware and Conexus at the beginning of my project to ask for demo users of the platforms. Only Conexus replied and invited me to a meeting where I was given information about their platforms and what they could offer in terms of demo users. This is the extent of my relationship with the companies, and my role has therefore not been to follow implementations or developments in the implementation of the platforms for commercial benefits or otherwise. My research role has been based solely on academic purposes without any affiliation to the companies. The upcoming chapter will present and synthesize the main findings of my project.

# 5. Synthesis of Findings

In this chapter, I will synthesize the findings in the three articles and present how these findings connect to each other to answer the overall research aim of my project. Because theory and methodology are extended empirically in my project, I refer to empirical findings, as well as the theoretical and methodological points highlighted in my project. These will lay the foundation for the discussions in Chapter 6.

## 5.1. Article I

Lunde, I. M., & Ottesen, E. (2020). Digital technologies in policy assemblages in Ireland and Norway: A visual network analysis. *European Educational Research Journal*, ahead of print, 1–19.

The main aim of Article I was to unfold governmental expectations to digitalize school leadership and teaching practices as presented in key policy documents in Ireland and Norway and to discuss their consequences for governance. The analysis focused on tracing actors who were expected to participate in digital practices in schools, following the descriptions in the policy documents. We utilized the notion of policy assemblage (Savage, 2019) and visualized the policy assemblages by utilizing Visual Network Analysis (VNA).

Empirically, the main findings point to governance practices, such as assessment and evaluation as being potentially connected by digital actors, such as performance data and learning analytics. This notion highlighted the importance of unpacking digital technologies as black boxes because the digital technologies presented in the policy documents signaled a dual function: pedagogical and organizational purposes and quality assessment purposes. For school leaders and teachers, there are two points worth stressing. In the case of Irish policy documents, we found that digitalization aims and strategies lay the foundation for datafication practices, albeit characterized by rather analog formats. This can potentially lead to passive reporting, and school leaders and teachers having to potentially navigate and collect data manually. This can, in turn, imply that *big data* is not necessarily visible in Irish secondary education. In the Norwegian policy documents, we found that digitalization was expected to replace manual labor by utilizing learning analytics and adaptive algorithms. We argued that while this may ease the work of school leaders and teachers (and at first glance save them valuable time), it

will likewise demand extensive considerations in terms of ethics, data protection and juridical issues, as well as pedagogical integration.

Theoretically, the use of the ANT notion of the network shows how digital technologies have the capabilities to exert the agency imbued in them, suggesting that they partake in important decision-making. It also shows how actors can merge their characteristics as they attach to each other to fulfil governmental ambitions. An example is the NQAS and learning analytics, as both depend on each other to become performative, and their relation is so intertwined that it becomes difficult to distinguish them from each other. The relational composition of the networks also showed, very explicitly, how material entities have the potential to become actors (some of which may become especially powerful) by contingent relations that showed momentary 'snapshots' of intended practice. Finally, the analysis showed that all actors can potentially be both social and material, thus showing the collapsed dualisms in ANT. Together, the main theoretical points in Article I examined the network as an effect by building on three overarching premises: heterogeneity, relationality and emergence. The three premises also constitute the main theoretical underpinnings of Savage's (2019) notion of policy assemblage.

The methodological points center on the methods' importance to the empirical and theoretical findings. Two premises were important: i) to follow and code specific actors, as described in Chapter 4 and ii) to show how policy assemblage can be coupled with VNA. These points were of special importance, as the way in which the analysis was performed allowed us to examine the policy documents by means of ANT concepts. Therefore, I argued that our methodological protocols were crucial to performing policy analysis through ANT in ways other than centering on dominant issues in the literature, such as studies of how policies travel (i.e., Williamson et al., 2018). Coupling ANT with VNA also allowed ANT sensitivities to be more tangible. In addition, these findings lay the foundation for how I chose to perform the data analysis in Articles II and III.

### 5.2. Article II

Lunde, I. M. (2021). Emergent school leader subjectivities in digitized practices: The case of VSware. *International Journal of Leadership in Education*, ahead of print, 1–21.

The main aim of Article II was to show how school leaders' subjectivities are mediated in their interactions with digital software. I interviewed the software VSware in addition to screen/audio recorded interviews with school leaders in three Irish secondary schools. The analysis centered on ANT premises (heterogeneity, relationality or semiotic relationality, and materialization of practice) as the foundation for discussing school leader subjectivities that emerged in practice. These were referred to as 'plug-ins' (subjectifiers) to mirror the school leaders' digital lives (cf. Latour, 2005). The analysis was further presented through scenes of practice that captured the minute negotiations of the relations.

There were three main empirical findings. First, I found that VSware encouraged school leaders to perform a series of activities by encouraging them to think about their own leadership roles and delegate tasks. Second, I found that both VSware and school leaders were able to act on each other. This was made possible by flexible scripts inherent in VSware, such as the edit

button in the behavior feature. Second, the interactions between VSware and the school leaders encouraged connections with external actors, such as the Child and Family Agency. I found traces of previous materializations of the Key Skills Framework (as such, connecting to policy documents from Article I) and possibilities for future materializations in terms of whole-school projects. Third, I noted that the examples from practice illuminated manual collections of school data and, as such, enforced the empirical findings from Article I. In sum, school leaders interacted with VSware to address challenging issues of school development and reporting.

The theoretical points centered on how the main premises of the network generated subjectivation as an effect. By using the main premises of the network as an analytical backdrop, I found that subjectivation was a relationally produced notion that made subjectivation plurally presented. Subjectivation as a relationally composed process was highlighted by examples of how both VSware and school leaders were able to act on each other. This further shows the collapsed dualism of subject/object.

Methodologically, the considerations were twofold. First, I followed the ontological primacy of action and did not assume that the networks generated any specific effect. Subjectivation was not identified as an effect until after the actors and relations were traced and analyzed. Thus, I followed some of the initial methodological steps, as in Article I, to follow actors and code relational data. Second, the interviews performed with the platforms showed methodological innovation in how to account for non-humans in educational research and presented how interviews with a digital technology can be explicitly coupled with accounts from the human informants in the screen recordings.

### 5.3. Article III

Lunde, I. M. (in review). Learning analytics as modes of anticipation: Enacting time in actor-networks. *Scandinavian Journal of Educational Research*.

The main aim of Article III was twofold. First, I aimed at unfolding anticipation in Norwegian school leaders' practices in interactions with the software packages Conexus Engage and Insight. Second, I aimed to problematize the traditional understanding of time in educational research as networked rather than chronological. I conceptualized anticipation as implicit presentations of time and further conceptualized time through ANT notions of fluidity and multiplicity. The analysis was presented through three modes of anticipation that were overarching presentations of the various enactments of anticipation and time that emerged from practice.

The empirical findings show how Engage and Insight emerged as relatively closed learning analytic platforms. School leaders had little autonomy within the platforms, but the analysis showed that school leaders were both encouraged by the platforms and acted on the platforms. The platforms structured problematizations of the uncertain, as well as the solutions. The networks stretched backward and forward in time through presentations of historical data. This prompted the future to be especially emphasized, as risk subjects were identified and school leaders were sequentially activated to perform a series of actions. This further showed that school leaders and the learning analytic platforms enacted anticipation in various ways: as

colors, benchmarks and other types of data stretching in time, and as chronological, present and parallel events to mention some. As such, the learning analytic platforms and the school leaders mirrored the extensive use of data to govern and lead schools, and formed part of an entangled whole where national and local (historical) data were important.

Theoretically, the article examines time more specifically as a network effect. The analysis showed that the way the networks connected to historical data, and the way the school leaders surveilled these, prompted presentations of the past, the present and the future to be juxtaposed and 'stacked' (Bratton, 2015; Mol, 2002). The past, and especially the future, was brought to the present through interactions between school leaders and learning analytic platforms. Anticipation was enacted in various ways that connected the various notions of time together to optimize the future in the present. Other than showing how time is performed through human–digital networks, however, the use of ANT in this article also sheds light on how fluidity is a main characteristic of actor-networks and how multiplicity does not exclude other actor-networks; they exist side by side and can potentially connect at other points in time and space. Therefore, the theoretical points in Article III build on the main premises of the network explored in Article I, as well as investigate time as the main network effect.

Methodologically, there were similar considerations to those in Article II. Time and anticipation were analyzed after the actors and relations were mapped, as their interactions showed various presentations of time and forethought of the future. This treated time as a network effect rather than as set priori. The interviews with the LAPs in Article III showed that these can be used as an analytical base and thus presented a second approach to account for the non-human that was both similar and different to its use in Article II.

### 5.4. Relationship of Empirical Findings, and Theoretical and Methodological Points between Articles

The relationship between the articles answers the overall aim of the PhD project to examine school leaders' practices with digital technologies in Irish and Norwegian schools and to explore their effects on school leadership and educational governance. There is a chronological progression of the articles, and the findings presented in this chapter suggest empirical, theoretical and methodological connections of inquiry (Figure 1).

First, the relationship between the articles shows a chronological progression, as illustrated by the numbering of the articles. Article I was written after the first data collection (selecting policy documents), Article II was written according to data collection at the first site (Irish secondary schools), and Article III features the second empirical site (Norwegian lower secondary schools). The second relationship between the articles entails a relationship between the empirical, theoretical and methodological discussions to answer the overall research aim of the project. They share a thematic focus on digital school leadership and governance and have theoretical and methodological similarities. In Article I, we found several policy expectations for digitalization at the school level that implied practices of evaluation, assessment and reporting. Empirically, it also pointed out some types of digital technologies that could be relevant to study in practice (i.e., learning analytic platforms in Norwegian schools). Theoretically, we argued that there are some main features of networks and that the practices

they mirror can potentially be steered by digital actors, such as learning analytics and performance data. Methodologically, we expanded the policy assemblage by coupling its notions with VNA and, as such, designing several steps of analysis that helped the sometimes vague conceptualizations of ANT become more tangible. Article I was thus a steppingstone for Articles II and III, empirically, theoretically and partly methodologically (reflected in the arrows between Article I and Articles II and III in Figure 1).

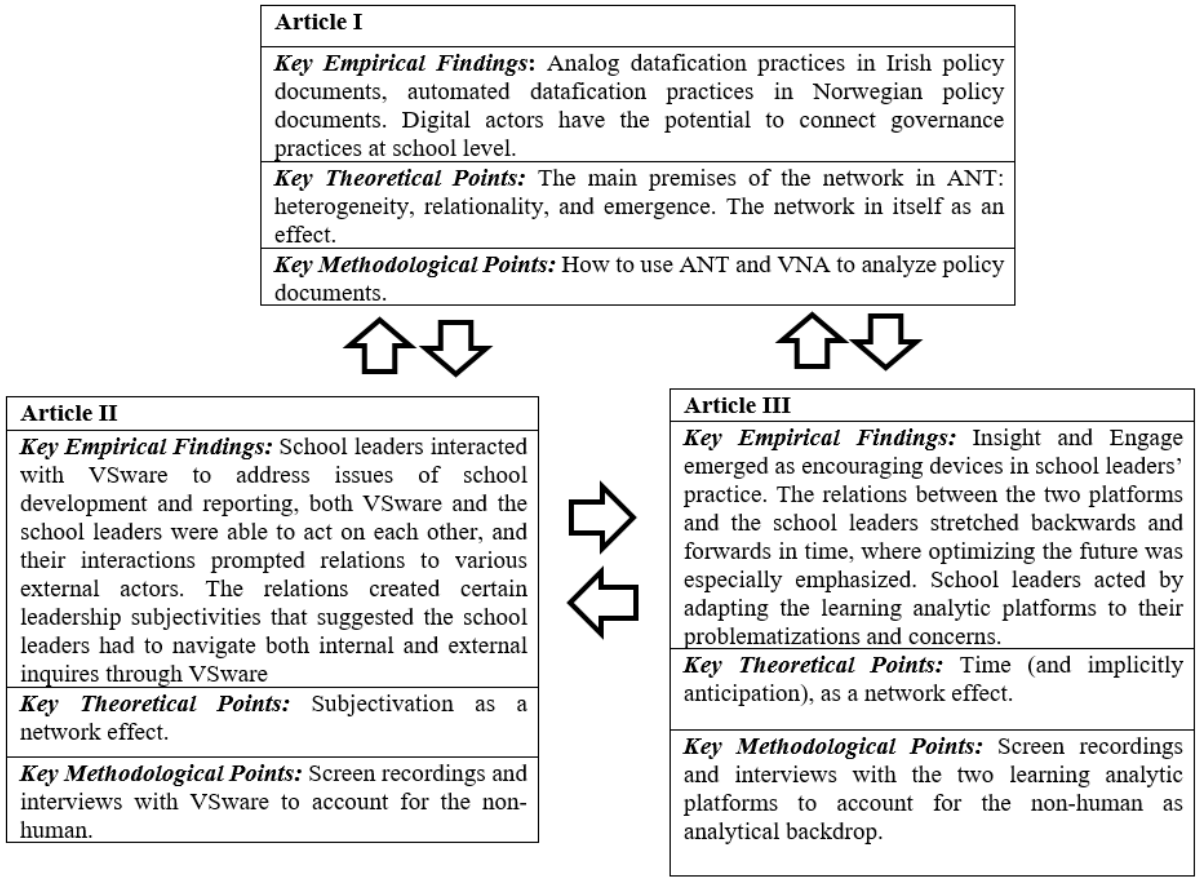


Figure 1: Empirical, theoretical and methodological connection between articles.

In Article II, I built on the notions of what constitutes a network and what makes an actor an actor, which were discussed in Article I. Here, I expanded on these notions by considering other types of network effects; subjectivation. The main empirical findings include how school leaders interacted with VSware elements and other external actors and how both school leaders and VSware acted on each other as various leadership subjectivities emerged. I chose to analytically follow actors by partly unpacking one of the main actors (VSware) and following certain parts of the software. The use of screen prints and screen recordings from VSware (interviews and creating narratives of elements inherent to VSware) showed a specific way of accounting for non-humans. In Article III, I built on the methodological findings of Article I (following actors and coding relational data) and Article II (following parts of the LAP's and interviews with the platforms). However, the way I used the screen prints from Insight and Engage was more interwoven in the text. Moreover, I considered another type of network effect, time and (implicitly) anticipation.

The different actors I followed in the three articles, the various ways of accounting for non-humans, and the different types of network effects covered in the three articles show the deductive connections in my thesis by integrating theoretical and methodological ANT analyses. The empirical themes in the three articles further show how my project evolved inductively, based on effects that emerged from the collected data. Together, the three articles answer the overall research aim by informing on digital school leadership practices as policy expectations for practice (Article I), interactions with learning management systems (Article II) and learning analytic platforms (Article III). They further constructed examples of how governance pervades these digital practices by accounting for the governing relations and interactions emerging from the practices. Therefore, the arrows between all three articles in Figure 1 also show how all three articles inform each other and shed light on the different effects of digitization in school leadership and educational governance. The progression of my project can, in this sense, be said to not be entirely chronological but as a connected progression that moved back and forth between the articles. In sum, the three different articles unfolded three different networks that at some point connected to each other (i.e., policy documents in Article I resurfaced in practice in Article II). It was not my intention to expand the networks to a point where the networks from the three articles connect more explicitly, but together, they showed how their findings inform a grander governing machine that describes how digitization in contemporary education emerges in examples from school leadership and governance. In the upcoming chapter, I will extend this chapter to discuss the specific empirical, theoretical and methodological contributions of my project.

# 6. Discussion of Contributions

In this chapter, I build on and extend the findings presented in Chapter 5, as well as connect them to the topics covered in the preceding chapters of this extended abstract. I highlight the empirical, theoretical and methodological contributions of my project.

## 6.1. Empirical Contributions

In this section, I continue the arguments made in Chapters 2 and 5 to discuss the empirical contributions of my project. I highlight three main empirical contributions: the performative and networked side of digitization practices in schools, a contribution within the literature in Ireland and Norway and insight into digitized leadership practices in schools.

The first empirical contribution of my project confirms previous findings about the performative side of digital technologies and the networked practices in which they emerge (Decuypere, 2016; Decuypere & Simons, 2020; Koyama, 2015; Ottesen, 2018; Williamson et al., 2018). The three articles identified both the potential (Article I) and the realities (Articles II and III) of how digital technologies work to encourage certain actions in school leaders' practice. The performative characteristics of the digital emerged empirically in various ways: by intending to connect practices of evaluation, reporting and assessment together (Article I), by contributing to the activation of school leader subjectivities (Article II), and by encouraging a set of actions that folded the future and the past in the present (Article III). The findings further show the various networks in which digital technologies operate, primarily at the school level,

but at times also extending to places and times outside of school: networks between school leaders, teachers, performance data, learning analytics, reports, assessments and professional development (Article I), networks between school leaders, school management systems, external agencies and student reports (Article II), and networks between school leaders, learning analytic platforms, historical data and municipal superintendents (Article III). These networks span from schools to governments and private companies. Compared to earlier studies on the performative and networked side of how digitized policy and practice operate (Brøgger & Staunæs, 2016; Decuypere, 2016; Decuypere & Simons, 2020; Williamson, 2016b; Williamson et al., 2018), my project extended their empirical contributions by showing evidence in schools (and more specifically, in secondary schools).

A second empirical contribution in my project extends the contributions above within research from Ireland and Norway. Earlier studies in these two contexts have examined how data are received by school leaders and teachers and how it creates certain tensions between professional/internal practice and external practice (Gunnulfsen, 2017; Mausethagen, 2013; McNamara et al., 2020; Skerritt et al., 2021). The relationship between data and digital technologies has not received much attention in these two contexts. My findings contribute to empirically expanding the datafication literature in Ireland and Norway through two accounts. First, it confirms a strong emphasis on datafication *and* digitization at the policy level in both cases. Article II also confirms previous findings in both contexts (i.e., Mausethagen, 2013; Skerritt et al., 2021), where there are certain tensions between adhering to external inquiries (i.e., reporting through TUSLA) and securing appropriate internal measures (staff training, correct information on VSware and monitoring progress). School leaders must balance both aspects. Article III extends these known tensions and makes a new contribution to this debate. The second mode of anticipation in Article III shows that school leaders work with anonymized data, while simultaneously having to identify which students belong to the anonymized data (see the quote in the second mode of anticipation). School leaders in Norway are increasingly being held juridically accountable for students' wellbeing through the Education Act (1998, §9A). Simultaneously, they must also follow general GDPR rules. This suggests certain tensions arise between different data expectations on juridical and ethical levels. School leaders cannot accommodate GDPR rules that suggest full anonymity of student data in the student survey (for instance, data suggesting some students experience frequent bullying in school), as well as securing appropriate measures for students experiencing that type of bullying or violation of their wellbeing in school (cf. Education Act, 1998, §9A). The tensions identified in Articles II and III can therefore also be said to confirm the findings identified in Article I. There are rather analog formats of datafication in the Irish schools that suggest time-consuming activities of staff training and fact checking, and in the Norwegian schools, there are automated forms of datafication that suggest challenging issues of ethics and law.

My project also extends insights into specific leadership practices in which digitization is prominent (Ottesen, 2018; Selwyn, 2011, 2016; Selwyn et al., 2015; Taglietti, 2020). In Article II, I highlighted the practices of in-house monitoring of teachers and students, adjusting the software to fit internal concerns and external reporting. In Article III, I highlighted the practices of analyzing historical data by surveilling student data over time (for the same group of students), calculating risk subjects and encouraging leadership action in the present. Unfolding

the different activities where school leaders interact with digital technologies provides an important extension of broader arguments for how data and digital technologies work to promote effectiveness, school quality and established governing hierarchies (Selwyn, 2011; 2016; Ottesen, 2018; Taglietti, 2020). An important contribution in my project is that I highlight how both digital technologies (the non-human) and school leaders (the human) act on each other in these practices. Earlier research has often privileged one over the other, whereas some have focused mainly on the performative effects of the digital tool or datasets (i.e., Brøgger & Staunæs, 2016; Decuypere, 2016; Decuypere & Simons, 2020; Williamson, 2016b; Sheail, 2017), and others have used school leaders as the starting point (i.e., Selwyn, 2011; 2016; Selwyn et al., 2015; Taglietti, 2020). In Article II, I framed the analysis by showing examples of how both VSware and the school leaders act on each other: VSware acts by activating school leaders to internalize their leadership roles and duties (scene one) and by encouraging external reporting (scene three). School leaders act on VSware by adjusting behavior categories to fit their own efforts and concerns (scene two) and by fact-checking information and making inscriptions on VSware to feel confident in their leadership jobs (scene three). In Article III, I showed examples of how Engage and Insight enact anticipation, as well as how school leaders act on those modes of anticipation; Engage and Insight encourage student surveillance across time, risk management and actions in the present to secure the future (all modes of anticipation). School leaders act by choosing the tests and data that fit with new and old problematizations in relation to established governing routines with municipal superintendents (third mode of anticipation). In this sense, my findings show how both actors can act on each other or govern each other, implying that the ability to exert governance in digitized practices is fluid and agency can be found in both humans and non-humans simultaneously.

The consistency between the findings within the three Irish schools and the three Norwegian schools makes a further contribution to understanding how digital technologies work in schools. Although the schools that participated in my project varied in size and location (and school type at the Irish site), their enactments were quite similar. The degree to which they used the digital technologies varied; some reported using them more than others, but the way in which they interacted with the tools was similar (sometimes identical). This shows the standardization inscribed to the tools, where administration and leadership result in 'ticking boxes' digitally and practically to adhere to contemporary governance expectations (Mac Ruairc, 2020). It further shows that data analytics are starting to connect to school management systems (Article II), suggesting that digital technologies play an administrative function, as well as a 'meta' role in providing data to support school leadership (Selwyn, 2011).

### 6.2. Theoretical Contributions

In this section, I build on the empirical findings and contributions discussed above, as well as extend the theoretical points made in Chapter 3. I will highlight two main theoretical contributions of my project: applying ANT sensitivities to the study of school leadership and applying ANT sensitivities to the study of educational governance in schools. An overview and summary of the main theoretical contributions to school leadership and educational governance are presented in Table 2. In addition, I briefly highlight a third theoretical contribution that contributes partly to educational research in general and partly to ANT.

The first theoretical contribution of this thesis is to develop a more anti-anthropocentric approach to studying school leadership by applying ANT sensitivities. The main premises of the network (heterogeneity, relationality and emergence) give insight into how material things partake in important activities in school leadership practice by acknowledging the connected, sociomaterial nature of such practice. This also informs empirical discussions of the performative and networked sides of digitization. The study of sociomaterial activities has largely been overlooked in the school leadership literature, often in favor of studies dealing with leadership classifications and effectiveness models (Bush, 2013; Leithwood et al., 1999; Rhodes & Brundrett, 2010; Robinson et al., 2009). In another strain, we find sub-studies in educational leadership that deal with more critical approaches (Courtney et al., 2021; Gunter, 2011; Niesche, 2013; Niesche & Heffernan, 2020). Especially to the issue of subjectivation, the latter leadership literature has tended to favor approaches that highlight contextual, historical and social influences in the making of the school leader, without explicit conceptualizations of the performative and material forms these influences take in practice (i.e., Niesche, 2013; Niesche & Heffernan, 2020; see my argument in Chapter 3.2.3). Such studies often deal with the rationales and perceptions of humans without interrogating the 'invitational quality' of non-humans (Adams & Thompson, 2016). In other words, there is little conceptual work on interrogating the material and relational sides of school leadership practice. My use of ANT to study school leaders is therefore an important contribution both to the general mainstream leadership literature and to the more critically oriented approaches, as it gives voice to the sometimes overlooked and disruptive actors in mundane school leadership practices. I write 'mundane school leadership practices' with careful consideration here, as I believe that my conceptualizations of ANT can be used to study school leaders in a wide range of practices, not just those connecting to digital technologies. As I argue in Chapter 4.5.1, my conceptualizations of ANT are analytically generable, which suggests that ANT can be further developed and utilized to study other leadership activities, such as administrative tasks and local school cooperation and in relation to curriculum enactments, such as assessments (these are some examples, but the list may go on).

Moreover, my use of ANT to study school leaders provides an opportunity to move away from simplistic (and sometimes quite instrumental) approaches that do not fully capture the complexities and tensions that emerge when humans and non-humans interact. In particular, ANT provides the opposite of instrumentalism, which destabilizes 'the widespread account of technology as stable singular tools separate from and under the control of human beings' (Sørensen, 2009, p. 32). In addition to heterogeneity and relationality, sensitivities, such as emergence, fluidity and multiplicity, are also important in this regard (see Table 2). As presented in Chapters 1 and 2, the current educational (political) climate favors the use of data and digital technologies as a main 'ingredient' in educational leadership (Landri & Gorur, 2021). However, I argue that these practices are in the making and, therefore, in the beginning stages conceptually. The risk is that such practices can be oversimplified conceptually by only relating to the materials as 'something out there,' without applying explicit notions that can analytically draw nearer to how such materials contribute to quite complex entanglements in practice. Applying notions such as emergence, fluidity and multiplicity will highlight how connections are disrupted or how they are being made and being held stable over time in

practice through material and social means. For instance, by carefully tracing the characteristics of actors and relations (including the role of school leaders), where they move, where they change and where they are enacted multiply. This will shed light on that which is 'black-boxed' in digitization and not yet visible by first glance (Latour, 1987). In this regard, I believe that ANT offers a way to draw nearer to these minute negotiations that move in multiplicity, and the sensitivities in themselves are a flexible way to approach the complexities of school leadership practices by moving between theory and empirical data to raise awareness of what sociomaterial practices 'do' in regards to both the human and non-human partaking (Fenwick & Edwards, 2012).

The second main theoretical contribution of this thesis is the use of ANT sensitivities to study educational governance in schools. This is first and foremost exemplified by the collapsed dualisms of far/close, small scale/large scale and inside/outside in ANT, which lay the foundation for the analysis in all three articles (Latour, 1996a). As argued in Chapter 3, these collapsed dualisms provide the opportunity to think about governance as something that is not happening 'outside' of schools or as approaching the issue as distinguished 'top-down' or 'bottom-up' studies. On the one hand, my project was carried out at the school level. This is the case for the empirical data collected in schools, as well as the policy documents, because we approached the analysis by looking at expectations for practice. On the other hand, even if my project is carried out primarily at micro levels (schools), the connections traced show connections to other governing actors, such as the NQAS (Article I), the police (Article II) and municipal superintendents (Article III). My project therefore extends the examples from schools to other governing actors. While earlier studies in the politics of digitization have emphasized the potential of governing actors becoming connected at the policy level and/or interplay between larger institutions and markets (Hartong, 2018; Player-Koro et al., 2018; Williamson, 2017; Williamson et al., 2018), this thesis adds to these previous discussions by conceptually accounting for these connections in schools. By being informed by the collapsed spatial and temporal dualisms, this thesis thus adds to the previous discussions on digitization and governance by showing how schools are becoming sites of governance where governance is produced between internal and external processes (micro and macro). This includes, to a certain extent, the growing presence of private providers present in day-to-day activities in schools, suggesting that their governing roles are becoming visible at the two sites. Multiplicity also adds to this discussion as it highlights how different governing levels enact a practice in various ways, sometimes juxtaposed (see Article III, all modes of anticipation show the enactments of anticipation by different actors—numbers, colors, school leaders, municipal superintendents).

The use of ANT to study governance in schools has further contributed to discussions of governing actors. I have framed this primarily by highlighting actors that have gained powerful roles in the networks, such as boundary actors (Article I), an edit button (Article II), historical data (Article III) and school leaders (all three articles). These discussions have been made explicit to various extents in the articles. However, as briefly highlighted in Chapter 3, applying ANT to study governance in schools contributes to conceptualizing how actors can act on each other and possibly govern each other (Latour, 2005). In one sense, this can disrupt the symmetry in ANT in that some actors become more powerful than others. That is not to say that symmetry is not possible to conceptualize through ANT; rather, symmetry is an ontological starting point

(Fenwick & Edwards, 2012; Law, 2004). Actors can emerge symmetrically or asymmetrically, depending on how their interactions unfold, which Articles II and III especially show. My contribution to understanding governing actors in education is therefore centered on giving all actors, human and non-human, the possibility of exerting agency and developing a strategic role in a network by being highly connected (Decuypere, 2019; Landri, 2021). This is a horizontal and 'flat' way of thinking about power distribution (Fenwick & Edwards, 2012), and I built on the main premises of the network to theorize ways to not downplay the agencies of certain actors, restricting the autonomy of either actor or overly relying on the accounts of individual actors.

