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Exploring Activities Regarding Technology-Enhanced Learning in a One-to-One Initiative

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ABSTRACT

The uptake and use of digital technologies in the classroom was studied in Unos Umeå, a One-to-One (1:1) initiative between Umeå University and the municipality of Umeå in Sweden. The focus was set on teachers' expectations and activities regarding Technology-Enhanced Learning (TEL). Possibilities and challenges in teachers' activities were analyzed using the Ecology of Resources Model (Luckin, 2010). Creating collaborative learning environments, furthering teachers' skills in Information and Communication Technology (ICT) and supporting laptop use will have implications for TEL.

Keywords

digital technologies; 1:1; tel; teachers, laptops

INTRODUCTION

In Europe, Information and Communication Technology (ICT) and computer access in schools continue to increase (European Commission, 2013). This development also implies the need to identify policies and practices which support new learning environments (OECD, 2009), a holistic approach to ICT in schools and the importance of providing students with twenty-first century skills (OECD, 2012). Despite some consensus on what twenty-first century skills are, for example, critical thinking and problem solving, teaching strategies for these skills seldom seem to be well implemented in educational practice (Voogt et al., 2013a). If students do not develop the ICT-skills needed, a strong boost for teachers in digital technologies may be needed. This boost would imply radical policy change (European Commission, 2013; Olofsson et al., 2011). Impact on educational standards and more vocational and social significance in curriculum development, together with ICT as a catalyst for curriculum reform will be important in the uptake and use of ICT (Hammond, 2013). There appear to be great challenges in Europe in achieving Technology-Enhanced Learning (TEL) in general, and specifically in K-12 practices



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(Olofsson, Lindberg, & Hauge, 2014). To meet these challenges, more research is needed (Fischer et al., 2014).

This paper is one attempt to take on some of the challenges expressed by Fischer et al. (2014). It is based on the 1:1 initiative Unos Umeå, a joint research project between Umeå University and the municipality of Umeå in Sweden. The 1:1 initiative here means one laptop per student. The project offered the opportunity to explore how digital technologies, defined here as laptops and interactive whiteboards, together with TEL were used in practice in the classroom and how these activities developed over a period of three years. The main results from previous studies in this project (Håkansson Lindqvist 2013; 2015) reveal that alleviating technical problems, targeting low student use, teacher collaboration and professional development were seen as important for gaining and sustaining TEL in the classroom.

This paper presents the findings of the initial phase (Phase 1) and second phase (Phase 2) of the 1:1 initiative regarding teachers' initial expectations and the development of activities in practice in one school in the research project. The reason for mapping the teachers' expected activities was to gain information about the teachers' expectations for some of the effects the use of digital technologies and TEL could have on their work. This information formed the backdrop when, using classroom observations and teacher interviews, the development in teachers' activities in the classroom regarding digital technologies and TEL over six months was analyzed and described.

The following research questions are posed in this paper: (1) How can teachers' expectations regarding the effects of the use of digital technologies and TEL on their work be described?; (2) What development, if any, can be seen in teachers' activities between Phase 1 and Phase 2?; (3) How can this development be understood as possibilities and challenges for digital technologies and TEL?

LITERATURE REVIEW

As in many other professions, teachers are expected to use technology to increase their effectiveness (Ertmer & Ottenbreit-Leftwich, 2010). In order to do this, teachers need to develop their own use of technology and integrate these skills into relevant school practices (Rosado & Bélisle, 2006). Although Teacher Professional Development (TPD) in ICT is seldom compulsory, many teachers are generally confident about the use of ICT and devote spare time to the study of ICT (cf. European Commission, 2013). There are strong barriers preventing teachers from using technology, such as existing beliefs about technology and current levels of knowledge and skills (Ertmer et al., 2012). Therefore teachers' beliefs about good instruction and learning must be supported by contextual, cognitive and affective factors in school environments (Ertmer & Ottenbreit-Leftwich, 2013), if change is to take place. Here, the role of the

teacher is central (Hattie, 2009). Skilled and confident teachers are said to be more important for delivering ICT-skills and knowledge than the latest equipment (European Commission, 2103). However, teachers need time to discuss content, students' work, pedagogy and technology (Drayton et al., 2010). Ertmer and Ottenbreit-Leftwich (2013) in a similar way point out that the process of teachers' activities regarding the uptake and use of digital technologies in schools and the shift from technology to pedagogy takes time. The same researchers also stress the importance of teachers believing in their own abilities and that they work in a culture which embraces a type of TPD intertwining technical, pedagogical and subject-related didactic competences (Ertmer and Ottenbreit-Leftwich, 2010; cf. Mishra & Koehler, 2006; Voogt et al., 2013b). Moreover, for TPD to work, it should be collaborative and situated in teachers' everyday practice (Vrasidas, 2014).

