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Power and control in the one-to-one computing classroom: students' perspectives on teachers' didactical design

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Abstract

This paper reports on a research study that scrutinised the student perspective on teachers' different didactical designs from lessons in the one-to-one computing classroom. Specifically, the aim was to describe and understand three different clusters of didactical design in the one-to-one computing classroom from the student perspective. Each of the three clusters represents different interactions between teachers and students. The research questions embrace how the teachers or students, through the didactical design, will have an advantage over the other. The empirical material was based on student focus groups interviews, enhanced through the method of stimulated recall where different photographs of teaching and learning situations from the one-to-one computing classroom were shown to the students. The results demonstrate three empirical themes: students' learning in class, students' learning outside class, and classroom assessment. From a theoretical lens of power and control, the students' reasoning demonstrates approaches to how teachers regulate students and to how students can make decisions in their learning process. For handling students' demands, specifically in pedagogical plans, the one-to-one computing classroom becomes one component for making students' learning processes smoother regarding when to study and how to study.

Keywords: qualitative, one-to-one computing, power, control, didactics

Introduction

Information and communication technology (ICT) in education is embedded in a discourse that highlights a terminology based on innovation and

modernisation of schools (Bocconi, Kampylis, & Punie, 2013). ICT has been considered as a catalyst (Brown, 2006) for changing schools and education. Among those making this change, confidence in so-called one-to-one computing initiatives has been reported worldwide (Islam & Grönlund, 2016). However, the growing interest in one-to-one computing in compulsory schooling presents some major challenges. One challenge concerns the spatiality when the ICT learning environment is changing from computer labs isolated from the classrooms to classrooms equipped with one device on each student's desk, a wireless network (Penuel, 2006), and cloud computing for sharing, retrieving, and storing information (Gonzales-Martinez, Bote-Lorenzo, Gomez-Sanches & Cano-Parra, 2015). Another challenge concerns how the different subject traditions construct different preconditions regarding students' possibilities to influence and control the content (Hjelmér & Rosvall, 2016; Lindmark, 2013). For example, mathematics and the sciences are based on established content hierarchies where one area needs to be studied before the next. Here, the teacher strongly monitors the content. In contrast, social studies and religion content can focus on contemporary issues in society, and students' experiences can be considered as content. Thus, independent of subject, a didactical design embraces both the design of the physical learning environment, including ICTs, and the design of the teaching practice regarding communication about content, pace, and assessment during teaching and learning (Bergström, Mårell-Olsson, & Jahnke, 2017).

The Swedish context in particular provides a large number of one-to-one computing initiatives with both laptops and tablets reported in almost all of the 290 Swedish municipalities (Becker & Taawo, 2017). Controversially, equipping classrooms with more devices is not per se the means for change (Bocconi et al., 2013), and increased attention on meaningful didactical design is needed (Ilomäki, Paavola, Lakkala, & Kantosalo, 2016). Regarding this issue, Laurillard and Derntl (2014) argue that one aspect of design concerns the extent to which students are allowed to take some control in the teaching and learning process. Otherwise, they warn that the use of ICTs can simply replicate previous traditions for teaching and learning. Further, in Klein and Kleinman's (2002) perspective on the social construction of technology the enacted didactical design in the one-to-one computing classroom should be considered as a design process between teachers and students. In this process, power indicates the interaction between teachers and students, the rules that order the interactions, and how other things contribute to differences in their relationship. Against this background, it was found that the student perspective on teachers' didactical design in the one-to-one computing classroom was rarely examined in the literature. This paper aims to increase the understanding of three different clusters of didactical design in the one-to-one computing classroom through a student perspective. The following research questions were asked: How can variations within, as well as between, the three clusters be understood in terms of power and control? How can different orientations to meaning regulate and construct possibilities in students' learning processes?

A focus group interview study was conducted in order to better understand different didactical designs from the perspective of the students. Before presenting the methodology and findings, an introduction to didactical design research and one-to-one computing is provided next.

Didactical design

In this study, the concept of didactical design was used based on the German and European tradition of Didaktik. Regarding the first term, didactics, some confusion exists because for some readers it can carry negative connotations, especially through the English-language understanding of didactics as teacher-centred and students' passive learning (Hamilton, 1999). When considering didactics from the German tradition of Didaktik (e.g. Klafki, 2000) as well as

the French tradition (Sensevy, 2012), a humanistic philosophy (Lund & Hauge, 2011; Bergström, 2012) seems to underpin the teacher–student–content triad. In addition, Jahnke et al. (2017) argue that to break the negative connotations, "*one central component of didaktik is the cultivation of social relationships*" (Jahnke et al, 2017, p.2). The next term, design, has strong connections to the different didactical elements teachers use when giving form to a lesson. The foundation of design in this paper follows Simon's definition of design as "*everybody designs who devises courses of action aimed at changing existing situations into preferred ones*" (Simon, 1996, pp.4-5). These quotations regarding cultivation and change highlight how one social group is understood in relation to other groups. Similarly, to be able to acknowledge change, one needs to consider different didactical designs in relation to each other. In what follows, we point to the wider perspective of didactical design in the one-to-one computing classroom and the rarely reported student perspective on teachers' didactical design.