The use of ANT sensitivities to analyze policy documents also offers a theoretical contribution to thinking about educational governance at the school level. A large proportion of studies in educational governance that center on digitization (and that do policy document analyses) tend to focus on how these policies travel, adopt and are adapted into different sectors and national contexts (i.e., Williamson et al., 2018). This is also the case for studies that use the notion of policy assemblage (cf. Savage, 2019). On the one hand, I could have conceptualized how digitization policies have traveled and been adapted similarly or differently between Ireland and Norway. Such a conceptualization would have favored rich contextual analyses for comparative purposes and could also offer important insights into how policy documents can become governing actors (which could extend the findings in, for instance, Article II, where The Framework for Junior Cycle was presented as a materialized actor). On the other hand, using ANT to study the actors that are defined in the text allowed us to conceptualize how policy ambitions put forward important imaginaries that can potentially steer practice by examining exactly who or what are defined in the text as actors (Asdal, 2015; Asdal & Reinertsen, 2020). My project therefore contributes to conceptualizing digitization policies beyond the discussion of traveling policies between cross-national and cross-sectoral networks; rather, ANT shows that digitization dives into schools and can pose very specific effects for school leaders and teachers (Hartong, 2016). I will return to this contribution when I describe my methodological contributions in the next section.

A third theoretical contribution centers on the use of ANT to conceptualize time and anticipation. This contributes partly to general educational research and partly to ANT. The dominant form of thinking about time in education has been linear, or chronological, highlighted by the practices of exams and time-tabling (see Article III; Gulson & Webb, 2017; Lingard, 2021). My project, particularly Article III and Chapter 3 of this extended abstract, adds a contribution to these conceptualizations by thinking about time as a processual phenomenon that presents fluid and multiple enactments of time (cf. Law, 1999; Mol, 2002; Mol & Law, 1994). I have de-linearized time in educational life, following the rhythm of the networks in digitized practices. Conceptualizing time in connection to digital technologies also contributes to the literature by presenting learning analytic platforms as new instruments of time. This adds a new dimension to studying time and governing in education, which has traditionally focused mainly on policy texts and curricula (i.e., Bansel, 2016; Voogt & Roblin, 2012). Moreover, time has gained limited attention in ANT, and discussions of space have often been privileged (see, for instance, the list of chapters in Blok et al., 2020). Some exceptions are Latour's (1984)

comment on time in modernity and his 'trains of thought' essay (Latour, 1996b). His argument is that time is a network effect folded by relations. Mol's (2002) notion of multiplicity is also an important contribution to thinking about time through ANT, as it suggests that relational compositions create many realities that exist over time and/or are juxtaposed. Nevertheless, time has been quite implicit in ANT sensitivities, even in Latour's (1984, 1996) and Mol's (2002) works, where time is treated in close connection to how space can be conceptualized. I argue that my conceptualization in Article III has used ANT sensitivities to explicitly target the conceptualization of time (show how networks 'make' time), and in so doing has contributed to further developing a more tangible approach to studying time through ANT. This is, however, a conceptual work that I will continue to develop.

Table 2: Overview and summary of the main theoretical contributions to school leadership and educational governance research.

| **Key Sensitivity/ Notions** | **Main Network Effect** | **Main theoretical contributions to school leadership and governance** |
|---|---|---|
| Heterogeneity (Latour, 2005; Law, 2009; Law & Singleton, 2005) | The Network | Understanding that material things can carry agency and are active contributors in building school leadership and governance |
| Relationality (Latour, 2005; Law, 2009) | The Network | Actors, in practice, rely on each other in one way or another to become performative. Shows the connected nature of practice |
| Emergence (Latour, 2005) | The Network | Sheds light on how digitized practices are less stable than what it might seem (always 'becoming') |
| Collapsed far/close, small scale/large scale, inside/outside dualism (Latour, 1996a) | Time and Space | Shows how issues that are physically 'outside' of schools, such as external issues of governance, are also produced within schools |
| Fluidity (Law, 1999; Mol & Law, 1994) | Time and Space | Helps explore movements in the network and between networks, suggesting time and space can emerge from these movements |
| Multiplicity (Mol, 2002; Mol & Law, 1994) | Time and Space | Helps explore how one single phenomena, such as time, may be enacted multiply in various networks/sites and within one single network/site |
| Collapsed subject/object dualism + 'plug-in' (Latour, 2005; Law, 2009) | Subjectivation | A processual and anti-anthropocentric view of subjectivation that acknowledges 'outside' contributions in the making of school leader subjectivities, without restricting the agency and autonomy of school leaders |

### 6.3. Methodological Contributions

In this section, I build on the methodological descriptions in Chapters 4 and 5 and discuss my methodological contributions in regard to three points: coupling VNA with policy assemblage, screen-recorded interviews and interviews with the platforms, and studying school leadership practice and educational governance through digital methods. My methodological contributions are summarized in Table 3.

The first methodological contribution of my project is the use of VNA and ANT sensitivities (in particular, the notion of policy assemblage). Visualizing actor-networks has rarely been used in sociomaterial studies, but there are a few examples (see Decuypere, 2019a; Decuypere & Simons, 2014; Latour et al., 2012; Luke, 2020). In Decuypere (2019a), VNA is explicitly conceptualized within a 'relational turn' where the theoretical premises of sociomaterial approaches are built upon, with their distinct features of interdependency, symmetry and a flat ontology. There are similar conceptualizations in other studies using VNA and ANT (Decuypere & Simons, 2014; Latour et al., 2012; Luke, 2020). Therefore, Article I contributes to continuing the development of VNA as a qualitative method to study sociomaterial practice, as our analytical premise resembles the conceptual and methodological work already established. However, Article I also adds a new contribution to this development; the specific visualization of the notion of policy assemblage. Conceptualizing Savage's (2019) notion of policy assemblage analytically through VNA is new, and our analysis in Article I therefore adds important methodological contributions with regard to two points. First, it relates the main notions of policy assemblage to VNA techniques. For instance, the policy assemblage view of agency and power as relationally composed (Savage, 2019) was directly connected to the visualization of boundary actors (Decuypere, 2019). This explicit coupling strengthens both the methodological side of policy assemblage and the conceptual side of VNA. Following clear analytical and methodological protocols also helped the notion of policy assemblage and VNA become more tangible. Second, it builds network analyses by interrogating the notion of policy assemblage at the local level, which overlaps with some of the theoretical contributions discussed above. 'Policy assemblage' has often been used to study policy mobility and how policies travel, and not necessarily centered on the use of materials (digital or otherwise) in schools (although, see Koyama, 2015). We utilized the notion of policy assemblage to show the sociomaterial consequences at the school level, which VNA allowed us to do by drawing on a stronger focus on the materialization of policy through heterogeneity and relationality.

The second methodological contribution is my use of screen/audio recorded interviews and interviews with the platforms to facilitate empirical data that account for both human and non-human voices in practice. In the broader (qualitative) educational leadership research, common data collection methods include audio and (social) video-recorded interviews (see Brooks & Normore, 2015), video and analog observations (i.e., Gunnulfsen, 2017), as well as accompanying materials, such as texts in various formats (i.e., Jensen & Ottesen, 2022). Qualitative research in educational governance tends to favor the same research methods, as well as different document analyses.The value of screen-recorded interviews has not yet been highlighted in the field of educational leadership (or governance). However, screen recordings have been used in other fields, such as in classroom studies (Beiler, 2021; Beiler et al., 2021; Ho, 2021), although these are not rooted in an ANT approach and thus have had other goals regarding the analysis of these recordings. My use of screen/audio recorded interviews and interviews with the platforms is therefore a methodological contribution by two accounts: to educational leadership and governance research following the train-of-thought presented in Chapter 6.2, where I argued for a need to encompass heterogeneity and relationality analytically, and to adapt the screen recording method to an ANT approach.

Screen recordings allowed me to follow interactions between the school leaders and the digital technologies examined in my project, which further allowed my analysis to rely not only on human accounts but also non-human voices. This is a methodological strength in my project in that it lifts attention to what digital technologies actually *do* in practice by placing them symmetrically to the school leaders and by attuning to the main ontological premises of ANT (Law, 2004). It was also a case of being ethically considerate of voices that are not traditionally shown in educational research. With this, I do not mean that digital technologies are a marginalized voice, as can be found in inquiries of race, sexual orientation, disability, or political and religious beliefs. Rather, I argue that *things* tend to be so overlooked in educational research that their active contribution in real life is downplayed. Following digital technologies in practice sheds light on several repercussions of contemporary educational phenomena, and methodologically acknowledging this entails that their performances are made visible and accessible to others who do not necessarily have access to digital systems, as these tend to be offered solely to targeted audiences. This means that the performative characteristics of the digital technologies studied in my project have been made visible to everyone who does not work in schools, as well as it has raised awareness for those working in schools. In particular, the screen recordings were useful methodological tools for showing how digital technologies, together with other actors, produce certain visions of governance. An example is Article III, which shows how LAPs encourage anticipation at several governing levels to ensure a desired future. A second example is the reporting to outside agencies, inscribed to VSware, accompanied by examples from the school leaders, which imply that various external organizations get insight into student data (Article II).

There were also pragmatic benefits of using screen recordings, which included the presence of digital technologies in the interviews with school leaders. Having the platforms present during the interviews for the school leaders to interact with, made the discussions livelier and helped the school leaders recall and elaborate on how they usually interacted with the platforms (Greenbaum, 2000). A specific example was during group interviews with middle leaders in Norwegian schools. The year heads most frequently interacted with Engage in their daily practice, while they interacted less with Insight and sometimes had trouble recalling specific features of the platform. By navigating the platform in the moment, they were able to 'jump-back' to the occasions in which they used Insight and thus contribute to the discussions in the interviews. Another pragmatic side to using screen recordings also includes benefits for me as a researcher. There were no practical issues in carrying recording devices between national borders, and the screen recordings proved to be less time-consuming than, for instance, simply observing. Observations could suggest prolonged time in the schools (days and weeks), while my interviews took only a few hours out of a normal working day. This saved me a lot of valuable time, as well as being time-beneficial for the school leaders who participated and could potentially have contributed to their willingness to participate. Screen recordings also provided me with richer data than what pure audio-recorded interviews would generate; interactions were easily traced, and I did not have to make extensive field notes to track who and what interacted during the interviews.

Framing my methodological protocols with screen prints as 'interviews with platforms' (Adams & Thompson, 2016) also contributes to highlighting the non-human voices as an accompanying

method to the screen recordings. My argument here is that my methodological design also further developed the screen-recording method to be adapted to an ANT approach. Using other methods to accompany screen recordings is not uncommon in classroom studies, although these have usually included field notes and more traditional methods of building contextual data (see, for instance, Beiler, 2021). Screen prints have been used to segment the screen recordings to add in transcriptions, while not added as a second data collection method (i.e., Ho, 2021). There is also one example in the literature that uses ANT coupled with screen recordings to study learning practices in UK universities (Luke, 2020); however, screen prints from the screen recordings in that study were also used to show evidence of how the human participants perceived and enacted practice. Studying materials by examining the practice of humans as a starting point is also not uncommon in the wider literature (with or without ANT and screen recordings), both in educational research (i.e., Jensen & Ottesen, 2022) and other fields, such as design research (i.e., Comi & Whyte, 2017). However, I argue that 'interviewing' the materials as a symmetrical starting point (not just relying on observing or interviewing humans) and giving the screen prints status as a second data collection method (in tandem with the screen recordings) is innovative and a methodological contribution because it explicitly identifies the digital as an actor in relation to the humans. Put differently, there is great benefit in using screen recordings of human interviews and interviews with the devices under scrutiny *together*. My contribution to the method of screen recording is thus to use ANT as a framework to study digital interactions; through heterogeneity (acknowledging that all entities have the potential to become actors) and relationality (entities depend on each other to become performative and several research methods should be developed to interrogate both actors; interviewing materials such as digital platforms through screen prints should be given status as a separate data collection method that works in tandem with the screen recordings).

The third methodological contribution of my project, studying school leadership practice and educational governance through digital methods, overlaps with the previous contributions of screen recordings and interviews with platforms, but it also brings forward a new argument. In particular, this contribution centers on the interplay between several research fields and disciplines that I have drawn from in my project. School leadership and educational governance are fields that at times overlap with each other but that also draw on other fields and disciplines, such as educational policy, sociology, pedagogy and political science. My project has a strong reference to sociology by drawing on ANT. ANT is, of course, an approach used in a variety of fields (anthropology, architecture, education, philosophy, etc.), as well as in the interdisciplinary field STS (in which ANT has especially gained a foothold) that invites exploration of the relationships between disciplines to answer overall questions of how science, technology, culture and society interrelate (Jasanoff et al., 2001). School leadership and educational governance have tended not to draw from STS approaches regarding their research methods (although, see Landri, 2021). The use of 'natively digital' data generated from the tools (screen recordings and screen prints) (Rogers, 2009) contributes to interrogating the possibilities for the fields of school leadership and educational governance to exploit digital methods and, as such, contribute to methodological learning and adaptation from STS. It specifically contributes to two considerations: i) disassembling traditional boundaries between the 'digital life' and practice (breaking down dualisms) and ii) extending a 'methodological

repertoire' for school leadership and educational governance (Snee et al., 2016). The first consideration builds on the theoretical and methodological contribution of acknowledging the agency of material things and symmetrically drawing closer to phenomena. The second point considers my methodological contributions to inviting new research disciplines to the fields of school leadership and educational governance to expand their analytical views and identify alternative and innovative methods to study how school life is becoming increasingly sociomaterial.

Table 3: Overview and summary of main methodological contributions

| **Main Methodological Points** | **Main Methodological Contributions** |
|---|---|
| Using VNA and Policy Assemblage together (cf. Decuypere, 2019a; Savage, 2019) | Contributes to both VNA and Policy Assemblage:<br>- Further develop VNA as a qualitative method to study sociomaterial network analyses by strengthening its' conceptual basis<br>- Strengthens the methodological side of policy assemblage, as well as makes it more applicable to use at the school level |
| Screen recordings and interviews with digital technologies used together | Contributes to methodologically uphold heterogeneity and relationality in researching school leadership and educational governance:<br>- Gives voice to the non-human<br>- Makes digital technologies visible and accessible to more people<br>- Time-beneficial method<br>Contributes to adapting the screen recording method in conjunction with ANT:<br>- Using screen recordings and interviews of the digital technologies together, as the latter is given status as a second data collection method |
| Studying school leadership practice and educational governance through digital methods | Contributes to the research fields school leadership and educational governance to draw from other disciplines, such as STS:<br>- Breaks down boundaries between digital life and practice.<br>- Extends a methodological repertoire with innovative methods to the two research fields |

# 7. Concluding Remarks

This thesis has provided insight into digitized practices in Irish secondary education and Norwegian lower secondary education through examples from policy and practice. Overall, this thesis has illustrated various effects in school leadership and governance levels that emerge when school leaders and digital technologies interact or are expected to interact. In summary, this thesis has shown how school leadership and educational governance have been transformed (or emerged as effects in themselves) in recent years by the effects of digitization, which suggests three important insights. First, it suggests that there are new actors partaking in leadership tasks in schools and in the overall governing of schools, which implies other ways of understanding agency and who has the authority to act. Second, it suggests that these actors bring forward decentralized forms of governing (hence, 'governance'), which at times is shown

in an interplay between the private and the public. Third, the findings also suggest that due to the various ways in which digitization unfolds, certain (new) data practices and leadership structures are starting to emerge. This includes the approaches in which school leader's move between group data and individual student data to identify the students in the datasets, advocating for data practices that can accommodate both juridical and ethical expectations (Norwegian schools). It also includes the various structures that are put in place to ensure that internal data is shared with a vast number of external actors (Irish schools), also suggesting challenging repercussions in ethics and data protection, as well as the manual labor of school leaders and teachers. Digitized practices are consequently new spaces for governing and leading education. Moreover, the thesis also shows how digitization is not a uniform phenomenon but that the unfolding's are multiple, with different actors partaking at different moments, while there are still some standardized effects of these practices, illuminated by the similar enactments across schools (and some similar repercussions at both sites).

The work has further illustrated how the main actors in these practices (the school leaders and digital technologies) exert agency over each other, providing a nuanced but critical view of these practices. The combined datasets of policy documents, screen/audio recorded interviews and interviews with the digital technologies have allowed to follow several actors and show how external and internal processes of digitization unfold at the school level. This thesis has several contributions (empirical, theoretical and methodological), and has advanced developments in the literature on digitization (and datafication) of school leadership and educational governance empirically, theoretically and methodologically by drawing from other disciplines, such as STS. This thesis also makes some contributions to the overall educational literature and in connecting ANT to appropriate methods.

The findings of this thesis suggest some implications for school leaders. For school leaders in Ireland, it suggests time-consuming activities connected to datafication and urges for the more effective use of tools, such as VSware. The way forms of data analytics (in particular, behavior monitoring) pervades learning management systems, such as VSware, suggest that there are some challenges to the ethical use of student data for school leaders in Ireland, urging for leadership teams that have the necessary knowledge to exploit these data. In particular, my findings suggest there is a need for reflections on what kind of behavior data is necessary and explorations of whether such behavior monitoring contributes to increased learning for students. For Norwegian school leaders, the findings also imply a strong emphasis on juridical and ethical issues when engaging with learning analytic platforms, especially in considering what situations it is permissible to engage with individual and group data in parallel and as such breaking certain aspects of data privacy. Local school leaders need to engage with these issues directly and would benefit from not leaving such concerns to other levels in the governing hierarchy, as school leaders themselves can be held accountable. Since I began my doctoral project in 2018, an entire pandemic has endured and changed many realities, including those in schools. We are facing great changes in how we think about school quality and assessment. Digitalization is one of its driving factors, and it has expanded at unprecedented speed for the last two years. Only in the first few months of 2020, EdTech companies attained three billion dollars, which is nearly 10% of the profit from last decade's total (Williamson, 2020). There is no doubt that schools are now spaces for digitalization, and, as my project has shown, these

efforts are strongly coupled with efforts to lead and govern schools. Being aware of what digital technologies can and cannot do is therefore an important requisite for all school leaders leading schools today and in the future.

My findings further suggest some implications for policymakers. First, policymakers need insight into how digital technologies imbued with forms of data analytics work in practice with respect to the competence and skills of people working in schools. The necessary competencies to deal with the effects digital technologies have in practice are likely to be different from those taught in teacher education programs five years ago, ten years ago and so on. Thus, there is a great need to offer continuing education for everyone working in schools, adapted to their digital working lives. In Norway, the use of learning analytics in education has, since this projects' beginning, gained increasing attention, including a new expert group working for the Ministry of Education and Research (2021). This shows a growing effort to evaluate the impact of data analytics in schools, and my project will provide policymakers with important findings in this regard. Second, the increased digitalization strategies pervading the policy level in both Ireland and Norway, such as interactive digital curriculum tools, suggests that policymakers will have access to a great deal of user data. Knowing how to use these data ethically and legally and for what purposes will be equally important for policymakers. Third, there is a need to gain clarity in who owns school data, as my project shows that a large number of external parties are given access to the data. This also taps into the issue of digital platforms stemming from private and private/public partnerships. Who is responsible for the necessary data protection, and consequently, in what parts of the network is culpability distributed? Who gains acces to the data and how do they handle the data? These are increasingly important questions to ask, and for policymakers this may imply a redistribution of governing power, where other actors (such as commercial companies) engage directly with schools and can become the face of expertise.

The use of sociomaterial approaches to study the digital practices of school leaders has shown the complexities of these practices by interrogating how actors in these practices act. While sociomaterial concepts and methodologies have not traditionally been used in the school leadership and educational governance literature, the three articles in my project have been published in mainstream (and well-acknowledged) leadership and education journals, which suggests that ANT concepts are being acknowledged as important approaches to studying how digitization pervades mundane school life. My project has demonstrated ANT's potential in the research fields by means of approaching the phenomenon theoretically and methodologically (and empirically).

Future studies may examine how school leaders negotiate with different types of laws and regulations in data-use. Preferably, such studies can show how actors, such as the Education Act or GDPR, become stable or unstable presentations of practice, examining which of them gain a powerful role in the networks and, as such, become the golden rule to follow in schools, as school leaders engage with different datasets to adhere to governing expectations. Other studies may also inquire into how digital technologies, including learning management systems and learning analytic platforms, interact with other actors in education, such as students, parents/legal guardians, and educational boards. This study has displayed the interactions at the leadership level (and teachers in Article I), but other human actors were also visible in the

networks. Following their interactions in various enactments with digital technologies will further inform the multiplicity of digitization, in particular. Finally, future studies may also choose to expand the networks more than in this project. Such an expansion can further show where ideas, values and interests imbued in digital technologies stem from. Given the ongoing expansion of digital technologies for educational purposes, the phenomenon of digitization is only in the beginning stages of research, and its importance will only continue to expand. My hope is that educational research fields will continue to bring awareness to digitized practices for all those acting in education.

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# Appendices

Appendix 1: Interview guide in English, individual interviews

| **Category** | **Question** | **Possible follow-up question/extra information** |
|---|---|---|
| Opening | First, tell me in short about your job as a principal at this school.<br><br>-What digital data technology/software does your school use, and for how long has it been used?<br><br>-How did you decide to use this/these software package(s)?<br><br>-Did you get training on how to use the software? From whom, and how was the training organized? | <br><br><br><br>VsWare, but have there been others? |
| | -In short, describe how you as a principal use VsWare. What purpose does it serve for you?<br><br>- What kind of information/data does the software gather?<br><br>- Who has access to this information?<br><br>- How is the information/data presented within the software?<br><br>-How would you normally go about analyzing the information that lies within the software? | Describe a short scenario. What colleagues are involved? What features from VSware? Any specific elements?<br><br><br><br><br>Visualizations, diagrams, statistics. Data in relation to what?<br><br>Give examples! |

| | | |
|---|---|---|
| | -Are there expectations from other actors to use software, such as VsWare? If so, who would that be, and how would they use VsWare in conversations with your school? | |
| Closing questions | -What are the challenges in using VsWare?<br><br>-Why do you think schools across Ireland are using VsWare software?<br><br>-Would you recommend VsWare to other school leaders/schools?<br><br>-In your opinion, what are the limitations and opportunities for using VsWare? | |

Appendix 2: Interview guide in English, group interviews

**PART I**

| **Category** | **Question** | **Possible follow-up questions/extra information** |
|---|---|---|
| Opening | -First, tell me in short about your jobs here at the school.<br><br>-What type of DDT do you use in this school?<br><br>-Tell me about your experiences with VsWare: how did you decide to start using VsWare? On background of what?<br><br>-Did you receive any training before starting using VsWare? From who, how? | <br><br><br>VsWare, but are there others? |
| | Here are some examples of components in the VsWare software. Print screens 1, 2, 3, etc.<br>Take a moment and describe what you see on each print screen.<br><br>Describe situations when you might use this/these VsWare components.<br><br>-Are these VsWare functions comprehensible? Why/why not?<br><br>-Do you use VsWare in conversations with other actors/people?<br><br>-Are there expectations from other actors to use digital data technologies in your school? | -Print screens on the screen. Show print screens, first, second, third.<br><br>-What type of data can you find on the print screens? How is it collected, by who?<br><br>-What are the visualizations on the print screens? Self-made or available on the DDT?<br><br>-Which of the VsWare components do they usually use?<br><br>-What characterizes these sorts of conversation? |
| Closing | -What are the challenges with the use of VsWare?<br><br>-Would you recommend VsWare to other school leaders and schools? Why/why not? | |

| | | |
|---|---|---|
| | -The vast majority of schools in Ireland use VsWare today. Why do you think that's the case?<br><br>-In your opinion, what are the limitations and possibilities of using VsWare? | |

**PART II**

A SITUATION FROM PRACTICE

Imagine an ordinary meeting with the leadership team at the school. You have recently gathered and processed information on the VsWare software about your students. You have decided to set up a meeting with the leadership team to discuss the information that has come up through VsWare. The target of the meeting is to analyze the information (data) that has been gathered and to discuss its implications for the school.

How would you proceed with the meeting?

As you proceed, you might have a few points in mind:

- What information have you gathered? How?
- Information about who?
- Do you bring information from other sources? What kind of sources?
- What characterizes the conversations and cooperation you might have during the meeting?
- What happens next (after the meeting)?

Appendix 3: Interview guide in Norwegian, individual interview

| **Kategori** | **Spørsmål** | **Mulige oppfølgingsspørsmål/ekstra informasjon** |
|---|---|---|
| Introduksjon | Fortell først kort om din jobb som rektor her på skolen.<br><br>-Hvilke digitale data teknologier/plattform bruker skolen deres, og hvor lenge har den blitt brukt?<br><br>-Hvordan ble det bestemt at dere skulle ta i bruk Conexus? På bakgrunn av hva/hvem?<br><br>-Fikk dere opplæring i hvordan å bruke denne digitale data teknologien? I så fall, fra hvem og hvordan foregikk opplæringen? | Brukes det flere digitale data teknologier/har det blitt brukt andre digitale data teknologier på skolen før? |
| | -Hva slags informasjon henter programvaren inn?<br><br>-Hvem har tilgang til denne informasjonen?<br><br>-Hvordan presenteres informasjonen/dataene?<br><br>-Hvordan vil du vanligvis gå frem for å tolke informasjonen som ligger i programvaren?<br><br>-Beskriv kort hvordan du som rektor bruker Conexus i din jobb. | Basert på hvilke kilder?<br><br>Visualiseringer, diagrammer, stastistikk? Data i relasjon til hva?<br><br>Beskriv!<br><br>Beskriv kort et slikt scenario. Hvem er involvert fra kollegiet? Hvilke praksiser? |

| | | |
|---|---|---|
| | - Er det forventninger knyttet til bruken av plattformen fra andre aktører? | |
| Avsluttende | -Hvilke utfordringer og muligheter er det ved bruken av plattformen?<br><br>- Anbefaler du andre skoleledere å bruke Conexus? Hvorfor/hvorfor ikke?<br><br>-På Conexus sine hjemmesider står det at over 30.000 skoler i Norge bruker verktøyet. Hvorfor tror du det er tilfelle? | |

Appendix 4: Interview guide in Norwegian, group interview

**DEL I**

| **Kategori** | **Spørsmål** | **Mulige oppfølgingsspørsmål/ekstra informasjon** |
|---|---|---|
| Introduksjon | -Aller først, fortell meg kort om dere selv og jobben deres her på skolen.<br><br>-Hvilke type DDT bruker dere her på skolen?<br><br>-Fortell meg om deres erfaring med Conexus: hva gjorde at dere startet å bruke verktøyet i utgangspunktet? På bakgrunn av hvem/hva?<br><br>-Fikk dere opplæring i bruken av Conexus? Fra hvem og hvordan foregikk opplæringen? | <br><br><br><br>Conexus, men har de brukt andre DDT?<br><br><br>Hvor lenge har skolen brukt Conexus, og hvem har brukt det? |
| | Jeg vil nå presentere noen eksempler fra Conexus.<br>Eksempel 1,2, 3 osv<br>Bruk et øyeblikk, og beskriv hva dere ser på hvert av eksemplene.<br><br>-Er det enkelt å forstå disse funksjonene på Conexus?<br><br>Fortell meg om situasjoner der dere ville brukt disse funksjonene av Conexus.<br><br><br><br><br><br><br><br><br><br>-Brukes Conexus i samtale med andre aktører?<br><br>-Er det andre aktører som forventer at dere skal bruke Conexus på deres skole? Hvordan? | -Skjermdumper vises på skjermen.<br><br><br>Hva slags data finner vi på Conexus? Hvem har samlet inn dataene, hvordan?<br><br>Hva slags visualiseringer finnes på verktøyet? Er de laget av lærerne selv, eller tilgjengelig på verktøyet?<br><br><br>Hvilke funksjoner i Conexus bruker de vanligvis? |

| | | |
|---|---|---|
| Avsluttende | -Hvilke utfordringer og muligheter har dere hatt med bruk av Conexus?<br><br>-Anbefaler dere andre skoleledere å bruke Conexus? Hvorfor/hvorfor ikke?<br><br>-På Conexus sine hjemmesider står det at over 30.000 skoler bruker Conexus. Hvorfor tror dere det er tilfelle? | |

**DEL II**

SITUASJON I PRAKSIS

Se for dere et vanlig ledermøte på skolen deres. Dere har nylig samlet inn informasjon fra Insight og Engage om elevene deres på åttende trinn. Dere har bestemt dere for å sette opp et møte med lederteamet for å diskutere det dere har funnet av informasjon plattformene. Målet for møtet er å analysere den informasjonen dere har med dere (dataene), og diskutere implikasjoner for skolen.