In the meantime, technology deployment in the form of 1:1 initiatives continues throughout the world, although "little is known about the prevalence, scale, and scope of these programs" (Richardson et al., 2013, p. 5). Laptops are perhaps not the solution for educational change; however, they can be seen as amplifying tools, given pedagogical, administrative and ICT-support structures as well as engaged teachers (Warschauer, 2006). Studies of 1:1 initiatives can be based on motivational factors, involvement, learning results, critical reflection, effects on student and teacher collaboration, TPD and organizational issues such as the role of the school leader and policy implementation (Bebell & O'Dwyer, 2010; Penuel, 2006; Silvernail & Lane, 2004; Solhaug, 2009). One-to-One initiatives have been shown to lack sustainability, being abandoned as schools lack the finances and staff needed for rigorous evaluation (Hu, 2007). Fried (2008) discusses the unstructured use of laptops in lecture courses, laptop use interfering with learning and the need to focus on promoting appropriate use. When used appropriately, there appears to be a potential for transformative added value in the 1:1 classroom, but it also presents challenges for teaching, classroom management and high-quality TPD (Dunleavy, Dextert, & Heinecke, 2007). International research (Dunleavy, Dextert, & Heinecke, 2007; Weston & Bain, 2010) as well as research in a Swedish context (Tallvid & Hallerström, 2009; Tallvid, 2010; Fleischer, 2012; Grönlund et al., 2012; Grönlund, Andersson, & Wiklund, 2013) reveals that in the end, the question is how laptops can enable new ways of teaching and learning. In short, it is primarily a question of pedagogy and not technology.

With this previous research as a backdrop, this study will examine teachers' initial expectations regarding some of the effects the use of digital technologies and TEL can have on their work, together with the potential development of teachers' activities related to the uptake and use of digital technologies and TEL in the classroom. The study aspires to contribute to this research, with a specific focus on the possibilities and challenges implied in the development from technology to pedagogy in teaching activities and classroom practices.

THEORETICAL FRAMEWORK

The sociocultural approach can be described as developmental, regarding learning as an interaction between individuals and their sociocultural environment (Vygotsky, 1978). This places demands on the surrounding environment, context and design (Luckin, 2010). The Ecology of Resources Model (Luckin, 2010) can be used as a framework for examining and describing learning practices in the classroom. As the model provides a holistic view, placing the focus on the learner, it has been fruitful in providing an explorative snapshot design of the resource elements surrounding the learner over time, and how to design a set of elements to enhance the learning process (Luckin, 2010). The model illustrates the resource elements, *Environment*, *Knowledge and Skills*, and *Tools and people*, available to the learner, and *filters*, which can either enable or restrain the resources available to the learner. In this study, filters are used as a theoretical concept for analysis, i.e. how they are manifested in the form of restraints which can make it difficult to access the resource elements available. The choice of this model and the use of the theoretical concept of filters (Luckin, 2010) can be seen as an important part of identifying and describing possibilities and challenges for the uptake and use of digital technologies, supporting TEL and change in the classroom environment.

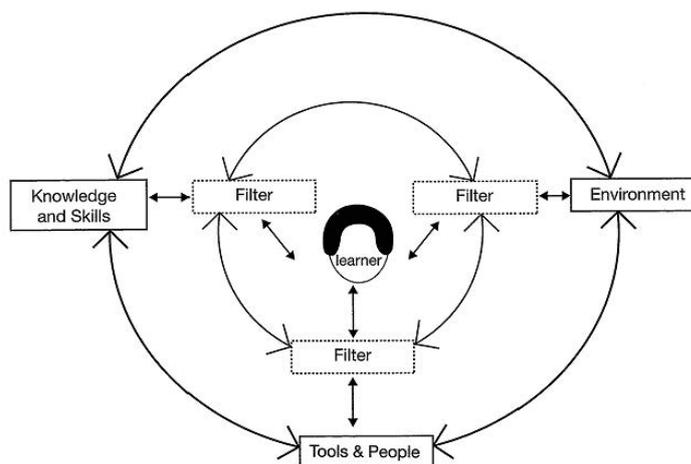


Figure 1 The Ecology of Resources Model. Elements and their filters. Luckin (2010, p. 94)

In this study, the Ecology of Resources Model (Luckin, 2010) is used to illustrate how filters are manifested for teachers as learners. The resources in the context of the two classrooms will be in focus.

