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## ACTUAL AND POTENTIAL PEDAGOGICAL USE OF TABLETS IN SCHOOLS

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**Abstract:** *This study reviews the potential of tablet technology for teaching and learning. In autumn 2012, we conducted a focused survey comprising quantitative and qualitative questions with Finnish teachers (N = 171, from 54 schools). We focused on perceived pedagogical opportunities and the actualized pedagogical potential of tablets at schools. The survey results indicate that the actual usefulness of tablets in schools was significantly less than what teachers perceived as the pedagogical potential. However, the results demonstrate the positive impact these devices are having on teaching and learning, as well as prompting changes in pedagogical perspectives. Teachers stated that tablets can diversify and enhance teaching and learning in many ways, particularly in supporting learners' motivation and independent learning, and promoting engaging teaching methods. Nevertheless, teachers voiced concern that the student-to-device ratio at the moment is too low, thus serving as a barrier to widespread use of tablets.*

**Keywords:** *sustaining practices, tablets, ICT, innovative pedagogy, student-centered education, mobile learning.*

### INTRODUCTION

In recent years, mobile technologies such as tablet devices have become more powerful and popular. The tablet devices (hereinafter called *tablets*) are usually smaller than laptops but larger than smartphones. The laptop interface is controlled by a mouse, whereas the primary means of input on the tablet is the touch-screen. Because tablets are also portable and lightweight, they are easy to use anywhere and anytime. Moreover, tablets allow flexible access to information on the Internet, an ease of use, and flexibility that is highly attractive to many users.

International Data Corporation (2013) forecasts that the worldwide smart connected device market, comprising personal computers (PCs), tablets, and smartphones, will grow 27.8% in 2013. Although this growth will be driven by tablet and smartphone shipments, the PC market

is expected to remain larger. However, by the end of 2015, the forecast indicates that tablet shipments will surpass PC shipments. The market growth for tablets as compared to notebook computers is significant (Shim, 2012), with the increasing general use suggesting a growing impact on the educational sector.

Further, dramatic improvements in the tablet's technological features make them educationally appropriate. According to Futuresource Consulting (2013), global sales of mobile computing devices for K12 education increased 29% in 2012, and that tablet sales in the educational sector are expected to surpass notebooks by the end of 2013. From this point of view, tablets look to become staples in classrooms.

Despite the huge popularity of tablets, very few published studies have addressed the impact of tablets on learning and teaching (Heinrich, 2012), although the number is growing. We seek to contribute to this trend by studying how Finnish teachers view the potential of tablets and how they have used them in their classrooms. In many ways, Finland is an ideal country in which to conduct this type of research because the national core curricula (Finnish National Board of Education, 2011) provide significant pedagogical freedom for and trust in teachers. In terms of this paper, we discuss findings derived from bringing together the actual pedagogical use of tablets with the perceived pedagogical potential of tablets in the Finnish school context.

The following section involves a review of the literature related to the use of information and communication technologies (ICTs), and specifically tablets, in educational settings, with a focus on Finnish educational settings. As such, it forms the theoretical framework for using tablets in education. The paper continues with the research design and results, and concludes with reflective remarks for future research.

## **ICTS AND TABLETS IN EDUCATIONAL SETTINGS**

It is becoming increasingly important to value contemporary students as “digital natives” because ICTs are an integral part of their lives and societies (Oblinger & Oblinger, 2005; Philip, 2007; Tapscott, 2008). Since ICTs are so intimately intertwined with students' everyday lives, the question arises regarding how to apply the informal learning opportunities of these technologies to formal education (see, e.g., Richards, 2004; Sefton-Green, 2004; Tondeur, van Braak, & Valcke, 2007). This kind of approach could enrich learning and motivate and engage students in learning activities (Vesisenaho & Dillon, 2013). Additionally, concepts such as the seamless learning environment, mobilized curriculum, and one-to-one computing emphasize mobile technologies as valuable learning tools, as well as a means to bridge formal and informal learning (Chan et al., 2006; Looi et al., 2010; Penuel, 2006). A relevant strand of research suggests the learning process benefits when students apply their out-of-school ICT skills to formal learning tasks (Ilomäki & Rantanen, 2007; Volman & van Eck, 2001). When seeking technological manifestation of the aforementioned concepts and their subnotions, the tablet can be considered a prime candidate.