Hvordan vil dere gå frem?

Mens dere diskuterer, kan det være lurt å tenke på dette:

- Hva slags informasjon har dere samlet? Hvordan?
- Informasjon om hvem?
- Henter dere inn informasjon fra andre steder? Hvilke?
- Hva slags samtaler/samarbeid har dere for å analysere dataene?
- Hva skjer videre (etter møtet)?

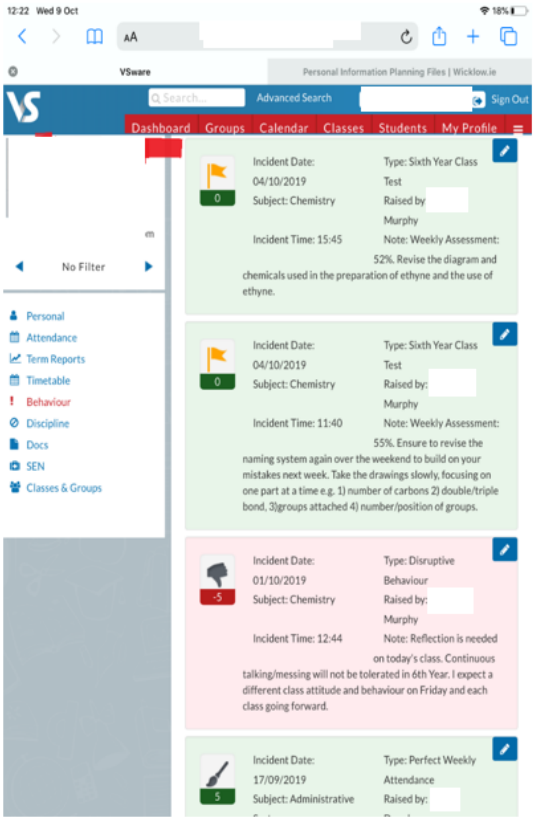
Appendix 5: Example of transcription

behavior of the class. Emm, so those students got disruptive behaviour and a minus 5 with that. so they have an overall behavior score that is in green and red. So their parents have access to that. #00:07:03-2#

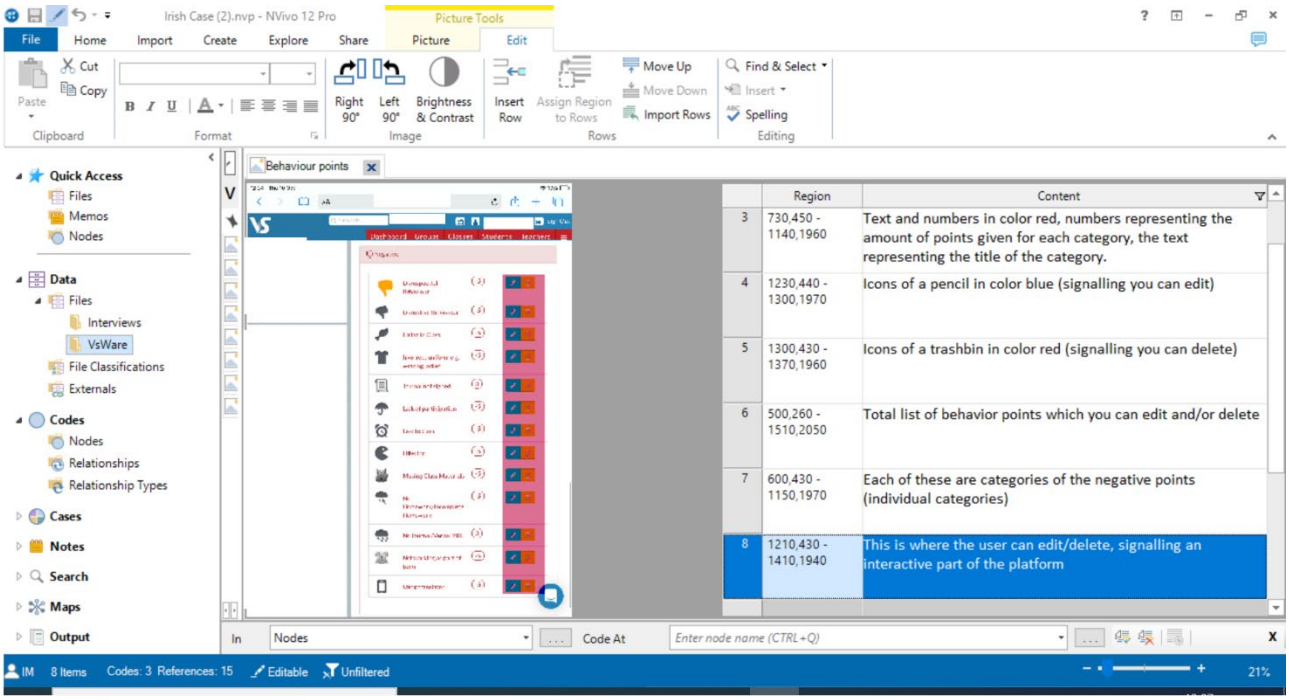
Ida: the first one here, is an assessment one, the first two here. While the red one here is more of a behavior... #00:07:13-6#

ML1: Yeah the type is disruptive behavior, and if you look at the one below that's that students' tutor for perfect weekly attendance. They got quite high. #00:07:22-3#

ML1: So this part of VsWare, the part that you are looking at we call behavior, this is basically a link to home. So parents have a log in to this and we ask them to log in weekly, so they can see this. And this is, we call the positive and negative notes. So it's taking the case of old style school journal. So you know, missing class materials, or no homework, or forgetting your kit. That would all, that could all be recorded there, but it would be a red, a negative, or it could be obviously, ML3 is using it for the class test, but it could be for excellent team work, excellent class work, you know it's a positive and negative, but there is an indicator of behavior I guess in school, and it's very positive in School 2. And about, between



Appendix 6: Example of interviews with the platforms in Nvivo



Appendix 7: Example of coding scheme in Article I

| ACTORS | RELATIONS | DESCRIPTIONS OF PRACTICE/SEGMENTS |
|---|---|---|
| **Performance Data** | - School leaders<br>- Teachers<br>- Students | School leaders and teachers may access performance data that can later be used for formative (developing student learning), as well as summative (evaluating student learning), assessment. Digital technologies have the potential to evaluate student performance and schools can "gather information about students' learning from multiple sources and teachers can use this data to design more appropriate student learning activities" (Department of Education and Skills, 2015b, p. 24). |
| **The Junior Cycle Profile of Achievement** | - School leaders<br>- Teachers<br>- Students<br>- Classroom-based assessment<br>- Junior Certificate<br>- Performance data | A reporting process that awards achievement to junior cycle students across different areas. "All aspects of assessment will contribute to providing a comprehensive picture of student achievement and will be captured in the Junior Cycle Profile of Achievement" (Department of Education and skills, 2015b, p. 40). The Junior Cycle Profile of Achievement may record student achievement on state-certified examinations (Junior Certificate), student achievement on classroom-based assessment and performance data on other areas of learning, such as project work, to encourage and support school leaders' and teachers' work. |

Appendix 8: Example of coding scheme in Article II

| Described Practice (activity) | Actors | Relations | Contextual Information/Segments from data |
|---|---|---|---|
| *Short description of described activity* | *Overview of all partaking actors in the described activity* | *Overview of all relations* | *Additional contextual information from screen prints and interviews* |
| Daily monitoring | Principal<br>Attendance pie chart on VSware (whole-school)<br>Students<br>Parents | Principal–Attendance pie chart (monitor)<br>Principal–Students (monitor individual students there are concerns about)<br>Principal–Parents (monitor) | "I can see then exactly who's out for today, so we have 60 students out. (…) It tells me that there are 47% of them, their parents, haven't phoned in. (…) You get the whole, you can check if anybody in or out, or if it was kids that you were particularly worried about, you can check they are in" (School B, Principal).<br>"I can also check on VSware if teachers have missed calling the role, that will pop up there too" (School B, Principal). |
| Monitoring overall attendance (continuous) | Principal<br>Attendance records on VSware | Principal–Attendance records on VSware (monitor) | "If I'm concerned about a pattern, I can go into the students record and see well how many days have they missed, have they been out for three days, four days or whatever" (School B, Principal). |

Appendix 9: Example of coding scheme in Article III

| **Segments from transcriptions** *Contextual information* | **Activity** | **Relations/interactions** | **Time** *Past/present/future* |
|---|---|---|---|
| "We use it to map new 8th graders who come to us. And in a way, that's work that has been done in primary, right" | Analyzing trends of upcoming/future students | Principal—results from primary on Conexus Engage (past results) | Results from the past (primary) are presented to map future students |
| "And then, we look at what has happened between 8th and 9th grade (…) sometimes it has not gone too well, and that's not good for anyone, right. So first, as a leadership team, we sit and look at that [results from national tests on Conexus]. We try to analyze by looking backwards, and I would say we do that with all these datasets, we look backwards to see whether there is a consistent trend." | Analyzing trends of present students | Leadership team—national test results on Conexus Insight (present results) | Past (results) and present (results) Chronological |

Appendix 10: Consent form in English

# Request for participation in the research project

## Digital Governance in Education: How School Leaders' Practices in Ireland and Norway are Assembled by Social and Material Entities.

You are hereby invited to participate in a doctoral research project at the Department of Teacher Education and School Research, University of Oslo (Norway), conducted by PhD candidate Ida M. Lunde.

# Background and Purpose

This is a PhD project in educational leadership that aims to research school leaders' use of digital data technologies in Ireland and Norway. Three Junior Cycle Schools in Ireland (Dublin and Galway area) will be asked to participate in the study. You have been asked to join this study because you meet the set criteria. Please read below for practical information.

# Participation in the study

If your school wishes to participate and contribute to the study, there will be in-depth interviews held with the respected principals at each school, as well as group interviews with participants holding other leadership positions at the school.

The principal from each school will be asked to sit for an in-depth interview (30–60 min). These in-depth interviews will focus on practices with digital data technologies in relation to questions of leadership.

In addition, three to four Subject Department Leaders at the Junior Cycle level (representing four different subject departments) will be asked to do a focus group interview (45 min).

The in-depth interviews and group interviews will be audio and screen recorded. Participants will be asked to take printscreens of the digital data software and anonymize it (delete student data) before the group interview takes place. During the group interviews, the anonymized printscreens will be available on a computer screen, and a software will film the screen (while audio recording the participants). **The participants themselves will not be filmed during the interviews.** The group interviews will include a short set of questions about the schools' use of digital data technologies, as well as a case will be given for collective discussions.

### What happens with the data/information about you?

All data will be handled with confidentiality and stored accordingly. The University of Oslo's and the Norwegian Center for Research Data's (NSD) guidelines for storage of personal data will be followed. The data will be handled only by the PhD candidate and the supervisor(s) of the project. A scrambling key will be kept, which means that names will be anonymized. The

scrambling key will be stored separate to the datasets. The respondents will not be directly identified in the final product (the dissertation and following articles), but there may be background information. For example, what grade he/she works as a subject department leader. The name of the schools, or any information that would allow for the schools to be identified, will not be documented.

The study is planned to end September 2022. For analysis purposes and verification of data, the data material will be anonymized for two years after the end of the project, and no later than September 2024. This means that the name list / scrambling key and all recordings of the interviews will be deleted by then.

**Voluntarily**
It is optional to participate in this study, and you can withdraw your consent at any time without reason. If you withdraw, all information/data about you will be anonymized and deleted. You can withdraw through contacting the PhD candidate Ida M. Lunde by phone or email.

**Your rights**
As long as you may be identified in the data material, you have a right to:

- Gain insight to what personal data is registered about you;
- Edit your personal data;
- Get your personal data deleted or restricted;
- Get a copy of your personal data (data portability); and
- Send a complaint to the NSD about the processing of your personal data.

**What gives us the right to use your personal information?**
We process information based on your consent.

The project has been approved by the NSD (Norwegian Center for Research Data AS).

**Where can I find out more?**
If you wish to participate or have questions regarding the study and your rights, please contact:

- PhD Candidate Ida Martínez Lunde, i.c.l.martinez@ils.uio.no +4795859984, or
- Main supervisor, Professor Eli Ottesen, eli.ottesen@ils.uio.no
- Co-supervisor, Professor Gerry Mac Ruairc, gerry.macruairc@nuigalway.ie
- UiO's data protection officer at the internal auditing unit: Morten Opsal, personvernombud@uio.no
- NSD – Norwegian Center for Research Data, personvernombudet@nsd.no, +4755582117

# Consent to participate in the study

I have received information about the study and I consent to participate in interviews and/or group interviews.

---

(Signed by respondent, date)

Appendix 11: Consent form in Norwegian

# Forespørsel om deltakelse - Samtykkeskjema

## Digital Governance in Education: How School Leaders' Practices in Ireland and Norway are Assembled by Social and Material Entities.

Du inviteres herved til å delta i et doktorgradsprosjekt ved Institutt for lærerutdanning og skoleforskning (ILS) ved Universitet i Oslo.

# Bakgrunn og formål

Doktorgradsprosjektet er innen utdanningsledelse som ønsker å undersøke hvordan skoleledere bruker digitale data teknologier i Norge og Irland. Tre skoler i Norge vil bli bedt om å delta i studiet. Din skole inviteres til å delta i prosjektet fordi den passer kriteriene.

# Hva innebærer deltakelse i studien?

Ønsker skolen deres skole å delta i studiet vil det innebære 1 intervju med rektor (45 min), og 1 fokusgruppe intervju (1 time) med øvrige mellomledere på skolen. Både de individuelle intervjuene og fokusgruppe intervjuene vil fokusere på hvordan digitale data teknologier brukes av ledergruppen ved skolen.

Det vil være lydopptak av de individuelle intervjuene, samt opptak av skjerm (demo-brukere av Conexus Engage og Insight). Deltakerne vil ikke bli filmet.

### Hva skjer med informasjonen om deg?

Alle personopplysninger vil bli behandlet konfidensielt og i samsvar med Universitetet i Oslos' og NSDs retningslinjer for innhenting og lagring av data. Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Informasjon om dine personopplysninger vil oppbevares på et trygt sted, og ikke i datamaterialet. For å sørge for at din personinformasjon ikke fremgår i datamaterialet vil en navneliste (også kjent som «koblingsnøkkel») bli oppbevart adskilt fra datamaterialet. Denne navnelisten vil ligge på et trygt sted uten innsyn. Kun involverte parter som ivaretar konfidensialitet vil ha tilgang til dine opplysninger: forsker, veileder og databehandler.

Deltakerne og skolene skal ikke kunne gjenkjennes i publikasjon (publisert doktorgradsavhandling).

Prosjektet skal etter planen avsluttes september 2022. For analyseformål og etterprøving av data anonymiseres datamaterialet to år etter prosjektslutt, dvs. senest innen september 2024. Dette innebærer at navnelisten/koblingsnøkkelen og alt opptak fra intervjuene og observasjoner blir slettet.

**Frivillig deltakelse**
Det er frivillig å delta i studien, og du kan når som helst trekke ditt samtykke uten å oppgi noen grunn. Dersom du trekker deg, vil alle opplysninger om deg bli anonymisert. Ønsker du å trekke deg kan du formidle dette muntlig (telefon) eller skriftlig (epost) til prosjektansvarlig Ida M. Lunde.

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

**Dine rettigheter**
Så lenge du kan identifiseres i datamaterialet, har du rett til:
- innsyn i hvilke personopplysninger som er registrert om deg,
- å få rettet personopplysninger om deg,
- få slettet eller begrenset personopplysninger om deg,
- få utlevert en kopi av dine personopplysninger (dataportabilitet), og
- å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

**Hva gir oss rett til å behandle personopplysninger om deg?**
Vi behandler opplysninger om deg basert på ditt samtykke.

NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

**Hvor kan jeg finne ut mer?**
Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:
- Ida Martinez Lunde, tlf: 95859984, e-post: i.c.l.martinez@ils.uio.no
- Hovedveileder, Professor Eli Ottesen, eli.ottesen@ils.uio.no
- Biveileder, Professor Gerry Mac Ruairc, gerry.macruairc@nuigalway.ie
- Vårt personvernombud: Personvernombud for administrative behandlinger av personopplysninger ved UiO: Morten Opsal, e-post: personvernombud@uio.no
- NSD – Norsk senter for forskningsdata AS, på epost (personvernombudet@nsd.no) eller telefon: 55 58 21 17.

# Samtykke til deltakelse i studien

Jeg har mottatt informasjon om studien, og er villig til å delta

(Signert av prosjektdeltaker, dato)

Jeg samtykker til følgende:

☐ Å delta på intervju eller gruppeintervju

Appendix 12: Data management plan (Norwegian)

# Datahåndteringsplan:

Dataene som skal samles inn er 1) kvalitative intervjuer med rektorer på 6 skoler (3 skoler i Irland og 3 skoler i Norge), 2) gruppeintervju med mellomledere på samme 6 skoler.

Datatypene er:

1) Lydopptak av intervju
2) Video av skjerm
3) Egne notater

**Datainnsamlingen:**

Intervju med rektorer og mellomledere; fokus er hvordan de bruker digitale data teknologier på skolen for å informere om egen praksis og videre utviklingsarbeid.

- På forhånd vil deltakerne ha fått beskjed om å ta printscreens fra den digitale data teknologien de bruker på skolen, og sladde navn og annen sensitiv og identifiserbar persondata (Irland).
- Disse anonymiserte printscreens'ene (eller demo-brukere) vil bli tatt med på intervjuene (på PC skjerm og evt. koble opp på storskjerm).
- Deltakerne står fritt til å ta opp printscreens og demo-brukere under intervjuet og diskusjonene, men kan også velge å ikke gjøre det.
- Skjermen med printscreens vil bli filmet med GoPro under intervjuene. Kamera vil filme kun skjermen (deltakere vil ikke bli filmet), og klarer samtidig å fange opp lydopptak av diskusjonene fra deltakerne. Dette vil kunne vise når deltakerne tar opp eventuelle resultater/visualiseringer/diagrammer i diskusjonen.
- Minnekort brukt av kamera vil kopieres over til egnet lagring for GULE data innen rimelig tid etter intervjuet og minnekortet overskrives for å sikre forsvarlig sletting.
- Jeg vil selv være tilstede under intervjuene å skrive ned gangen i diskusjonen for å kunne identifisere hvem som sier hva under intervjuene.

**Hva skjer om det skulle komme opp sensitive opplysninger under intervjuene?**

- Deltakerne vil på forhånd ha blitt instruert i å ikke diskutere enkeltelever eller enkeltelevers data, men holde seg til bruken av elevdata og programvaren i lederjobben. De vil også bli instruert i å snakke på generell basis, for eksempel «høyt presterende elever» istedenfor spesifikke navn eller elevgrupper.

**Håndtering ved avvik fra plan / forutsetninger**

- Om det likevel skulle oppstå en situasjon hvor sensitive opplysninger blir nevnt, vil opptaksdelen med denne informasjonen umiddelbart bli redigert bort og forsvarlig slettet (dette er mulig å sikre ved nevnte rutiner for sletting av lagringskort og kun bruk av kryptert lagring på PC).

**Hva skjer med dataene etterpå?**

- Dataene vil bli lagret på en PC med passordbeskyttelse og kryptering
- Dataene vil bli transkribert.

- En koblingsnøkkel vil bli laget for alle skolene slik at det ikke vil være mulig å identifisere deltakerne i transkripsjonene.
- Det er kun jeg som vil ha tilgang til dataene.
- Data vil lagres etter UiO sin lagringsguide
- Studiet er planlagt å ende i september 2022. For analyseformål og etterprøving av data anonymiseres og beholdes datamateriale i en noe forlenget periode, men senest to år etter prosjektslutt, dvs. innen september 2024. Etter dette vil dataene bli slettet.

Appendix 13: Confidentiality declaration (Norwegian)

# Taushetserklæring til transkribering

_____ skal transkribere tre (3) intervjuer i PhD-prosjektet Digital Governance in Education: How School Leaders' Practices in Ireland and Norway are Assembled by Social and Material Entities. Han/hun vil lønnes av forskergruppen CLEG – Curriculum, Leadership and Educational Governance.

Jeg er innforstått med at jeg i mitt arbeid vil få tilgang til opplysninger som kan være taushetsbelagt og at jeg plikter å sette meg inn i relevante personvernregler, samt NSDs og UiO retningslinjer for behandling av personopplysninger.

Jeg er kjent med og forplikter meg med dette til å hindre at uvedkommende får adgang eller kjennskap til noens personlige forhold, eller tekniske innretninger og fremgangsmåter i transkriberingen. Taushetsplikten omfatter all informasjon om PhD-prosjektet, Universitetet i Oslo, samt personopplysninger jeg får kjennskap til i transkripsjonene.

- Datamaterialet skal ikke deles med en tredjepart, fremvises til andre, eller benyttes til egen virksomhet eller i arbeid for andre.
- Originaldata skal kun arbeides med på UiOs utstyr og skal **ikke** åpnes via andre medier.
- Transkripsjonene skal resultere i avidentifiserte data med medfølgende krypteringsnøkkel som lagres separat fra hverandre.
- All data (originaldata, avidentifiserte data og krypteringsnøkkel) skal slettes så fort som mulig etter endt arbeid, i tråd med UiOs lover og retningslinjer.

Brudd på taushetsplikten kan medføre straff, erstatningsansvar, disiplinære reaksjoner eller andre arbeidsrettslige følger. Alle data hentes inn i regi av PhD-prosjektet og omfavnes dermed av NSD-godkjenningen i prosjektet (prosjekt 582355). Dataene er i utgangspunktet vurdert til å være gule, og må håndteres etter gjeldende personvernregler. Dataene eies av PhD-prosjektet (ved stipendiat Ida-Cheyenne Martinez Lunde), og kan kun brukes i det aktuelle prosjektet og eventuell videre forskning knyttet til prosjektet, med publisering/innlevering innen 05.10.2022.

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Sted: _____ Dato: _____

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Signatur prosjektleder (stipendiat): _____

# Part II

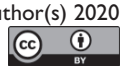
# The Articles

# I

General submission

EERJ European Educational Research Journal

European Educational Research Journal
1–19



DOI: 10.1177/1474904120972291
journals.sagepub.com/home/eer


# Digital technologies in policy assemblages in Ireland and Norway: A visual network analysis

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## Abstract

Increasingly, school leaders and teachers are being expected to use digital technologies to collect data to analyze, plan and organize teaching and learning. Such expectations can be traced to a number of policy initiatives over the last decade. This study is concerned with how educational policy puts forward ambitions of digital school leadership and teaching practices by deploying the concept of policy assemblage. We analyzed six policy documents from Ireland and Norway to identify the actors assembled to fulfill governmental ambitions and practices with digital technologies in schools. The unpacking of actors that may partake in such assemblages was visualized and analyzed using visual network analysis. The findings indicate digital school leadership and teaching practices in Ireland and Norway have the potential to be steered by digital actors that facilitate multiple activities at once and shed light on the diverse and multifaceted relationships that make up these governing practices.

## Keywords

Policy assemblage, visual network analysis, digital education governance, school leaders, teachers

## Introduction

Education policy is becoming more digitalized as digital technologies increasingly facilitate the real-time collection, distribution and circulation of student data required to govern education today. The education policy literature has studied the use of student data by engaging in studies of 'governance by numbers' – where school inspections, reform and international comparisons demonstrate the current interest in making educational aspects calculable and thus governable (see, for instance, Lingard et al., 2012; Ozga, 2009). However, the digitization and datafication of educational governance (Williamson, 2017) is more than simply collating numbers as data; digital software, codes and

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algorithms are fundamental in 'making data work'. Such digital formations enable new forms of digital policy instruments and are essential in contemporary school practices (Selwyn, 2015). We are, according to some, entering an age of digital education governance (Landri, 2018; Margetts and Dunleavy, 2013; Williamson, 2016a).

In turn, governmental ambitions to use digital technologies in education progressively influence mundane school practices. School leaders and teachers are increasingly expected to use digital software to collect and distribute digital data to confront challenging issues in curriculum, assessment and school development (Ottesen, 2018). Digital technologies are thus increasingly expected to have the capacity to partake in school leadership and teaching practices, often by acting upon governance issues. The unpacking of governmental projects, aims and ambitions to digitalize school leadership and teaching practices calls for an analysis of how these expected practices can be operationalized by digital means. This paper suggests employing policy assemblage, a concept often used in actor-network theory (ANT), to unfold the complexities that constitute digital governmental ambitions. Policy assemblage has been explored in a variety of fields – environmental and city-plan projects (Li, 2007; McCann and Ward, 2012), in a policy of 'creative industries' (Prince, 2010) and, increasingly, in education policy studies (Koyama, 2015; Mulcahy, 2015). Within education policy research, policy assemblage has principally surfaced in discussions of policy mobility and the role of international discourses in national policy (Gorur, 2011; Savage, 2019). Questions of the role of digital technologies in education policy and practice have nevertheless been less prominent in policy assemblage literature. Moreover, while several studies on digital education governance have utilized conceptualizations within ANT and provided fruitful analyses of educational platforms and software (i.e. Decuypere, 2016; Romito et al., 2020), we took a step back from digital software, webpages and platforms as we examined the arrangements of potential actors to take part in digital practices in schools. We deployed the concept of policy assemblage by analyzing policy documents as 'snapshots' of ongoing digitalization strategies in two country-specific cases (Ireland and Norway) and, by doing so, merging discussions of digital education governance with the theoretical and methodological potential of policy assemblage. In other words, we make use of policy assemblage to unfold and understand how policy documents arrange actors in assemblages to encourage and steer school practices with digital technologies, which actors constitute such arrangements and what the very consequences of these arrangements pose for the governance of school leadership and teaching practices.

The aim of this paper is thus two-fold: we aim to unfold governmental expectations to digitalize school leadership and teaching practices as presented in key policy documents from Ireland and Norway and discuss their consequences for governance. The paper is guided by the following research questions:

1. How are actors assembled in key policy documents from Ireland and Norway to display governmental ambitions for the enhancement of digital technologies?
2. What imagined practices for teachers' and school leaders' use of digital technologies emerge from the composition of relationships between the actors in the policy assemblages, and what may these imply for educational governance?

The two cases were chosen based on two rationales. First, both countries have newly introduced curriculum reforms and have made considerable efforts to digitalize education. In Norway, ongoing efforts for the digitization and datafication of education include the complete digitalization of policy plans, strategies, assessment and curriculum. The National Quality Assessment System (NQAS) has, since its introduction in 2004, assisted the digital collection and distribution of school data (Gunnulfsen, 2017). Currently, several municipalities have introduced one-to-one devices in

Norwegian schools with a myriad of automated solutions. In Ireland, the fear of lagging behind internationally in the 1990s sparked a digital revolution in all parts of society (Gleeson, 2010). Today, all components of the new curricula, guidance material and school inspection reports are solely available on digital platforms. The ongoing Irish educational reform also signals 'planting the ICT flag' in new changes to curriculum and assessment (McGarr and Johnston, 2019). Second, while both Ireland and Norway have made substantial efforts to digitize educational governance, such efforts have been less prominent in the research literature within both countries. In Norway, studies have debated data-based governance by examining the use of student data to the NQAS in particular (see, for instance, Gunnulfsen and Møller, 2017; Skedsmo and Møller, 2016). Such studies have revealed that while Norwegian education governance is characterized by low stakes, school leaders and teachers are encouraged to improve quality by engaging in data-informed practices that are vital for the monitoring of the national education system. In Ireland, studies have examined the use of student data for accountability purposes, self-evaluation and data-informed decision-making at the school level (Gilleece, 2014; O'Brien et al., 2019; Young et al., 2018), and thus contributing to the governance-by-numbers literature. In both countries, less attention has been paid to the potentials of the digital in data-informed practices, and governing forces of digital technology. Recent studies from other contexts show that the growing interest in educational policy to govern through data is enabled by fast-growing digital technologies (i.e. Landri, 2018, Williamson, 2016b). This calls for research that can empirically investigate the potentials of digital governing actors.

