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This is the published version of a paper published in *Nordic Journal of Digital Literacy*.

Citation for the original published paper (version of record):

Bergström, P. (2019)

Illustrating and analysing power and control relations in Finnish one-to-one computing classrooms Teacher practices in grades 7-9

Nordic Journal of Digital Literacy, 14(3-4): 117-133

<https://doi.org/10.18261/issn.1891-943x-2019-03-04-03>

Access to the published version may require subscription.

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Illustrating and analysing power and control relations in Finnish one-to-one computing classrooms

Teacher practices in grades 7–9

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Abstract

This paper reports on teacher practices in tablet-based Finnish one-to-one computing classrooms in grades 7–9. The aim of this study was to increase the understanding of teacher practices by illustrating and analysing the relations of power and control in Finnish teachers' one-to-one computing classrooms. The study applied methods based on classroom observations, photographs and audio recordings of the teachers' communication. Within the context of this study, the results indicate two theoretically distinct, but varying, forms of teaching practice. These teaching practices demonstrate contrasts with regard to how the classroom spaces were organised, including one-to-one computing, as well as the teacher-enacted communication with students. Based on how power and control either was retained by the teachers or distributed to the students, this paper highlights how different meanings were constructed in student learning.

Keywords

One-to-one computing, Finnish teachers, power, control, qualitative

Introduction

The digitalisation of K–12 education has developed rapidly worldwide through so-called one-to-one computing initiatives based on one laptop or tablet for each student (Islam & Grönlund, 2016). In the Nordic countries, studies of teacher practices in one-to-one computing classrooms have been made in Sweden (Fleischer, 2013; Håkansson Lindqvist, 2015; Tallvid, 2015), in Norway (Blikstad-Balas, 2012; Elstad & Christophersen, 2017), and in Denmark (Lorentzen, 2012; Norqvist, 2016), while Finland still seems to be a blind spot on this map (Bocconi, Kampylis, & Punie, 2013). Important knowledge and understanding about Finnish teacher practices in the one-to-one computing classroom is, therefore, not available.

Background

This study is part of a larger Nordic research project, including a series of sub-studies with the common research objective of examining teacher practices in one-to-one computing classrooms in Denmark, Sweden and Finland (Jahnke, Bergström, Mårell-Olsson, Häll, & Kumar, 2017). Across the project, replicated methodology was followed based on how

teachers were selected and how data was collected. This paper reports on Finnish teacher practices in the one-to-one computing classroom for Finnish grades 7–9. In this municipality, each student in grades 7–9 was equipped with a personal tablet (iPad), wireless internet access in the school buildings, software for schoolwork (Penuel, 2006), and cloud storage for storing, sharing, and retrieving information (Gonzales-Martinez, Bote-Lorenzo, Gomez-Sanches, & Cano-Parra, 2015). The one-to-one computing model was based on the premise that the school bought the tablets, but then the students took responsibility for them. The students were allowed to take the tablets home.

At the classroom level, Finnish teachers are prized for their high academic standards (Sahlberg, 2007, 2011; Sjøby, 2015), but also criticised for maintaining power and control through traditional teaching forms by organising students in straight lines lectured by one teacher (Carlgren, Klette, Mýrdal, Schnack, & Simola, 2006; Simola, 2005). Since the mid-1980s, one-to-one computing can be considered to be one step in the process of bringing Information and Communication Technology (ICT) into Finnish teacher practices (Ilomäki, 2008; Sipilä, 2013). In general, one-to-one computing is considered to be an innovation in their striving for the modernisation of teaching and learning through increased use of student-centred learning methods (Sjøby, 2006; Bocconi, Kampylis & Punie, 2013). Elstad and Christophersen (2017) argue that the classroom layout and the arrangement of desks in the one-to-one computing classroom creates challenges to teacher practices based on the teacher ability to see what the students use their devices for. Nevertheless, Laurillard and Derntl (2014) argue that, without involving student control in teaching, the use of ICT tools may simply replicate traditional teaching patterns based on teacher power and control.

In the Finnish school contexts and practices, one-to-one computing has the potential to challenge established power and control relationships (Hinings, Gegenhuber & Greenwood, 2018). The Finnish context provides rich material for exploring a clash of paradigms between different teaching traditions, in other words to what extent power and control is either kept by the teacher or distributed to the students. At a general level, this paper aims to increase the understanding of teacher practices in the one-to-one computing classroom. Specifically, this paper aims to illustrate and analyse power and control relations in Finnish teacher practices based on how they organise the one-to-one computing classroom spaces and how they communicate in teaching. The following research questions were addressed:

- What kind of similarities and differences can be found within and between teacher practices in the one-to-one computing classrooms?
- From a power and control perspective, how can variations of teacher practices in the one-to-one computing classrooms be understood?

The next section presents the literature related to teacher practices with one-to-one computing before the study continues with the theoretical framework.