CONTEXT

This Swedish research project followed a 1:1 initiative in two schools over a period of three years, from fall 2011 until spring 2014. Four classes in two schools were studied. The schools were chosen by the municipality of Umeå. The classes and the teachers teaching in these classes were chosen in dialogue

with the school leaders. This study comprised teachers ($N=25$) from one of the two schools, a middle-sized compulsory school in central Umeå. The school can be characterized as seeing the use of digital technologies as supporting students' learning. Upon the implementation of the 1:1 initiative, teachers had previously had laptops; the infusion of technology meant that all students received laptops in early fall 2011, to borrow free of charge for use both in school and at home.

Teachers in the initiative were offered professional training through five online modules to increase their ICT-skills, from basic ICT-programs to more advanced multimedia programs. At the start of the initiative, two thirds of the teachers at the school had achieved the recommended level (level 3) of ICT-training. In-house seminars, workshops in digital technologies and individual supervision by an educational technologist were also provided.

METHOD

The empirical data in this study can be said to be threefold (online survey, interviews and classroom observations); this in an attempt to achieve a more complex and rich form of data and a wider understanding of the 1:1 initiative in this specific context through data-source triangulation (Hammersley & Atkinson, 2007). The survey is the empirical base of Phase 1 (initial stage) studying teachers' initial expectations regarding some of the effects of the use of digital technologies and TEL can have on their work. In order to achieve deeper insight into how these expected activities developed into activities in the classroom, teacher interviews and classroom observations were done over a period of six months.

Of the 25 teachers who completed the initial survey, five teachers ($N=5$) were interviewed (June 2012). These five teachers were chosen due to their direct involvement in teaching the students in the classes in the 1:1 initiative, as class mentors or specifically supporting the classes. These five teachers represented a wide range of subjects from Swedish, English, Math, Biology and Physics to Civics, Art and Music.

Additional data was also collected through classroom observations ($N=70$; in total 63 hours) during spring 2012 and follow-up observations in fall 2012. These observations involved all of the 14 teachers who taught different subjects in the two classes, including the five teachers who were interviewed. The interviews and the classroom observations comprised the empirical data for Phase 2, i.e. some six months into the 1:1 initiative. Interviews and observations were used in order to discover development in teachers' activities between Phase 1 and Phase 2.

Online Survey (Phase 1)

At the starting point of the 1:1 initiative, there were 35 teachers working at the school. In total 25 teachers at the school ($N=25$) anonymously participated in an online survey (November 2011). The teachers who took part in the survey represented all subjects included in compulsory school. The response rate was 71 %. The survey concerned four themes: preparedness for the 1:1 initiative, expectations prior to the 1:1 initiative, expected activities regarding own learning and use of digital technologies, and expected activities for the future in regard to the uptake and use of digital technologies. These themes were all related to the question about the effects the use of digital technologies and TEL would have on the teachers' work. The survey questions were specifically related to ICT-training, present and expected use of digital technologies in the classroom, experienced level of training in technology and pedagogy, experienced level of preparation, student use and expected activities for TPD and new teaching methods. Prior to distributing the survey, it was evaluated by four teachers outside the project, who provided suggestions for improvement. The results of the online survey are found under the section Findings under Phase 1. Here, teachers' comments and answers to open questions in the survey are noted as Survey Teacher (*ST1–ST25*).

Interviews and Classroom Observations (Phase 2)

Using the data collected in the survey (Phase 1) themes regarding teachers' expected activities and other related questions were studied further through semi-structured interviews (Bryman, 2008) and classroom observations. In total, 14 teachers were observed, and the number of observations of the teachers was linked to the students' schedule.

The classes were chosen by the school leaders, while the teachers ($N=5$) who were interviewed were mentors or supported the two classes in focus in this study. The interviews took place at the school, lasting up to 45 minutes. The themes included in the interview guide were related to teachers' and students' activities with the uptake and use of digital technologies in the classroom.

The classroom observations took place in selective intermittent time mode (Jeffrey & Troman, 2004), i.e. over a longer period of time and with flexibility in the frequency of the visits. Participation took place as an onlooker observer (Patton, 2002), i.e. the author taking on the role of a student in the classroom, taking field notes and gaining information and contextual insight about the initiative through being present. Field notes were taken continually during the observations and later rewritten in the form of systematic tables. This included descriptive statistics regarding the number of students and laptops, the theme of the lesson, classroom activities, discussions and laptop use. Special note was taken of so-called critical incidents (Tripp, 1993) as significant episodes in a certain context, which were not routine occurrences. The observations, distributed over all subjects, comprised 70 lessons or 63 hours. The results of the interviews and the classroom observations are found under the section

Findings under Phase 2. The interviews are noted as Interview Teacher (*IT1–IT5*). The classroom observations are noted as (*B1–B70*).