The Finnish National Board of Education (2011) determines the national core curricula for Finnish elementary, lower secondary (middle), upper secondary (high), and vocational schools; it includes the objectives and core contents of various subjects, as well as the concept of learning, principles of assessment, and articulation of good learning environments and pedagogies. Local education authorities and school administrators draw their more specialized curricula from the framework of the national core curricula. However, the teachers have the freedom to choose their

own teaching methods and materials to achieve the objectives stated in their school's curriculum, even though specific guidelines for choosing suitable methods are included within the national curricula (Finnish National Board of Education, 2011).

Despite the freedom of choice and pedagogical self-design, the methods of teaching and learning are still in many respects quite traditional, teacher-centered, and classroom-bounded: The active role of the student and benefits from peer and/or independent learning are too rarely observed (see, e.g., Kankaanranta & Norrena, 2010). The same issues were observed in the educational systems of other countries (see Osborne & Hennessy, 2003; Schulz-Zander, Büchter, & Dalmer, 2002). The traditional teacher-centered strategy is primarily information transmission, whereas the active role of the pupil is highlighted in student-centered approaches. In other words, knowledge via teacher-centered teaching is transmitted from teachers to learners, who are presumed to be receptive vessels (Pinnegar & Erickson, 2010). Yet this notion neither aligns with the current scientific understanding of learning, nor with contemporary conceptions of pedagogy (e.g., Bransford, Brown, & Cocking, 1999; Lonka, Hakkarainen, & Sintonen, 2000; Mitra, Leat, Dolan, & Crawley, 2010).

Traditional, teacher-centered, and classroom-bounded practices were observed repeatedly in the Innovative Teaching and Learning research, which was carried out in seven countries, including Finland (Kankaanranta & Norrena, 2010). The study reports that the teaching practices in Finnish schools were notably more student-centered than elsewhere but that the practices related to ICT integration and to extending learning outside the classroom were relatively low level and infrequent. It is safe to say that ICTs have not been widely integrated into schools and educational practices in Finland yet. Rather, large differences in terms of educational use of ICTs have been identified between regions, schools, and levels of schooling (i.e., primary, secondary), as Kankaanranta, Palonen, Kejonen, and Ärje (2011) found.

Pedagogical practices have been the subject of many studies related to the use of ICTs in education. One study, in particular, focused on teachers' views about how ICT use has changed teaching. The IEA<sup>1</sup> Second Information Technology in Education Study (SITES) 2006 was an international comparative study of pedagogy and ICT use in schools. The study investigated what happens in the classrooms and how ICTs are used in them, and contained a Finnish substudy (see Kankaanranta & Puhakka, 2008). Linnakylä and Nurmela (2012) applied the same type of survey questions from the SITES 2006 research in a Finland-wide study focusing on learning games and virtual worlds. Such pedagogical studies, while addressing a specific type of learning via technology, also have applicability for studies involving the tablet as a learning tool.

The current popularity of the tablet reflects its mobility, intuitiveness, attractiveness, and ease of use by way of the touch screen and interface. Furthermore, a wide range of available applications has resulted in a multitude of ways in which the tablet can be utilized. In a way, the tablet has bridged the gap between the smartphone and the laptop computer, in that the tablet has the capacity and usability of a laptop computer for a broad and effective variety of content creation, but also is as mobile and portable as a smartphone, making it available "24-7."

Tablets have made significant inroads into the educational context. For instance, the Finnish National Board of Education has supported several projects that are implementing mobile technologies such as tablets within and beyond the classroom (The Finnish National Board of Education, 2013). The intuitive capabilities of the tablet, combined with a range of applications, can appeal to and motivate learners who are immersed already in technologies (Melhuish & Falloon, 2010). However, one could argue that, as products marketed for

individual entertainment use, tablets are designed primarily for purposes other than formal educational. For this reason, the focus of research and application should be on exploring how the tablet can be integrated effectively into innovative teaching practices (i.e., not only for the delivery of content or edutainment; Melhuish & Falloon, 2010).

Despite the huge popularity of tablets, few studies have addressed the impact of tablets on teaching and learning. Tablet studies mainly focus on the functionality of the tool as compared to other devices, the applications available, and the attractiveness of the tablet (Heinrich, 2012).

In Grant and Barbour's (2013) case study focusing on science teachers' iPad deployment, the participating teachers believed that the iPad had many potential classroom uses. However, most of the teachers used iPad primarily as a personal learning tool, teacher resource, or supplemental tool for explaining concepts to students in the classroom. The teachers in this study felt that the potential use of the iPad as a classroom device was limited because the student-to-device ratio was limited. For this reason, the teachers described the ways in which tablets were theoretically practical for the students rather than how they had been applied.