Literature

Adapting teaching to one-to-one computing is not without its challenges. Considering the preconditions of the physical learning environment, many schools were designed and built during the last century, so new ICTs and new teaching approaches have been forced into existing school buildings (Tondeur De Bruyne, Van Den Driessche, McKenny & Zandvliet, 2015; Elstad & Christophersen, 2017). Before one-to-one computing, teacher access to ICT varied between a couple of desktop computers arranged at the back of the classroom to the

clearly-defined spaces of computer labs with several desktop computers (Zandvliet & Fraser, 2004; Karaseva, Pruulmann-Vengerfeldt & Siibak, 2013; Tondeur et al., 2015). When ICTs are organised as such, Karaseva et al. (2013) report a lack of seamless integration, which essentially means that the spontaneous use of ICTs cannot occur, the computer lab environment highlights the difficulties of mixing equipment for ordinary classroom use into the practice of the lab, and some teachers report that the use of computer labs is a reward when students have completed assignments. In a literature review, Harper and Milman (2016) identified three major themes on one-to-one computing within 46 articles between 2004 and 2014: student achievement, changes to the classroom environment, and student motivation and involvement. Changes to the classroom environment concern student learning, differentiated instruction, constructivist teaching and cooperative learning.

A great number of studies report similarities and differences in teacher practices in the one-to-one computing classroom (Pegrum, Oakley, & Faulkner, 2013; Saudelli & Ciampa, 2014; Håkansson Lindqvist, 2015; Bergström, Mårell-Olsson & Jahnke, 2019; Jahnke et al., 2017; Bergland Holen, Hung, & Gourneau, 2017; Mårell-Olsson, Bergström, & Jahnke, 2019). Longitudinal studies scarcely exist. One exception is Tay's (2016) study over the course of three years which highlighted the fact that it takes time to change teaching methods. Tay (2016) reports that, during the third year of the study, the effects of one-to-one computing were reflected in significant reductions in teacher lecturing and an increase in student group discussions. Another aspect of teacher practices concern the wide variations in one-to-one computing use that range from classrooms totally based on one-to-one computing to classrooms with limited or no use at all (Pegrum, Oakley, & Faulkner, 2013; Saudelli & Ciampa, 2014; Player-Koro & Tallvid, 2015; Håkansson Lindqvist, 2015; Bergström et al., 2019), or tablets as a teacher tool or a student tool (Mårell-Olsson et al., 2019). According to Player-Koro and Tallvid (2015), the assessment system plays a major role in teacher practices. Thus, there is a need for alignment between one-to-one computing teaching practices and the one-to-one computing assessment practices.

From another perspective on limited use of one-to-one computing in teacher practices, researchers have addressed symbolic borders (Bergström et al., 2019; Willermark, 2018) between dominant and non-dominant content traditions. Blikstad-Balas (2012) describes tensions between teachers and students, based on the domination of a textbook discourse, based on content exclusively for teachers in contrast to free content from the internet available to both teachers and students under similar preconditions. However, in classrooms where teachers demonstrate frequent use, a convincing amount of research reports increased student control and unpredictability in student learning (Bergland Holen, Hung, & Gourneau, 2017; Ciampa, 2014; Kjällander, 2011; Tallvid, 2015). For example, Bergland Holen et al. (2017) indicate that increased student control can be traced back to the provision of one-to-one computing with content available on the internet. Thus, previous research highlights what can be understood as tension between teachers and students, where the access to one-to-one computing appears to sneak up and increase student control irrespective of how the teachers think and act. This study further analyses teacher practices in the one-to-one computing classroom by using a theoretical framework of power and control.

Theoretical framework

The theoretical framework draws on Bernstein's (1990, 2000) theorising on the relationship between objects in a room and human communication in the room. Bernstein's theory was developed at a time without one-to-one computing, and therefore the symbolic meaning

regarding the historical shift from computer labs to one-to-one computing has been considered in the description of the theory based on his key concepts concerning power and control: classification and framing.

The concept of classification: who is power conferred upon?

In his later work, Bernstein's (2000) concept of classification informs us about the power relationship between objects in a room. A classroom constructs different preconditions for symbolic power where: "The internal classification refers to the arrangements of the space and the objects within it. [...] In a classroom with strong classification, there is a specialisation of spaces" (Bernstein, 2000, p. 14). This essentially means that a highly specialised classroom space constructs symbolic borders with other classroom spaces. Thus, based on relatively strong or weak values, classification informs us about the relationships between different objects in a room, called themes (e.g. desks). The theme's position of power will be revealed in any attempt to change its degree of specialisation. This way of thinking about how relations can be understood between different themes informs us as to whom power is conferred on in the classroom space. Strong classification indicates an explicit order where teachers hold power, while weak classification indicates a blurred order, where power is distributed from teacher to student.

The concept of framing: who controls what?

Recent research into digital innovation in organisations informs us, among other things, that the opportunities provided by ICTs concern what people can do with them (Hinings et al., 2018). One way of studying such opportunities in the one-to-one computing classroom may be through teacher communication and the concept of framing. Framing refers to the locus of control, or "who controls what" (Bernstein, 2000, p. 12, Bernstein's italics). Framing is a relative concept, either strong or weak. Bernstein defines framing using the following themes: selection, sequence, pacing, evaluation, and hierarchy in communication between teacher and student and between students. Strong framing in the selection of content demonstrates a visual and explicit practice: the teacher makes the decisions, for example by suggesting a web page. If framing is weak, the teacher distributes control to the students by asking students to select the content, for example by producing a video so the practice becomes implicit and less visual.