Irish and Norwegian policy documents were treated as two separate cases to illuminate the entangled relationships of policy assemblages in relation to digitalization. That is, we treated the policy documents as 'windows' into the descriptions of inherent relations in the policy assemblages. There is great potential in doing a text-based analysis of a policy assemblage because policy documents constitute temporary stabilization of a range of interests, knowledge and intentions (Rose and Miller, 2010). Analyzing the relations formed between potential actors within the policy documents reveals governmental arrangements of actors to better steer digitalization in schools as is desired. Although having two country cases may serve as an entry point to compare across contexts (Steiner-Khamsi, 2013), and simple comparisons may arise when the two cases are discussed, this paper does not seek to compare the cases per se. This means that a comparative methodology was not used in the process of analyzing the policy documents. Rather, we shed light on how specific policy assemblages of digitalization in education unfold by using two country-specific cases.

This paper will proceed as follows: first, the nature of policy assemblages with its sensibilities will be explained. Then the methodology and analytical steps will be presented by using visual network analysis (VNA), visualizing the heterogeneous relations within the policy assemblages. VNA, together with policy assemblage, serves as a stepping-stone to analyze and problematize the expectations of practice and governance that emerge from the inherent relations. Lastly, the discussion and conclusion will address issues arising from the analysis and suggestions for further research.

## Policy assemblage as a sensibility

We use the concept of policy assemblage as the analytical approach in this paper. In education, the concept has emerged in particular in the ANT field (Fenwick, 2010; Gorur, 2011). Law (2009: 6) suggests ANT can be considered as a way of exploring 'the strategic, relational, and productive character of particular heterogeneous actor-networks'. Policy assemblage builds on this notion, as its core focus is that the formation of assemblages is contingent on distinct relationships between heterogeneous actors and the emerging relationships between parts and wholes (Savage, 2019). In this section, we introduce policy assemblage as a *sensibility* by relating it to the focus of this paper

– the coming together of heterogeneous actors in policy texts targeting ambitions of digital school leadership and teaching practices. We used three guiding foundations outlined by Savage (2019): (a) exteriority and emergence; (b) heterogeneity, relationality and flux; and (c) power, politics and agency.

Concerning the above foundations, exteriority and emergence relate to an interest in the interaction and arrangement of entities, not the 'essence' of the entities per se. It is through the arrangement of entities that emergent effects and possibilities are forged. The particular arrangements of actors in policy documents are constructed to achieve some desired effects (Savage, 2019), but whether or not this will work in intended or unintended ways must be empirically investigated. Nevertheless, keeping the notion of emergence in mind, we analyzed the assemblages by exploring how depicted entities are arranged in the policy texts and thus are imagined to 'become' in the ways they are arranged to enhance the use of digital technologies in schools. This implies a strong focus on the (intended) nature of interactions and relations in our analysis, as how entities are brought together in the policy texts determines their characteristics and potential effects. Further, assemblages are characterized by relations of exteriority (Savage, 2019). Specific policy texts, such as the ones we analyzed, are material artifacts that depict the relations among elements that are, at the same time, exterior to the policy itself – that is, actors that are identified within assemblages in policy texts can be part of other distinctive assemblages, where their inherent relations change and thus produce other effects. While we acknowledge that the actors in the assemblage may be part of extending, larger or different assemblages, we analyzed the policy texts as 'snapshots' of governing arrangements targeting the enhancement of digital technologies by school leaders and teachers. This has consequences for where we chose to cut the assemblages and will be described in the methodology section.

The second core foundation (heterogeneity, relationality and flux) implies that the actors brought together in an assemblage are heterogeneous but held together through the temporarily formed relations. Actors are thus arranged together in policy texts to strategically steer and govern education, and given the abovementioned commitments to emergence and exteriority, assemblages have a 'contingent rather than necessary relationship, brought together into particular relational configurations which have mutable rather than fixed forms' (Savage, 2019: 7). In this sense, policy assemblages are not things, but the 'process of making and unmaking the thing(s)' (Jackson and Mazzei, 2011: 22) – a process of always arranging, rearranging, organizing and coming together. It is the particular arrangements of actors, their relations and the characteristics of these relations that generate actors to assume particular roles and performances and thus the potential to achieve a governing function. In this study, we did not analyze expectations targeted towards school leaders and teachers in isolation but decentered human intention and action (as is common in ANT) by unfolding the entanglements of heterogeneous actors that all have the potential to steer practices as part of their functioning (Fenwick and Edwards, 2012). That is, we committed to studying the emerging relations that form between school leaders, teachers and other actors in the assemblages within the descriptions in the policy texts.

Tracing the heterogeneous relations between entities in an assemblage will disclose not only the links between the various actors, but also how they coalesce in *regions* and overlaps of regions (*interface*) that create *boundary actors* (Decuypere, 2019). These are methodological considerations, but are also vital within the third core foundation (power, politics and agency). Given the abovementioned notion of heterogeneity, relationality and flux, agency emerges in particular arrangements of entities, and power is therefore seen as relationally composed (Savage, 2019). This study is concerned with analyzing how the specific composition of heterogeneous entities in governmental ambitions of the digital may put forward certain expectations of school leaders and teachers – that is, we studied the relational power as an effect of the assemblages with implications

for school leadership and teaching practices in schools. To exemplify, we studied clusters of actors in regions, whereas we wanted to examine how some regions may overlap with other regions to understand how agency and power may be distributed in the assemblages. Those actors that reside in this overlap (boundary actors) are expected to partake in more than one practice, implying that several actors in the assemblage are dependent on those boundary actors to perform a practice. Boundary actors thus have a vital role in the assemblage (Decuypere, 2019); without them, a practice may be unable to take place. We use the notion of interfaces and boundary actors as representations of how power is distributed in the assemblages. Tracing the agency and power of actors in the assemblages indicates who or what is expected to perform the practice alongside school leaders and teachers, and the consequences such a relational composition has for the distribution of tasks. Keeping in mind that although the government can forge assemblages in policy texts, the agency and power of actors does not extend beyond the policy text itself. We therefore treated the policy assemblages as *potential* actors and relations that are strategically arranged in the policy text to encourage, direct and assign roles to school leaders and teachers.

## Methodology: visual network analysis

Upholding the analytical foci above, studying the relational arrangement of entities and the consequences such arrangements may generate was a central interest in our analysis. This poses some methodological considerations, reflected in the various steps in our analysis. In what follows, we give attention to the data and how we proceeded to code the dataset to maintain a focus on heterogeneous relations. We then give room for how we have visually analyzed the data by using VNA, and the specific considerations of the form of the VNAs in our analysis will then be made clear. A fourth step, describing the assemblages' possible effects, forms the basis for the discussion of this paper.

In a preliminary search, we skimmed key policy documents in the period from 2000 to 2019. Following the purpose of the study, we then selected documents that explicitly set forth ambitions for digitalization in Irish and Norwegian schools (see Table 1). Since the governing structure and traditions vary between the two countries, the official status of the selected documents (green papers, white papers, strategies, frameworks) varies as well. For the policy documents that were not distinct digital strategy reports, we used search words to guide us to specific chapters and segments of chapters dealing with digitalization. Search words include data, digital/digitalization and technology/technologies/technological.

Once we had identified passages that covered governmental ambitions of digitalization in schools, we identified which were relevant to answer our research questions. Since a fundamental focus in our analysis is school leaders and teachers (and thus, these are the actors we 'followed' in our analysis), we chose to only include segments of the data that articulated clear aims for school leaders and teachers. Assemblages can potentially be infinite (Savage, 2019). The methodological choice of relevant segments to analyze was thus based on a 'cutting' of the assemblage (Strathern, 1996). We cut the assemblages by two considerations, considering our research questions: the descriptions of digitalization in education and potential practices within the described digitalization in the direct sphere of school leaders and teachers. We do not aim to extend the policy assemblages further than these two focal points in this paper.

When coding relational data, focusing on a particular actor(s) or group(s) of actor(s) is often the starting point (Decuypere, 2019). Our starting point was school leaders and teachers because our interest lies in expectations of digitalization associated with their practices. Hence, we coded actors based on their described expectation to perform an activity, their capacity to act and their capacity to give meaning to an activity (Callon, 2005) associated with school leaders and teachers practice. For instance, we coded *performance data* as an actor in the Irish case

**Table 1.** Policy documents analyzed.

| Irish policy documents analyzed | Norwegian policy documents analyzed |
|---|---|
| *Schools IT 2000* (Department of Education and Skills, 2000) | *Fremtidens Skole* (The school of the future) (NOU 2015:8, 2015) |
| *Framework for Junior Cycle 2015* (Department for Education and Skills (2015a) | *Framtid, fornyelse og digitalisering. Digitaliseringsstrategi for grunnopplæringen 2017–2021* (The future, renewal and digitalization. Digitalization strategy for basic education 2017–2021) (Ministry of Education and Research, 2017a) |
| *Digital Strategy for Schools 2015–2020 – Enhancing Teaching, Learning and Assessment* (Department for Education and Skills (2015b) | *Lærelyst - tidlig innsats og kvalitet i skolen*. Meld. St. 21(Apprenticeship - early efforts and quality in school. Report St. 21). (Ministry of Education and Research, 2017b) |

**Table 2.** Excerpt from the coding scheme.

| Actors | Relations | Descriptions of practice/segments |
|---|---|---|
| **Performance data** | - School leaders<br>- Teachers<br>- Students | School leaders and teachers may access performance data that can later be used for formative (developing student learning) as well as summative (evaluating student learning) assessment. Digital technologies have the potential to evaluate student performance and schools can 'gather information about students' learning from multiple sources and teachers can use this data to design more appropriate student learning activities' (Department of Education and Skills, 2015b: 24). |
| **The Junior Cycle Profile of Achievement** | - School leaders<br>- Teachers<br>- Students<br>- Classroom-based assessment<br>- Junior Certificate<br>- Performance data | A reporting process that awards achievement to junior cycle students across different areas. 'All aspects of assessment will contribute to providing a comprehensive picture of student achievement and will be captured in the Junior Cycle Profile of Achievement' (Department of Education and Skills, 2015a: 40). The Junior Cycle Profile of Achievement may record student achievement on state-certified examinations (Junior Certificate), student achievement on classroom-based assessment, and performance data on other areas of learning such as project work to encourage and support school leaders' and teachers' work. |

because it is explicitly described to make school leaders' and teachers' work with formative and summative assessment more effective. In this example, we can identify performance data as an actor because it is imagined to effectuate assessment practices and, by doing this, forms links with school leaders and teachers. When examining the actor the *Junior Cycle Profile of Achievement* (*JCPA*), however, we were able to identify a relation to performance data, as the former actor relies on the latter to enable a reporting process. Performance data, on the other hand, is supposed to be 'taken up' by the JCPA and be rendered visible. Thus, when coding relations between actors, we looked for reliance as the example above shows. Moreover, we coded actors as detailed as possible, drawing solely on the information provided in the documents. That is, when descriptions in the Norwegian case told a story of how big data introduces the use of learning analytics and adaptive algorithms in schools, we did not code big data as an actor but rather *learning analytics* and *adaptive algorithms* as two separate actors in order to

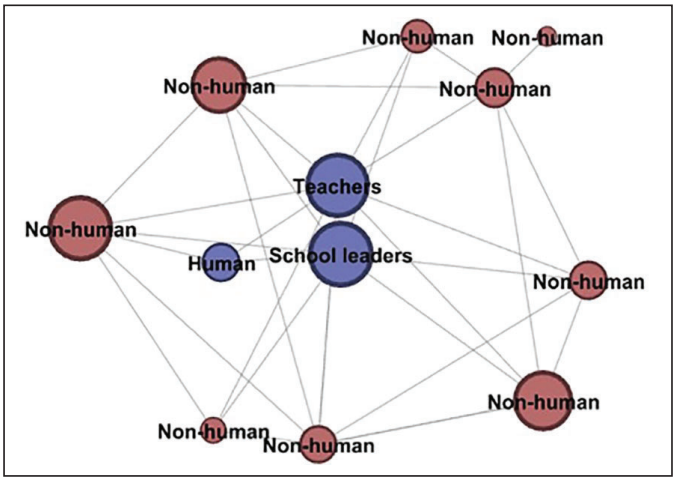


**Figure 1.** The visual network analysis according to actors and relations.

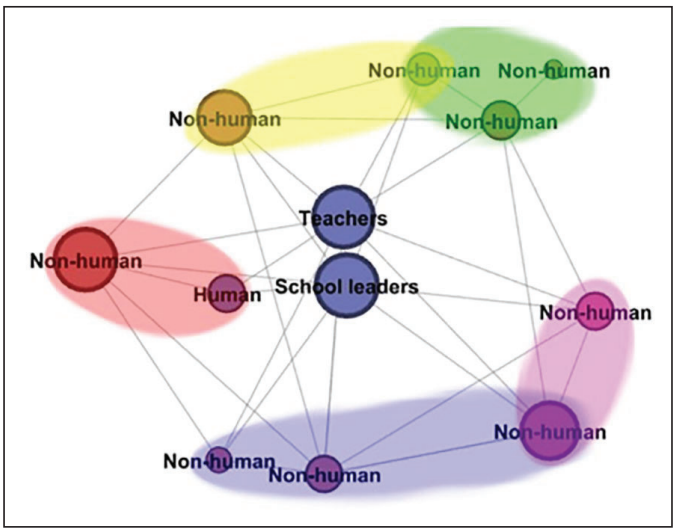


**Figure 2.** The visual network analysis according to regions.

unfold the assemblage as much as possible and avoid further 'black boxing' of the assemblage (Latour, 1987).

The actors and their relations were coded with accompanying descriptions taken from the segments in the policy documents (see Table 2). This helped to build and analyze the visualization of the assemblage, such as in determining how some actors are expected to frequently interact with each other. We visualized the assemblage in a VNA using the open-source platform Gephi. Much like the notion of policy assemblage, the main aim of VNA is to visually present the relational composition of a specific phenomenon by using qualitative data and give room for an analysis of the effects such relationships might generate (Venturini et al., 2016). We manually plotted in our findings based on the coding scheme below. Each case was visualized through an individual VNA – that is, we created a visual of the policy assemblage separately for the Irish and Norwegian documents.

Understanding the heterogeneity and relationality (Savage, 2019) within our VNA is important to understand the visual of the assemblages. School leaders and teachers as actors (nodes) have a central position in the assemblages because these are the actors we 'followed' in our analysis (see Figure 1); however, they are obligatory points of passage in the assemblage in that they form relations with all actors in the assemblage.[1] That is, school leaders and teachers are centers in the

assemblage as a consequence of our point of departure, and the regions mirror policy intentions of leadership and teaching practices in schools. We identified and color-coded both human (blue) and nonhuman actors (red) that were imagined to form links with school leaders' and teachers' practice with digital technologies in schools. The sizes of the nodes do not relate to how many times the actors are mentioned in the documents, but rather to the specific relations they are expected to take in the practice of digital technologies in education. Actors gain size in our VNA as other actors heavily relate to them; hence, there may be several 'centers' in the assemblage in addition to school leaders and teachers. To identify these centers, we proceeded to further analyze the form of the assemblage (Figure 2).

Actors that were expected to frequently interact with each other were placed closer to each other in the VNA. These concentrations of actors made up *regions* in the assemblage, some of which may have corresponding centers within them. While Gephi has an algorithm that can shape the network in accordance with the concentration of relations (Jacomy et al., 2014), we did not make use of this algorithm because our dataset was small and it did not provide us with a useful visualization. Instead, the placement of the nodes as well as the coloring of the regions was done manually. The descriptions in the coding scheme were particularly helpful in this event and were interpreted to build our analysis of regions. As regions can be said to be presentations of activities in an assemblage (Decuypere and Simons, 2014), we identified regions by analyzing the intended practices the actors were to facilitate. Actors that were described to enable a specific practice *together* – for instance, performance data and the JCPA as enablers of a reporting practice – were positioned together in regions. This consequently means that we deployed visual network analysis to visualize actors, relations and regions that emerged from our policy assemblage analysis. Moreover, the *interfaces* of the regions are areas where the regions overlap (Decuypere, 2019). Some actors may be positioned at these interfaces (*boundary actors*), meaning that they have the ability to partake in more than one practice. The boundary actors in the two VNAs were of particular interest, as they have the potential to realize multiple activities. Building on the analysis of regions, interfaces and boundary actors (the composition and form of the assemblage), the effects of such arrangements will be discussed. Common in ANT is studying how certain arrangements of actors (assemblages) may produce powerful effects (Fenwick et al., 2011). We center the discussion of the effects on our analysis on power, politics and agency (Savage, 2019) as we explore the analysis's repercussions for educational governance.

## Unfolding policy assemblages

In the following sections, we will present the policy assemblages through VNA. A wide range of heterogeneous actors were identified, and their potential workings were analyzed. The analysis will be presented by focusing on two points: (a) the composition of the assemblage in terms of actors and relations; and (b) the form of the assemblage in terms of regions, interfaces and boundary actors. Each country case will be presented and analyzed individually, describing only a few main findings from each case. Please note that the actors are written in italics.

## The Irish case

### *Composition of the assemblage: actors and relations*

The first VNA (Figure 3) shows several heterogeneous actors that are expected to interact with Irish school leaders and teachers: human actors such as *students* and *parents/guardians* and nonhuman actors such as *school self-evaluation* (SSE), *performance data, classroom-based assessment*

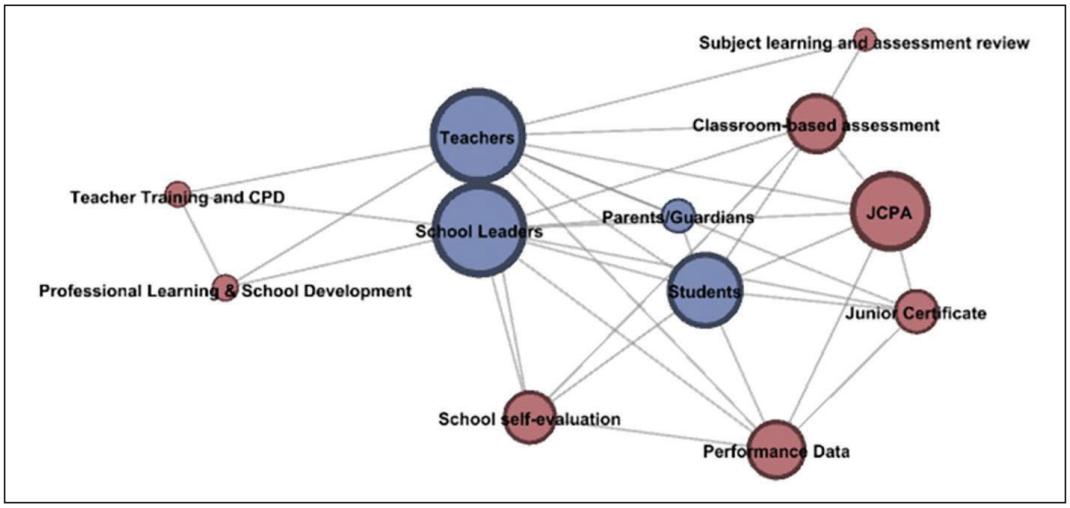


**Figure 3.** The Irish visual network analysis according to actors and relations.

(CBA) and *the Junior Certificate*. For instance, the actor *SSE* is supposed to enable a collaborative, reflective process of internal school review that affords the possibility of gathering information from a range of sources. Student data is systematically gathered to identify how teachers teach and 'how pupils learn' (Department of Education and Skills, 2015b: 22). The action enabled by *SSE* is then centered on two premises: gathering student data and providing insight into teaching and learning practices for internal evaluation. It is here that relations to other entities may form: relation to *students*, students' information is collected from the *Junior Certificate* (external exam given at the end of the junior cycle) and from *CBA* (annual assessment taking place through classroom activities), and *performance data* in general. SSE is, in this case, dependent on digital data from the above actors to actualize itself and utilize digital technologies to its full potential as is envisioned in the policy documents: for school leaders and teachers to 'take ownership of their own development and improvement' (Department of Education and Skills, 2015b: 22). Whether the information to be gathered in SSE is available in one digital platform or software or whether teachers and school leaders will have to gather different data from different places themselves is not clear.

The actor *JCPA* is to facilitate a reporting process at the end of the junior cycle, introduced as part of the ongoing curriculum reform at the junior cycle level (lower secondary). The *JCPA* will assist school leaders and teachers in obtaining a 'comprehensive picture of student achievement' (Department of Education and Skills, 2015a: 40). Each *student* has their individual JCPA, a report on achievement across a wide range of areas such as the *Junior Certificate, CBA* and *performance data* in general. While it may be evident that the *JCPA* is dependent on other actors in the region (such as *CBA* and *performance data*) to become performative, the same actors are likewise dependent on the JCPA to be rendered visible and thus have the ability to give meaning to an activity (Callon, 2005). For instance, *CBA* builds on formative assessments conducted in classrooms. The process of using CBA to inform teachers and school leaders of student achievement, however, may partly be performed by the *JCPA*, as it reports on the assessment and thus makes it visible and ready-to-use. Moreover, *performance data* is in the Irish case data from formative (developing student learning) and summative (evaluating student learning) assessments that fall outside of concrete processes/events such as *CBA* or the *Junior Certificate*. Actors that interact with *performance data* in the assemblage include *students* (it is their performance data), *school leaders* and *teachers* (who are to use performance data in their practice) and nonhuman actors such as the *JCPA*, the *Junior Certificate* and *SSE* (which rely on performance data to enable reporting, assessment and evaluation practices). In particular, the policy documents portray *performance data* as necessary in

the collection and evaluation of student performance and for teachers to 'design more appropriate student learning activities' (Department of Education and Skills, 2015b: 24).

The analysis of the composition of the assemblage shows that governmental ambitions to enhance the use of digital technologies in Irish schools are emergent (entities gain performative characteristics and 'become' in relation to each other), heterogeneous and relational (Savage, 2019), as several human and nonhuman actors have been identified. We have started by describing particular actors in the assemblage and the expected relations the actors are to take on. How agency and power are potentially distributed in the assemblage, however, requires a further analysis of the form of the assemblage.

## *Form of the assemblage: regions, interfaces and boundary actors*

The outline of heterogeneous actors and relations above indicates that each actor has the potential to exert agency (Callon, 2005). It also shows that agency is dependent on the relations in the assemblage (Savage, 2019). In Figure 4, we have highlighted clusters of actors that tend to interact with each other in regions. The regions were defined by analyzing the intended practices that the actors are to partake in, and we identified five clear-cut regions in the assemblage. In what follows, we will describe different regions by pointing at the imagined practices within them. Figure 4 shows that some, but not all, regions overlap. Although not all regions overlap, this does not imply that the actors in the different regions are expected to entirely interact separately from each other. As is also visible in Figure 4, actors may have relations across regions; however, they may not be expected to interact as frequently as with other actors within their region. In this sense, the assemblage is connected throughout. It would be outside the intentions of this paper to report on all the five regions identified and we will therefore limit ourselves to present the analysis for the regions that overlap.

The orange region to the right contains actors and relations related to reporting and assessment. This is the region in the assemblage with the most actors involved, and it contains several centers such as the *JCPA*. As previously noted, the *JCPA* enables a reporting practice by interacting with actors (the *CBA* and the *Junior Certificate*) that perform practices of assessment. On the outskirts of the orange region, *performance data* can be found. *Performance data* is part of the orange region as it is taken up by actors such as the *JCPA* to report on performance data from formative and summative assessments. Moreover, *performance data* is located in the interface of the orange

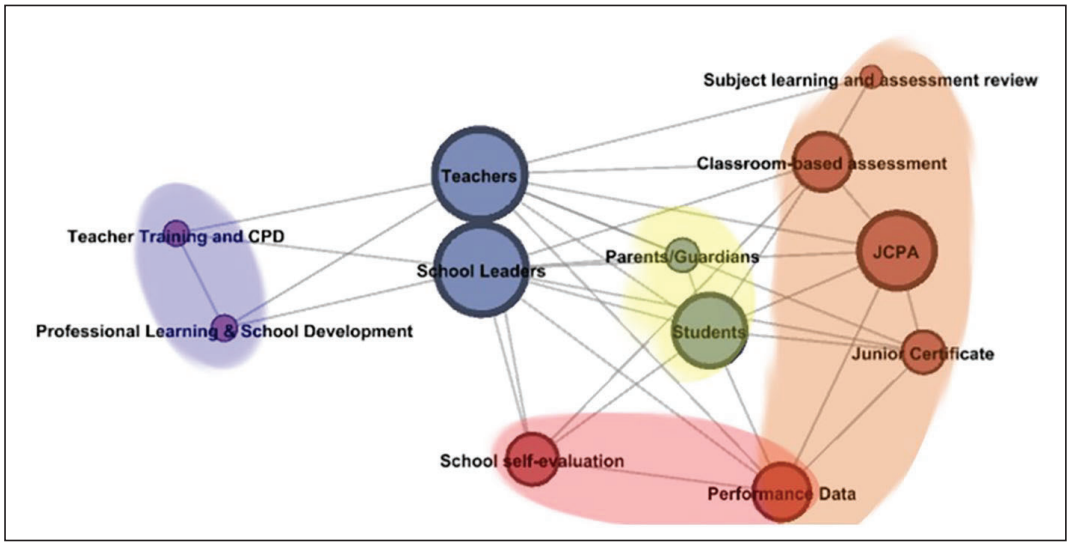


**Figure 4.** The Irish visual network analysis according to regions.

and red regions. This position makes *performance data* a boundary actor. The region in red, which mainly consists of one actor in addition to performance data (*SSE*), is expected to perform a digital practice of internal evaluation. *Performance data* acts as a boundary actor, as its workings are 'soaked up' by the additional centers in the two overlapping regions and thus have the potential to facilitate more than one practice at once. Without *performance data*, the *JCPA* would lose one of its main sources for information, and this could potentially limit the digital insight for school leaders and teachers on assessment. Likewise, without *performance data, SSE* would be deprived of its digital characteristics and stripped down to a much more analog evaluation practice and might not have been included in our analysis at all, as we were interested in mapping actors linked to digitalization in schools. This positions performance data as a crucial actor in the assemblage. It not only enables practices of internal evaluation, assessment and reporting concurrently, but also, by being a boundary actor, has the potential to regulate and connect the interactions between the two regions (Decuypere, 2019) and thus simultaneously connect and merge the different (imagined) practices. The potential of the boundary actor *performance data* indicates that school leaders and teachers are expected to engage in several practices at the same time (evaluation, assessment and reporting) when making use of digital technologies in their practice.

In sum, the assemblage of the Irish case shows there are several human and nonhuman actors expected to facilitate school leaders' and teachers' use of digital technologies in schools. The analysis visualizes that Irish school leaders' and teachers' imagined practice with digital technologies are potentially composed of several emerging regions – each with their constituent actors that produce one or several imagined activities, some of which may overlap. Keeping Savage's (2019) three analytical foci in mind, our analysis has visualized how actors emerge in the relations they are expected to take in the assemblage, their potential to exert agency relationally and how power may potentially be distributed through boundary actors. The regions, and the assemblage in itself, will not be able to perform the activities of evaluation, assessment and reporting through human or nonhuman actors alone.