Burden, Hopkins, Male, Martin, & Trala (2012) reported on a comprehensive evaluation undertaken for schools and local authorities in Scotland. The aim of the study was to identify how the use of iPads in schools impacted teaching and learning, and their results indicated that the tablets had a profound impact in the classrooms. Teachers stated that iPads had altered the dynamics of the classes and enabled a wide range of learning activities. Nevertheless, the teachers acknowledged that they used the iPads mainly as a substitute for other existing technology and that they had not necessarily transformed their pedagogical practices, although they had aspirations to do so. The personal ownership of the device was seen as the most important factor of successful use and deployment of iPads in educational contexts (Burden et al., 2012).

Similarly, Heinrich (2012) reviewed the impact on learning and teaching of the introduction of iPad at Longfield Academy, in Kent, in southeast England. He found a significant and positive impact on learning, as well as an evolving pedagogy. The implementation of a one-to-one scheme was found to be particularly successful. The key reported uses of the iPads were for researching topics online, mind mapping, creating presentations, and word processing. Collaborative working also was reported to be common. Both the teachers and pupils wanted to expand the use of iPads and described multiple ways iPads could be used. The author concluded that good ideas are being surfaced and, although some teachers still are using iPads as a substitute for traditional technologies, many teachers are potential agents of change.

Based on the literature, the process of incorporating tablets into school learning can fall into two main categories: using tablets to support and improve traditional school tasks and using tablets to extend practices (Sheehy et al., 2005). The literature suggests that teachers have begun to see the potential of tablet technology even though tablets are not designed in terms of educational application and need to be consciously integrated into teaching practices. Even so, only a few studies highlight the differences between the pedagogical opportunities of tablets and the actual pedagogical use of tablets. For this reason we researched the following themes via a self-reporting instrument distributed to teachers:

- What are the pedagogical opportunities of tablets?
- What are the actual pedagogical uses of tablets in the classroom?
- Are there differences between the pedagogical potential of using tablets and their actual pedagogical use, as reported by the teachers? And, if so, what are those differences?

In this study, we were especially interested in the teaching practices that influence students' learning. Other pedagogical school activities, such as teachers' classwork planning, creation of learning materials, and so on, although interesting and worthy of further research, are beyond the scope of our focus on teaching practices. Teachers were selected as the target group for two key reasons: They know and can describe their teaching practices, and they can identify the kind of changes tablets have brought to the learning process.

## METHOD

In this study, we focused on teachers' reporting of the potential and actual pedagogical use of tablets in the classroom. The selection was made because the teachers are the gateway for renewing pedagogical perspectives and practices and, in parallel, they take into use various new methods, such as employing technologies. We collected the data by way of a questionnaire comprising 31 items in following three focus areas:

- Demographics and general information on using tablets in school (8 items);
- Suitable, challenging, and actual ways of using tablets in learning, based on experience and expectations (11 items); and
- Ways to support using, and learning to use, tablets (12 items).

### The Survey Instrument, Target Group, and Response Rate

The survey was administered as a part of the larger SysTech<sup>2</sup> value network project, which aims to innovate Finnish education by developing strategies and practices for improving technology use and offering new pedagogical approaches for schools. This paper is based on the data arising from the second set of questions of that multipart survey. The survey was conducted in the Finnish language to native Finnish-speaking teachers, and the results have been translated into English by the researchers.

The instrument for data collection was a self-report questionnaire. The instrument was structured as a Web survey (see the Appendix) that provided closed- and open-ended questions: 17 were quantitative and 14 were qualitative. The two main questions, those regarding the teachers' views about the perceived pedagogical opportunities and the actual pedagogical use of the tablets, were based on the SITES 2006 research used within the Finnish context (see Kankaanranta & Puhakka, 2008). It is worth noting that tablets were introduced to the marketplace after the SITES 2006 study was completed. The main questions and their follow-ups were related to, for instance, subject matter knowledge, learning motivation, and problem-solving, independent learning, and collaborative skills. We decided to simplify the response scale from a Likert range to a Yes/No option and to adapt it further to gather information not only on teachers' ideas about the opportunities for using tablets, but also their actual use. Furthermore, the open-ended (qualitative) questions throughout the item were intended to gather deeper-level, richer responses than the quantitative answer structure would allow.