Methodology

This study was based on a qualitative research design developed in the larger research project into one-to-one computing in Nordic schools. Some ethnographically-inspired methods were conducted comprising classroom observations, retrospective teacher and student interviews, and interviews of principals. The analysis in this study, replicated the Swedish study based on the material collected in 14 classroom observations. Hence, a theory-driven analysis was conducted guided by three main steps: 1) sampling, 2) developing themes and codes, and 3) validating and applying the codes (Boyatzis, 1998, p. 35-37). The theory applied was Bernstein's (2000) theory on power and control.

Sampling

Similar to other studies of teacher practices in the one-to-one computing classroom (Player-Koro & Tallvid, 2015; Smith & Santori, 2015; Bergström et al., 2019; Jahnke et al., 2017), criteria-based sampling (Patton, 1990) was applied where teachers who used one-to-

one computing in teaching, so-called early adopters (Rogers, 2003), were selected. The early adopters are users who are among the first to adopt an innovation in practice. Accordingly, in other studies, as well as in this study, the strategy for finding such practices was to consult school principals. This essentially means that the principals selected the cohort of teachers based on the guiding criteria of early adopters. However, here we cannot underestimate the principals' power in cases where teachers might have been reluctant to participate.

A brief contextualisation of the one-to-one computing initiative

Two similar schools (A and B) formed the context of this study. These schools were visited twice, first in the spring and a second time in the autumn of 2015. The two schools' architecture are similar to what is considered normal for the modern era between 1946 and 1979 (Lippman, 2010), and Lippman explains, "These environments intended learning to occur primarily in classrooms, whereas corridors were planned to allow teachers and students to move between instructional spaces and administrative areas" (Lippman, 2010, p. 85).

The Finnish municipality distributed one tablet (iPad) to each student in school grades 7-9 in the autumn 2014. The one-to-one computing initiative was framed by an earlier advance introduction to the teachers. For building familiarity with the tablet, all teachers gained access to the tablets before the summer holiday. The suppliers of the tablets provided an introduction course for the teachers at basic level (e.g. how to install software applications). Locally in the schools, pedagogical cafés were held as a forum among colleagues to share and discuss pedagogy and methods in the one-to-one computing classroom.

Data collection

The first classroom observations took place when teachers and pupils had used tablets for six months. In total, 14 classroom observations were carried out in grades 7–9 with 11 teachers in the subjects Counselling, English, Finnish Language, Geography, Health Education, Home Economics, Mathematics, Physics and Religion. Accordingly, three teachers were visited twice in the subjects Home Economics, Geography and Religion. Furthermore, this selection is not without consequences, and previous research informs us about different subject traditions (Karaseva et al., 2013), and that subjects are relays of different power relationships (Bernstein, 2000).

The class sizes ranged from 6 to 25 students in each lesson. Three types of data were collected during the observations. First, teacher communication in practice was audio recorded. After each school visit, the audio files were sent to a chartered translator who first transcribed the files into Finnish text and then translated the text into Swedish. Second, the observers made field notes of what was going on in the classroom. Third, panorama photos were used to document the classroom space, and photos from different situations were used to document teacher instructions and student work on their tablets. The triangulation of the described data sources from the classroom observations enabled the possibility to compare and validate episodes from each individual classroom observation, which arguably contributed to the trustworthiness of the analysis (Miles, Huberman & Saldaña, 2014). Each lesson lasted about 45 minutes and the audio-recorded material amounted to 10 hours and 30 minutes.

Developing themes and code

The process of developing themes and code was guided by Boyatzis three steps: 1) generating a code, 2) reviewing and revising the code, and 3) reliability (Boyatzis, 1998, p. 35).

Nvivo[®] software was used for organisation and analysis of the data based on the coding schemes for classification and framing.

Step 1: generating a code

The thematic code of teacher practices in the one-to-one computing classroom was constructed from Bernstein's (2000) research on power and control, previous research where power and control was used to understand teacher practices without one-to-one computing (Neves, Morais & Alfonso, 2004) as well as recent research on teacher practice in the one-to-one computing classroom (Bergström et al., 2019). The procedure began with Bernstein's (2000) key concept of power — classification — which was used to code and analyse teacher organisation of the physical classroom space. As presented in Table 1, seven themes of classification were assessed on a two-point scale as strong or weak.

Table 1 Classification themes and one example extract

Themes	Signs C+	Signs C-	
1. Desks	From front to back: desks in straight lines, corridors From left to right: separation of students	From front to back: desks in groups, no clear path From left to right: affordances of student-student interaction	Photographs
2. Whose space	Use of the teacher's desk	The teacher sits among the students	Photographs Field notes
3. Classroom – outside classroom	Students study only in the classroom	Students study both inside and outside the classroom	Field notes
4. Digital resources	The teacher separates textbooks and digital material	The teacher integrates digital material on the same basis as textbook material	Field notes Audio recordings
5. Selection of software applications (apps)	Subject-specific apps are used in the majority (e.g. a game in mathematics)	Generic apps are used in the majority (e.g. apps for making films)	Field notes Audio recordings
6. Teacher-student	The teacher's communication is authoritarian	The teacher's communication is dialogical	Audio recordings
7. Student-student	Activities are organised as individual studies	Activities are organised as peer or group studies	Photographs Field notes
<p>Extract of category 4. Digital resources</p> <p>C+ “The teacher says “Are you ready” it is time for “listen and repeat”. From the web-based textbook, she plays a short phrase and all students follow the phrase by saying it in choir. The teachers say also the phrase together with the students. She makes some comments on Finnish, it is a question she asks “what is the difference between an explicit and implicit question” (ID03, Field note 150210).</p> <p>C- “The observer asks the girl in the right upper corner what they are doing. One group study “refugees” and they are working on a presentation in Keynote. The other group of two girls working on “the freedom of speech” and they use iMovie. They argue that they have the freedom to choose how they would like to design the presentations. The content of study they find on Wikipedia.” (ID01, Field note 150209).</p>			