Analysis

When analyzing the results of interview data, Kvale (1996) refers to categorization. This process was used for the categorization of the open questions in the teacher survey and the field notes from the classroom observations. The open questions in the survey provided the possibility to unfold new insights regarding teachers' expected activities and activities with digital technologies in the classroom (Kvale, 2007). The data categorization and the initial analysis were performed by the author and thereafter reviewed with colleagues and with the head of the author's research group as a critical friend review (Handal, 1999). Thus, the activities regarding the uptake and use of digital technologies as expressed by teachers were validated through text in the survey, talk in interviews and actual use through observations. Thereafter, the Ecology of Resources Model and the concept of filters was used for further interpretation and analysis (Luckin, 2010).

Ethical Issues

This study, registration number 2011-269-31Ö, was reviewed by the Regional Ethical Review Board, Umeå University, Sweden.

FINDINGS

In this section, the findings from the survey, interviews and classroom observations are presented according to the two phases.

Phase 1

In the following section, the findings regarding the initial online survey are reported concerning preparedness, use and own teaching and learning.

Preparedness for the 1:1 initiative

Two thirds of the teachers who answered the survey had worked as teachers for more than 10 years, and the remaining third for more than three years. While two thirds of the teachers were undecided when asked whether they felt prepared for the initiative, the remaining third of the teachers reported either not being prepared or prepared to a low extent, or being prepared to a high or very high extent.

How teachers experienced the level of TPD they had received for using digital technologies in the classroom was reported in terms of training in pedagogy, respectively, and technology. The results are illustrated in Table 1.

TABLE 1 LEVEL OF PROFESSIONAL TRAINING IN PEDAGOGY AND TECHNOLOGY AS EXPERIENCED BY TEACHERS

	Pedagogy (Number of teachers)	<i>Percent</i>	Technology (Number of teachers)	<i>Percent</i>
None	3	12 %	3	12 %
Low level	10	40 %	12	48 %
Undecided	7	28 %	9	36 %
High	5	20 %	1	4 %
Very high level	0	0 %	0	0 %
<i>Total</i>	25	100 %	25	100 %

As seen in Table 1, very few teachers experienced professional training in pedagogy or technology to be at a high or very high level. The majority of teachers experienced professional training in both areas to be at a low level, or were undecided.

Use and expected future use

None of the teachers in this study reported using digital technologies in the classroom on a daily basis in the initial phase of the 1:1 initiative. While approximately a third of the teachers used digital technologies once a week, the remaining two thirds reported using digital technologies once a month, once per term, or seldom or never.

Digital technologies were used by teachers to present information, provide subject content information in class, give students task instructions, give response to submitted tasks, and provide administrative and planning information. One third of the teachers saw laptops in teaching as providing rich opportunities, while the remaining teachers were negative or undecided. While some teachers reported no special planning strategies for expected activities, others found it difficult to foresee the changes: *It feels as though we are only in the beginning and that the ideas and educational tools are not fully developed* (ST11).

Teachers were asked about the impact of laptops on student use. Teachers saw the possibility of improving students' ICT-competence, i.e. using the laptops as: *an introduction to social media and the possibility of talking about ergonomics and netiquette* (ST22). Other possibilities were helping students with special needs: *easier for students who have writing problems and learning disabilities* (ST23) and individualization: *easier to create tasks for each respective student* (ST17). Teachers also expected challenges: *The realist in me sees that time and energy (initially) will be spent on controlling and directing students' work toward the right things* (ST5).

Own Learning, Teaching and TPD

When asked if the 1:1 initiative was expected to lead to activities for own learning and teaching opportunities, two thirds of the teachers expected their ICT competence to improve somewhat or to a high level, while one third of the teachers were undecided. These comments ranged from no new learning: *I am using knowledge that I already have* (ST10), to the need for time in the learning process: *I am quick in learning some things, while other things mature slowly* (ST12). Some teachers expected a stimulating process: *It feels fun to develop teaching with new work methods and to be forced to learn more in order to keep up with students' knowledge* (ST13). All of the teachers in this study expected the uptake and use of digital technologies to have a certain effect on the development of their teaching and TPD, with the majority reporting to some extent or to a high extent.

How the use of digital technologies and TEL was expected to affect teachers' work in regard to the organization of classroom teaching, more planning, more administration, more work at home and at school is illustrated in Table 2.