For the target group, we selected teachers at 80 schools that had tablets in use to some extent. The schools were recruited nationwide from a full educational client list of tablet purchases from the largest educational sector retailer in Finland, and comprised urban, suburban,

and rural primary schools, lower and upper secondary schools, and vocational education institutes. We acknowledge that this method of selection involved limitations because all of the schools on this list had implemented tablets to some degree into their teaching and learning processes, and thus may not represent all schools in Finland. Moreover, the survey did not include other schools that may have purchased tablets through another retailer. Nevertheless, we opted for this large group of target schools in order to ensure a diversity of usage and experience with tablets among their teachers.

The survey was delivered to schools via their headmasters or the schools' ICT contact persons during autumn 2012 (September 20–October 2). We asked these contact persons to make the survey available to their teachers during the data collection timeframe. Multiple responses from the same school were allowed.

### **The Analysis Process**

In the data analysis, we applied a mixed methods protocol (Creswell, 2003) to the quantitative and qualitative survey responses. The quantitative descriptive results provided an overview of the phenomenon. Differences between the pedagogical opportunities and actual use of the tablet were analyzed using the Wilcoxon signed ranks test, a nonparametric test, equivalent to the dependent *t*-test and most applicable for data comprising Yes/No answers (Metsämuuronen, 2005). It was used to compare the two sets of responses that came from the same participants. The analysis for the pedagogical opportunities involved the answers from all respondents (171), but the analysis of the actual use data involved 169 respondents because two respondents submitted incomplete surveys. As a result, the Wilcoxon signed ranks test that compares the potential pedagogical opportunities data to the actual use data was conducted on the 169 respondents.

The open-ended questions were analyzed qualitatively using content analysis (Roth, 2005) via Atlas-ti software. The content analysis was theory-driven to find additional information related to pedagogical ways of using tablets (potential or actual) related to the quantitative items in the survey.

## **RESULTS**

By the end of the two weeks that the survey was open, one or more respondents from 54 schools had completed the survey. This resulted in a comparably good 68% coverage of the targeted schools; we saw no substantive differences between the responding and nonresponding schools. Moreover, we view this as a good response rate, considering the fact that 24.0% (41/171) of respondents had not used tablets in any teaching activities.

The respondents of this study were 171 teachers: 56% from upper secondary school; 29% from lower secondary school; 20% from primary school; and 10% from vocational institutions; some reported teaching at more than one level. We received no responses from the tertiary-level institutions. The average age of the respondents was 42 years (range: 25–62 years), and 62% were women. The majority of respondents had tenure of between 11 and 20 years; only 15% were in the profession for fewer than 5 years. Subject-specific teachers represented the highest number of respondents (61%), while 20% of respondents were

classroom teachers, and 19% were “other,” such as headmasters (who also teach) or special education teachers. Among the subject teachers, the most prominent subjects were history/social studies (10%), Finnish literature (6%), and English and mathematics (both 5%).

The respondents using the tablet the longest, typically for 10 to 11 months, also most often held the viewpoint that the use of tablets facilitated active teaching and learning methods. They used the tablet either daily or weekly. These teachers stressed the need for more tablets, with the goal of each student having access to a device (one-to-one distribution of tablets). Further, they expressed a desire for access to resources that could support generating new ideas for applying tablets in the learning situation. The background data do not specify the relation between the nonprofessional, personal use versus professional use of tablets, but the ideas of one-to-one computing and “learning by using” are central themes. Of note, however, is that 3.5% of the respondents reported that they have not used tablets at all.

The vast majority of the informants (91%) indicated that tablets offer significant potential to renew pedagogical practices. The teachers stated that tablets can diversify and enhance teaching and learning in many ways. The next two sections explicate the teachers’ views about the perceived pedagogical opportunities and the actual pedagogical use, including some concrete examples. The focus of the final subsection specifically highlights the differences between these two.

### Teachers’ Reporting the Pedagogical Opportunities of Tablets

The three most commonly reported pedagogical prospects for tablet use were improving learners’ motivation (86%), facilitating active teaching and learning (82%), and supporting independent learning (70%). But, as presented in Table 1, many of the other aspects surveyed drew a majority agreement as well. However, the teachers seemed to consider tablets as tools for individual use, with only 42% of the informants highlighting the opportunities to support collaboration through tablet use. On the other hand, the teachers reported that tablets have the potential to strengthen the individual learning experience (64%), as well as support both low-performing students (56%) and gifted students (53%). Based on these results, the teachers seem to be promoting student-centered learning. This reflects earlier research that indicated teachers have ambition to change pedagogy (e.g., Hennessy, Ruthven, & Brindley, 2005).