Then, a thematic code for teacher communication in practice was generated based on the concept of framing, or who controls what. The empirical material was based on the transcripts of the audio recordings. The coding scheme focused on Bernstein's (2000) themes of framing – selection, sequence, pacing, evaluation and the hierarchical relationships between teacher and student and between students. These concepts were coded on a four-point scale, as illustrated in Table 2.

Table 2 Extract of one framing theme

Theme	F++	F+	F-	F- -
Selection of content	Teachers provide a fixed frame of mandatory content for the students	Teachers provide a fixed frame of mandatory content for the students, accepting students' suggestions	Teachers provide different content to choose from without referring to priorities and ask students to make a selection	Teachers ask students to suggest a selection (of content)
<p>F++ ID02 (F^T): “During the previous lesson we studied fat. Up to today, we have covered all fat as food energy, and today we carry through with vitamins and minerals.”</p> <p>F+ ID02 (F^T): “For those of you searching for information, start in ShowBie and open that one [a file]. Yes, that one and this is the link [hyper links]. First priority is to use these ones. You can also use Google and search for information.”</p> <p>F- ID04 (F^T): Teacher: You have a question? Student: Who selects the topic? Teacher: It is you who select the topics. Here can you find the [list of] topics.</p> <p>F- - ID05 (F^T): “Your task is to learn the food culture in a European country and collect pictures of different courses. You are allowed to use Google and search for pictures as you wish.”</p>				

Reviewing and revising the code

Initially, codes and themes from previous research were reported and used in professional development activities between researchers and teachers (Neves et al., 2004). With the inspiration of using the Neves et al. (2004) researcher-teacher relationship as a unit of analysis, the previous code was developed and applied to the teacher-student relationship as the unit of analysis (Bergström et al., 2019). For this study, the above coding schemes were reviewed and revised with trained experts in the theory. In particular, the ICT categories were scrutinised. The experts reasoned that software applications can be used to retain teacher power, for example when using a drill software in mathematics which is in line with the fifth theme in Table 1 regarding software application as either subject-specific or generic. Another group of colleagues scrutinised, among other things, the fourth theme in Table 1, which was changed from “one-to-one computing” to the broader term of “digital resources”.

Reliability

Regarding the reliability of the code, Boyatzis (1998) emphasises the importance of using trained experts on the theory when judging consistency. The empirical material was initially coded by the researcher. Two colleagues who were trained experts on Bernstein’s (2000) theory of classification and framing critically read and assessed the interpretations of the coded material over time. This process contributed to the adjustment of the interpretations. Then, one year after the last assessment with colleagues, the consistency of the coding was measured using a coding agreement (Krippendorf, 2011), where the author re-coded the material from two classroom observations. The percentage agreement between the initial coding and the re-coding was 100% for the classroom space and 93% for the teacher communication.

Findings

The following sections present and analyse the 14 classroom observations with support of a typology. The typology is used as an attempt to illustrate teacher practices through Bernstein's (2000) theoretical lens of power and control.