## The Norwegian case

### *Composition of the assemblage: actors and relations*

In the Norwegian case, we identified several heterogeneous actors that have the potential to perform practices with digital technologies (see Figure 5): *adaptive algorithms, learning analytics*, the *quality assessment system* (NQAS), the *point-of-view* (PoV) analysis tool and so forth. To offer school leaders and teachers important information from each student's progress, digital platforms with *adaptive algorithms* and *learning analytics* may be applied. *Adaptive algorithms* are described as facilitators of differentiating a test-based practice – where the potential to steer the direction of a test, based on the students' abilities, is performed by the *adaptive algorithms* themselves. *Adaptive algorithms* form relations with *learning analytics*, as these two actors are often described together, nearly as a 'pair', in the policy documents – that is, 'new technologies and the use of big data opens up the opportunity for material with adaptive algorithms and learning analytics' (Ministry of Education and Research, 2017a: 19; translation by authors). We find that *adaptive algorithms* may feed into some sort of *learning analytics* depending on the purpose of the action and correspondingly assist learning analytics in a specific activity, such as the collection of student data. *Learning analytics* is described to give new opportunities for insight (Ministry of Education and Research, 2017a) and forms relations with *students* (students' development in a wide range of areas is tracked over time), *school leaders* and *teachers* (expected to exploit it to inform on student achievement, their own practice and to identify school development issues), as well as the *NQAS* and the *PoV analysis tool*. We found that *learning analytics* as an actor illustrates its potential for

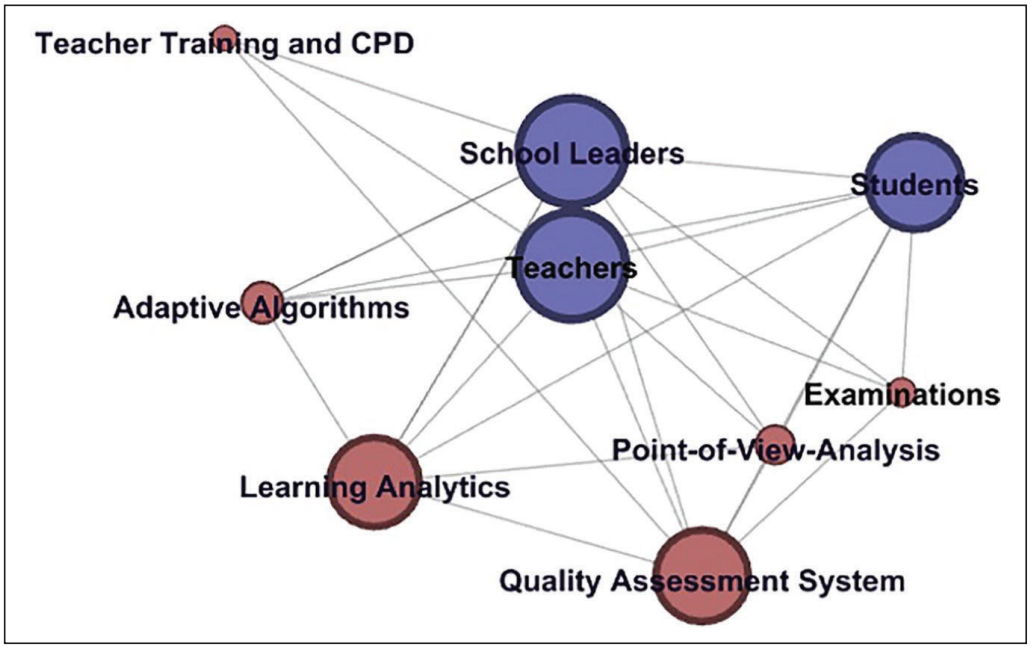


**Figure 5.** The Norwegian visual network analysis according to actors and relations.

differentiation of teaching and learning. The ability to give students feedback continuously is also of value. Most important, however, is learning analytics' potential in teachers' work with formative assessment. In this framing, digital platforms with learning analytics track individual students' development over time and may include student results, evaluations and observations from teachers and school leaders.

As school leaders and teachers are expected to interact with learning analytics to track student development and identify school development issues, *learning analytics* is the actor that potentially *performs* the action of gathering and collating data. School leaders and teachers, on the other hand, *exploit* the information provided by learning analytics and may choose to *act upon* that specific information. Together, school leaders, teachers and learning analytics may perform the practice of analyzing student data for quality and school development issues.

The actor *NQAS* is a national quality assessment system. As an actor, it is expected to improve the quality of teaching through various (digital) information sources such as standardized tests, national tests, user studies, inspectorate data and available statistics. Schools are to use the information available in the *NQAS* to evaluate their practice and identify school development issues. We found that the information available in the NQAS builds on several forms of *learning analytics*. Other relations include the *PoV analysis tool*. The PoV is a reflection tool for self-evaluation, where the aim is to reflect upon schools' practice and identify areas for school development based on intentions from the NQAS. The *PoV analysis tool* interacts with *NQAS* as it is to systematically revise the information within it. The information to be revised is provided by forms of *learning analytics* that track *student* development. School leaders and teachers may revise the information by engaging with the *PoV analysis tool* to ensure quality assessment as is intended by the *NQAS* and enforce school development.

Actors in the assemblage start to gain performative characteristics as they, together, are expected to take part in or reinforce school leaders and teachers' practice with digital technologies. The analysis provided above shows that actors gain the potential to act by means of the arranged relations, and together they generate a specific strategy for digitalization in schools (Savage, 2019). One actor without the other could potentially showcase a different assemblage completely, as the

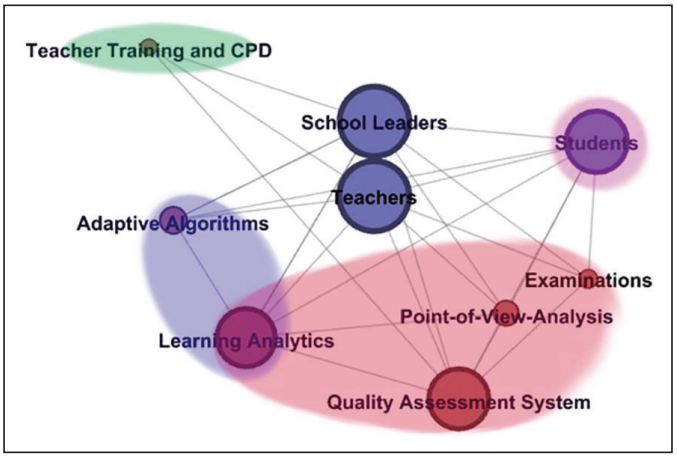


**Figure 6.** The Norwegian visual network analysis according to regions.

notion of exteriority reminds us (Savage, 2019). This intensifies the importance of viewing a practice as relationally composed: what would the practice look like if we were to take out an actor such as *learning analytics* from the assemblage? We continue the analysis by diving into the form of the VNA and discussions of (potentially) powerful actors in the assemblage.

## *Form of the assemblage: regions, interfaces and boundary actors*

The VNA of the Norwegian case in terms of form shows four regions. As in the Irish case, actors interact within and across regions, but the actors expected to interact the most are clustered together. The purple region to the left in Figure 6 is characterized by digital actors. The expected practice in the purple region is centered on student assessment and the differentiation of teaching and learning. *Adaptive algorithms* may differentiate the level within a test for each student based on information from students' ability to answer a test question. The information provided by *adaptive algorithms* may feed into *learning analytics*, which affords the possibility of tracking *student* development over a certain period, in different areas of teaching and learning. In turn, learning analytics may be used by *school leaders* and *teachers* in formative assessment.

The red region in the bottom right is characterized by practices of quality assessment with the *NQAS* and the *PoV analysis tool* as driving actors. The red region overlaps in an interface with the purple region, where the boundary actor *learning analytics* resides. In the purple region, *learning analytics* has the capacity and potential to take part in practices of student assessment, preferably on multiple assessments and over a period of time. *Learning analytics* thus holds the possibility of collecting large quantities of data. Without learning analytics in the purple region, school leaders and teachers could potentially miss out on important insight into each student's capacities (Ministry of Education and Research, 2017a), and the collection of student data would be based on lesser forms of automation. In the red region, *learning analytics* may be used to gather vast amounts of information to feed into the *NQAS* and the *PoV analysis tool* and, by so doing, is intended to track, evaluate and organize multiple aspects of teaching and learning in schools. Without learning analytics as an important contributor to the *NQAS* and the *PoV analysis tool*, we argue quality assessment would lose a substantial part of its intentions to govern and steer education in Norway. *Learning analytics*, being a boundary actor, holds the potential to take part in and connect several practices at once. By enabling assessment practices within schools (purple region), *learning analytics* lays the very foundation for the *NQAS* and the *PoV analysis tool* (red region) to become performative and give meaning to action (Callon, 2005). It becomes nearly

impossible to distinguish the imagined practices of student assessment (purple region) and quality assessment (red region) in the Norwegian case, as these practices are excessively intertwined by the workings of *learning analytics*. In this sense, the purple and red regions are held together by the relations that are strategically arranged in the documents (Savage, 2019), with learning analytics as a boundary actor.

## Discussion

In this paper, we aimed at exploring the heterogeneous entities that constitute governmental expectations of digital technologies in education presented in key policy documents in Ireland and Norway. We found several heterogeneous actors that are imagined to partake in digital technology practices alongside school leaders and teachers: *digital actors* such as performance data, learning analytics and adaptive algorithms; *material actors* such as the JCPA, SSE, NQAS and the PoV analysis tool; and *human beings* such as students. We can make this distinction of actors by grouping them in types of actors, which serves to summarize the composition of the assemblage. However, as our analysis indicates actors may connect and exert agency beyond their individual functioning (the relational composition of the assemblage), it leads to an understanding of actors being not entirely human or entirely not-human but rather having the ability to merge with other actors and thus merge with other actors' characteristics. We consequently found that a practice with digital technologies is not intended to be only material, digital or social, but actors are expected to come together and emerge to serve more than one purpose at once. In policy assemblages, actors have a contingent relationship that is mutable rather than fixed (Savage, 2019). We argue this is also true for the practices that they produce, and by examining policy documents as 'snapshots' we found that the school leaders' and teachers' imagined practice with digital technologies is in potential flux, represented by interfaces as overlaps of practices. Two boundary actors in the assemblages exemplify our argument: performance data and learning analytics enable two or more practices to merge. This implies that several different activities with digital technologies may take place at the same time and digital actors such as performance data and learning analytics can morph with school leaders and teachers, and thus bring forward practices shaped by human and nonhuman actors conjointly.

From a policy assemblage and ANT perspective, particular heterogeneous entities do not obtain performative quality if they are examined in isolation (Fenwick et al., 2011). In fact, the very aim of policy assemblage is to unfold the various heterogeneous relations to reveal the effects such arrangements may have for power (Savage, 2019). Our analysis has shown how entities are assembled relationally and its implications for agency and power. Agency becomes a question of the emergence through relations, and when relations exist, forged actors 'become' and are remodeled, as their capacities to perform an activity may change according to their relations. The relations between learning analytics and NQAS exemplify this: without learning analytics, NQAS would form a quality assessment practice based on entirely different premises. NQAS, in fact, relies on learning analytics to perform the policy intentions of effectively tracking, monitoring and steering education. Entities in the policy assemblages are thus frequently being *realized by* and *dependent on* each other to become performative. In this sense, heterogeneous actors are emergent and in flux through the specific relations they take on and associates the first two analytical focus points discussed by Savage (2019).

The notion of power, politics and agency takes the analysis slightly further by examining where power (in forms of interfaces and boundary actors) may form in the assemblage, and Savage (2019) reminds us that actors are arranged strategically. This, we argue, feeds into discussions about the

possible effects the assemblage may generate or, in other words, what consequences the composition of the assemblages poses for educational governance. This study's findings suggest that the relational composition of actors in relation to the digital serve to put forward a specific policy agenda where processes of governance and digitalization are intertwined. To follow the previous example, learning analytics and NQAS' relation in the Norwegian case can be seen as interdependent, as the former actor effectuates processes of student assessment *and* quality assessment by gathering information and the latter reinforces the information (at least by intention) to facilitate schools to take part in and evaluate the information. In the Irish case, the relation between performance data and SSE implies that evaluation done by school leaders and teachers in schools may not be possible to achieve without digital data. In other words, the NQAS highly relies on complex forms of digitization and datafication (Williamson, 2017), hereby learning analytics, to become an actor and materialize itself. Likewise, the SSE relies on performance data and thus forms of datafication (Williamson, 2017) to make an evaluation activity a reality. The school leadership and teaching practices connected by the agency and power of the (digital) boundary actors are thus characterized by varying forms of governance mechanisms, and we make an argument that while governance may be digital, digital actors are likewise pervaded by notions of governance in the two assemblages.

In this sense, we found that traditional governance mechanisms such as assessment, quality assessment and evaluation may be partly or fully performed by digital actors, creating a constant audit trail of student performance made visual and thus amenable to identify issues in education quality. This finding can be seen as reflecting forms of digital education governance (Williamson, 2016a) that have begun to influence large parts of European education systems. However, while the two VNAs may initially showcase that both cases carry notions of digital education governance, we depicted that the forms of governance within the two cases are based on disparate premises. On the one hand, the Irish case shows elements of datafication – as data in various forms is valued as partaking actors in school practices of assessment, reporting and evaluation. While this might display a notion of datafication, it does not portray the collection, distribution and analysis of educational data being replaced by automated digital solutions. These are rather descriptions of passive reporting and simple arithmetic enactments to be done by Irish teachers and school leaders. In the Norwegian case, however, the notion of digital technologies replaces certain operations of collating data by expecting that learning analytics and adaptive algorithms be part of digital practices alongside school leaders and teachers. While this may aid school leaders and teachers in their quest to improve quality in their respective schools, the interactions with adaptive algorithms and learning analytics will demand high quality in the software *and* the actual use by teachers and school leaders, as well as ethical considerations of monitoring, privacy and security (Ministry of Education and Research, 2017a). As such, our analysis has unfolded two *examples* of policy intentions of digital education governance. We argue the presentation of two country cases has provided productive analyses of the ubiquitous nature of digital education governance and the analyses may lay the foundation for further empirical investigations of the phenomenon within Ireland and Norway, and beyond.

## Concluding remarks

Increasingly across European education systems, student data is being collected, distributed and analyzed to gain detailed and individualized knowledge to inform all levels of decision-making in education (Williamson, 2017). This study finds that practices with digital technologies have been established in educational policy documents in Ireland and Norway by the strategic arrangement of heterogeneous actors in policy assemblages (Savage, 2019). Actors are assembled to put

forward governmental ambitions of the digital which, generally, are characterized by imagined practices of assessment, quality assessment and evaluation. For school leaders and teachers, our analysis implies that when using digital technologies as is intended in the policy documents, several practices may be performed at once by various heterogeneous actors. In Ireland, these practices may still be characterized by analog formats but requires a significant amount of work from school leaders and teachers to gather the digital information as is imagined. In Norway, automated solutions of data-gathering pervade the policy assemblage. While such actors (learning analytics and adaptive algorithms) may ease the work of school leaders and teachers, great competence and ethical consideration in handling such complex forms of digital formations is required. For educational governance, our analysis explored the digital actors' potential to steer the educational direction to enhance multiple governance mechanisms at once, such as assessment and evaluation, and as such presented two examples of how digital education governance may unfold in Ireland and Norway.

That said, we stress that our analysis does not display the reality in schools. We simultaneously acknowledge that whenever there are boundaries (or cutting) of an assemblage, there is a risk of some actors becoming invisible. We believe that studying the phenomenon of digital school leadership and teaching practice *in practice* may have yielded other particular compositions of the assemblages. Future studies may therefore examine how digital technologies are used in schools; how data is collected, distributed, visualized and analyzed within the schools; the networks and relations that arise from such practices; and the possible responses generated in school leaders and teachers' practice with digital technologies. In this light, we also acknowledge that our analysis is limited to discussions of power. Consequently, we have not made claims of true power relations but rather framed our analysis as the potential to exert power and agency. This is, however, an important question to consider in digital education governance as discussions of nonhuman actors are given analytical attention. ANT concepts of policy analysis such as policy assemblage invite researchers to view policy and practice as assemblages of heterogeneous actors and visually present their processes of coming together. This positions policy assemblage as a promising approach to investigate digital education governance.

## Acknowledgements

The authors would like to thank the anonymous reviewers for highly productive comments. The authors would also like to thank colleagues in the research group Curriculum, Leadership and Educational Governance at the Faculty of Educational Sciences, University of Oslo, as well as Professor Gerry Mac Ruairc at National University Ireland Galway for helpful feedback throughout the process.

## Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The author(s) received no financial support for the research, authorship and/or publication of this article.

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## Note

1. Callon (2007) uses the notion of 'obligatory passage points' to refer to actors in an assemblage as indispensable for an action to take place. School leaders' and teachers' are obligatory points of passage in our analysis because all other actors in the assemblage (potentially) rely on the two centers to become performative.

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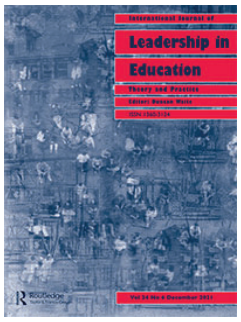

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ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tedl20

# Emergent school leader subjectivities in digitized practices: the case of VSware

Ida Martinez Lunde

**To cite this article:** Ida Martinez Lunde (2021): Emergent school leader subjectivities in digitized practices: the case of VSware, International Journal of Leadership in Education, DOI: 10.1080/13603124.2021.2000034

**To link to this article:** https://doi.org/10.1080/13603124.2021.2000034



Published online: 25 Nov 2021.

INTERNATIONAL JOURNAL OF LEADERSHIP IN EDUCATION
https://doi.org/10.1080/13603124.2021.2000034

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# Emergent school leader subjectivities in digitized practices: the case of VSware

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**ABSTRACT**

This article provides insight into digitized school leadership practices in Irish schools, and the making of the school leader in mediations with the sociomaterial relations emerging from these practices. Drawing on actor-network theory, the study illustrates how school leaders' subjectivities emerge through relations and attachments to VSware, a software package for monitoring student attendance, behavior, and performance. VSware elements and interviews with school leaders at three secondary schools are analyzed using material-semiotic methodology. Findings indicate the school leaders constantly emerge in their leadership positions in schools through relations that are intrinsic and external to the VSware software, whereas VSware elements work as highly specific 'subjectifiers'. Likewise, findings show that school leaders can shape and steer elements in VSware. This suggests the relations and subjectivities that emerge in digitized leadership practices in schools have fluid characteristics, albeit with different and sometimes asymmetrical ways of 'acting on each other'.

## Introduction

This article provides insight into digitized school leadership practices in Irish schools, and the making of the school leader in mediations with the sociomaterial relations emerging from these practices. Since the introduction of SchoolsIT in 2000, Irish schools have undergone various digitalization phases. The most recent initiative, Digital Strategy for Schools 2015–2020, highlights digital school leadership as vital for effective integration of other school policies and initiatives, such as School Self-Evaluation (SSE; Department of Education and Skills, 2015a). With the dual commitment to integrating data use for school accountability with digitalization, Irish school principals produce and have access to a vast amount of digital data, albeit with varying assimilation in practice (O'Brien et al., 2019). Data-driven leadership is made possible and enhanced by digital technologies of education (Williamson, 2017), and implies a strong emphasis on governing knowledge through performance monitoring and surveillance, putting at the forefront school leadership that can document, operate, and exploit school data (Selwyn, 2016). Although studies have revealed the narratives

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and identity stories of school leaders in the neo-liberal climate by referring to policy, accountability, and use of data (Gunnulfsen, 2021; Heffernan, 2018; Rezai-Rashti & Segeren, 2020; Sugrue, 2015), the making of the school leader by 'zooming-in' (Nicolini, 2012) on digitized practices remains underdeveloped (although, see Landri, 2021).

In social sciences, the terms *subject* and *subjectivity* often refer to various processes of micro- and macro-sociological approaches that emphasize human intention, action, and response in various ways. One can find subjectivity viewed as a force of mind and rationality (Boudon, 1986), the embodied subject with representations of bodily responses, such as affect (Braidotti, 2013; Brøgger, 2018), and the political subject in various systemic, historical, and cultural contexts (Cremonesi et al., 2016; Niesche, 2013; Niesche & Heffernan, 2020).

In this study, I decenter intrinsic human properties as something retained from the mind, the body, the history, or the context. I draw on actor-network theory (ANT) to conceptualize subjectivation as emerging human actors that form attachments and relations to their social world. In this view, the school leader internalizes certain properties only as they attach to other entities that allow them to *become*. This is not to say that context, history, and culture are disconnected from the subject in the ANT perspective; on the contrary, the subject is expressed through constantly fluctuating configurations that *make* the social world and the actor at various points in time and space. For 'outside' expressions to be internalized, one has to understand practice through configurations that may stretch indefinitely through various relations among humans, things, and discourses. An eminent characteristic of these relations is their ability to work as 'subjectifiers' (Latour, 2005). Therefore, the practice and its constituent relations are the focus in this article, as opposed to the subject as an ontological figure (Rebughini, 2014).

Digital practices make an interesting case, as our digital lives enable us to activate a whole range of activities. Websites, software, and platforms are enfolding and enfolded by the social, and when studied in practice, the digital actively enacts particular user subjectivities. Although some literature has focused on the digital subject as subjects existing in (and only in) data, models, biometrics, and so on (Goriunova, 2019), the interest in this paper is how the subjectivities of school leaders are mediated in their interactions with digital software. In education, scholars have found that students' subjectivities may be found in data, numerical or visualized (see for instance, Nemorin, 2017). However, digital software that targets the learner can enact various subjectivities extending from the students' point of view because educational technology is designed to serve many different actors. For school leaders, data-driven practices imply an interaction with student data as they are collated and analyzed to address challenging issues of curriculum, quality, and development. This suggests that leadership subjectivities may also emerge from the enactment of a software program that assesses students' learning and motivation, although the subjectivities are usually connected to leadership responsibilities of monitoring teachers' work, evaluating in-house practices, reporting, and surveilling. Therefore, in this paper, I have chosen to investigate and disentangle VSware in school leadership practices, a software package offered to Irish secondary schools to monitor student attendance, behavior, and performance. The elusive nature of how digital–human assemblages create certain school leadership subjectivities and

simultaneously construct and reconstruct each other is highlighted by referring to ANT (analytical framework) and material-semiotics (methodology) in this article. I ask the following research questions:

RQ1: What are the relations that emerge within and between VSware, school leaders, and other actors?

RQ2: How do school leadership subjectivities emerge in the relations between VSware, school leaders, and other actors?

The paper is organized as follows: First, I present the theoretical underpinnings of ANT and subjectivation. Building on these premises, I present the methodological considerations as twofold within a material-semiotic approach; the methodological steps done to examine relations within the VSware software and the analysis of school leaders' practice with VSware at three secondary schools in Ireland. Then I present my findings and discuss them as 'scenes' of practice, before pointing to contributions and considerations for future research.

## Analytical framework

In this section, I highlight three main sensitivities of ANT that are deployed to discuss subjectivity as an emerging effect (Latour, 2005; Moser, 2003). I take a broad view of what constitutes school leadership, and I refer to school leaders as all of those holding leadership positions in various forms within schools (principals, assistant principals, year heads, etc.). Moreover, following the ANT perspective, actors include any given entity that participates in an activity, gives meaning to an activity, or is affected by an activity in relation to other actors (Latour, 2005).

### *ANT in human–digital assemblages*[1]

This study displays three connected features of ANT: heterogeneity, semiotic relationality, and materiality, or materialization of practice (Law, 2009). I use *heterogeneity* in this analysis as an analytical starting point. In ANT, human and non-human actors may form a configuration of practice and are of equal importance to the analysis (Law, 2009). This implies the analysis is sensitive to the performative effects of human–digital assemblages. In the first part of the analysis, heterogeneous entities (such as data in various forms, organizations, educational frameworks, and so forth) were identified. Although this first step demonstrates a 'mapping' of entities (Crossley, 2015; Youdell & McGimpsey, 2015), ANT remains a relational approach. *Semiotic relationality* refers to a view of practice as configurations of entities that define and shape one another through the relations they form (Fenwick & Edwards, 2012; Law, 2009). Such a relational notion negates the 'individual' in how actors act, and that a practice cannot be reduced to individual actors' capacities (Crossley, 2015). Instead, ANT builds on interdependency in that an actor cannot do or influence a practice in and by itself, but does so as the actor *becomes* through interactions and relations to other actors (as they, too, 'become'). The study of such emergent actors implies that school leaders, or a digital element from VSware, obtain

their properties and characteristics as a result of materialization processes that make up such entanglements. Consequently, the analysis of the relations is reflected as a stepping stone for identifying the actors.

In the process of the materialization of monitoring software like VSware, actors may emerge with certain characteristics. A school leader may emerge as successful or not based on visualized school data, and a student may emerge as 'low performing' or 'high performing': Both are from the same digital element of software like VSware but display the different sorts of relations (and effects) attached to it. This *materiality* (Law, 2009), or *materialization of practice*, attributes fluid characteristics to relational configurations. Although the performative properties of actors are established relationally, these same actors are not detached from previous, present, or future assemblages. In practice, this implies that the materialization of school leaders' use of VSware may maintain traces of other materializations, for example, processes of national school completion programs. This notion suggests various internal and external relations enfolded in digitized leadership practice. It also displays how leadership subjectivities may be shaped by, and mutually shape, the configuration of practice through its constituent actors.

## Subjectivities as emerging effects of human–digital assemblages

The relational premise in this paper has two main focuses: disentangling relations and tracing the emerging effects of these relations (Crossley, 2015; Decuypere, 2019a; Fenwick & Edwards, 2012). I draw from Latour's (2005) work to analyze subjectivity as an emerging effect that is relationally produced and made possible in practice. Thus, by drawing on *semiotic relationality*, I analyze and discuss the subjectivities that emerge from material-semiotic relations in human–digital assemblages as 'neither inherent intellectual capacities nor a socially constructed core of identities in individualized, natural bodies, but positions made possible in material practices and relations' (Moser, 2003, p. 86). The exact force of the semiotic relations is described by Latour (2005) as a fluid essence of 'subjectifiers' or 'plug-ins'. Plug-ins, a term used to mirror our digital lives, relate to bits and pieces of practice that when attached to the human actor *activate* and internalize what was not necessarily always visible. Thus, school leaders are composed of layers and layers of the self as a provisional achievement of the assemblage (Decuypere, 2019b; Latour, 2005). The central point is that an actor's characteristics are *attached*, meaning it is not a human property but a constant state of becoming, and thus, a constant circulation of emerging subjectivities. In the analysis, I look for relations and actors as 'plug-ins' that directly or indirectly contribute to building the school leader within interactions with VSware. Therefore, entities that I did not deem as contributing to the establishment of school leaders as actors are not included in the analysis.

In Latour's (2005) proposed process of emerging subjectivities, the subject is shaped through relations, but they are mutually able to shape whatever or whoever they are shaped by. I frame this simultaneity as the ability to 'act on each other'. The flux of digital elements (numbers, colors, or other data visualizations) is often static in the sense that these elements have already been 'produced'. The notion of subjectivities is far more fluid, and is always being constructed and reconstructed by its relational agentic forces (Højgaard & Søndergaard, 2011). However, a subject (a school leader) can alter the aims of the data produced or gather a new series of data that may have different characteristics

and ambitions to provide alternative information about the same cause. In turn, the school leader may adapt to the piece of data by changing school policy, and it may cause a reshaping of the school leaders' subjectivity as they are assembled and mobilized. This exemplifies the simultaneous, mutual, and agentic shaping of actors in semiotic relations, albeit with varying actions taking place in terms of altering (the data) and being set in motion (the school leader). It also implies that all actors are able to govern, and be governed, as a continuous process in practice (Fenwick, 2010; Højgaard & Søndergaard, 2011).

Last, as the process of concurrent, past, and future *materializations* reminds us, actors may hold traces of other relations that extend beyond the analyzed configuration. In this article, this is shown in terms of digital actors in VSware that hold certain characteristics in relation to external actors, such as texts, frameworks, and outside organizations.

## Methodology: tracing actors, relations, and emerging subjectivities

In this section, I introduce a short description of VSware, the types of data collected from the software, and the mode of analysis and description for the analysis of the software. Then I focus on the second data set (interviews) and the analytical tools.

### *VSware: potential actors, actions, and subjectivities*

VSware is a software package offered to Irish schools by the Ireland-based company with the same name. The software package includes features for attendance tracking, assessment and assessment analysis, behavior records, and scheduling. VSware is available on mobile applications, iPad applications as well as online, and has an Office 365 integration. Access must be granted and is monitored by the schools, and students and parents may be provided access. VSware was purposefully selected for this study because it draws on data-driven school leadership practices that update in real time and is one of the most frequently used software packages in Irish secondary schools. In the first part of the study, I positioned myself as a potential user of the VSware software. Because of issues concerning data protection, screenshots provided by the informants were used as data from VSware.[2] Two VSware features (attendance and behavior) were chosen to display the relational composition within and between VSware, school leaders, and other actors.[3]

ANT offers sensibility toward understanding practices as always material, and always semiotic because the relations that form between elements give meaning to an activity (Akrich & Latour, 1992). I combined the ANT sensitivities with material-semiotics in the analysis of the VSware screenshots, an approach that is commonly used in digital systems research, and that can easily be applied to the unpacking of digital software (Cabitza & Mattozzi, 2017; Landri, 2019; Mattozzi, 2010).