TABLE 2 TEACHERS' EXPECTATIONS REGARDING THE EFFECTS OF THE USE OF DIGITAL TECHNOLOGIES ON THEIR WORK

Effects on teachers' work	No effect/effect to a low extent	Undecided	Effect to some extent/ to a high extent	Percent
Alternative organization of teaching	8 %	32 %	60 %	100 %
More planning	4 %	44 %	52 %	100 %
More administration	20 %	28 %	52 %	100 %
More collaboration with other teachers	28 %	52 %	20 %	100 %
More efficient work methods	8 %	28 %	64 %	100 %
New forms of teaching	0 %	4 %	96 %	100 %

As seen in Table 2, the majority of teachers expected new forms of teaching. More than half of the teachers were undecided regarding more collaboration with other teachers and expected to see more administration and planning. Furthermore, two thirds of the teachers in this study expected an alternative organization of teaching and more efficient work methods.

Phase 2

In the following section, the findings from the interviews with the teachers, Interview Teachers (IT1–IT5), and classroom observations (B1–B70) are reported in regard to preparedness, use and own teaching and learning in their activities in regard to the uptake and use of digital technologies and TEL in the classroom. With the survey results as a backdrop, an important aspect here was to trace what development, if any, could be seen in teachers' activities between Phase 1 and Phase 2.

Preparedness for the 1:1 Initiative

The teachers expressed a continued optimistic view of the 1:1 initiative at Phase 2: *Everyone has a laptop and they all have the world in front of them on the screen* (IT2). Hopes for TEL were also expressed: *I think it will be really exciting to see if the learning is improved* (IT1). This optimistic view was also noted in classroom observations, where teachers presented information with their laptops and engaged the students in the use of their laptops (e.g., B7, B16, B48, etc.). Teachers gave students the opportunity to, for example, hold presentations on frogs (B50), show houses that they designed (B52) and practice English grammar (B63).

Teachers' Laptop Use in the Classroom

A large variation in teachers' use of ICT was seen during the classroom observations. Many lessons did not include work with the laptop (e.g., B12, B35, B60, etc.). In fully digitalized lessons, teachers encouraged students to use their laptops for taking notes (B32), writing essays (B44), searching the Internet for information (B8, B42) and for drawing (B27). Even if not encouraged by the teachers, students used laptops for activities other than schoolwork, including games, Internet use, social media and music (e.g., B4, B15, B58, etc.). Teachers expressed students' activities as ranging on a continuum from *a distraction* (IT2) to *a great supplement* (IT5).

Teachers' Reflections on Laptop Use

In the interviews, the aspect of reflective use was reported. Here, teachers noted an awareness and a need to reflect upon how and when to use the laptop: *I don't think that we are used to it [laptop use] yet. It is difficult. You maybe need the laptop for ten minutes. Other lessons you don't need the laptop at all* (IT4). This was also expressed as working in the right manner: *It is not certain that all teachers, including myself, use the laptops correctly* (IT3). Another teacher chose the time-wise most efficient work method: *It is faster to print out paper and correct it and hand it back directly. I feel like a crook, but I have actually done this* (IT4).

Teachers' activities toward reflective use were also noted in the classroom observations. Teachers asked students to close their laptops at the start of the lesson and during class. The phrases *Please close your laptops* and *Turn off your laptops, you don't need them today* in order to start working was heard more than once as teachers signaled the start of a lesson to gain attention (e.g., B2, B7, B16, etc.). Another teacher stated: *I am the only one who is allowed to have a laptop right now* (B31).

Dilemmas in setting rules for laptop use occurred in the interviews as a challenge:

We give them warnings and then we take the laptop for the day or for three days. They just have to manage without the laptop. Then we relented. OK,

if they really need to have the laptop to work. And now they really need the laptop. (IT4)

Teachers were active in the classroom to help students to focus (B3, B33). They reminded students to use the tools the laptop provided: *There are so many that need help with spelling and syntax and they can listen to their own texts. But here you also have to be a driving force* (IT5). Another challenge expressed by teachers was isolated student laptop use and the lack of collaboration that this might imply: *I am worried that they will each be sitting with their own laptop* (IT3). Concerns were also expressed regarding the overall use of digital technologies and TEL: *Get rid of them, throw them out and interact more purely with each other without technology, because that works, too* (IT4).

Need for Increased ICT-Skills and Time for TPD

The need for time to learn the new technology was expressed in the interviews. The balance between the time invested and the direct benefit in the classroom was noted: *But the interactive whiteboard, I have not seen the gains in using it yet* (IT5). Teachers also expressed possibilities of developing ICT-skills during spare time, as time at work was scarce or non-existent: *I should be able to learn the technology by myself really. It's just about sitting down and doing it. This summer, if the weather isn't so great, then I'll learn* (IT5).

During one classroom observation, the lack of skills in ICT was also noted by a teacher who was involved in a student workshop. Here, the teacher noted that students had more advanced skills in the programs, but this, according to the teacher, was not a problem: *since the students were able to fix things and complete the tasks by themselves* (B21).