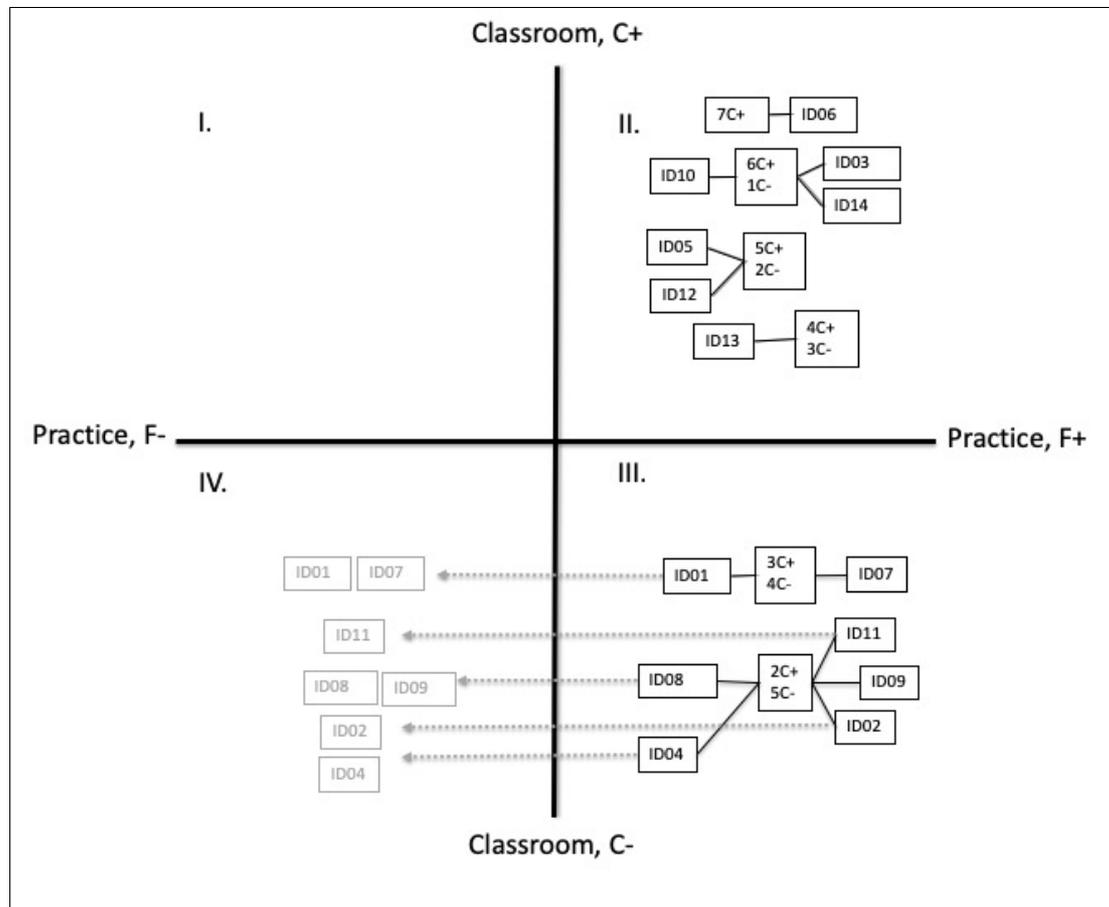


Figure 1 Teacher practices in the one-to-one computing classroom

Figure 1 illustrates the typology by using four Quadrants (I-IV) of teacher practices. The vertical dimension reflects the concept of classification as either strong or weak, which was used to illustrate power relations based on the organisation of the classroom space. The horizontal dimension reflects the concept of framing as either strong or weak, which was used to illustrate who controls what in teacher communication. The teacher practices were located in Quadrants II, III and IV. None of the teacher practices were located in Quadrant I. The description and analysis of the teacher practices in Quadrants II, III and IV have a similar structure based on the intersections of the horizontal and vertical axes. The teacher practices in each Quadrant presents 1) an analysis of constructed power relationships based on the organisation of the classroom space, and 2) an analysis of who controls what based on teacher-enacted communication in practice.

Quadrant II: retaining power and control in teacher practices

In Figure 1, Quadrant II illustrates seven teacher practices where at least four of seven classification categories (arrangement of desks, whose space, inside classroom – outside classroom, digital resources, selection of software applications, teacher-student and student-student) indicated strong classification. The seven teacher practices in Quadrant II cover the

subjects of Finnish Language (ID06), Mathematics (ID10), English (ID03), Home Economics (ID14), Geography (ID09), Physics (ID10) and Health Education (ID13). In the description and analysis of teacher practices in Quadrant II, a panorama photograph is used to illustrate both the organisation of the classroom space and the scene for teacher communication in practice.

Teacher power through the organisation of the classroom space

This section presents and analyses how power was held in teacher practices in light of the organisation of the classroom spaces.



Figure 2 Teacher practices in Quadrant II.

Figure 2 illustrates a typical Quadrant II organisation of classroom space. In such a classroom space, desks were often organised in lines, either as single desks or in pairs. This organisation formed corridors between the front and back of the classroom, which made it easy for the teacher to move up and down the classroom. Such organisation indicates an explicit order based on strong classification conferring power on the teacher. The explicit order in Quadrant II was further enhanced through the visual space between students which possibly limits opportunities for student-to-student interaction. Separation of students indicates strong classification where power is conferred on the teacher. Further examination of Figure 2 shows the teacher was located around the teacher's desk which illustrates the separation between teacher space and student space. Such positions in this space indicate an explicit order and strong classification where power is conferred on the teacher. In some teacher practices, the paper-based activities had become digitalised, as one teacher said: "the activity is the same as without the iPad, the only difference is that the paper is distributed by using ShowBie" (ID03, Field note 150210). Other examples highlight, for example, teacher use of presentation software when lecturing or the use of e-books similar to textbooks, but online. The quotation and narrative indicate strong classification in which the explicit previous order in practice was replicated when using one-to-one computing in a similar manner to classrooms without one-to-one computing. When considering the teacher role and the student role, the strong classification was typical for all teachers (N=7) through explicit and disciplined teacher-student communication, for example, "Five minutes. Keep your focus on your own work" (ID05, Audio recording 150211). The above statement indicates that the teacher has the right in their role to hold student to order, which confers power on the teacher.

Retaining control in teacher communication in practice

Figure 2 sets the scene for the typical communication taking place within teacher practices in Quadrant II in Figure 1. As illustrated in Figure 2, all seven teachers in Quadrant II used a textbook and the projector or document camera to communicate sections from the

enlarged image of the textbook verbally. Such use and communication on content indicated strong framing, based on teacher control with regard to both the content students should study and in which sequence it should be acquired. Similarly, teachers' who used a digitalised textbook (an e-book) demonstrated communication as when using the textbook: "Pick up your e-book in mathematics on the iPad. Select page 43. On page 43 you will find tasks about geometry. So... now start doing them." (ID10, audio recording 150212). The above quotation indicates strong framing in the categories of selection and sequence, which means that these themes are strongly controlled by the teacher. In Quadrant II, the pace was strongly controlled as illustrated in two examples. First, in one teacher's lecture, the use of a Keynote supported the teacher in communication slide by slide without interruption. Such an approach controlled the pace strongly during 35 minutes of a 45-minute period. Second, the use of questions and answers from the textbook, similar to one teacher's examination of the students' homework in English, the teacher said:

Teacher: Alright next [sentence], Arturi?