First, I analyzed the VSware data (screenshots) to disclose the digital elements. I paid particular attention to digital elements such as colors, icons, text, figures, and numbers. From these data, I analyzed the semiotic relationality (Law, 2009) between the various digital elements and examined how colors are used, how colors are used to distinguish one from the other, links that are established between different colors, and the relations between colors and other elements, such as a specific icon in the software. When I spotted links between elements, I analyzed what types of actions the elements encourage (scripts),

how users are addressed, and the type of interactions users may construct with the software. This analysis yielded insight into the way in which user subjectivities may emerge (Decuypere et al., 2014), and how school leaders may 'act on' the software. As the last step, I analyzed relations that may extend beyond the inherent VSware elements when materialized in practice (Law, 2009). They include relations to human actors in various positions, but also to materials, such as curriculum frameworks. While structuring this part of the analysis as potential actors, relations, and materializations of practice, I view the material-semiotic analysis of VSware as a tentative result of the subjectivities that may emerge as school leaders interact with the software.

### *External relations: interviews*

As ANT reminds us, it is only within a practice that relations and their effects may fully emerge (Crossley, 2015; Fenwick & Edwards, 2012; Law, 2009). The relations inherent to VSware can take different spatial relations beyond their own stable interactions. The second data set of this study is the interviews conducted with school principals and middle management (see Table 1). Schools were chosen based on their everyday practice with VSware at the secondary level (Junior and Senior Cycle). The school leadership roles of the informants varied, but all middle managers were members of the schools' management teams.

To map actors and relations in practice, it was important to allow for a particular mode of design and analysis for the interviews. Although observing or 'shadowing' school leaders would have shed light on some in-house leadership practices, it is my belief that this type of approach would have been more fruitful had the main aim of this study been digitized leadership practices in general, and not targeted toward a specific software. Additionally, to avoid issues of access and data protection, another type of design was sought as a way of gaining rich and thick descriptions. The individual interviews were conducted with the principals, and group interviews were conducted with informants who were middle managers. All interviews were semi-structured, where the primary focus was on bringing the narratives of the VSware activities to the forefront. Informants were asked to describe their personal use of the VSware features. The screenshots were brought to the interviews and displayed through a projector. The interviews were recorded by using the software Captura, which records sound and onscreen activity simultaneously. The informants were asked to reflect upon and describe situations using the software, and were able to demonstrate and exemplify by interacting with representations of VSware during the interviews. The main aim of the interviews was to examine the relations that take place in the informants' interaction with the software. When deemed necessary, I probed by asking questions about exactly what

**Table 1.** List of interviewed informants.

| Informants | School A (Sa) | School B (Sb) | School C (Sc) | Total |
|---|---|---|---|---|
| Principals | 1 | 1 | 1 | 3 |
| Deputy principals | 0 | 1 | 0 | 1 |
| Assistant principals | 0 | 1 | 0 | 1 |
| Year heads/heads of departments | 3 | 2 | 2 | 7 |
| SNE coordinators | 0 | 0 | 1 | 1 |
| TOTAL | 4 | 5 | 4 | 13 |

elements, who or what engaged in the activities the informants portrayed. The interviews were later transcribed, with accompanying screenshots according to the discussions taking place in the interviews. The interview design used the three ANT sensitivities as parameters: I followed the actors and relations by engaging with the informants' descriptions of their actions (Latour, 2005).

The interviews were analyzed according to 'scenes' of practice. Each scene is introduced by a segment from the interview data, with a brief description of the activity. The segments (or quotations) are presented in the scenes to account for the informants' reflections, and as a presentation of the subjectivation process stemming from the digitized practice. Then, the heterogeneity and semiotic relationality (Law, 2009) of the scene are analyzed. The actor characteristics materialized from the relations are then used as a stepping stone to analyze school leaders' subjectivities as they emerge, reemerge, and dis-emerge in interactions with plug-ins (Ferreira, 2020; Latour, 2005) during the various scenes. Rather than classifying the school leaders as actors in a given leadership orientation, I looked for clues in the uses of VSware that pointed to specific techniques of the self (Ferreira, 2020). For instance, in the description of using VSware data to report to outside agencies, a school principal (School A) noted:

> If I'm on the phone with an outside agency, I can print all that information, attendance, all that, or I can look up the school reports, and at a glance, I can say yes, she's doing well in history, she's doing well in geography, she's not so good at maths. So I have it [VSware attendance data] in front of me.

In this quote, the actors identified are an outside agency, VSware attendance information, school reports, and the principal. The relation of interest, in particular, is between VSware data and the principal, as the former works as a 'plug-in' for the school leader to emerge as confident in his effort to respond to an external inquiry by having the VSware data 'in front' of him at that particular moment.

Last, I focus on the premises of the relation to discuss how the actors 'act on each other' as they mutually shape one another (Fenwick & Edwards, 2012; Højgaard & Søndergaard, 2011). The discussion builds on the previous analysis of actors and relations to determine 'who does what' and in that way, shed light on the sometimes asymmetrical ways of how actors contribute to an activity.

## Unpacking relations and subjectivities within and beyond VSware

I focus on two points in the presentation of the analysis: the inherent elements and relations of VSware and external relations of VSware and leadership subjectivities as emerging effects.

### *The VSware software*

In this section, I draw from the material-semiotic analysis to unpack VSware's digital elements. The analysis shows how VSware emerges as software with multiple material, digital, and discursive elements. Simultaneously, the analysis addresses how VSware enables certain actions, by looking at how the relations between digital elements address and invite school leaders to contribute to a specific activity.

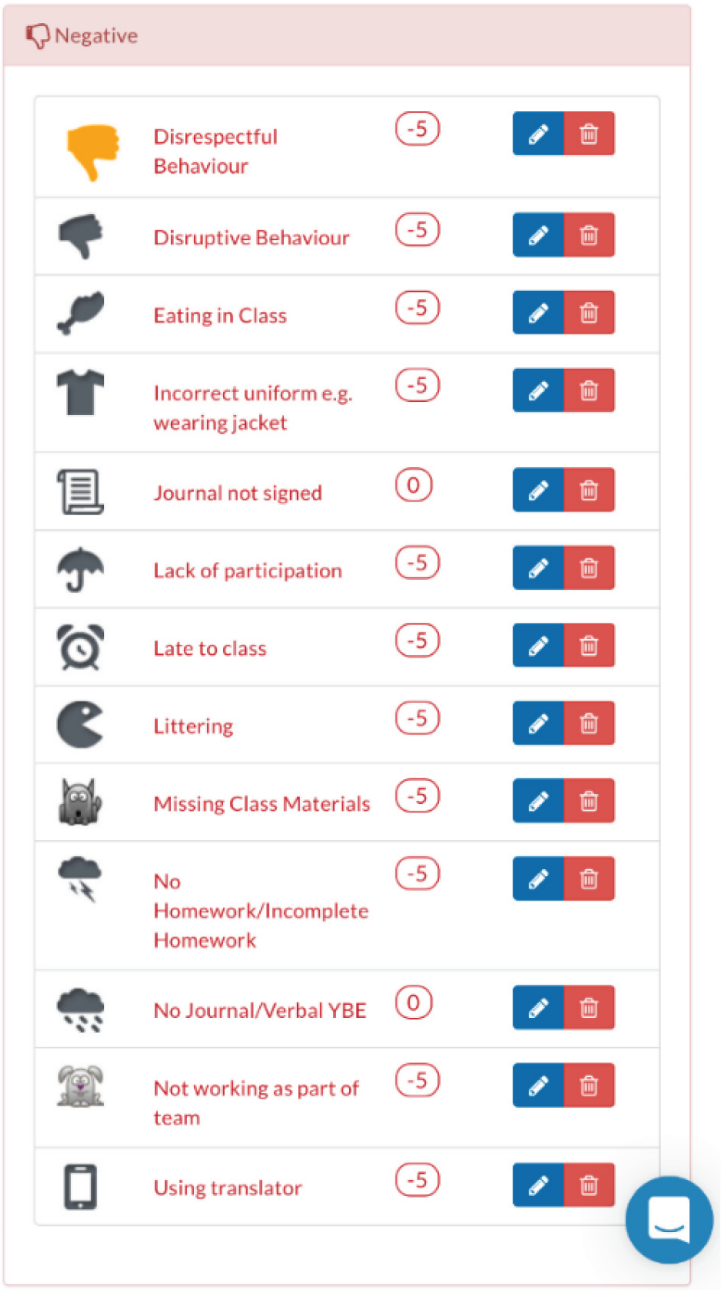


Figure 1. Negative VSware behavior categories.

The behavior page on VSware encompasses behavior categories (Figure 1 and Figure 2), and behavior entries (Figure 3). Figure 1 and Figure 2 show behavior categories. Icons, text, and numbers are framed in the behavior categories. The text in each category is written in red or green, depending on whether the category awards negative or positive behavior. The accompanying numbers indicate scores, and the icons to the right provide visuals for each behavior category. The framed behavior categories are user-friendly and intuitive for potential users: school leaders, teachers, students, and parents.

VSware includes many behavior categories, some of which represent key skills from the Key Skills Framework in the New Junior Cycle (the current school curriculum for the lower secondary level in Ireland), such as 'being creative', 'managing information and thinking', 'staying well', and 'managing myself' (Department of Education and Skills, ,

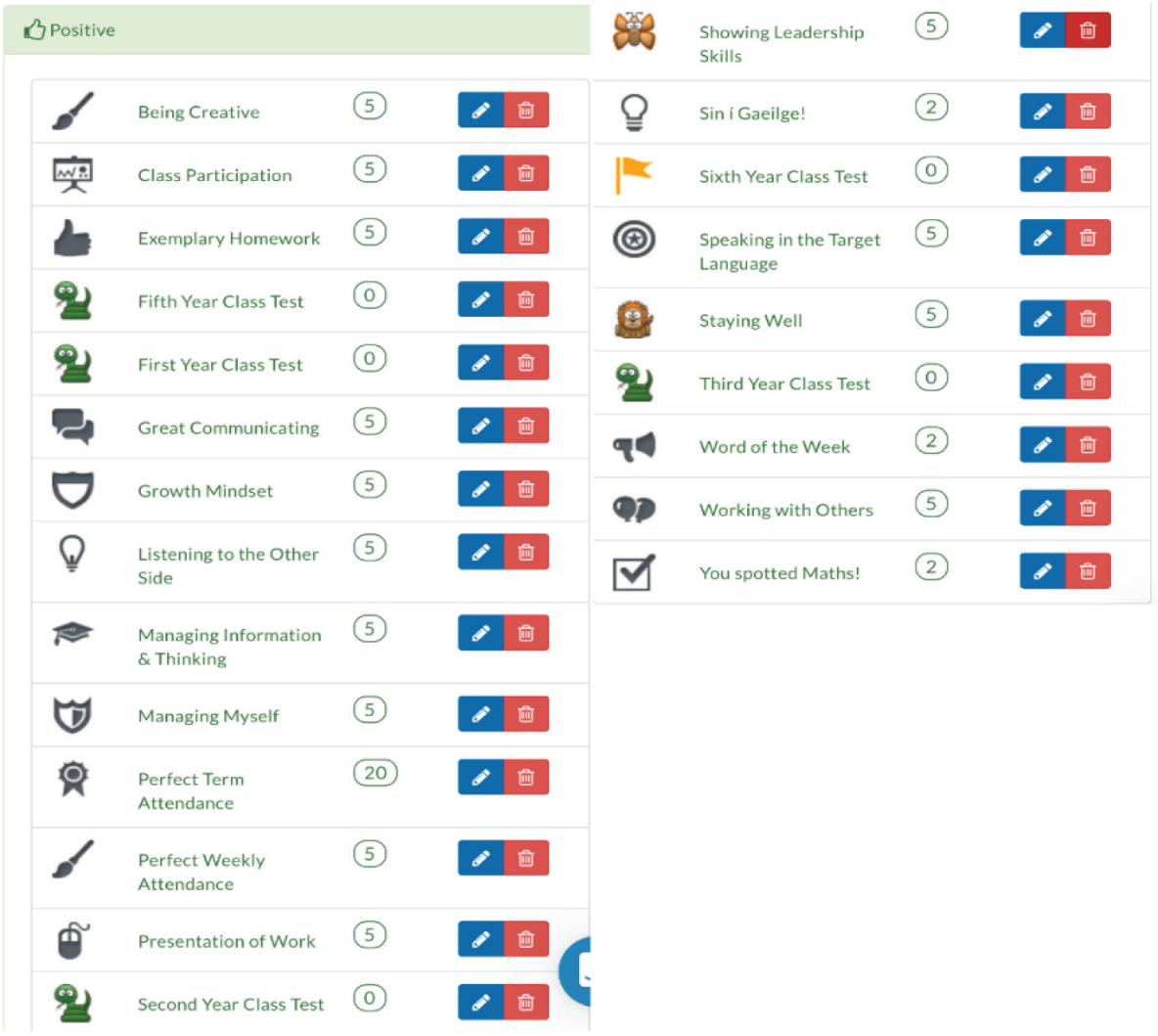


Figure 2. Positive VSware behavior categories.

2015b). However, as the two elements to the far right in the behavior sections indicate (Figure 1 and Figure 2), the user may change or delete the categories: The blue pencil symbolizes an editing function, and the red trashcan icon signifies that the user may delete the category. On one hand, the behavior categories work as a point system, where teachers and school leaders are encouraged to award students points for certain behavior. On the other hand, the point system 'does' more than simply encourage and provide school leaders with a ready-to-use classification for desired student behavior: The system provides the possibility to invite users to interact with the point system by adding customized categories. In this sense, school leaders are encouraged to evaluate the quality of the point system and to make changes according to their school circumstances. As users make changes to the point system, they can also change what is framed, or included, as valued and disvalued behavior. In relation to the other icons, text, and numbers, the edit and delete icons gesture the specific action of altering and adapting a behavior-awarding system.

As students are given points based on their behavior, it is registered as a behavior entry in VSware (Figure 3). The background color of the entry corresponds to positive and negative behavior. Included in each behavior entry are icons, the number of points, and

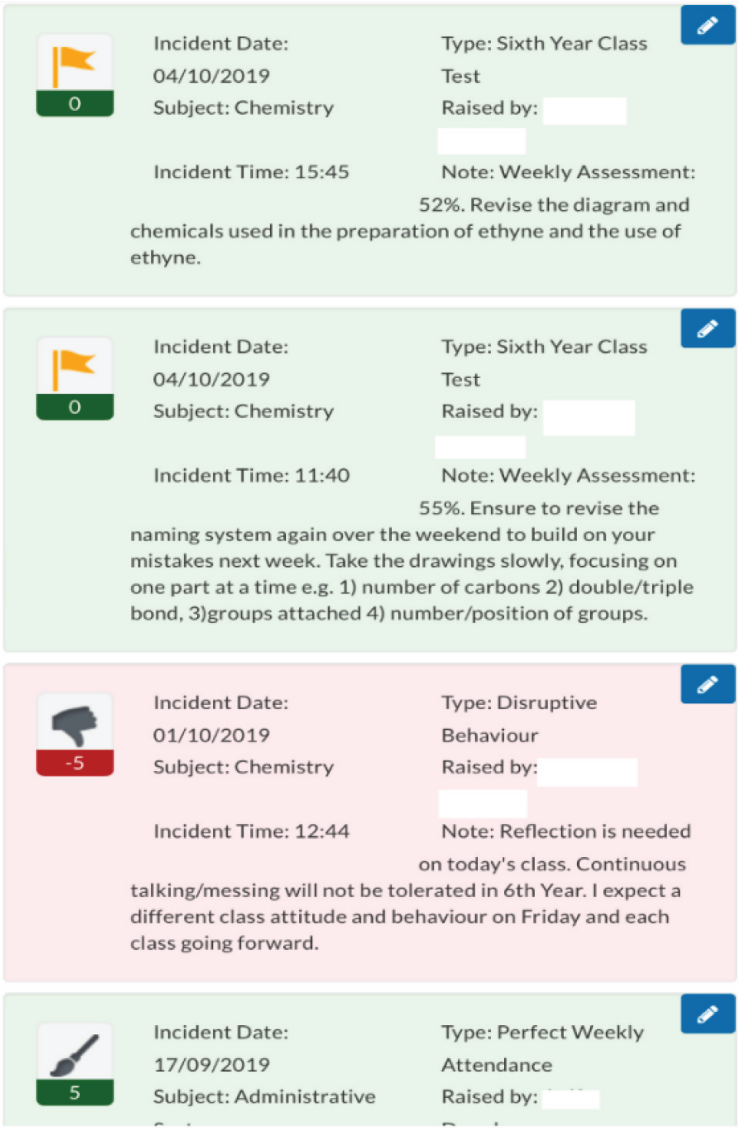


Figure 3. Behavior entries in VSware.

five rows of text. The textual elements represent data: the date and time of the incident, the subject, the type of behavior awarded, who gave or registered the VSware points, and a notes section for a qualitative description of the incident. At the top-left corner, there is a blue pencil icon, meaning the behavior entry can be edited. For school leaders, the behavior entries work mainly as an inscription activity, but the behavior entry also invites continuous monitoring (of students' and teachers' work) and may be used for reporting purposes. In addition, the person with editing access (usually the year heads and the principal) can edit the behavior entry, in the event that something needs editing.

The color theme continues and is expanded in the VSware attendance feature. Figure 4 shows a student's attendance record for the 2019–2020 academic year. There are three different color-coded pie charts, including a line underneath that has four different color headings. The pie chart to the far left titled Absent Days has three contrasting colors: red, amber, and green. The text underneath explains the meanings of the colors: Red is absent, amber is partially absent, green is present, and blue is unexplained absence. As can be seen at the top of the Absent Days pie

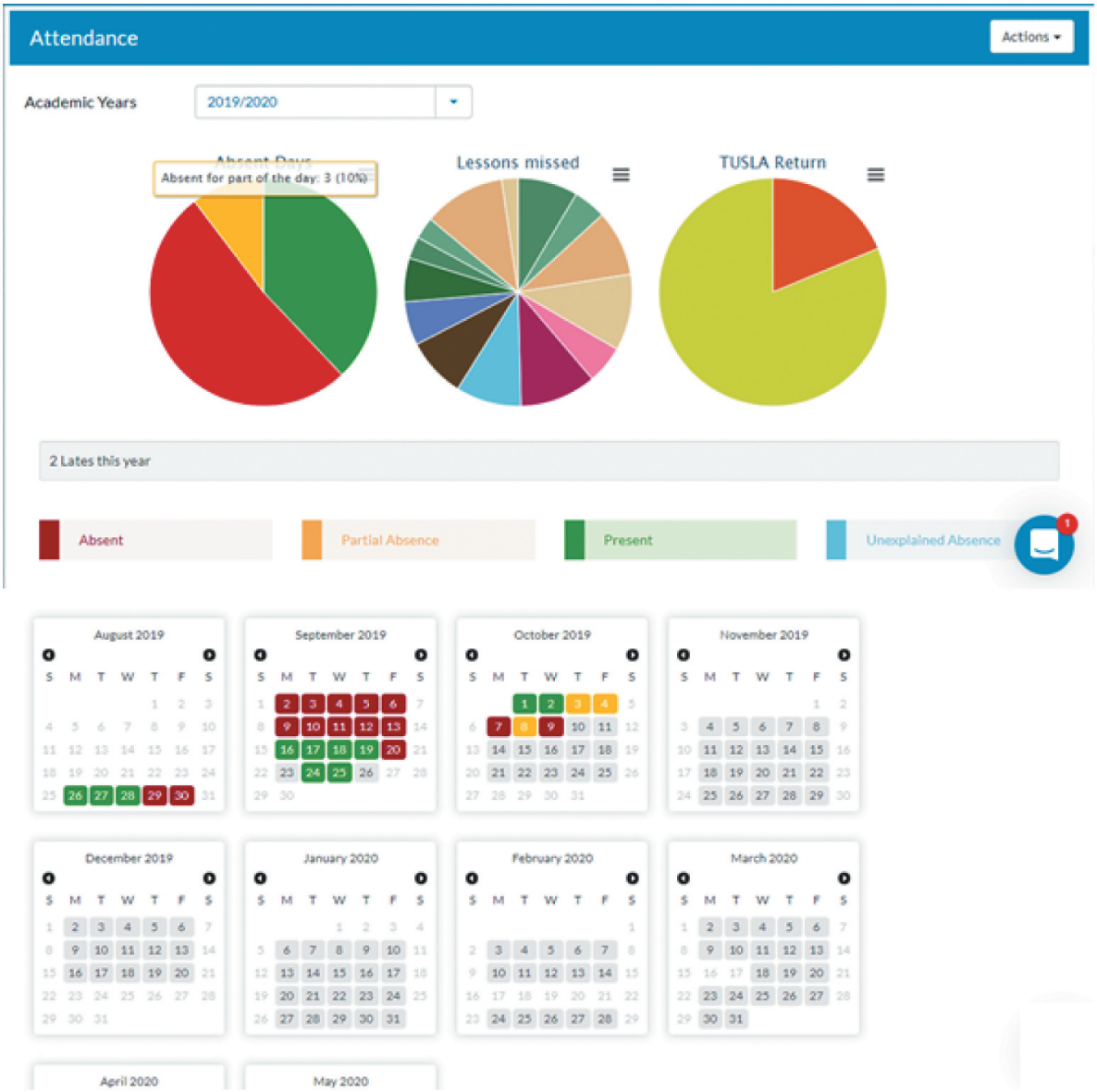


Figure 4. Student attendance record shown in pie charts and calendars on VSware.

chart, VSware shows the number of days and the percentage of (type of) absences by clicking on the specific colors in the pie chart. The pie chart in the middle, Lessons Missed, has nine different colors; all represent specific school subjects. By clicking on a color, the user gains information on which subjects the student has been absent. The pie chart to the far right, TUSLA Return, is lime green and orange and represents an established practice of attendance reporting to the Irish Child and Family Agency. Orange signifies the number of days absent above a certain level (20 days), while lime green represents the days present in school.

Below the pie charts, there is a calendar of the academic year. Grey dates are standard school days, white dates are national holidays, and red, amber, and green dates represent the attendance information shown in the pie chart to the far left. The three color-coded pie charts and the color calendar mainly encourage inscription and reporting activity, as well as being a source of information on student attendance. The pie charts that visualize

attendance in school and within school subjects encourage attendance tracking for internal use, but the TUSLA Return pie chart works as a direct link between the school, the student, home, and the Child and Family Agency.

The analysis of VSware indicated various relations between colors, icons, text, numbers, and figures, all representations of links between (digital) elements. In terms of descriptions of activities and potential subjectivities, two points should be emphasized. First, the setup of the behavior feature on VSware allows for certain flexibility and autonomy. Users (in this case, school leaders) are invited to employ a predefined list of behavior categories as well as modify the categories. The categories can be modified according to the schools' needs. Similarly, the behavior entries can be modified if the user changes their mind, or if the year head or principal notices something is missing or needs editing. This flexibility within the behavior monitoring scripts gives a sense of autonomy, and although the predefined categories may steer school leaders and teachers toward awarding certain behaviors, they are simultaneously encouraged to challenge these categories. These are clear indications of mutual and agentic shaping of actors, respectively, defining the characteristics of the relation that emerges between the behavior categories and the user (Fenwick & Edwards, 2012; Højgaard & Søndergaard, 2011). Both actors may emerge as 'the governed' and 'the one who governs' as the material-semiotic relation encourages both actors to 'act on each other'. Put differently, school leaders may emerge as an autonomous subject.

Second, although the inherent relations between the digital elements of VSware may encourage monitoring, inscription, reporting, and editing practices, the software also encourages certain external relationships for these activities to take place. These relations include relations with outside agencies, as well as material actors such as curriculum frameworks. On one hand, the predefined categories in the VSware behavior feature link to the Key Skills Framework, and in so doing show traces of previous materializations of the assessment of these key skills. On the other hand, the other categories in relation to the edit and delete functions imply that there may be additional materialization processes tied to the same behavior feature in the past and the future, for instance, in terms of specific school targets at the class, subject, or school level. This is also the case for the TUSLA Return pie chart as it suggests external relations with the Child and Family Agency, whereas attendance records materialize as a reporting practice to external actors. In this case, the user, school leaders, may emerge as accountable to outside agencies.

## *VSware in use: emerging leadership subjectivities*

In this section, I provide a short description of the three schools and the leadership teams' predominant practices with VSware. Then, I present my findings as 'scenes' of practice.

School A is a medium-sized Catholic voluntary secondary school in an urban area. The school is enrolled in the Delivering Equality of Opportunity in Schools (DEIS) program, a support program for schools with high percentages of students from socio-economically disadvantaged areas. The informants from School A reported that their predominant use of VSware included internal monitoring of attendance and behavior, as well as reporting to a vast number of external agencies and partnerships. School B is a large Educate Together secondary school[4] in a suburban area. The school has made substantial efforts to digitalize their teaching and learning, including one-to-one devices

for all students and staff. The informants reported numerous activities tied to VSware, which include daily and weekly monitoring of attendance, behavior, assessment, rewarding students, home–school communication (parents have been given VSware access), and (some) reporting to outside agencies. School C is a large Catholic voluntary secondary school in a rural area. The school staff stated a wish to digitalize a greater extent of internal data use and reported that their main use of VSware included internal monitoring and information exchange. All three schools reported that they used VSware elements (numerical and qualitative data, pie charts, etc.) in leadership meetings, such as care team meetings, as well as in informed conversations with students and parents. In addition, the three schools indicated that data recorded on VSware would be presented in the event of external inspections.

### *Scene 1: targeting students in whole-school strategies and care team meetings*

During the course of whole-school strategies, leadership meetings are set up to follow the schools' development; however, the informants reported that the same issues were often raised in care team meetings (pastoral meetings that address students' well-being). Depending on the issue, the staff present at these meetings usually have a specialist and/or leadership role: guidance counselors, principals, deputy principals, year heads, and special needs education (SNE) coordinators. In the description of an ongoing whole-school strategy targeting attendance, VSware elements are presented as central actors:

> So I guess I would be looking at total attendance numbers, and then that broken down, comparing it to our school target, then narrow it down to the top offenders. It's really, mainly, data coming from VSware, for something like attendance that is, you are either in or you are out, but we would maybe be supplementing that with some feedback from tutors and year heads, regarding maybe special circumstances and reasons why you are not in school. And I guess we would be looking at what interventions we would need to put in place, looking at all our leadership roles to support the student. What would the tutor do, what would year head do, what would the deputy principal do? And then, coming up with an action plan and a date for when we will run this data and see if we've made any improvement. (ML1, School B)

Attendance numbers (as numerical data in VSware), tutors, year heads, the deputy principal, and the strategy as a whole present as actors, as they contribute to the activity of targeting specific students or student groups to reach the desired attendance objectives. This assemblage of relations indicates two central points. First, aggregated data from VSware (attendance) activate the leadership team to gather qualitative information (which may, in turn, materialize as actors during the course of the strategy) about specific students. This suggests that although the VSware data take an active part in this specific scene, the data's actor-like characteristics also extend in time to future presentations of the whole-school strategy. Second, within the segment above, we find the description 'interventions we would need to put in place' followed by 'looking at our leadership roles to support the student'. The action of putting in place interventions suggests the second action of distributing tasks and responsibilities. Thus, the VSware data not only *activate* the school leaders but also initiate certain actions of *internalizations* of leadership roles. This suggests the relation performs an action that allows for school leaders' characteristics to emerge as they attach to VSware attendance data, and their leadership role internalizes in accordance with the action (Ferreira, 2020). These relational

characteristics suggest the relation is a plug-in (Latour, 2005), a subjectifier that allows the school leaders to *become* in terms of their leadership duties. This is also highlighted in the descriptions of care team meetings:

> The information that we bring would be, depending on who is bringing information, you know, a year head might bring attendance records from VSware, behavior points that have been issued by various teachers, Guidance might bring evidence of a phone call which they've had with various agencies or parents, the deputy would always bring a record of serial offenders. Students would hit our radar, and we would appoint members of the care team to follow up. (ML3, School C)

In this quote, one can detect that the school leaders emerge in their leadership position at the schools, as the year heads, deputy principal, etc. The school leader also emerges as data informed at different levels in agreement with their established role in the assemblage. The type of data (and thus, the actor) interacting with the different school leaders varies. In this view, the school leaders as data-informed emerge with more particularities according to the characteristics of the data; the school leaders emerge as data-informed by quantitative measures (year head, deputy principal) or qualitative measures (guidance counselor). These findings indicate that in this specific scene, the school leaders materialize their leadership positions within the schools through their relations with VSware and other actors (i.e. phone call records) and in that way, make the invisible characteristics of the school leader in leadership meetings visible, tangible, and traceable. This scene also highlights the fluidity of subjectivation in human–digital assemblages (Decuypere, 2019b; Højgaard & Søndergaard, 2011). The role of the school leader (as a quantitative-informed year head or a qualitative-informed guidance counselor) shifts according to the data that attach to the leader. Thus, school leaders as actors may experience a change in characteristics according to the relations the leaders form with the digital actors.