As part of the qualitative component of this research, teachers were asked to describe in more detail the pedagogical opportunities they saw for tablet use in the classroom. Several teachers (37) stated that the tablets have the potential to diversify the teaching in many ways. As an example, one teacher commented, “*The learning is more student-centered because the child can participate, control, and evaluate his/her own learning process as well as interact with others*” (Respondent 130).

The opportunity for quick information retrieval, knowledge generation, and improved communication also were highlighted, with 32 respondents mentioning these aspects. The possibility for extending the learning environment was noted by 30 teachers. And 15 respondents indicated that the opportunities afforded by tablet use in the classroom are almost limitless. One teacher suggested that tablets provide an “*unlimited number of opportunities from which to take advantage, for instance, from vocabulary even to problem-based learning*” (Respondent 171).



**Table 1.** Perceived Pedagogical Opportunities Reported by the Teachers ( $N = 171$ ).

Pedagogical Use	Yes	No	SD
Strengthening the individual learning experience	<b>112</b> (64%)	59 (36%)	.477
Increasing learning motivation	<b>149</b> (86%)	22 (14%)	.336
Facilitate active teaching and learning methods	<b>143</b> (82%)	28 (18%)	.371
Strengthening problem-solving skills	78 (45%)	<b>93</b> (55%)	.500
Strengthening communication skills	<b>116</b> (67%)	55 (33%)	.468
Strengthening collaboration	72 (42%)	<b>99</b> (48%)	.495
Integrating knowledge and skills	<b>101</b> (58%)	70 (42%)	.493
Improving learning outcomes	62 (36%)	<b>109</b> (64%)	.482
Supporting low-performing students	<b>97</b> (56%)	74 (44%)	.497
Supporting gifted students	<b>92</b> (53%)	79 (47%)	.500
As an assessment tool	70 (41%)	<b>101</b> (59%)	.493
Learning knowledge content	<b>90</b> (52%)	81 (48%)	.501
Supporting Independent learning	<b>121</b> (70%)	50 (30%)	.456

*Note.* The highest responses for a given pedagogical use are bolded.

### Teachers' Reporting the Actual Pedagogical Use of Tablets

The three most common pedagogical uses of tablets (see Table 2) were for improving learners' motivation (56%), facilitating active teaching and learning (52%), and learning knowledge content (38%). The use of tablets in supporting knowledge content is particularly notable in that the actual use was considerably lower than would have been expected from the responses regarding the potential pedagogical opportunities. Perhaps the quick and easy access to information is self-evident and that the teachers did not see the practical application of tablets for supporting knowledge content in the same realm as their theoretical vision for this opportunity. It appears that these teachers used tablets mainly to motivate and engage students.

As part of the open-ended questions, the respondents gave concrete examples of how they used the tablets in the teaching and learning processes. In regard to facilitating learners' motivation, Respondent 115 stated, "*In biology class, the students took photographs related to the concepts of [biological] diversity, and each group made a presentation about their concept. Field trips and photographing enliven lessons and students loved that they could have an impact on the outcome.*" When employing pedagogies aimed at engaging students more in the

**Table 2.** Actual Pedagogical Uses Reported by the Teachers ( $N = 169$ ).

Pedagogical Use	Yes	No	SD
Strengthening the individual learning experience	60 (36%)	<b>109</b> (64%)	.480
Increasing learning motivation	<b>95</b> (56%)	74 (44%)	.498
Facilitate active teaching and learning methods	<b>88</b> (52%)	81 (18%)	.501
Strengthening problem-solving skills	22 (13%)	<b>147</b> (87%)	.337
Strengthening communication skills	51 (30%)	<b>118</b> (70%)	.460
Strengthening collaboration	46 (27%)	<b>123</b> (73%)	.446
Integrating knowledge and skills	55 (33%)	<b>114</b> (67%)	.470
Improving learning outcomes	28 (17%)	<b>141</b> (83%)	.373
Supporting low-performing students	31 (18%)	<b>138</b> (83%)	.388
Supporting gifted students	28 (17%)	<b>141</b> (83%)	.373
As an assessment tool	25 (15%)	<b>144</b> (85%)	.356
Learning knowledge content	65 (38%)	<b>104</b> (62%)	.488
Supporting Independent learning	35 (21%)	<b>134</b> (79%)	.406

Note. The highest responses for a given pedagogical use are bolded.