Didactical design and one-to-one computing

The concept of didactical design has been used for about 10 years in the analysis of teachers' teaching with ICT specifically (Hudson, 2008, 2011; Rostvall & Selander, 2008; Selander & Kress, 2010; Jahnke et al, 2014; Jahnke et al, 2017). Other studies on didactics range from teachers' working process of transforming curriculum content into a lesson (Hopmann, 2007) to teachers' enacted practice of teaching. A few Nordic studies exist on teachers' didactical design in the one-to-one computing classroom. Kjällander's (2011) study reported on increased unpredictability in students learning, while other studies examined how teachers' didactical design varies (Jahnke et al, 2014; Jahnke et al, 2017; Bergström et al, 2017). In the international literature on one-to-one computing, an extensive number of research reports have focused not explicitly on teachers' didactical design, but implicitly on students through teachers' efforts to teach in the one-to-one computing classroom (Blikstad-Balas, 2012; Håkansson Lindqvist, 2015; Norqvist, 2016; Pegrum, Oakley, & Faulkner, 2013; Player-Koro & Tallvid, 2015; Saudelli & Ciampa, 2014). These studies used the relationship between social groups, or objects, to understand the teaching practice based on different theoretical frameworks. Further, policy studies highlight one-to-one computing as both an equity issue for avoiding the digital divide by increasing students' technical competence and a technology issue for moving towards 21st-century skills (e.g. problem-solving skills) (Zucker & Light, 2009, Voogt et al., 2013). Regarding students' learning, studies have focused on one-to-one computing for individual learning, collaborative learning, and cooperative learning (Andersson, Wiklund, & Hatakka, 2016; Håkansson Lindqvist, 2013; Zheng, Arada, Niiya, & Warschauer, 2014). These studies report on great variations in the learning approaches in the studied schools. Drawing on the student perspective that is missing in the one-to-one computing research, and findings of how teachers' didactical designs vary, we decided to investigate students' views about teachers' didactical designs.

Methodology

Four different cohorts of students were selected with the aim to scrutinise three different clusters of didactical designs. The study of teachers' didactical designs was part of a larger research project that studied Swedish teacher's didactical design in compulsory schooling with established one-to-one computing initiatives between the years 2014 and 2016. Here, one didactical design represents one lesson. In total, 23 teachers' didactical designs were documented through classroom observations based on written documentation, photographs, and audio recordings. These methods were applied in order to document both the design of the learning space and the design of the enacted practice. Further, the use of different methods made triangulations of the data from photographs,

audio recordings, and written documentation possible. Thus, based on how the different classrooms were physically organised an attempt was made to map these in relation to interactions in the teacher-student relationship. These findings were reported as variations within, as well as between, the teachers' 23 didactical designs. The findings report on three clusters of didactical designs in the one-to-one computing context: 1) practices described as rather traditional where the teachers make the decisions, 2) practices where students are involved to some extent in decisions, and 3) practices described as student-active where students to a great extent make decisions. These results are reported in another paper (Bergström et al. 2017). By bringing the students' perspective into the foreground, additional understanding about teachers' didactical design is possible.

Selection process

One reason for selecting the four lessons below was that in grade 2, 5, and 7 the principals advised us to visit the teachers because they were recognised as good examples of teachers who used one-to-one computing frequently during teaching and learning. The grade 8 lesson was based on some students' advice about a teacher who, from their perspective, was good at using ICT. For the first (1) and second (2) cluster of didactical designs, two cohorts of students in grade 2 and 5 were selected. For the third cluster (3), which were the most student-active designs, two cohorts of students in grade 7 and 8 were selected. Below, a brief contextual description is given of these didactical designs.

Lesson in grade 2 – traditional teaching
The grade 2 lesson represented a traditional didactical design based upon a unidirectional teacher-student interaction from teacher to student. The students were organised in pairs with one tablet for two students. Here, the students studied mathematics and the commutative rule for 60 minutes. From a list of three numbers – 2, 5, and 10 – students were asked to make an illustration, for example, of 2 × 5 and 5 × 2 by using different materials (e.g. piles of scissors or toy bears) and taking and writing the numbers in the software application (app) BookCreator. This instruction was given at the start of the lesson and then imitated during the lesson. When a task was completed, the students presented the assignment to another group of students and continued by doing the task in the same sequence again but selecting another combination of numbers from the three original numbers.