### *Scene 2: adjustment of behavior categories and registered data*

The previous analysis of actors inherent to VSware indicated certain flexibility for users. The informants called attention to two things in this regard: their opportunity to make desired changes to behavior categories and to make necessary changes to secure correct information. First, the schools had made substantial changes to the VSware behavior categories by adding new ones. This was done predominantly to reflect new whole-school strategies and projects:

> That [Growth Mindset category on VSware] was actually only recently added, stemming from a leadership meeting on the end of this year. (. . .) We have always been a growth mindset school; we kind of wanted to recognize that effort on VSware as well. (ML2, School B)

In this short quote, the actors are an added growth mind-set category in VSware (see Figure 2), the leadership team, and the school as a whole. In addition to these actor relations, I draw attention to the actor that makes the materialization of added categories a reality: the blue pencil button in Figure 1 and Figure 2. Within the scene of adjusting the behavior categories, the blue pencil button works as a highly specific plug-in (Latour, 2005). The action of adding a new category (here, growth mind-set) renders self-reflection possible and sets school leaders in motion to make it their 'own' which allows them to act on the digital

actors in a greater extent than in scene 1. This segment highlights how the school leader emerges as an autonomous subject, not only by inherent scripts of the software (Akrich & Latour, 1992; Cabitza & Mattozzi, 2017) but also by the presentations of interactions in practice. New behavior categories, and thus, a new series of data, are constructed to visualize other aspects of the school, such as their work with growth mind-set. Other self-customized categories include 'you spotted maths!' and 'sin i Gaeilge' (Figure 2). These categories do not pertain to certain student behaviors; instead, the categories mirror school efforts to optimize numeracy and use of the Irish language. In this case, the school leader's characteristics are not only defined by VSware; the leaders are also able to change the characteristics of the digital actor to move beyond its intentions of monitoring student behavior, and by so doing, forge relations with external actors, such as national or local whole-school strategies.

Second, the school leaders at all three schools reflected clear responsibilities tied to their autonomous role in practice. This became especially evident in a scenario portrayed by one principal, where the relation between the school leaders, teachers, and behavior data implies VSware serves as an important actor in monitoring, controlling, and intervening in teachers' work:

> Sometimes, teachers go in and vent, the steam coming out the computer because they are so angry at what has just happened. Sometimes you get the 'I'm so, so angry, and I am fuming,' and I'm saying well that's not really relevant, because if I bring a parent in, and I have to read this back to the parent . . . Some teachers were using VSware entries as a punishment (. . .), so we're saying, as a teacher you must record what happened, and record what you did to deal with the situation. (. . .) I'm there to monitor that every day because it's great to have the statistics. (Principal, School A)

In this segment, the principal is describing the qualitative comments in behavior entries (Figure 3) and his efforts to monitor what teachers record. He described how he, in some cases, engages directly with the behavior entry by using the editing function of the blue pencil button. Moreover, he later appointed other members of the leadership team to carry out collective comment training for school staff. The blue pencil may be identified as a plug-in that allows for activation of the school leader as a monitor of teachers' work, aiming attention at a new series of activities, including staff training. Although scene 1 established a school leader's fluid notion of subjectivities, scene 2 attributes flexible and adjustable characteristics to the traditionally stable (digital) actor as well. As a result, the dual function of the digital actor (the blue pencil button) illustrates how they present themselves with various leadership subjectivities, according to the attachments formed with the leaders. This finding indicates the ability of 'acting on each other' as intrinsic to human–digital assemblages (Fenwick & Edwards, 2012; Højgaard & Søndergaard, 2011).

### *Scene 3: reporting to outside agencies*

The informants described using VSware to report to various outside agencies. The following quotation illustrates informal reporting to external social workers:

> The number of outside agencies that I worked with who care for the kids; social workers who are different, external services, and they ring up and you know, I would talk to them (. . .), I can open up the thing [VSware] and they're talking and saying, you know, 'Is attendance an issue?,' and I can say, 'Well no, she hasn't missed one day this week, or she hasn't missed any days the last month,' and it's all there in front of me. (Principal, School A)

Another segment exemplifies reporting to the Garda (police) and securing that they have the necessary information to know their school:

> They [Garda] could come along; there could be a trial about absenteeism. Maybe they are bringing a parent to court because of lack of attendance. I need to have accurate records, and another court case was missing school, and having inappropriate relationships, they were trying to track the date a student was out, to try to convict somebody, and again, it was important that I had accurate information. (Principal, School A)

The specific VSware element that emerged as an actor in both segments above is attendance data (Figure 4), in relation to other actors, such as the principal, social workers, and the Garda. In this case, attendance data work as a specific plug-in that ensures the school principal is able to emerge as a confident and responsible school leader who has accurate records for his students. This highlights how data-informed activities allow the school leaders to function confidently in their roles within the school. In a broader picture, the attendance data play an important role in surveillance performed by schools (Williamson, 2017), where the school leaders can position themselves in systemic tasks as they forge relations with external actors.

Moreover, Latour (2005) reminded us that plug-ins are specific *activators*. The actions motivated by attendance data in this case are setting school leaders in motion to secure correct information in VSware as the data are 'only as good as the people who record it' (Principal, School C). The characteristics of attendance data as a plug-in continue to materialize in school leaders' exact protocols for fact-checking attendance data before external inquiries are made:

> Where you see an amber there [Figure 4], that is whether they are in-and-out in one day. Red is they're absent, and green means they're present. But also, amber could mean a missed register. So I would have to open up a lot of those ambers and be going, 'Oh, present, present, present, blank, present, present. I'm guessing that student was there.' And I'd basically mark them in. But, 'cause all those gaps, because if I'm running an attendance report or if there are those gaps, it won't, I won't obviously get a true picture. So I spend a lot of time looking at those amber little dots there. Wishing they were red or green. (ML1, School B)

The characteristics of attendance data in relation to the school leader and outside agencies remain stable in the sense that it sets the human actors in motion to collect and report factual data. However, the data materialize as more fine-grained as they are defined by colors; red, green, and amber. From this notion, I find that the plug-in in question is not attendance data in general, but broken down in color and visualized attendance data; all of which may represent three disparate plug-ins that may activate different sorts of actions. Red may activate a support apparatus for the student; amber may activate fact-checking among the leadership team.

While the school leader emerges as confident or responsible, by identifying issues with the data, they actively become a leader who engages directly with the data in terms of recording. This is made possible by internalizing their leadership responsibilities (Ferreira, 2020) and is materialized in terms of accurate data records.

## Discussion and concluding remarks

The material-semiotic analysis of VSware in school leadership practice identified several actors that participated in activities of leadership meetings, reporting processes, and in-house data work. These actors include outside agencies and partnerships, national and local school improvement projects, individuals in varying positions linked to the schools, texts and other materials, as well as VSware digital elements that emerged as actors in the interactions with the actors above. Thus, the heterogeneity is clear from the analysis. However, as is intrinsic to ANT, actors have the ability to 'act on each other' as a result of the materialization process (Fenwick & Edwards, 2012; Højgaard & Søndergaard, 2011; Law, 2009).

On one hand, the analysis illustrated how digitally stable VSware elements materialize as actors; the blue pencil button emerges as an important contributor in building the schools' commitments to whole-school strategies, and the color dates in Figure 4 emerge as vital for the activity of reporting to not only TUSLA but also other outside agencies, such as the Garda. On the other hand, the flexibility of VSware allowed for the digital elements to become over-and-over again, each time with different inherent characteristics. The blue pencil button exemplifies this notion; it allowed school leaders to change behavior entries and behavior categories, which consequently, changed the scripts of the elements. Thus, the software's characteristics emerged according to the interactions it participated in to fit the schools' priorities and contextual concerns.

This is also true for the school leaders in the digitized assemblage: A range of school leader subjectivities emerged through interactions with VSware elements, such as color pie charts, color dates, and icons that signaled editing functions. The analysis showed how the school leaders built their own sense of leadership tasks and duties according to what was happening 'outside' in the digitized practices. For instance, as scene 1 illustrates, the school leaders emerged in their leadership positions in the schools after the data on VSware had informed on a specific concern about students' attendance. When attached to the color attendance data, school leaders were *activated* to perform a series of future actions that internalized in terms of reflections of their roles and egos. In scene 3, as the quotations showed, the school leaders subscribed to VSware data to become more confident and provisionally competent in their job. As subjectifiers, or plug-ins, the VSware data put into motion a set of reflections that declared the school leaders were responsible mediators between teachers' work and external inquiries. This finding indicates two things. First, it illustrates how school leaders' subjectivities are not 'owned' by them, but become in fluctuating relationships. Thus, the school leader as a subject is plural; a result of the digitized practice that is more than the school leader and less than everything within the practice. Instead, the school leader is fluid and contingent on time and space, and everything and everyone that 'happen' or become in direct relation to them. This conforms to the view of the human as an actor network where nothing pertains to the subject, but it is made to be 'by a swarm of other agencies' (Latour, 2005).

Second, the fluid nature of the emerging school leaders (and the VSware actors) suggests their governing role also changes. In scene 1, VSware emerges as static and more inclined to govern its users. It creates priorities for school leaders that may otherwise not have been corporal and visible. In contrast, in scenes 2 and 3, VSware materializes as more flexible. As the material-semiotic analysis showed, the blue pencil button provides school leaders somewhat of a governing role. In scene 2, this is evident as school leaders change behavior categories and thus, change the categories' intentionality; they also directly alter or modify registered data. In relation to the blue pencil button, the data, thus, emerge as less static than one would think, and the school leader is able to act upon the other actors (behavior entries and data). This illustrates how all actors were able to 'act on each other' as a result of the materialization of the assemblage, but that these processes are dependent on the specific activity, and may change as fast as a new series of actions takes place (Moser, 2003).

Existing literatures in education leadership have explored data-driven practices by highlighting accountability measures, standardization, and school improvement (i.e. Heffernan, 2018; Niesche, 2013; Sugrue, 2015). Although these in-house practices are undoubtedly linked to external-internal, and individual-systemic processes, such literature has often dealt with the phenomenon by referring to anthropocentric reflections of how the leader identity is constructed. This article contributes to this considerable research by decentering the human experience and putting the enactment center stage through ANT. The design of the study has allowed to account for the performative characteristics of digital elements, such as data, as they attach and de-attach from school leaders in practice.

Adopting a sensitivity toward sociomaterial framings like ANT can highlight not only the material (and digital) side of leadership enactment, but also how the school leaders function and participate in leadership duties that include various actors, partnerships, and interests. These ideas of the networked subject can help in understanding mundane tensions where school leaders negotiate their own and others' governing roles. These are issues that are likely to stretch to overarching representations of school governance that are presented in ready-to-use digital solutions, in the form of software, apps, or persuasive guidelines. We need to better understand the various material processes that stretch between time and space through which numerous people, discourses, and practices are presented in software like VSware. Digital tools are not neutral devices, but enablers of certain concerns, facts, and problematizations. Consequently, software like VSware will encourage and show traces of subjectivities connected to humans in various positions linked to schools.

Future studies might examine how software like VSware presents several subjectivities within the same piece of data, be it leadership subjectivities, student subjectivities, or institutional subjectivities. Such studies may also address the various practices that connect the different subjectivities, rather than analyzing one practice at a time. The assemblages of relationships constituting such notions can potentially (and preferably) shed light on negotiations between the various actors. In this regard, ANT as an analytical approach presents as empirically capable of examining school leadership and practice as assemblages of things and people in continuous governing processes in education.

## Notes

1. Although 'assemblage' may refer to several sociomaterial conceptualizations, I do not use it as a concept in this article.
2. The informants were asked to take screenshots of features in the software they often used in their daily practice and anonymize them.
3. VSware has data-based features for attendance tracking, behavior reporting, and assessment. The former two were chosen for the analysis because the informants used these features the most, and because the assessment feature was relatively new in VSware at the time.
4. Educate Together Schools are non-fee-paying schools that are not under the patronage of the Catholic Church (and are not affiliated with any specific religion). They are state-funded and teach the National Curriculum.

## Disclosure statement

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

## Notes on contributor

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III

# Learning analytics as modes of anticipation: enacting time in actor-networks

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# Learning analytics as modes of anticipation: enacting time in actor-networks

Learning analytics platforms (LAPs) have become important modes of anticipatory governance in education. Educational futures are governed by utilizing various forms of learning analytics to track student data over time, suggesting that school leaders and teachers are expected to improve school quality by engaging with digital presentations of prediction, anticipation, and decision-making. This study investigates the LAPs Conexus Engage and Insight as they unfold in school leaders' practice by drawing from actor-network theory. School leaders' interaction with the tools are examined through audio and screen recorded interviews at three lower secondary schools in Norway. The findings show how anticipation emerged in actor-networks as both fluid and stable, encouraging the problematizations and priorities of school leaders. School leaders also adapted the LAPs to their own practice. The findings further suggested that time emerges on the premises of LAPs as entangled events rather than through chronological understandings of time.

Keywords: learning analytics, anticipation, time, actor-network theory, school leaders.

## Introduction

Learning analytics platforms (LAPs) have become important modes of anticipating education as they emphasize the prediction of educational futures by virtues of forethought and risk, impacting the course of action for the user interacting with the platform (Beer, 2018; Mackenzie, 2013; West et al., 2016). LAPs refer to forms of data mining that track students' development over time and can, in this sense, steer the present by referring to possible images of the future, while also drawing on lessons from the past (Gedrimiene et al., 2020; Thompson & Cook, 2017). Such emerging forms of data use enable schools to govern educational futures and have been described as forms of anticipation (Williamson, 2016). Anticipation is 'the palpable effect of the speculative future on the present' (Adams et al., 2009, p.247). The strong connection to the future, in this understanding of anticipation, implies that time is an essential component; the way time emerges in educational life makes anticipation a speculative practice. Anticipation in education is thus about orienting learning in time, of creating connections with the past and the future, and of using prediction as a narrative mode to invoke actions in the present.

Anticipating the future in education has previously been studied by exploring how policy and curriculum construct images of the future on a national and international level (for instance Bansel, 2016; Voogt and Roblin, 2012). Some recent studies however, show how education now produces new instruments of anticipation, such as LAPs. Connecting anticipation to digital technologies are in early stages of development (Lingard, 2021), however, two main research strains can be presented: one that explicitly targets anticipation as embedded in LAPs (Williamson, 2016; Webb et al., 2020), and one that implicitly discusses anticipation in LAPs and similar digital technologies through conceptualizations of time (Decuypere and Simons, 2020; Hassan, 2017; Lingard and Thompson, 2017). These studies draw from different theoretical approaches, but what they have

in common is that they critically address how anticipation and time gain new meanings in digital educational environments by interrogating issues of educational politics and practice. The majority of the studies this far are theorizations, or studies of inherent properties of platforms, meaning few have investigated what happens in schools when the tools are employed (although see Alirezabeigi et al., 2022 for research on student level). Studies exploring how anticipation in LAPs encourage problematizations and decision making in schools remains underdeveloped.

This article makes further contributions to this body of research by examining two LAPs in practice (Engage and Insight) as they unfold in school leaders' work-life. The platforms are developed by the company Conexus that work in cooperation with the Norwegian Directorate for Education and Training. They are designed to combine data from multiple sources, including the Directorate's yearly student survey ('elevundersøkelsen'), national tests, and mapping tests stemming from over 30 different learning modules (Conexus, 2021). Academic performance and wellbeing can be compared across the different data sources, and some utilize visualizations that resemble a traffic light system. The two LAPs are offered across the Scandinavian countries and are utilized by the majority of Norwegian municipalities (Conexus, 2021).

In Norway, the trend of anticipating education can be attributed to various governing initiatives over the last decade. Efforts include the introduction of the National Quality Assessment System (NQAS), where national tests were introduced, in addition to self-evaluations, student surveys, and publicly available statistics (Bergesen, 2006). These efforts are characterized by predictive forms of testing, usually in reference to national standards and benchmarks. In the aftermath of these new quality measures, several national webpages and platforms have been developed to provide schools with various datasets in one place, including Engage and Insight (Caspersen et al., 2017). Today, anticipating education is digitalized in the form of policy texts and curricula (imagining 'the future school'), the introduction of the value-added indicator (schools' contribution to student achievement), and an increased interest in learning analytics and adaptive tests through various digitalization strategies in basic education and training[1] (Directorate for Education and Training, 2020; Ministry of Education and Research, 2017). Within Norwegian schools, educational futures are governed through an increased concern with how new learning technology will develop educational practices considering unpredictable futures and societal risks (Hansen et al., 2021). School leaders are responsible for facilitating these processes and ensuring that their students have the necessary skills to learn and adapt to future uncertainties (Lunde & Gunnulfsen, 2021).

The main aim of this article is to unfold anticipation in Norwegian school leaders' interactions with two LAPs. I further aim to problematize the traditional understanding of time in educational research as chronological by drawing from actor-network theory (ANT) to conduct analyses on the interactions that produce and connect anticipation in practice. I analyzed data from three lower secondary schools in Norway, including interviews with screen recordings from the LAPs. I asked

[1] Here, basic education and training refers to primary and lower secondary levels.

two main questions: i) How do LAPs, in practice, enact[2] anticipation? ii) How do school leaders act on these modes of anticipation?

The article proceeds in five sections. First, I begin by discussing how anticipation is intrinsic to LAPs. Secondly, I introduce how to think about time and anticipation through ANT. Third, I present the data, methods, and analytical steps of the study. Fourth, I unfold the LAPs by structuring the findings in three modes of anticipation. Finally, I discuss the multiple modes of anticipation that emerged in the examples drawn from school leaders' practice and what these may imply for the understanding of time in education. In the conclusion, I discuss this article's contributions and suggest further routes of inquiry.

## Anticipation in Learning Analytics Platforms

> Learning analytics platforms act as anticipatory devices that are embedded within the pedagogic routines of the classroom, and are based on technical developments in 'machine learning'. The importance of machine learning algorithms is that they exhibit some tendencies of emergence, adaptivity, anticipation and prediction (Williamson, 2016, p. 136).

In the quotation above, Williamson (2016) describes the production of big data through learning analytics as a new form of anticipation that monitor, track, and audit students' development, optimizing teaching and learning over time. Typically, LAPs connect the past to the present and future by drawing upon data, things, people, subjectivities, and values to predict the future (Williamson, 2016). Consequently, to understand how LAPs enact particular modes of anticipation, it is important to understand the arrangements of time that may emerge in practice. Linear time was created in modern times as a way of structuring and administrating life as an "arrow of time" (Latour, 2005), a timeline oriented towards the future. This has been the dominant form of managing time in education and can also be found in LAPs as a broad form of 'computational policy' (Gulson & Webb, 2017). Other practices of chronological time in education include timetabling, performance goals, and end-of-year examinations. Although the present is the object of intervention, the past and the future become manageable and governable through interventions in the present.

After being prompted by *risk subjects* (e.g., a score below the national average), school leaders may engage in processes that consider *how* they can move forward (Adams et al., 2009), including accepting that both the past and future can be presented and acted upon in the present. Thus, the future and the past may encourage school leaders' habits, tasks, and concerns (Luckin et al., 2016). The focus on action as a way for anticipation to emerge conforms to science and technology studies (STS) and ANT literature, where scholars argue that "platforms are what platforms do" (Bratton, 2015, p. 41). Platforms prepare for action by modeling past, present, and future outcomes as numerical and visual data, textual recommendations, and support material (Kaliisa et al., 2021; Van Dijk, 2013). By organizing its internal elements, such as data and text, platforms represent an external environment in which the action takes place. School leaders, as the heads of schools and

[2] I use 'enactment' as a word, and not a concept in this article.

prime authorities to secure in-house quality, are one external reality that can be prompted by the plan of action inscribed to the platform (Bratton, 2015). In this sense, an LAP is a framing machine that has the ability to draw time together through interactions in practice. Thus, platforms should be analyzed by the performance they enable in practice, as they favor and blur some actions over others. In the next section, the analytical framework used in this study is presented to explore how LAPs may emerge as a form of anticipation in practice, as effects of time produced by actor-networks.

## Actor-Network Theory (ANT) and Time

ANT is an approach that has widely been used in the STS literature but also in fields such as anthropology, sociology, philosophy of social science, and education. In general, ANT seeks to treat human and non-human actors symmetrically (Law, 2004), which in this study implies that LAPs can become performative and obtain agential characteristics. In addition to directing attention to the anti-anthropocentric notion of agency, ANT is a relational approach concerned with how actors coalesce in networks of social practice (Latour, 2005; Law, 2004). This means that school leaders as individuals cannot be confined to their own intentions, perceptions, or actions in practice; they are shaped by whatever or whomever they interact with. ANT concepts are used as 'sensitivities', meaning, they are used as analytical lens to draw nearer to a phenomenon. Early ANT studies are characterized by the works of scholars like Bruno Latour and Michel Callon, and include discussions of how actors come to be actors (both human and non-human) and how these are enrolled in networks. 'After-ANT' studies proliferated towards the end of the 1990s, aiming to further broaden the conceptual scope of ANT by exploring links within networks and showing multiple modes of reality (see for instance Law, 2004). I draw inspiration from the 'after-ANT' turn to construct the analytical lens in this study.

The previous section explaining anticipation suggested that to understand anticipation in education, there is also a need to understand time. Traditionally, ANT literature rarely discusses time. An exception is Latour's (1988) comment on time in modernity, where he urges scholars to focus on "the construction of time itself on the basis of the agents' own translations" (p. 51), suggesting that time is folded by relations. Despite ANT's limited attention devoted to time (explicitly), time is implicitly described as a possible effect of actor-networks (Fenwick & Edwards, 2012; Thompson & Cook, 2015). Actor-networks are fluid, meaning they exist in particular places of space and time (Decuypere, 2019). As actors form different or extending relations in practice, so does the network, indicating that actors may enact time through any connections with actors in the past, present, or future. In this sense, there are two concomitant points I use to consider time through ANT: a) examining the fluidity of actor-networks, and b) considering how time emerges in multiple ways through the fluid actor-networks. I draw from two ANT sensitivities to address these two points: fluidity and multiplicity.

A network in its accomplished state is a frozen mirror of an activity or practice. Simultaneously, networks are 'black-boxed' in that they conceal all the negotiations that have brought the network to life, making the network a fluid presentation of the social world (Latour, 1987). Connections between actors are negotiated by forces of persuasion, governance, resistance, and opposition (Fenwick & Edwards, 2012). The emphasis is less on the structure but rather on how actors move and change across time and space. This can be illustrated by an example from schools. A school improvement project on numeracy brings together school leaders, texts, guidelines, numbers, and schemes during the course of an introductory leadership meeting. This network can be stable by stretching during the course of the project and into the future, for instance, as the leadership team makes changes to the next semester's timetable to fit with new priorities. In this case, the network has extended in time. However, during a second meeting, there are contesting thoughts on the necessity of introducing a new school improvement project, as national test results from the year before show that there is no immediate risk concerning students' numeracy skills; this contention makes the network appear less static. The network established in the first leadership meeting is broken by a set of new relations (and a new actor), dating back to a year-old test. It may be that the new actor, last years' national test results, circulates towards future leadership meetings 'gathering allies, shaping thoughts and action and thus creating new networks' (Fenwick & Edwards, 2012, p. 14), as it shows that literacy as opposed to numeracy seems to be the *risk subject* at the school (Adams et al., 2009). In this sense, networks are fluid, as actors retain their agency and integrity by virtue of the relations that are formed (Law, 1999). 'Fluidity' therefore moves the analytical attention towards movement in relations and interactions (Fenwick and Edwards, 2012), and I have used this sensitivity to draw nearer to interactions between school leaders, the LAPs and other actors that emerged in their direct sphere. LAPs' ability to anticipate, and possibly steer action, can in this sense be said to not center around a number of allies, but rather about keeping those interactions stable over time (Law, 1999).

As a network effect, time can be conceived as mechanics that emerge out of particular network compositions (Decuypere, 2019). The example above indicates that whenever actors connect with other actors at different points in time, they simultaneously perform time. The actors' ability to partake in multiple networks simultaneously and/or across time is therefore essential (Deleuze, 1988). From the specific example above, the national test results can connect and emerge with other networks at any given point in time or space. National test results may emerge as an actor in multiple schools, district offices, departments, and directorates and can come to present different things in different practices because the way the relations unfold is different (Law & Singleton, 2014). Mol (2002) utilized the ANT sensitivity of 'multiplicity' to describe how practices are enacted differently. That study explored different enactments of atherosclerosis based on clinicians', pathologists', and radiographers' practice, among others. These enactments were emphasized because they illustrate multiple realities. Multiplicity suggests that when the world is made of relational compositions that can attach, detach, and re-attach (as was discussed above), many realities will exist over time and alongside each other (Law & Singleton, 2014; Mol, 2002). In this sense, time also becomes networked.

Networked time is different from that of linear clock time. Likewise, if the network represents a digital platform in practice, the network follows the logic of the digital as a "febrile and discontinuous" process (Hassan, 2017, p. 76). Therefore, time may emerge as limitless or bounded; it can span backwards for years or only reach the next few minutes—there are multiple ways for them to unfold. Moreover, just as an actor does not exist in isolation, time can also be thought of as interconnected (Sheail, 2018). This suggests that there is a relationship *between* times that connect with each other.

In this article, the fluidity and multiplicity of time coalesce to illustrate multiple webs of relations that enact anticipation and encourages school leaders to act accordingly. I chose to use these two sensitivities as analytical lens in my analysis because they resonate strongly with the performative effects of LAPs. LAPs, being digital devices that can adapt to and adapt practice, are devices whose inherent characteristics can change and mean different things according to how their activities unfold in practice (Ruppert et al., 2013). This attunes to an understanding of practice as fluid, and as multiple, because the different relational compositions move and are enacted continuously through digital flows. In addition, the two sensitivities provide a novel understanding of time in digital education practices, which explores more closely how different times exist conjointly. While LAPs can be thought of as an activity and a place in which school leadership practice emerges, where space and time are closely linked (Decuypere & Simons, 2020; Lingard and Thompson, 2017), this article focuses on an area that has been somewhat neglected in educational research (Lingard, 2021); micro examples of how LAPs produce modes of anticipation in schools. In other words, anticipation is presented implicitly in the performance of time within the actor-networks of the LAPs. In the forthcoming section, the methodological steps taken to place the analysis at the level of enactment (rather than perception) are presented to explain how the data collection and analysis was designed to account for school leaders' interactions with the LAPs.

## Data and methods

### *Research setting and design*

Insight and Engage were both chosen as examples of LAPs in Norwegian school leaders' practice because the school leaders frequently interacted with data from both platforms when analyzing school results. This study aimed to 'follow' the actors through rich descriptions provided by school leaders at three lower secondary schools. Semi-structured interviews were conducted during the fall and winter of 2019/2020. Conexus platforms are utilized primarily in primary and lower secondary schools in Norway. Informants were interviewed in lower secondary schools for two reasons: assessment through numerical grading is introduced to Norwegian students as they enter lower secondary school; and a larger databank is available from lower secondary schools as it includes data registered throughout primary school, in addition to the data collected from 8$^{th}$ to 10$^{th}$ grade. These considerations suggest that data flow in the Conexus platforms is rich in lower

secondary schools and would provide further examples from practice. Thus, participating schools were selected based on grade level (lower secondary), that their municipality had purchased and mandated the use of Conexus platforms, and that the leadership teams used Insight and Engage as part of their leadership roles within the schools.

All three schools reside in Eastern Norway, but in three different municipalities. School A is a medium-large lower secondary school in a suburban area, whereas School B is a medium-sized lower secondary school in an urban area, and School C is a small lower secondary school in a rural area (Table 1). Please note that all names are pseudonyms that do not reflect the informants' gender. Three individual interviews with school principals and three group interviews with middle management (deputy principals and year heads/ department heads; Table 1) were conducted. The number of informants from the three schools varied according to the size of the leadership team, which is based on the number of enrolled students in some municipalities. Informants that formed middle management usually covered several roles outside of their leadership duties, such as teaching and special needs education responsibilities. However, during the interviews, they answered and participated based on their leadership positions.