Teacher Collaboration

In Phase 2, teacher collaboration was reported as a challenge and a possibility: *There is the desire to do things together, but we don't have the time to sit together and plan* (IT2). Others stated that certain forms of collaboration already were in progress: *Everyone thought about what they were good at quite simply and helped each other out* (IT1). Teacher collaborative activities were noted in the classroom observations (B52). Teachers also helped each other out in using programs with students. In certain cases, teachers and students solved technical problems together (e.g., B7, B32, B67, etc.).

Findings in Summary

The development in teachers' expected activities and activities regarding preparedness, use and own teaching and learning from the Phase 1 to Phase 2 in this 1:1 initiative are illustrated in Table 3.

TABLE 3 FROM PHASE 1 TO PHASE 2 IN SUMMARY– DEVELOPMENT IN TEACHERS' ACTIVITIES

	Phase 1	Phase 2
Preparedness	Low, undecided level of preparation Optimistic or very optimistic view towards ICT	Insufficient preparation Continued optimistic view towards ICT
Use	Low laptop use initially Increased use expected Technological awareness	Increased laptop use in school Shift from use towards reflective use Pedagogical awareness
Own teaching and learning	Opportunities for TPD expected Classroom management issues expected New forms of teaching expected	Time needed for TPD and teacher collaboration Classroom management issues for maintaining student focus Element of choice for teachers and students

Teachers' use of the laptops as tools seem to have developed between Phase 1 and 2 from a non-reflective to a more reflective use. This development together with the need for increased TPD and time for collaboration and pedagogical discussions and increasing use were apparent. These aspects combined appear to illustrate a development in activities from the technology and tools per se toward an awareness of the pedagogical use of the laptops in the work in the classroom for learning.

DISCUSSION AND CONCLUSIONS

Using the Ecology of Resources Model framework (Luckin, 2010), the possibilities and challenges mentioned above can be interpreted as the manifestation of filters. These filters can be understood within creating new teaching activities and learning environments for teachers (resource element *Environment*), the furthering of teachers' ICT-skills (resource element *Knowledge and skills*) as well integrating actual everyday use of laptops (resource element *Tools and people*). Furthermore, the filters can be understood as having impact on the development from technological to pedagogical awareness as well as the possibilities and challenges for TEL and change in the classroom.

Environment and Filters

The first resource element is *Environment*. The filters here are manifested in tensions between old school methods and digital technologies. Work with digital technologies provides many opportunities which may lead to an increased interest in learning, motivation and involvement (Bebell & O'Dwyer, 2010; OECD, 2012). Many of the teachers in this study describe this development as attractive for many students and for themselves. This activity appears to be interesting and challenging and provides the possibility of developing new forms of teaching and learning.

The digitalized classroom involves a great amount of information. This access includes the need for teachers to sort and evaluate information and to create tasks which are suited for this type of work (cf. Dunleavy, Dextert, & Heinecke, 2007). Thus, teachers' abilities and opportunities to create digital learning activities and possibilities for TEL can be seen as a filter. Activities which would make work more structured and easier are described by the teachers in this study, as well as individualizing and adapting the activities to students to a greater extent (Tallvid, 2010). However, this requires time. Teachers' skills in supporting students based on their own level of knowledge will be important. This filter comprises achieving reflective use for learning. This will involve pedagogical choices in activities, such as deciding when new technologies which support TEL for the students are more suitable, when traditional methods are more suitable or when a mix of the two is the most efficient work method for learning (cf. Donovan, Hartley, & Strudler, 2007). In this study this balancing is expressed when teachers discuss the difficulties in knowing when and how to use the laptop. Teachers will also need to support a collaborative learning environment which engages students in appropriate work (Fried, 2008), without losing them in isolated computer work. In this study, teachers describe this as controlling and directing laptop use in the classroom.

Teachers need time to discuss content, students' work, pedagogics and technology (Drayton et al., 2010). The lack of opportunities to collaborate with other teachers regarding the use of digital technologies is seen as a filter. Collaboration with other teachers may provide possibilities to share experiences and examples of best practice (Ertmer & Ottenbreit-Leftwich, 2013) to further the use of digital technologies in the classroom and TEL. If these possibilities are not provided, this filter may hinder a reflective use of laptops and TEL. Although data collected through the survey revealed that the expected activities for teacher collaboration were mainly undecided or low in Phase 1, there is evidence of a development in terms of collaboration as a useful activity for learning in Phase 2. In the study, teachers over time seem to acknowledge the need for time to collaborate, and that solid teacher collaboration takes time to establish. These insights may pave the way for a creative and sustainable use of laptops in the classroom.