Lessons in grade 5 – toward students' active learning
The grade 5 lesson represents a practice in between the traditional approach to teaching and students' active learning, where the teacher-student interaction involved some student decisions. During the first 20 minutes, the teacher probed the students' individual skills with fractions by using the app Traffic Light for formative assessment. With this app, the student writes an answer on the tablet and presses either a green light for "no problems in understanding", a yellow light for "some problems in understanding", or a red light if "the problem was too difficult". During the next 60 minutes, the students became more active through problem-solving activities for the whole class, supported by group discussions among students, and by allowing students to enter the stage in front of the whiteboard by explaining a solution for the class. As a starting point for discussion, the teacher used the Mentimeter system "govote.at" for recording the students' answers.

Lesson in grade 7 – student active
The grade 7 lesson in sports is described as student active, where students' decisions was visible in the teacher-student interaction. This activity took its starting point from the national curriculum and in students' skills to conduct motion analysis in three lessons. The class worked in groups of two to four students and practiced four motions—two mandatory motions and two selected

by the students. The students decided in which sequence the motions should be practiced and analysed. The app Hudl Technique (designed to analyse and improve performance with slow motion video playback) was used to conduct the analysis in relation to the criteria. In Hudl, the students and teachers explicitly analysed the motions (e.g. a cartwheel) based on the affordances of slow motion and by pointing, for example, to a particular angle in a motion as illustrated through the video.

Lesson in grade 8 – student active
The grade 8 lesson in arts can be described as very student active based on significant students' decisions in the teacher-student interaction. In this didactical design, students were involved in decisions regarding the selection of content and in what sequence the content should be studied. Further, the students made decisions regarding pacing when they worked on a pedagogical plan with different tasks that needed to be accomplished during the semester. The students had to plan what area to start with and when the tasks associated with each area should be accomplished. The students worked in groups of four, with some collaborative work and some individual work. The teachers' teaching was based on what students reported in Google Classroom. A number of software applications were used during the lesson, and in order to keep track of students' work, the teacher and students frequently used Google Classroom, which included cloud computing and other Google apps (e.g. Google Presentation and Google Drive).

Focus group interviews

The teachers selected the students for the focus group interviews, keeping the group size between three and five students. The interviews were structured around two interview themes constructed from photographs of one-to-one computing practices. An initial analysis was made regarding the documented activities during these classroom observations. The first theme about teachers' methods of teaching concerned questions regarding collaborative work and the teachers' communication methods in the one-to-one computing classroom. The second theme, the students' approach to learning, probed students' awareness of what they should learn and how one-to-one computing could enhance their learning process. From our own previous experience of interviewing youth and children, we were familiar with the possible challenges in getting them to produce rich narratives. Therefore, across these themes, the approach of stimulated recall (Haglund, 2003) was used to probe students' experiences of different didactical designs by showing them photographs of different one-to-one computing practices, for example, student collaboration. Before the interview started, the students were informed about the interview, that photographs would be used to give examples of situations, and ethics. Depending on the students' age, the focus group interviews lasted between 23 and 35 minutes. In total, 11 focus group interviews were held including 23 girls and 18 boys from age 8 to 14.

Ethics

Ethical considerations were brought up in this study, especially because children were the interviewees. Before the research was conducted, the teachers distributed a statement of research ethics to the students' parents or guardians. The statement informed them about the purpose of the research and about beneficence, non-malfeasance, informed consent, and confidentiality/anonymity (Swedish Research Council, 2011). The responses from the parents were reviewed before the focus group interviews were conducted. By using such an approach, the teachers could identify any students who were not allowed to participate. Thereafter it was the teacher who formed the student focus groups based on students who volunteered. When the interview started, we informed the students that our intention was to learn from

their unique experience, that they were the experts. Here we informed the students that we accepted different degrees of participation, for example, what to do when someone did not want to discuss a question. Further, at the schools we were directed to either a group room or a classroom. Here we made an attempt to arrange the tables in a familiar way where we sat together with the students as one group. We also had to be the leader when some interviews got noisy and everybody wanted to speak. However, we cannot underestimate our power as adults in cases where students might have been reluctant to participate.

Thematic analysis

Thematic analysis is a process used for analysing qualitative data. This process is understood from the two perspectives of "*seeing*" and "*seeing as*" (Boyatzis, 1998, p. s1-4). To see something means to find patterns in the data that begin with a coding procedure, while to see as focuses on the interpretation and the analysis of bringing parts together into themes. The process of seeing took its starting point in a data-driven coding procedure in the software application Nvivo. Through a process of reducing the raw information into outlines of each unit of text, six coded areas were found: teaching approaches, use of ICT, order, evaluation, furniture, and simplicity. As a first step in making sense of these codes, meaning was searched for by looking for signs that included episodes, comparisons, and contrasting statements (Coffey & Atkinson, 1996) as well as what the interviewees explicitly or implicitly were saying in each unit. The perspective of seeing as was used in order to construct themes at a more abstract level. Issues of inter-rater reliability were raised between the authors where critical situations in students' narratives were highlighted, scrutinised, reconsidered, and rephrased. In summary, this process formed the three empirical themes of students' learning in class, students' learning outside class, and classroom assessment. In these themes, the differences in the students' perspective, were then interpreted through the theoretical framework elaborated on further below.