Because some aspects of the Conexus platforms relate to steering mechanisms, practices in which principals usually have a different role as opposed to middle management, each principal was interviewed individually to prevent them from silencing the other participants (Smithson, 2000). The principals were asked to describe their personal use of the LAPs, and audio of all interviews was recorded. As a way of being sensible to ANT's agential side, where LAPs are thought of as what they *do* (Bratton, 2015), the LAPs were utilized during the group interviews. A demo-user based on a fictional school with fictional data was used for both Insight and Engage. The informants interacted with the software throughout the interviews. Rather than 'staging' the group interviews by giving the informants specific tasks on the platforms, open-ended questions were asked. Examples of when the informants used the software, in what situations, how, and with whom, were explored. The informants themselves chose how and when to interact with the LAPs during the interviews; thus, anticipation in familiar events and activities of the informants was examined. The intention was to use LAPs in the individual interviews as well; however, it became evident that the principals did not voluntarily engage with the platforms during the interviews.

Table 1: Overview of participating schools and informants with pseudonyms.

| School | Informants (pseudonyms) | Size and grade levels |
|---|---|---|
| School A (Sa) | Markus (principal)<br>Petter (year head)<br>Karina (year head)<br>Lotte (year head) | 450–500 students<br>8th–10th grade |
| School B (Sb) | Therese (principal)<br>Marthe (year head)<br>Randi (year head) | 300–350 students<br>8th–10th grade |
| School C (Sc) | Anne (principal)<br>Lars (deputy principal)<br>Thomas (year head)<br>Ingeborg (year head)<br>Hedvig (year head) | 200–250 students<br>8th–10th grade |

The group interviews were recorded through the Captura software, which simultaneously recorded on-screen activity and audio. A backup recording was made that only recorded audio. The main aim of the interview design was two-fold: i) LAPs were used to invoke familiar situations to help the participants elaborate on examples from practice (Greenbaum, 2000); and ii) having LAPs 'present' during the interviews helped me follow both actors: the school leaders and the platforms. This captured a more symmetrical approach of following actors, as they were analyzed simultaneously based on what they performed in practice (Latour, 2005). The interviews were transcribed in two columns: one with text and one with screen prints of the platform features that were interacted with during the interviews. Based on these transcriptions, 16 screen prints were added to the analysis, including the front pages of Engage and Insight, results from national tests and the student survey, as well as individual student reports.

*Data analyses*

The interviews were analyzed in three steps. First, the interviews were analyzed to outline large trends in the data (Hsieh & Shannon, 2005) and to show the various actor-networks of LAP enactments in school leaders' practice. From this analysis, three main points were stressed:

i) There were several references to actors that belonged to past and future practices
ii) The platforms emerged as relatively closed, in which the school leaders had little or no chance to make changes to it digitally
iii) The school leaders were prompted to design a set of future actions. In this sense, the school leaders acted upon the modes of anticipation to optimize the present and the future, and some autonomy emerged in practice

In the second step, the interviews were coded relationally. Four columns were added, one for contextual information that included quotes from the interviews, one that included a short description of the activity, one for interactions and relations (including the period for these interactions where deemed necessary), and one that commented on the types of time that grew out of the actions (see Table 2). This part of the analysis disclosed the various networks that emerged in the informants' interactions with the LAPs, while simultaneously placing the networks in multiple enactments of time.

Table 2: Excerpts from the coding scheme.

| **Segments from transcriptions** *Contextual information* | **Activity** | **Relations/interactions** | **Time** *Past/present/future* |
|---|---|---|---|
| "We use it to map new 8th graders who come to us. And in a way, that's work that has been done in primary, right" | Analyzing trends of upcoming/future students | Principal – results from primary on Conexus Engage (past results) | Results from the past (primary) are presented to map future students |
| "And then, we look at what has happened between 8th and 9th grade (…) sometimes it has not gone too well, and that's not good for anyone, right. So first, as a leadership team, we sit and look at that [results from national tests on Conexus]. We try to analyze by looking backwards, and I would say we do that with all these datasets, we look backwards to see whether there is a consistent trend." | Analyzing trends of present students | Leadership team – national test results on Conexus Insight (present results) | Past (results) and present (results) Chronological |

The three schools proved to have similar enactments; thus, the coding scheme (interviews from each school were coded individually) was further developed. Rather than framing the analysis as three different enactments at three different schools, the first coding scheme was categorized into three main modes of anticipation in Nvivo. These present an overarching categorization of interactions between school leaders and the LAPs that produced time and anticipation. The screen prints, subtracted from the screen recordings, were included and analyzed at the level of action. The analysis displayed which elements from the LAPs that the school leaders connected with, and these were compared to the transcription data to illustrate how digital elements and school leaders emerged collectively in practice. Moreover, the design and analysis of the interviews (audio and

screen recordings) focused on actual interactions between the LAPs and school leaders, rather than through the informants' perceptions of interactions.

The main limitation of this study concerns the sample size. This study presents data from three schools in one country (although, three different municipalities), and its findings should therefore not be treated as generalizable, but as suggestive (Maxwell, 2012). Digital platforms, and their practices, are characterized by their particularities. This means that generalizations extending to other LAPs should also be treated as suggestive. However, the consistency in examples from practice across the three schools may strengthen the validity of the findings by implying analytical generalizations in that the findings can be used to invoke questions of what might unfold in other schools (Kvale and Brinkmann, 2009). In light of the analytical framework used in this study, I have therefore not attempted to quantify connections/interactions or generalize across contexts. Rather, I zoom in on a small number of practices.

## Unfolding modes of anticipation

Three modes of anticipation emerged from the analysis: a) analyzing trends, b) calculating risk subjects, and c) possibilities for action. These present several disparate but connected enactments of time as an implicit presentation of anticipation. This section shows how actor-networks move in time as anticipation emerges with different characteristics in the various enactments. Quotations from the interviews and screen prints are presented in the analysis to provide the readers with contextual information.

### *Analyzing trends: from near past to present future*

From the interviews, a dominant example from practice that emerged was the school leaders' frequent use of data to analyze trends within student groups. The level of data analysis at this stage focused on a group level, referring either to classes or to whole-grade groups. Inherent to these enactments were historical data and the stretches of time in which student data was gathered and made available to the school leaders. To engage with the data, school leaders interacted with data from Insight belonging to graduated, current, and incoming students. In the following quotes, the leadership team and the results from student surveys, exams, and end-of-year grades from various points in time materialize as actors by contributing to the action of analyzing school trends:

> We just got in the results from the student survey in 10th grade. Before the leadership meeting, I looked into the numbers on Insight. I made a PDF file where I see 10th grade this year, and I see 9th grade last year, meaning the same group of students (…). That's when we can identify what stands out; suddenly there is someone who is flaming red, while others are green (Petter, School A).

> The surveys on Insight are used on a processual basis, in addition to exam results and end-of-year-results. It's to monitor and follow the students' development over time (…). We carry out the student survey on all

> three grades [8th–10th grade], so we have the opportunity to follow the students through the three years. (…) We also have access to completion rates from upper secondary. So we go in and measure them [the students] three and five years after graduation. (…) And they have a portfolio from primary with different test results. The students we get in 8th grade, they have a lot of data on there [Insight and Engage] already, it usually starts with mandatory mapping tests in first, second, and third grade, and national tests in fifth grade (…) So after a while, Conexus gains a pretty big base of results that stays in the system (Anne, School C).

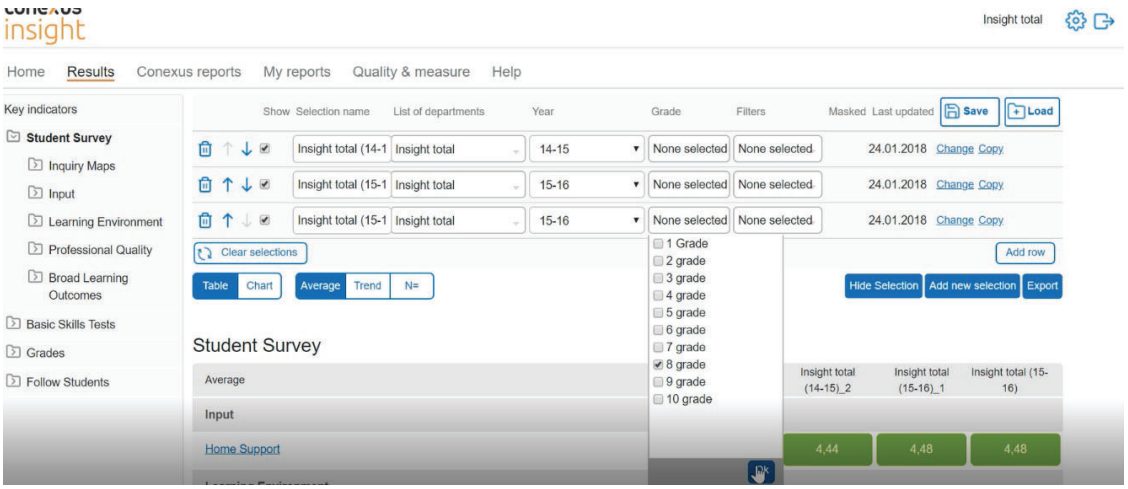

Figure 1: Historical data on Insight (demo-user)

In these examples, the network has stretched backwards in time by connecting to actors from the past. This includes historical data from students' past achievements at the primary level and within their time spent at lower secondary school (see Figure 1). Data is gathered and analyzed on a processual basis, i.e., last year's 9th graders who are now in the 10th grade. On the one hand, trends in student performance portray a linear enactment of time, as the school leaders follow the students chronologically from year to year. As LAPs, the platforms can organize chronological anticipations in the past, present, and future with a certain continuity (Webb et al., 2020). On the other hand, by connecting to pieces of historical data, multiple realities are enacted simultaneously (Law & Singleton, 2014; Mol, 2002), e.g., past and present performance. By interacting with data that represents a past reality (albeit for the same students), the past and present are juxtaposed and display two realities that connect through Insight and Engage.

The network also expands in time as informants follow the completion rates of graduated students. Their group of students may promptly graduate upper secondary school (within three years), or they may graduate within five, six, or eight years. In either case, following the students across their school life is extended and strengthened by attaching to the data referring to graduated students. Thus, anticipation is reinforced by gaining new allies (Law, 1999), which in this case, is presented by completion rates. As a form of time, completion rates can be thought of as 'present futures,' an enactment of the future that is fabricated and inhabited in the present. The network time, as explained by Hassan (2017), is here enacted by various timelines that are 'stacked' alongside each other (Bratton, 2015); the past, present, and future, but which emerge conjointly in 'real-time' (Luckin et al., 2016; Williamson, 2016). This reflects a form of anticipation that provides

surveillance on student performance at every level, even beyond the boundaries of a particular school, grade, or class (Luckin et al., 2016).

*Calculating risk subjects: betting on the future*

When large datasets are analyzed and school leaders look for trends indicating positive or negative curves, the data are rarely based on an individual. Once a deviation is detected, however, the school leaders move to look for answers in individual students, which can be seen in this example from Hedvig in School C:

> The student survey in our grade showed that some girls felt violated two to three times a month. It was dark red. So, we went on a mission to find out who these girls were.

By interrogating exactly whom the data belonged to, a set of new relations unfold as school leaders enroll new actors to take part in practice. In this particular case, the informants connected to several students, teachers, and other staff at school to identify the girls in the survey. In other cases, such as in School B, deviations in datasets were interrogated by crosschecking results on several standardized mapping tests in Engage. By creating a student report, the school leaders select a specific student from a list and choose several data points of interest. In Figure 2, the options are data from mapping tests in literacy, data connected to learning modules and teaching material, and data from the Directorate's tests (national tests and support tests in literacy). The informants reported that they often wanted to check whether low results on literacy in national testing could be explained by equally low scores on standardized reading tests by comparing data in the student reports. Thus, anticipation is enacted by the school leaders, colors, benchmarks, digital reports in PDF files, and fabrications of the future, all of which contribute to students being assessed as risk subjects.

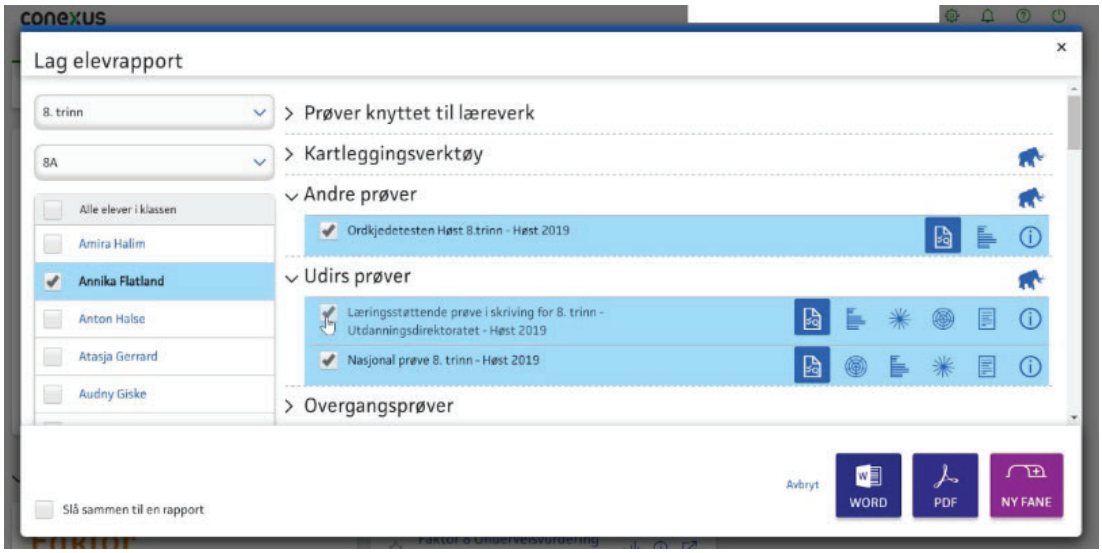


Figure 2: Student reports on Engage (demo-user)

Students become risk subjects based on two scenarios. In the first scenario, they are enacted as 'needles in a haystack' through colored areas or by their level of mastery, where they are compared to other students' performance and qualifications. For instance, in Figure 3, red displays immediate danger, and orange and yellow students dwell in a danger zone; when they turn green, they are no longer considered a risk. In Figure 4, national test scores are presented according to level of mastery, one (grey) being the lowest and five (purple) being the highest. In the second scenario, once the school leaders create an individual report, students at risk are emphasized with meticulous detail through digital reports (Figure 2). The once established network in the first mode of anticipation is now altered by a set of new relations: individual student reports, mapping tests, and other standardized tests. In the first mode of anticipation, the three 'doings' of time enacted groups of students, while this particular example enacts student groups as well as individual students as risk subjects, where the future is especially emphasized. The desired future gains new meaning in the present, as it is networked and brought to life in the present. Here, the actor-networks interact, as each gains new allies, and perform the same purpose to anticipate education and encourage school leaders in their daily practice (Fenwick & Edwards, 2012; Law, 1999).

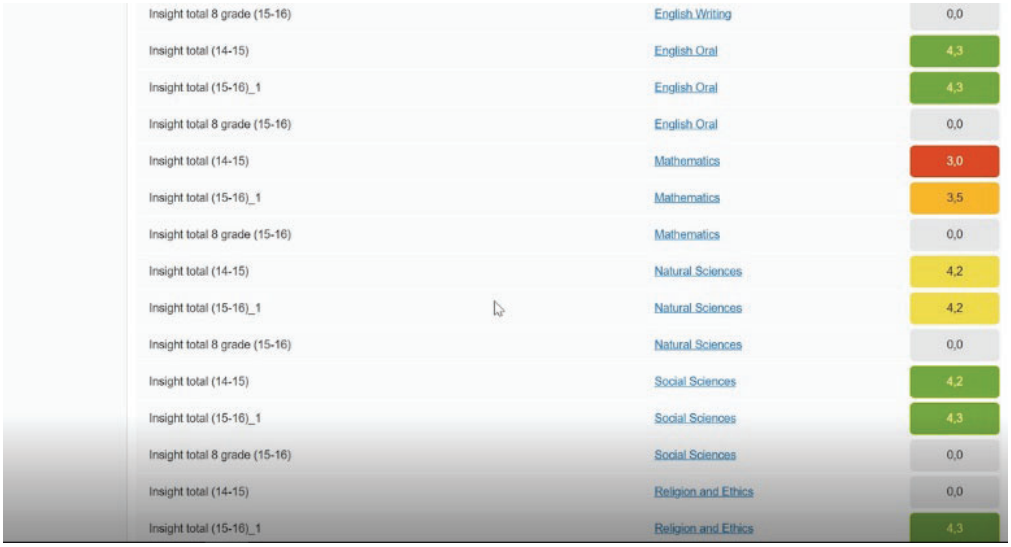


Figure 3: Colored data based on exam grades.

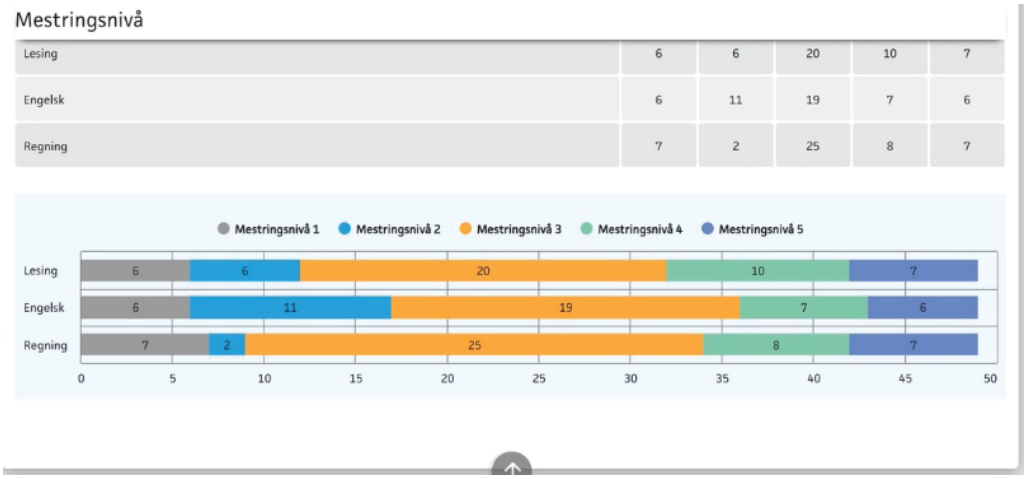


Figure 4: Colored data based on national test results.

The various elements and learning modules produced by the LAPs (student reports, visualized data, etc.) all connect to future predictions of exam results, school completion, and general life skills beyond school. The aim of anticipating risk focused on changing the course of chronological events that affected the students negatively, e.g., a yellow student turning red or staying red throughout school. As one leader expressed; "if there are any red students, we tend to address these first and foremost". In other words, there has been effort to optimize the future by underscoring what the school leaders can do now. The upcoming section will provide examples of how the school leaders acted to enroll the future in the present.

*Possibilities for action: a desired future*

An important tenet of studying platforms in practice is that they are what they *do*, or more precisely, platforms should be analyzed by the actions they encourage (Bratton, 2015). On the one hand, the Conexus platforms were relatively closed and bore few elements of a user-driven design (there are no edit and delete functions). Informants noted that they would have to make calls to the municipality or to Conexus' support to suggest even minor changes, and most of the time, such requests would not be considered. "We just have to trust them [the municipality and Conexus]," argued one principal. The following quotes show how the LAPs connect to such external processes with municipal superintendents and during in-house school development projects:

> We [the leadership team] get a response document based on results from Insight. We have a discussion on it and pick out things to say: this is something we have to take as a school, we have to work more with this area. And if there is a conclusion during the meeting that we have to do, then these are areas that will be targeted in school development projects. The response document is our basis. Maybe we have to work more with literacy, or numeracy, or to look at how we can engage the students more (Therese, School B).

> We've used it to find areas for development, and we've incorporated it in our school development plan (Karina, School A). Yes, and it has consequences for the schools' development plan, what we prioritize,

> because we can't work with everything at once, you can't have too many focus areas in that plan. But that [Conexus data] is reflected there [school development plan] (Lotte, School A).

The first quote refers to a quality development meeting with municipal superintendents. These meetings are usually held regularly in each municipality, where school principals and other members of the leadership team are invited to discuss school results. Here, Insight provides the school leaders and the municipal superintendents with data on school performance, and by connecting to the superintendent, Insight is generated by governing practices in which school leaders are held responsible for securing school results above a certain level. As one principal noted, "they really like it when it's green."

On the one hand, the two quotes above (and the previous screen shots) show how the LAPs encourage school leaders to target specific areas, which give certain direction to what school leaders can prioritize when engaging in important decision-making (i.e. targeting 'red' students, or students that have achieved the lowest level of mastery). According to the informants, certain tests on Engage provide school leaders with instructions and advice on how to help their students achieve higher levels (however, this feature was not available in the demo-users). This feature is called 'advice for measures', and suggests that Engage also works as an actor that offers packages of solutions to its users. The network therefore extends in time by following the tasks and concerns of school leaders as they initiate, change, and coordinate their schools' priorities. In this sense, anticipation demands action in the present by carefully considering *how* the future can be acted upon (Adams et al., 2009).

On the other hand, while the LAPs emerged as 'closed' in the sense that users have little autonomy within the platforms, some autonomy can be found in practice. The way school leaders acted on the anticipated futures, unfolded in two ways. First, the school leaders emphasized their autonomy in purchasing learning modules within the platforms. In general, the choice to purchase and use Insight and Engage lies on a municipal level, but schools stand free to choose learning modules and which tests to focus on (except of course, the nationally mandated tests and surveys) (Gilje et al., 2016). In this sense, the school leaders selected data from the LAPs that would serve their schools' priorities. Second, the quotes above show that data and reports from the LAPs are used to negotiate school development projects, both on a municipal level and at school level. When used in practice, the platforms thus invited connections to other actors; internally by connecting to teachers, in-house knowledge and school priorities, and externally to municipal superintendents and their policies. As these interactions unfolded, the school leaders adapted practice to fit with their contextual concerns, connecting to the LAPs to put forward a set of actions that would secure educational quality. In this sense, the school leaders acted on the anticipated futures by being encouraged by the LAPs, *and* by adjusting the use of the platforms to real-life scenarios. Put differently: the interactions yielded fluid activities with LAPs that show how both actors act in practice.

## Discussion

The analysis of school leaders' interaction with LAPs demonstrated how various actors move across time by attaching and detaching from the network and by interacting with actors that are presented in the past, present, and future. Thus, the relations unfolded fluidly according to the situations in practice (Fenwick & Edwards, 2012). In the first mode of anticipation, analyzing trends, the leadership team connected to results from national tests, student surveys and completion rates across points in time. In the second mode of anticipation, calculating risk subjects, the digital elements inherent to the LAPs extended their relations by forging connections with individualized data. Such data include the student reports and standardized tests on Engage. During the third mode of anticipation, possibilities for action, the network expanded both in terms of the actors involved and across time. Municipal superintendents attached to the network, and school improvement projects were initiated. The configuration of the LAPs was consequently also extended as school leaders performed activities that could span several weeks, months, and years, suggesting that other actors could be drawn in through future actions (Latour, 2005).

In agreement with Mol's (2002) notion of multiplicity, there were multiple modes of anticipation; therefore, they unfolded in multiple ways. Anticipation emerged as group data from the past, present, and future. Significant trends in the data enacted anticipation as both chronological and parallel events. The color red presents anticipation as a future risk for the schools, and green is anticipation as a desired state. However, anticipation is also a highly personalized process; student reports enact anticipation by providing a set of benchmarks that can be compared. School leaders enact anticipation by managing the future (and the past) in the present. Municipal superintendents enact anticipation by holding school leaders responsible for school quality in the form of numerical data from Insight. Therefore, anticipation is personalized, visualized, numerical, digital, and social – moving fluidly between the different points in time and enacted multiply by its various actors.

The multiple modes of anticipation have implications for how time is understood in education. Time is de-linearized by the web of relations that drive the arrow of time to become obsolete, as the temporal effects follow the rhythm of the network (Hassan, 2017). This suggests that time is enacted by the network, and more specifically, through human-digital networks. The modes of anticipation presented in this study include real-time fabrications and scenarios from the past and future that emerge as present possibilities for action. These findings further indicate that anticipation is not performed solely by projections of the future; conversely, the future (and the past) is made available in the present through surveillance, governing and practice (Luckin et al., 2016; Williamson, 2016). This leads to a concern for the individualized and personalized, components that platforms can offer through their extensive use of learning analytics and support material. That is to say, LAPs structure the uncertain, the possibilities for action, and the solutions.

School leaders acted on the modes of anticipation by enacting time as *probable* or *presumed*, indicating that the future can be predicted and foreseen following a consequential logic. For

example, if you ensure that your school targets literacy development, your results in national tests and your students will benefit equally. Thus, the LAPs and the school leaders, emerge as actors of contemporary educational values, governing targets that have been materialized and operationalized by determining what to problematize (Williamson, 2016). These findings illustrate the digital (data, visualizations), social (actions, school leaders, municipal superintendents), and temporal components (pasts, presents, and futures) of LAPs as main mechanisms in which a wide range of actors, things, and values are assembled to act on educational anticipation.

The larger picture of anticipating and governing educational futures stems from various intrinsic, but external, actors connected through the LAPs. A valuable example is the different learning modules where students are made into risk subjects. On the one hand, these learning modules are presented as a production of the Conexus platforms. On the other hand, several of these stem from educational publishers (sometimes in cooperation with Conexus), meaning that the definitions between what is considered a public (Conexus through their cooperation with the Directorate for Teaching and Training) or private actor (Conexus themselves and through integrations with several commercial companies) are blurred for the informants. This is further demonstrated by questions of who to 'trust,' as exemplified by one principal, who illustrated that he due to a lack of autonomy prescribed to the LAP, "just had to trust them". Questions of culpability and responsibility consequently became networked and black-boxed in practice, as 'them' refers to both municipal superintendents and Conexus. Rather than framing the platforms as working *in the service of governance*, however, the multiple modes of anticipation showed how the LAPs, and school leaders, work *as governance* (Bratton, 2015), as the events are not isolated or unrelated but form part of an entangled whole (Law & Singleton, 2014; Mol, 2002). The actor-networks have thus put into effect how LAPs and school leaders are part of a greater governing machine that feeds on the predicted and anticipated.

## Conclusion

This study asked how two LAPs enact anticipation in practice, and how school leaders act on these modes of anticipation. The LAPs emerged as actors in school leaders' practice, as they connected to several presentations of time to anticipate, predict, and encourage action. The three anticipation regimes presented through the actor networks showed how the platforms and school leaders connect to actors across time, in which time and anticipation were presentations of multiple events: chronological, parallel, and present activities. The LAPs enacted anticipation through colors, benchmarks, standards, and individual student reports by fabrications of the past, future, and present. The school leaders adjusted practice to fit with their own problematizations and new concerns that emerged from interacting with the platforms.

Existing research has debated the role of LAPs in anticipating education by discussions of digital policy, through the platform in-and-by itself, and by targeting students (Alirezabeigi, 2022; Decuypere & Simons, 2020; Williamson, 2016; Webb et al., 2020). While this body of research

has made considerable contributions to how time and anticipation come to be *other things* in education (rather than mere chronological events), this article has expanded on this notion through evidence in schools and school leaders' mundane work-life.

Using a sociomaterial approach, such as ANT, can disclose how digital technologies and LAPs participate in and adapt to current educational practices. The notion of actor-networks that stretch between networked times and spaces, producing various effects, could explain the governing forces of digital and material things in education. These are likely to affect various actors linked to schools, such as students, parents and legal guardians, teachers, municipal superintendents, and policy makers. Therefore, further empirical research may examine multiple enactments of LAPs by following multiple actors that range in their roles and positions in schools. Such studies can preferably explore such enactments in other school contexts, within and beyond Norway. Further studies can also unpack the black box of LAPs, tracing the various external actors linked to such devices, and evaluating the origin of the ideas, values, and recommendations for action that stem from these platforms to further understand where, when, and how anticipatory governance is produced.

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