

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

European Educational Research Journal

1–19

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DOI: 10.1177/1474904120972291

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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. Decuyper, 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* (Decuyper, 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 (Decuyper, 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 (Decuyper, 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
<i>Schools IT 2000</i> (Department of Education and Skills, 2000)	<i>Fremtidens Skole</i> (The school of the future) (NOU 2015:8, 2015)
<i>Framework for Junior Cycle 2015</i> (Department for Education and Skills (2015a))	<i>Framtid, fornyelse og digitalisering. Digitaliseringsstrategi for grunnsopplæringen 2017–2021</i> (The future, renewal and digitalization. Digitalization strategy for basic education 2017–2021) (Ministry of Education and Research, 2017a)
<i>Digital Strategy for Schools 2015–2020 – Enhancing Teaching, Learning and Assessment</i> (Department for Education and Skills (2015b))	<i>Lærelyst - tidlig innsats og kvalitet i skolen. Meld. St. 21</i> (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	<ul style="list-style-type: none"> - School leaders - Teachers - 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	<ul style="list-style-type: none"> - School leaders - Teachers - Students - Classroom-based assessment - Junior Certificate - 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

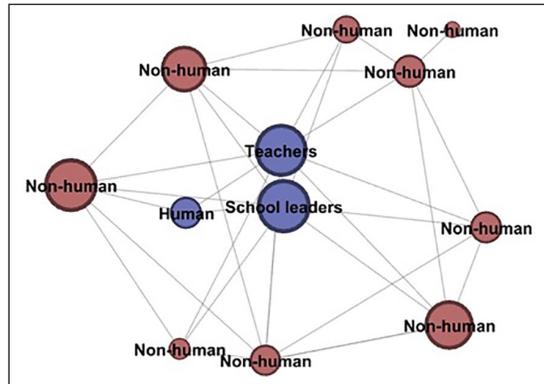


Figure 1. The visual network analysis according to actors and relations.

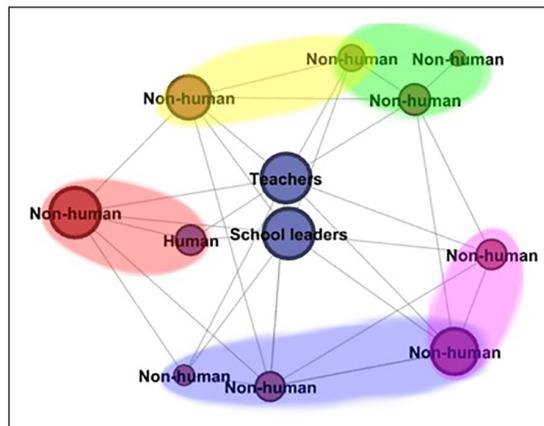


Figure 2. The visual network analysis according to regions.

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 (Decuyper 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 (Decuyper, 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*

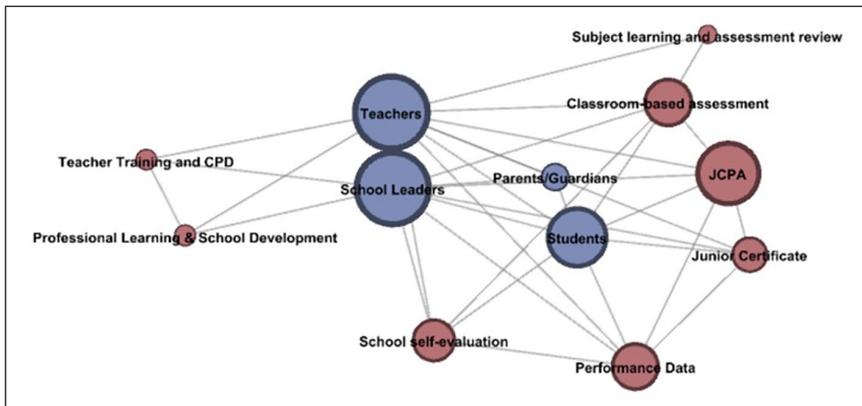


Figure 3. The Irish visual network analysis according to actors and relations.

(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

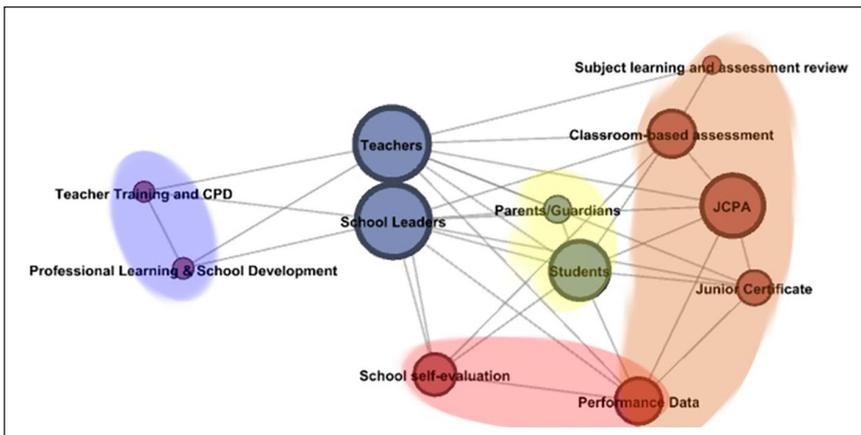


Figure 4. The Irish visual network analysis according to regions.

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

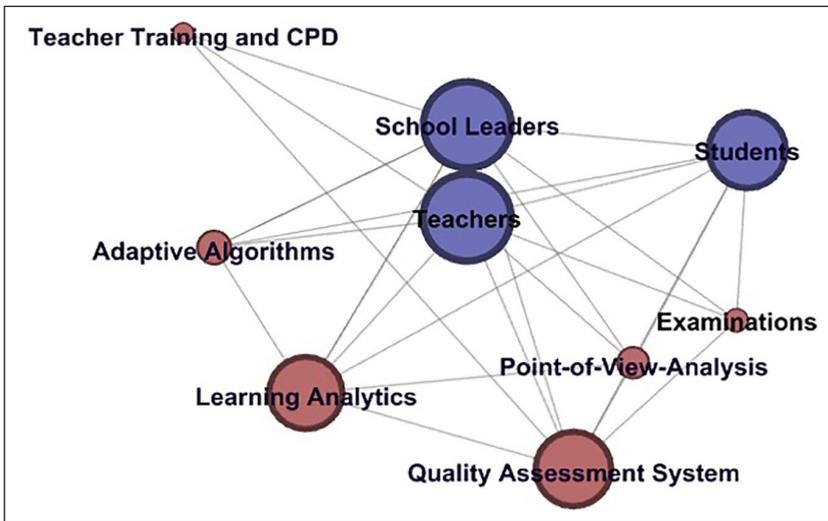


Figure 5. The Norwegian visual network analysis according to actors and relations.

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

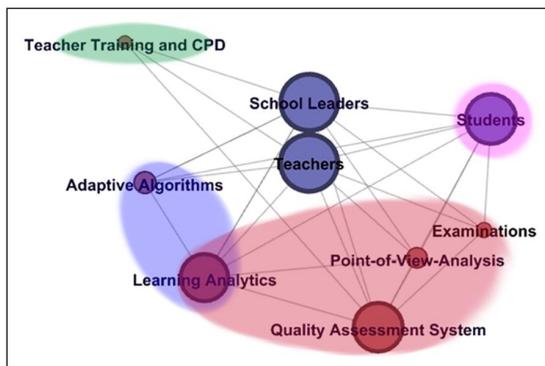


Figure 6. The Norwegian visual network analysis according to regions.

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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