Theoretical framework

School environments, school subjects, teachers, students, and ICTs are all relays of symbolic power and control (Bernstein, 1990, 2000). These concepts are used to inform us on how teachers or students can take advantage over others. This is operationalised through two key concepts – classification and framing. Classification refers to power relationships between categories (e.g. teachers and students). Depending on how specialised different categories are to each other, classification becomes either strong or weak. Bernstein argues that any attempt to challenge or disturb an established relationship will reveal the power relationships on which the classification is based and reproduced (Bernstein, 2000). Moreover, the concept of framing is helpful for understanding "who controls what" in the teacher-student interaction (Bernstein, 2000, p.12). Bernstein describes the locus of control from selection, sequence, pacing, assessment, and control over hierarchies in the teacher-student and student-student relations. Narratives that, for example, demonstrate a unidirectional communication from teacher to student indicate strong framing or teachers being in control, whereas signs of students' interaction and reasoning with the teacher indicate weak framing or increased student control. Further, when considering all power and control relations in the coded material, Bernstein's (1990) terminology of *orientations to meanings (*Bernstein, 1990, p. 15) were applied. Consider the shift from computer labs to one-to-one computing. The practice with desktop computers in labs is specialised to a practice for that specific context, while the one-to-one computing classroom blurs the relationship and become less specific. This is an example that demonstrate of how power positions are revealed between categories. The orientations to meaning in the former context is based on relations that was direct and specific,

whereas relations in the latter context was indirect and less specific. In this paper, orientations to meanings are used to address possible contrasts within, as well as between, each of the three themes

Findings

The results are structured according to the three empirical themes: (1) students' learning in class, (2) students' learning outside class, and (3) classroom assessment. These themes provide descriptions of the orientations to meanings from the students' perspective. In order to illustrate the teacher-student interplay, in the next section the students' voices are illustrated by typical excerpts from the discussions of the students. The quotations are often products from what the group has discussed together in the focus groups.

Students' learning in class

The students' learning in class indicated a formal practice based on a schedule where a formal activity takes place organised by the teacher. In this theme, one subtheme was found about meanings based on the teacher's power and control, while limited signs of meanings based on students' power and control were indicated.

Meanings based on the teacher's power and control
One example of a didactical design based on the teacher's strong control was indicated by the grade 2 students in the two framing categories that concern how content was selected and in which order content should be acquired:

> She used to say what we should do and show that to us. Yesterday, when you visited us, she did it like that. Other times, if, for example, we are using the textbook, she often shows us how. (grade 2 students)

This quotation indicates a structure where the teacher shows the students what they shall accomplish on the tablet and afterwards the students imitate and repeat, practicing the teacher's instruction. Students in grades 5, 7, and 8 met didactical designs where symbolic power and control were distributed to them. However, our awareness about the teachers' use of pedagogical plans helped us to find a difference when asking students about this issue. The plans were shared through the school's cloud computing service. A pedagogical plan is here considered as a bridge between the national curriculum and teachers' local planning (Hopmann, 2007), as observed here in a focus group:

> As soon as we start to work with a new topic, the teachers produce a document that emphasises what we shall learn, what we shall work with, and how to do it. (grade 5 students)

This quotation indicates teachers' strong control regarding the selection of content and to some extent the criteria for assessment. The grade 7 and 8 students were awarded grades every semester. This fact was reflected in what students said in the focus group about the grade levels from the national curriculum, for example:

> They publish the knowledge requirements for A, C, and E [a matrix from the national curriculum]. Then you get the documents in English language, social studies, Swedish language … I mean in different subjects. There you are told what you need to know to receive a specific grade. Then, you are aware of these and work to reach these requirements and develop further if you want a higher grade. (grade 7 students)

The above quotation indicates increased control in the framing category "evaluation", when students were informed about how they needed to perform

in relation to a specific grade. A practical example was outlined when the students reflected upon the observed lesson in sports. Here, the tablet was integrated for conducting motion analysis with stated criteria. As they explained:

> You know we will use analysis. During the Tuesday lesson, we recorded our performance in the app [Hudl]. We got a document that says what it is you should study in the film. If I, for example, perform a cartwheel, then I should study from the video whether I had good balance. (grade 7 student)

When comparing the above narratives about pedagogical plans with the narratives about pedagogical practice, we find that the teachers' symbolic power was distributed to the students when they worked with the framing category of "evaluation". In the motion analysis, it was the students who had the task to make the assessment regarding the quality of a motion. This indicates strong control from two perspectives because the criteria also become the content. Here we mean that the teacher does not use a textbook to frame the content of study, and one could say that the textbook corresponds with the criteria. Instead, in this case the teacher designed an activity that strictly was anchored in the teacher's pedagogical plan that in turn was based on criteria in the national curriculum.