Knowledge and Skills and Filters

The second resource element is *Knowledge and skills*. Here, the lack of competence and skills in ICT can be interpreted as a filter. The teachers in this study see the need for TPD in ICT and subject-related pedagogy. In a 1:1 initiative, competences of teachers and strategies for TPD change (Dunleavy, Dextert, & Heinecke, 2007; OECD, 2013). That so many of the teachers are undecided whether they are prepared in professional training in technology and pedagogy can be interpreted in at least two ways. Firstly, it may express that the professional training provided is sufficient, at least now, in the 1:1 initiative. However, it may also express a need for professional training, which involves a difficulty in expressing what type of professional training is neces-

sary. One teacher expresses this as the difficulty in deciding and describing if the TPD needed should focus on pedagogy or technology or both. This can be interpreted as the activities requiring a new form of professional development, which is a complex combination intertwining technical, pedagogical and subject-related didactic competences (Mishra & Koehler, 2006). This can be seen in this study in the development from the initial teacher opinions and activities in Phase 1 to the activities in Phase 2. At Phase 2, with a relatively short time having passed since the start of the initiative, it may be difficult to foresee and verbalize what specific professional training is necessary. However, it also illustrates an awareness among the teachers in this study about the role of the teacher in the digitalized classroom. ICT-strategies comprising more than just technology are important as well as the focus on the pedagogy behind the technology, i.e. from tools to learning (Ertmer & Ottenbreit-Leftwich, 2013).

The uncertainty regarding further TPD for what is to come can also be interpreted as a filter. Although ICT-training has been provided from the start of the 1:1 initiative, it is uncertain if there is a systematic plan for future TPD in ICT. Organized TPD will be needed in the school if the teachers are to be able to support students' work toward gaining twenty-first century skills, as expressed by one teacher as being forced to keep up with students' level of digital competence. As noted among the teachers, there are widespread differences in ICT-competences and subject-related skills. Therefore, providing teachers with ICT-training that is not adapted individually can also be said to manifest a filter. It will be important that these challenges in the furthering of professional development for teachers in new areas of competences (Mishra & Koehler, 2006) are made visible and alleviated, and will be important for TEL, change and the sustainability of this 1:1 initiative.

Tools and People and Filters

Tools and people is the third resource element. For the teachers who are involved in this 1:1 initiative, it is difficult to know what to expect. Challenges are expected to be found in the technology itself. Furthermore, the uncertainty regarding use of the laptops as tools for TEL can be said to manifest a filter within this resource element. Teaching will involve integrating and supporting the uptake of laptops in day-to-day work, such as actively accessing and distributing information inside the classroom with the help of digital technologies. The majority of the teachers in this study expect new forms of teaching activities, including allowing students to collaborate and share presentations, search for their own knowledge, and work together in class using online resources. These activities were noted in the classroom observations and appear to reflect this process in the classroom.

Whether or not to use the laptop as a tool in the classroom does not seem to be an issue among many of the teachers in this study. However, there is a need to decide when to use the laptop and the pedagogy behind the use (Ertmer & Ottenbreit-Leftwich, 2013). The time needed to learn how and when to use the laptops

as tools in the classroom can be interpreted as a filter. That teachers in this study keep up with both their subjects and technology during spare time and summer vacation is admirable, but not sustainable. If time is not provided, use will probably not increase and the possible benefits of TEL will not be achieved. Moreover, if time is not provided to increase efficient use, this will also have a negative impact on it, as it becomes easier to choose not to use the laptops in order to save time. The teacher who feels like a crook for not using digital tools in teaching activities when they are accessible, is one example of this.

The same will perhaps be true if the laptops as tools are to support TEL in the classroom. Difficulties in teaching and motivating the students to use the laptops for, as expressed by teachers, the right things in class, i.e. classroom management, is expected to be a challenge (Dunleavy, Dextert, & Heinecke, 2007). How activities are designed to meet these challenges is perhaps the most intensive challenge: to help students focus on classroom work and to use digital technologies as educational tools for learning to promote learning and TEL. This challenge can be said to manifest a filter which is twofold: student use that is not work-oriented and inefficient use, as expressed by one the teachers, when students do not use or forget to use the resources in the laptop, such as spelling, editing or the possibility to read and listen to texts in learning activities.

Teachers can perhaps be seen as their own filters. The teachers involved in this study work at a middle-sized compulsory school where ICT has been an important part of everyday work and of interest for both the school and the teachers. This has led to the participation in this 1:1 initiative. While none of the teachers in this study used ICT in their classrooms on a daily basis, many expressed the intentions and hopes of increasing activities in order to widen their competence in ICT. On the one hand, this use may appear to be at a very low level. On the other hand, it can perhaps be seen as the start of a process in the digitalized classroom (Weston & Bain, 2010) in which new work methods are slowly advancing. This work can be described as a development, as teachers weigh and balance the benefits of digital technologies and traditional teaching, adapting and changing methods and activities to support learning and TEL for students.