[The student replies]

Teacher: Yes. It is also possible to use "who" or "that". There is a comma, which indicates there are no problems. Of course, "who" is preferred when referring to a human being, but either is possible. (ID03, Audio recording 150210)

The above narrative and quotation show not only explicit activities and communication, but also how the communication space in the teacher-student relationship was polarised and controlled by the teacher. Further, the above quotation indicates communication concerning assessments in class, where almost all teachers ($N = 6$) demonstrated strong framing. Such communication emphasised student achievement in relation to specific criteria, which limited the possibility of the student not understanding the communication.

Quadrant III: distribution of power and control in teacher practices

In Figure 1, Quadrant III illustrates seven teacher practices where at least four of seven classification categories indicated weak classification. As illustrated via the grey dotted lines from Quadrant III to Quadrant IV, control was both held by the teacher and distributed to the students. The text below focuses on these seven teacher practices covering the subjects in Mathematics (ID07), Home Economics (ID02), Geography (ID09), Religion (ID01, ID04, ID11) and Counselling (ID08). In the description and analysis of teacher practices in Quadrants III and IV, a panorama photograph is used to illustrate both the organisation of the classroom space and the scene of teacher communication in practice.

Distribution of teacher power through the organisation of the classroom space

This section presents and analyses how power was distributed from the teacher to the students based on the organisation of the classroom space.



Figure 3 Teacher practices in Quadrant III

Figure 3 illustrates a typical Quadrant III organisation of classroom space. All the teachers, except for the teacher in Mathematics,¹ taught in ordinary classroom spaces. As illustrated in Figure 3, desks were often organised in groups which indicated weak classification and a blurred order, where power was distributed from the teacher to the students. Figure 3 illustrates the blurred order further, through two coded categories of weak classification. First, the students worked together in groups with student-student interaction. Second, the teacher taught among the students (in contrast to teaching from the teacher's desk), which blurred teacher and student space. Thus, power was distributed from the teacher to the students. In Quadrant III, almost all teacher practices (N=6) demonstrated use of one-to-one computing to produce material on the tablet, as illustrated by one teacher in Religion:

Now you will be doing a small project on the iPad about the Orthodox Church. [...] We will use two software applications today. When we start, we will use Popplet. After that Keynote. You will notice that there are two different software applications. [...] Then we will close Keynote and go back to Popplet. (ID11, Audio recording 151008)

The above quote was addressed to a practice where the students were guided to construct something new using different software applications. When producing on the tablet, students used both the textbook and the internet as complementary sources. Such a practice indicates weak classification and a blurred order between the use of one-to-one computing and other learning resources, and power was distributed from teacher to students. Even though the teacher in Mathematics did not use generic apps (e.g. Popplet) like the other teachers, video material was used for preparing students for upcoming lessons: “So normally I send them a video of what we are doing in the next lesson and they watch it at home” (ID07, field note 150212). When the amount of resources increases and a typical way forward is less clear cut, power is distributed from the teacher to the students. As illustrated in Figure 4, in two classroom observations (ID04 and ID11) the students were allowed to sit outside the classroom in the corridor. This indicates weak classification since what can be considered as the learning space is blurred, and power was distributed from teacher to students.

1. The teaching in the classroom observation ID07 was organised in a specially-designed room. This room included lamps that pointed upwards instead of downwards (to support screen reading), wall-to-wall carpets for reduced sound, and flat screens at the front and back of the classroom. High desks were organised in groups; there was no teacher's desk, and there were beanbags for students. Such a classroom space indicates weak classification.