Students' learning outside class

The theme about students' learning outside the classroom indicates an informal practice based on how students find a place, organise time, and decide how to perform a task. This theme is strongly related to the cloud computing software, so the grade 2 students were excluded from this activity. Two subthemes were identified.

Meanings based on teacher's power and control
The use of cloud computing for storing, retrieving, and sharing of information in grades 5, 7, and 8 helped the students with the sharing of documents and resources with others as well as keeping track of the study material. As one group commented,

> You have everything on the iPad and can send it online. It is not necessary to bring papers home so there is no possibility of losing papers. (grade 5 students)

This quotation indicates how teachers' sharing of documents and access to schoolwork 24/7 tacitly increased teachers' power and control. Another group added how the lists of tasks online became the teachers' tool for keeping track of the students' accomplishment:

> In Google Classroom, you have control of the assignments that you label as accomplished. It is important to know how to do that because this is the way you make the teacher aware that you have done the work" (grade 8 students)

These quotations about study structures indicate a rule to accomplish schoolwork on time. If that rule is broken, the opposite occurs, i.e. teachers lose symbolic power and control, which is addressed in the next subtheme.

Meanings based on distribution of power and control
Lists of tasks and criteria indicate subtle signs of a shift of pacing towards the students – when students get a list of assignments with deadlines, they have increased responsibility to meet these deadlines. Tacitly, the "piecework" approach indicated increased student control because they had to decide when they needed to carry on with schoolwork from a place other than at school (e.g. at home). Further, in the students' narratives, this working process revealed the additional use of cloud computing through affordances of sharing, as a group of grade 8 students described:

> [Focus group]: We used the tablet for everything, that is to say, searching for pictures and for information. We assembled the whole presentation and shared it with all members of the group.
> [Interviewer]: So, you shared it with the group so it would be possible for any group member to look at it later, even if someone were sick?
> [Focus group]: Yes, and that makes the process flexible because you can create a document that you can share with others even if you are located in different places. If I want to add something, I can just write it in the shared document. … and so can anyone else, wherever they are.

The above discussion indicates two aspects of power and control. First, the students emphasised the process of sharing through cloud computing. Here, sharing indicates the purpose of bringing students together, an enhancement provided by the one-to-one computing environment. In this way, the power relations (classification) between students become weaker. Second, based on the way that students described the process of working with content, for example, when they selected content from the Internet and assembled the whole presentation, this indicated increased control in the framing category "selection". Also, because students decided in which sequence the content was to be acquired, this indicates increased control in the framing category "sequence". Thus, control was shifted towards the students. Furthermore, the extract illustrates implications for the framing category "pacing" when students described how work could be organised both in school as well as out of school. The students' work is not bound to a fixed timeslot in a schedule, which indicates increased student responsibility in pacing and increased control by students.

Classroom assessment

This theme contains two subthemes where teachers' power and control, from the students' perspective, either was held by the teacher or distributed to the students. The students commented explicitly on the symbolic gesture of raising their hand in the classroom in the context of teachers' use of formative assessment.

Meanings based on teachers' power and control
The grade 2 students reported on one approach of confirming the right answer:

> Anyone who knows the answer has to raise their hand and then the teacher selects one of them to state the answer. If it is right, then she writes it [on the whiteboard]. It is right [emphasis] it goes on the whiteboard. (grade 2 students)

First, this quotation indicates that it is the teacher who has the right to decide the approach for asking students questions and deciding who is to reply, and this indicates strong teacher power. The quotation indicates strong control by the teacher by asking for the explicit answer on a task in relation to a criterion. Second, in the hierarchical student-to-student relationship, the approach indicates a hierarchy between those who know the answer and those who do not know. The grade 8 students' narratives about the form of formative assessment communication demonstrated a shift where some teachers had abandoned the idea of raising one's hand, as one group explained:

> You need to be alert. That is something the teachers started with now that we are in grade 8. Yes, because before it was the one who held up their hand who answered. But now the teacher says, 'You can just reply' […] You don't need to raise your hand [anymore]. (grade 8 student).

This quotation indicates another aspect of a teacher's strong symbolic power when changing the mode of probing the students' knowledge randomly without asking them to raise their hand.