Finally, at the Phase 2 stage, some six months into the 1:1 initiative, some of the teachers expressed concerns about whether their work in the classroom with digital technologies was good enough. The possibilities regarding educational change or school reform (Olofsson et al., 2011) are perhaps not the responsibility of teachers alone. The lack of pedagogical leadership, which supports the small steps with digital technologies in the classroom in everyday work, can be said to manifest a filter. Pedagogical leadership and support will be important for promoting TEL in the classroom, encouraging the teachers in this work, boosting confidence in ICT (cf. Ertmer & Ottenbreit-Leftwich, 2013) and providing support for those who have not yet started.

Discussion and Conclusions in Summary

In this paper, the focus was set on (1) the teachers' expectations regarding the effects of the use of digital technologies and TEL on their work; (2) what development, if any, can be seen in teachers' activities during a six-month period of time and; (3) how this development can be understood as possibilities and challenges for digital technologies and TEL. Developments were viewed between the initial phase of the 1:1 initiative (Phase 1) and after six months (Phase 2). This development could be understood as possibilities and challenges for TEL and change. In summary, the filters which are manifested in the empirical data can be illustrated in the Ecology of Resources Model (Luckin, 2010) in Figure 2 as follows:

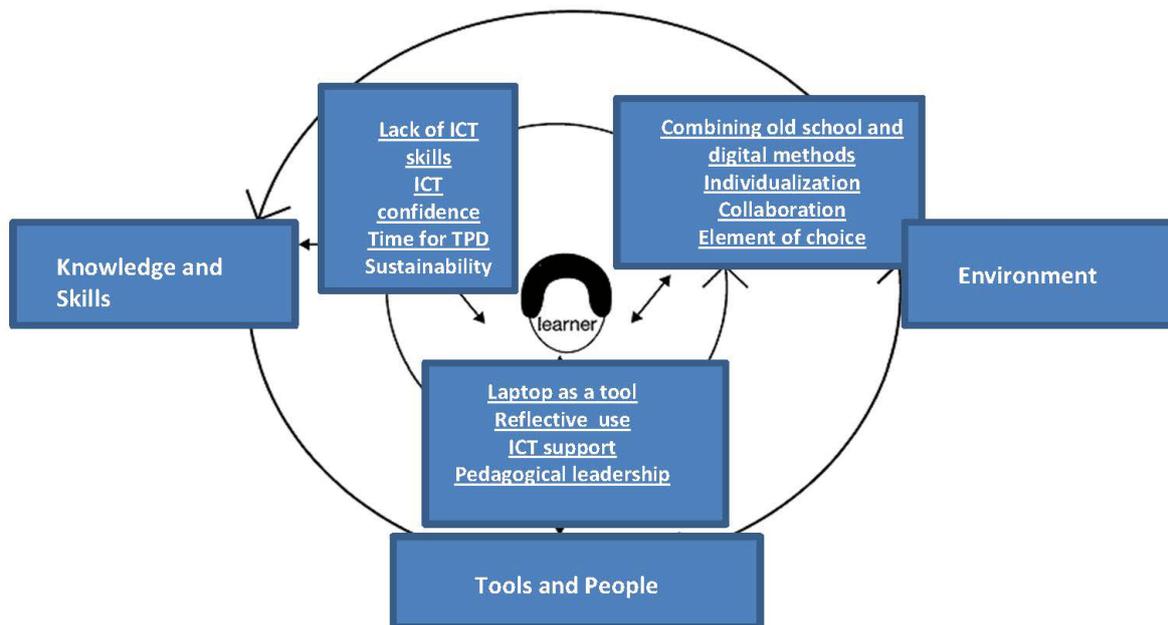


Figure 2 Elements and their filters in teachers' activities. The Ecology of Resources Model. Elements and their filters. Adapted with permission from Luckin (2010, p. 94)

In this study, teachers seem to be optimistic and realize the importance of the uptake and use of digital technologies and TEL in the classroom. It appears that a development from Phase 1 of the 1:1 initiative to Phase 2 has taken place, which entails teachers' increased focus on reflective use, ICT-skills and awareness of the pedagogy behind the technology. The concept of filters, as systematic challenges, sheds light on the complexity of the uptake and use of digital technologies in the classroom, and gives insight into the possibilities and challenges in activities which teachers face in everyday practice. Filters also make visible the support needed from school leaders and policy makers for making TEL in the 1:1 classroom sustainable, as well as the need for TPD and helping teachers move from technology to pedagogy to facilitate students' learning, TEL and change.

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