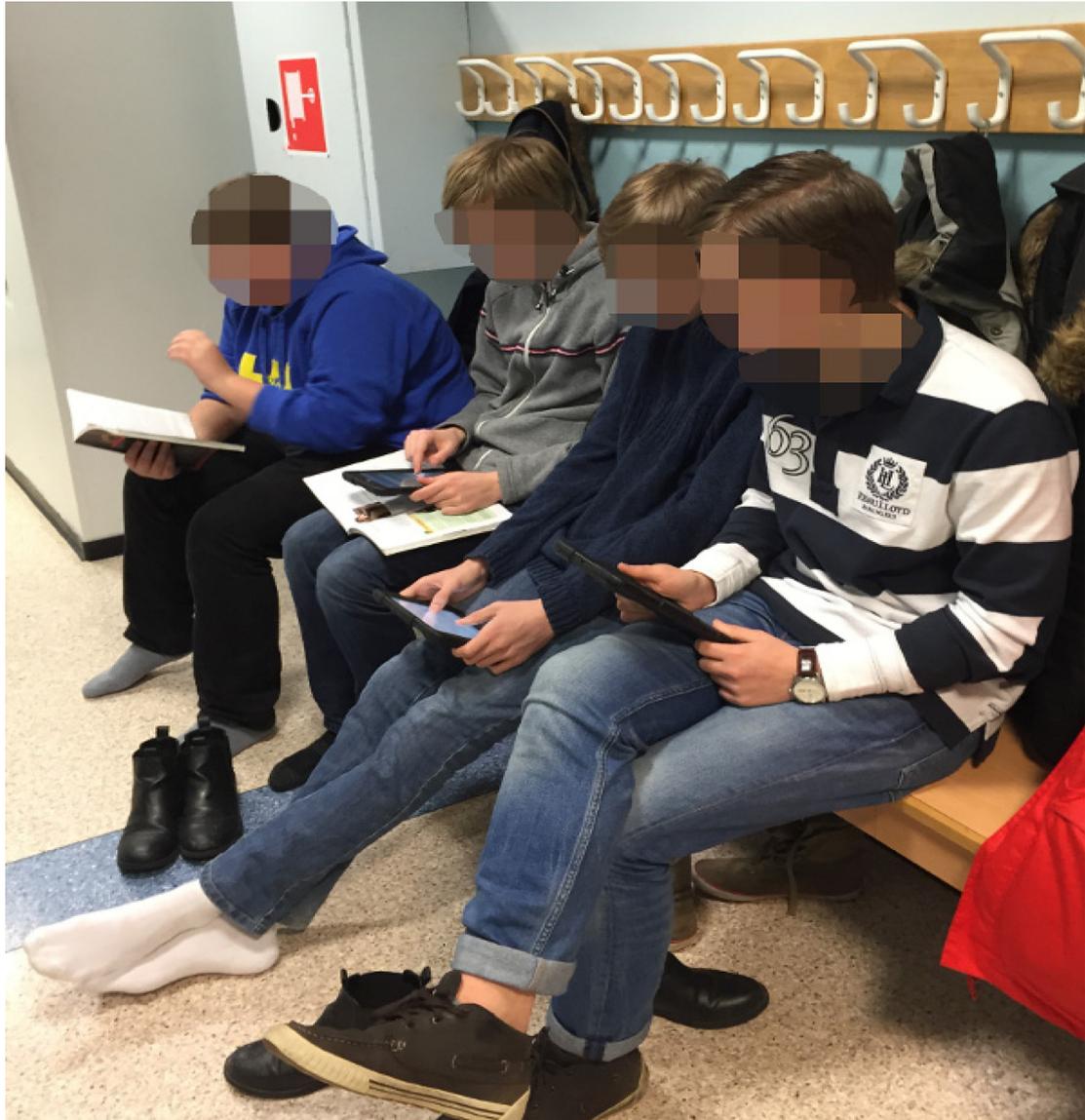


Figure 4 A group of students in the corridor

However, strong classification and an explicit order was found in all (N=7) of teacher communication regarding the teacher-student relationship.

Distribution of control in teacher practices

Figures 3 and 4 set the scene for typical communication within teacher practices in Quadrants III and IV from Figure 1. These two quadrants in Figure 1 illustrate both strong and weak framing. Thus in some categories, control was maintained, while in others, the control was distributed to the students illustrated via the grey dotted arrows from Quadrant III to Quadrant IV in Figure 1. It is common to all the seven classroom observations that all of the teachers demonstrated strong framing of the overarching sequence, as one teacher showed on the projector:

1. Make a Popplet where you put the words “Orthodox Church” in the middle.
2. Select one of the concepts below (icons, incense, fasting, worship, Orthodox Easter or Holy Saturday) and then create a Keynote of 1 or 2 slides to show the others at the front of the classroom. (ID11, Field note 151008)

The majority of the teachers (N=5) demonstrated similar communication as in the above field note. The first point indicates strong control by the teacher when selecting the overarching theme (Orthodox Church). Then in the second point, the teacher provides a list of contents from which the students select a topic. When students are asked to make a choice within the overarching theme, the practice was less visual which indicates weak framing and the control was distributed from teacher to students. Regarding pacing, all teachers showed strong control except for the three teachers in Religion who distributed the control. In Religion, control over pacing was distributed and communicated when the teachers gently, but still with some authority, pressed the students to finish their work:

So, the aim of this lesson is that this is the last lesson where you can work with your subject. How far have you come? And today, I would like to know when your group can present your lesson [to your classmates]. (ID01, Field recording, 150209)

In the above quotation, the distribution of control can be understood as a less visual practice since the teacher was not explicit in his/her communication and increased responsibility of achieving the deadline rests upon the students. In three classroom observations (ID08, ID11, ID09) the teachers used both strong and weak framing in their communication about student progress in relation to syllabus. Weak framing in communication about student progress distributed control from teacher to student, which can be observed:

Teacher: Hmmm. You need to think a bit about that.

Student: Could it be this one?

Teacher: No, no.

Student: What else could it be?

Teacher: Try to think. No.... What was the first thing you had?

Student: What?

Teacher: Yes. Think about it again. (ID09, Audio recording 151008)

The above exchange demonstrates how the teacher distributes some control to the students. The teacher communication can be considered to be implicit when guidance was given without providing the right answer in relation to the question. Such communication indicates increased student control in which the student needs to understand the implicit message when being asked to think about the question some more. Furthermore, considering the above exchange from the perspective of the hierarchy in the teacher-student relationship, in five classroom observations (ID01, ID04, ID08, ID09, ID11) the teachers communicated in a similar manner and involved the students in the communication through dialogue and reasoning.