Meanings based on distribution of power and control

In the context description of the four lessons, the grade 5 teacher demonstrated the use of ICT-based formative assessment tools and teaching methods. To avoid students' feelings about answering incorrectly in public, an online response system (govote.at) for formative assessment was used in the grade 5 lesson. Such an approach transferred symbolic power to the students because the identity of the students responding was hidden but the performance of the whole group was explicit. One group reflected upon their feelings in relation to the online formative assessment approach:

> It is rather good because if the teacher says, 'Please raise your hand,' and if everybody appears to agree, then it could be difficult to say what you really thought. You become the focus of attention and that can be rather hard. (grade 5 student)

Discussion

This paper was introduced by highlighting the need for meaningful didactical designs (Ilomäki et al., 2016). When considering a didactical design through the German tradition of Didaktik based on cultivation of social relations (Jahnke et al, 2017) and change (Simon, 1996), Bernstein's (1990, 2000) conceptual tools of power and control gave points of reference between, as well as within, the three clusters of didactical design. Further, in Klein and Kleinman's (2002) epistemology of a design process, the student perspective becomes as equally important as the teacher perspective for fully understand a didactical design in the one-to-one computing classroom. By adopting this approach, this study aimed to increase the understanding of three clusters of didactical designs in the one-to-one computing classroom from a student perspective.

Regarding the first research question about variations between, as well as within, the didactical design, Bernstein's (2000) concepts of power and control inform us about the teacher-student relationship. The themes of students' learning in class and students' learning outside class illustrate two levels of power and control – an external level and a practical level. We argue, following Bernstein (2000), that power and control is not a static phenomenon, but something more plastic that becomes "visible" by taking different perspectives. However, at an external level, where pedagogical plans and study structures in *Google Classroom* were provided, strong structures that regulate the students based on strong power and control could be found in the student's narratives. According to Bernstein (2000), this essentially means that the specialised context of the school is made visible for all students with regard to what is expected of them in the national curricula and syllabus. At the next level of practical examples from teaching and learning situations in the student's narratives, we noticed that the didactical designs empowered the students to take some decisions, for example, regarding evaluations that became possible through the tablets when conducting motion analysis. Similarly, but in another form, both grade 7 and 8 students reported increased empowerment when organising thematic studies. Thus, what was made visual was an external level with less room for students' empowerment while, at the level of practice, the teachers' didactical design constructed an orientation to meaning that highlighted students' empowerment in grades 5, 7, and 8. At the external level, power and control were kept by the teacher, while at the practical level power and control were distributed to the students. These two levels of the didactical designs demonstrate both signs of regulation and possibilities as well as students' understanding of increased empowerment. The social structures in the didactical design in grade 7 and 8 demonstrate the greatest potential for unpredictability in students' learning (Kjällander, 2011). As shown in other studies (Player-Koro & Tallvid, 2015), and in line with Bernstein (2000), the assessment system is of great importance for teachers' didactical designs regarding orientation to meanings. We conclude that by making goals and

criteria visible in pedagogical plans, education became more equal for all students independent of background.

In the second research question, the focus was on the orientation to meanings in students' learning processes. When the three clusters of didactical design are compared with the three themes, the distribution of power and control shows the different extents to which students are fostered to take responsibility and to be involved in their learning process. Again, the grade 5, 7 and 8 students' narratives demonstrated a greater potential for unpredictability (Kjällander, 2011) to take place in students' learning because the students are no longer just imitating the teachers' presentation (e.g. a model of how to solve something). How power and control are either kept or distributed illustrate different orientations to meaning in students' learning processes. Previous studies have shown varying approaches to learning (Andersson, Wiklund, & Hatakka, 2016; Håkansson Lindqvist, 2013; Zheng, Arada, Niiya, & Warschauer, 2014), but not in relation to power and control. We assume that orientations to meaning can be discussed in terms of 21st-century skills (Zucker & Light, 2009; Voogt et al., 2013) and whether students are fostered mainly through imitative teaching or through creative activities that affect them in more creative ways.

In this study, the student perspective was brought into the foreground. When taking the student perspective on the findings further, the findings possibly serve to embody the social construction of the one-to-one computing classroom (Klein & Kleinman, 2002). The student perspective highlights both how teachers' didactical design and the one-to-one computing classroom worked for the students from a theoretical lens of power and control. Moreover, when students are considered as one factor in the didactical design, we argue that they construct their own meaning for the didactical design and one-to-one computing.

Limitations

This paper contains some methodological limitations. Much can take place when visiting a school and interviewing small children and youths. The schools were very helpful during the visits, but we also had to adapt to the daily practice. Therefore, the same number of interviews was not conducted across the student groups even though that was our original intention. The selection process was not stringent, and during the research project we used the school principals in the selection of teachers. In informal student conversations, it came to our attention that one grade 8 teacher was particularly good with using one-to-one computing. Based on our curiosity, we broke with our selection criteria and visited the grade 8 teacher and thus the students he taught. In hindsight, we think this was a good decision that benefited this study. Another limitation concerns the background of classroom observations reported in the other paper. One consequence was that the classroom practice exists implicitly and without quotations from the teacher-student communication in the actual classroom situations as opposed to, or in addition to, the generalised comments in the student focus groups. Such material might have supported and strengthened the interpretations

Conclusions

From the students' perspective, this study demonstrates how different power and control relationships in teachers' didactical designs regulate and construct different possibilities in students' learning processes. The results indicate the use of pedagogical plans and criteria for maintaining teachers' power and control as well as for students' empowerment through the use of one-to-one computing and especially cloud-computing affordances. When power and control were distributed to the students, the use of one-to-one computing was one essential component for making students learning processes smoother

regarding when to study and how to study. The four lessons with their unique power and control structures in the three didactical design clusters from the previous study (Bergström et al, 2017) are to some extent both confirmed and extended by taking the student's perspective.

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References

Andersson, A., Wiklund, M., & Hatakka, M. (2016). Emerging collaborative and cooperative practices in 1:1 schools. *Technology, Pedagogy and Education, 25*(4). https://doi.org/10.1080/1475939X.2015.1060896

Becker, P., & Taawo, A. (2017). 1:1 initiatives in Sweden [In Swedish: 1.1 satsningar i Sverige]. Retrieved from http://www2.diu.se/framlar/egen-dator/

Bergström, P. (2012). Designing for the unknown. Didactical design for process-based assessment in technology-rich learning environments. (Doctoral thesis). Umeå, Umeå University. Retrieved from http://www.diva-portal.org/smash/get/diva2:516108/FULLTEXT01.pdf

Bergström, P., Mårell-Olsson, E., & Jahnke, I. (2017). Variations of symbolic power and control in the one-to-one computing classroom: Swedish teachers' enacted didactical design decisions. *Scandinavian Journal of Educational Research*. https://doi.org/10.1080/00313831.2017.1324902

Bernstein, B. (1990). *Class, codes and control: The structuring of pedagogic discourse* (Vol. 4). London and New York: Routledge.

Bernstein, B. (2000). *Pedagogy, symbolic control and identity: Theory, research, critique* (Revised Edition ed.). Lanham: Rowman & Littlefield Publishers, Inc.

Blikstad-Balas, M. (2012). Digital literacy in upper secondary school - What do students use their laptops for during teacher instruction. *Nordic Journal of Digital Literacy, 7*(2), 81-96.

Bocconi, S., Kampylis, P., & Punie, Y. (2013). Framing ICT-enabled innovation for learning: The case of one-to-one learning initiatives in Europe. *European Journal of Education, 48*(1), 113-130. https://doi.org/10.1111/ejed.12021

Boyatzis, R. (1998). *Thematic analysis and code development: Transforming qualitative information*. London and New Delhi: Sage publication.

Brown, T. H. (2006). Beyond constructivism: Navigationism in the knowledge era. *On the Horizon, 14*(3), 108-120.

Coffey, A., & Atkinson, P. (1996). *Making sense of qualitative data*. London and New Dehli: Sage publication.

Gonzales-Martinez, J. A., Bote-Lorenzo, M. L., Gomez-Sanches, E., & Cano-Parra, R. (2015). Cloud computing and education: A state-of-the-art survey. *Computers & Education, 80*, 132-151. https://doi.org/10.1016/j.compedu.2014.08.017

Haglund, B. (2003). Några anteckningar om en metod att generera data. *Pedagogisk Forskning i Sverige, 8(3)*, 145-157.

Hamilton, D. (1999). The pedagogic paradox (or why not didactics in England?). *Pedagogy, Culture & Society 7*, 135-152. https://doi.org/10.1080/14681369900200048

Hjelmér, C., & Rosvall, P.-Å. (2016). Does social justice count? 'Lived democracy' in mathematics classes in diverse Swedish upper secondary programmes. *Journal of Curriculum Studies*, 1-19. https://doi.org/10.1080/00220272.2016.1138326

Hopmann, S. (2007). Restrained teaching: the common core of Didaktik. *European Educational Research Journal*, 6(2) 109-124. https://doi.org/10.2304/eerj.2007.6.2.109

Hudson, B. (2008). Didactical design research for teaching as a design profession. In B. Hudson, & P. Zgaga (Eds.), *Teacher education policy in Europe: A voice of higher education institutions*. (pp. 223-238) Umeå: University of Umeå, Faculty of Teacher Education.

Hudson, B. (2011). Didactical design for technology enhanced learning. In B. Hudson, & M. Meyer (Eds.), *Beyond fragmentation: Didactics, learning and teaching in Europe* (pp. 223-238). Opladen and Farmington Hills: Verlag Barbara Budrich.

Håkansson Lindqvist, M. J. P. (2013). Possibilities and challenges for TEL from student perspective through the uptake and use of digital technologies in a 1:1 initiative. *Education Inquiry, 4*(4), 629-647.

Håkansson Lindqvist, M. J. P. (2015). Gaining and sustaining TEL in a 1:1 laptop initiative: Possibilities and challenges for teachers and students. *Computers in the Schools, 32*(1), 35-65. https://doi.org/10.1080/07380569.2015.1004274 .