Discussion

This paper began by describing some major challenges for Finnish teachers. The study serves to illustrate and analyse principles that are more general in terms of how power and control was either retained by the teacher or distributed to the students. The first research question implied similarities and differences in teacher practices in one-to-one computing classrooms, which was reflected through the teacher practices in the Quadrants in Figure 1. In Quadrant II, the teacher practices reflect some variation, however the theme as such may generally be characterised as a traditional system based on explicit organisation and communication that retains teacher power and control. Previous research from Finnish com-

pulsory school reports the strong use of traditional methods (Carlgren et al., 2006; Simola, 2005), which here is reflected in teachers' explicit practice in Quadrant II. In contrast, the teacher practices in Quadrants III and IV in Figure 1 reflect an implicit and less visual practice based on the distribution of teacher power and control to students. The diversity between Quadrants III and IV relates to the fact that, while some framing themes were coded to Quadrant III, there were other themes that were coded to Quadrant IV. These practices can be recognised by characteristics of: 1) group discussions and collaboration (Tay, 2016), 2) a mixed discourse of internet-based content and other resources (Bergland Holen et al., 2017; Blikstad-Balas, 2012), and 3) increased unpredictability in students' learning (Kjällander, 2011; Tallvid, 2015). The findings from Figure 1 lead to the second research question of how the variations in teacher practices in the one-to-one computing classrooms can be understood from a power and control perspective.

Regarding the second research question, the findings highlight two distinct practices. These practices construct two types of meaning in student learning, interpreted as products of how classroom spaces and practices were organised. When considering the relationship between the teacher practices in Quadrant II and III, Quadrant III can be considered to reveal power relationships (Bernstein, 2000). These power positions were possibly not a single effect of shifting from computers in labs (Zandvliet & Fraser, 2004) to one-to-one computing, but more of an ecology where the organisation of the classroom space and teacher communication in practice together construct something more than what each classification and framing theme contribute individually. When considering the approach to one-to-one computing in teacher practices in Quadrant II, this quadrant reflects an ecology which possibly enhanced a practice by merely transferring paper documents to digital documents. In other words, the tablet was the teachers' tool (Mårell-Olsson et al., 2019). In contrast, the approach to one-to-one computing in Quadrant III reflects an ecology that gave the students a stronger voice and more room to take decisions which was enhanced by, among other things, teachers' use of generic software applications. In other words, tablets were used as the students' tools (Mårell-Olsson et al., 2019).

From outside school, a discourse based on a terminology of change, innovation and modernisation (Bocconi et al., 2013) and increased student control (Laurillard & Derntl, 2014) impose pressure on schools. Critical studies argue that ICTs and new teaching approaches have been forced into existing school building (Tondeur et al., 2015; Elstad & Christophersen, 2017). These two perspectives were reflected in this study through the teacher practices in Quadrants II and III. The relationship between these quadrants indicated that established power relations were, among other things, disturbed by the one-to-one computing initiative. An implicit practice is not good for all students (Bernstein, 2000), and an explicit practice may be instrumental. Based on the findings in this study, the teacher practices in the different quadrants may serve as prototypes for organising classroom space and teacher communication in practice. Thus, a possible way forward to take a one-to-one computing initiative to the next level could be, on a small scale, to build training environments in existing school buildings based on power and control relationships reflected in Quadrants III and IV. Success in prototyping needs training in systematic analysis, the designing and the redesign of teacher practices since power and control relationships are revealed. However, in the long-term perspective new issues may possibly arise from such a development, such as "What purpose is school education organised for?", "Whose interests does it serve?", and "How should new technology-rich schools be organised?"

Limitations

Some methodological limitations must be mentioned. First, this research was conducted in one municipality and two schools. If material from other schools in other municipalities had been available, this might have produced a more general picture of the teaching practices in Finland. Much can be discovered when visiting a school, and the team had to adapt to the school's daily practice. One limitation concerned the teachers observed. In the project, we asked to observe lessons where the teachers used one-to-one computing. The research team did not envisage the possibility of visiting the same teacher twice, which resulted in three doubles. From the results, we can see that the two teachers in Home Economics and Geography changed their teaching between the observation occasions, while the teacher in Religion did not. The teacher interviews may possibly bring some new insights to these differences, which is a question for future research.

Conclusions and implications for future research

The results of this study indicate that Finnish teaching seems to be more diverse than was presented in previous research in English-language literature. The findings from these Finnish teacher practices in grades 7–9 made the variations between them, as well as within them, visible. Teacher practices in the quadrants highlighted how different meanings are constructed in student learning. Teacher practices in Quadrant II shed light on how traditional practices are maintained within a physical space where one-to-one computing serves to make some of the distribution processes smoother. Teacher practices in Quadrant III highlight, due to school buildings' constraints, a challenged physical space where one-to-one computing allows the teacher to bring in content from outside the school and allows a greater role in decision-making for the students. Teacher practices in the overlap between both Quadrants III and IV show more signs of student power and control. The findings presented here may support schools and teachers in their holistic thinking digitalising schools through one-to-one computing by showing that both space and practice need to be considered, since these relay power and control. For future research, the next step will be to analyse the teacher interviews in relation to how power and control were either retained by the teacher or distributed to the students.

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