Ilomäki, L., Paavola, S., Lakkala, M., & Kantosalo, A. (2016). Digital competence — an emergent boundary concept for policy and educational research. *Education and Information Technologies, 21*, 655-679. https://doi.org/10.1007/s10639-014-9346-4

Islam, S. M., & Grönlund, Å. (2016). An international literature review of 1:1 computing in schools. *Journal of Educational Change, 17*(2), 191-222. https://doi.org/10.1007/s10833-016-9271-y

Jahnke, I., Bergström, P., Mårell-Olsson, E., Häll, L., & Kumar, S. (2017). Digital didactical designs as research framework: iPad integration in Nordic schools. *Computers & Education*. 113 (1-15). https://doi.org/10.1016/j.compedu.2017.05.006

Jahnke, I., Norqvist, L., & Olsson, A. (2014). *Digital didactical designs of learning expeditions*. Lecture notes in Computer Science 8719. In C. Rensing, S. de Freitas, T. Ley, & P.J. Munoz-Merino (Eds). Open learning and teaching in educational communities. Paper presented at the European Conference on Technology Enhanced Learning EC-TEL 2014, Graz, Austria.

Kjällander, S. (2011). *Designs for learning in an extended digital environment*. (Doctoral compilation), Stockholm University, Stockholm.

Klafki, W. (2000). Didaktik analysis as the core of preparing instruction. In A. Westbury, S. Hopmann, & K. Riquarts (Eds.), *Teaching as a reflective practice* (pp. 139-156). Mahwah: Lawrence Erlbaum Associates.

Klein, H.K., & Kleinman, D.L. (2002). The social construction of technology: Structural considerations. *Science, Technology and Human Values*. 27 (1), 28-52.

Laurillard, D., & Derntl, M. (2014). Learner Centred Design - Overview. In Y. Mor, H. Mellar, Warburton, Steven, & N. Winters (Eds.), *Practical design patterns for teaching and learning with technology* (pp. 13-16). Rotterdam/Boston/Taipei: Sense.

Lindmark, T. (2013). *Samhällskunskapslärares ämneskonceptioner* (Doctoral Monography), Umeå, Umeå University. Retrieved from www.diva-portal.org/smash/get/diva2:663989/FULLTEXT01.pdf

Lund, A. & Hauge, T. E. (2011). Designs for teaching and learning in technology-rich learning environments. Nordic *Journal of Digital Literacy, 4(6)*, 258-272. https://doi.org/10.1080/15391523.2006.10782463

Norqvist, L. (2016). Learning, tablet, culture-coherence? *Universal journal of Educational Research,* 4(6), 1306-1318. https://doi.org/10.13189/ujer.2016.040608

Pegrum, M., Oakley, G., & Faulkner, R. (2013). Schools going mobile: A study of the adoption of mobile handheld technologies in Western Australia independent schools. *Australian Journal of Educational Technology, 29*(1), 66-81. https://doi.org/10.14742/ajet.64

Penuel, W. R. (2006). Implementation and effects of one-to-one computing initiatives: A research synthesis. *Journal of Research on Technology in Education, 38*(3), 329-349. https://doi.org/10.1080/15391523.2006.10782463

Player-Koro, C., & Tallvid, M. (2015). One laptop on each desk: teaching methods in technology rich classrooms. *Seminar.net: media, technology and lifelong learning, 11*(3).

Rostvall, A.-L., & Selander, S. (2008). *Design för lärande*. Stockholm: Nordsteds.

Saudelli, M. G., & Ciampa, K. (2014). Exploring the role of TPACK and teacher self-efficancy: an ethnographic case study of three iPad language arts classes. *Technology, Pedagogy and Education*, 1-21. https://doi.org/10.1080/1475939X.2014.979865

Selander, S., & Kress, G. (2010). *Design för lärande–ett multimodalt perspektiv*. Stockholm: Norstedts.

Sensevy, G. (2012). About the joint action theory of didactics. *Zeitschrift für Erziehungwissenschaft, 15*, 503-516. https://doi.org/10.1007/s11618-012-0305-9

Simon, H.A. (1996). *The science of the artificial (3ed)*. Cambridge: MIT Press.

Swedish Research Council. (2011). *Good research practice [In Swedish: God forskningssed]*. Vetenskapsrådets rapportserie 1 2011. Retrieved from https://publikationer.vr.se/produkt/god-forsningssed/ .

Zheng, B., Arada, K., Niiya, M., & Warschauer, M. (2014). One-to-one laptops in K-12 classrooms: voices of students. *Pedagogies: An International Journal, 9*(4). https://doi.org/10.1080/1554480X.2014.955499

Zucker, A. A., & Light, D. (2009). Laptop programs for students. *Science, 323 (5910)*, 82-85. https://doi.org/10.1126/science.1167705

Voogt, J., Erstad, O., Dede, C., & Mishra, P. (2013). Challenges to learning and schooling in the digital networked world of the 21st century. *Journal of Computer Assisted Learning, 29*, 403-413. https://doi.org/10.1111/jcal.12029