learning process, Respondent 36 noted, “*In biology class, I have used questionnaires to encourage students to respond and answer anonymously as well as to share their opinions.*” And Respondent 80 explained how the tablets facilitated students’ content learning: “*In physics and chemistry, I have used various applications to clarify concepts.*”

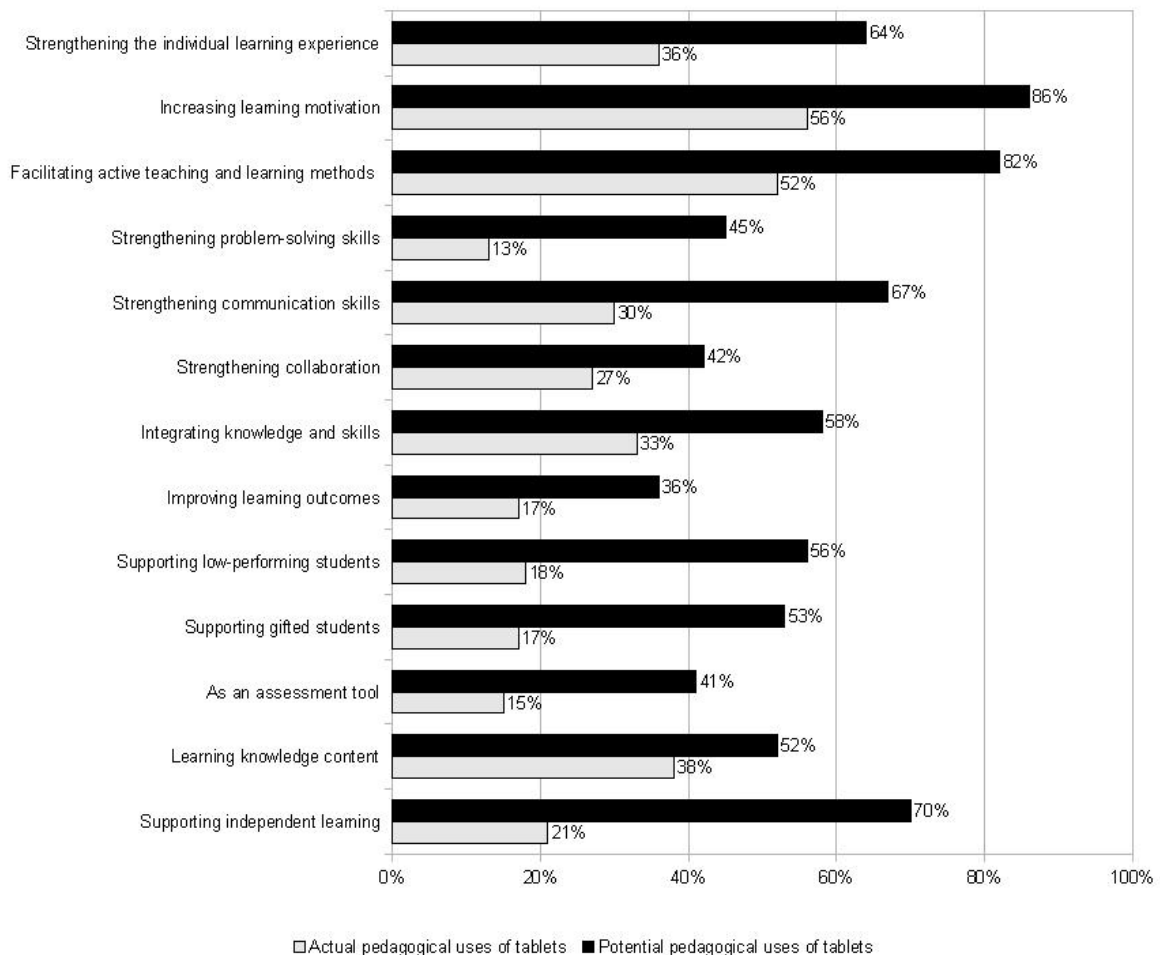
However, some areas of teaching and learning were not well supported by the use of tablets in class. Support for low-performing students (18%), gifted students (17%), independent learning (21%), and strengthening problem-solving (13%) skills remains low. Yet, the teachers who did integrate tablet use into their pedagogical practices offered concrete examples on how it could be done. Respondent 79 noted opportunities to support low-performing students’ learning in “*mathematics ([through] suitable apps especially for special education).*” Tablet use also supported independent learning in Respondent 14’s class: “*Our intention is to support learners’ learning process (knowledge content, independent learning, and refreshing lessons learned earlier).*” And Respondent 66 demonstrated how students’ problem-solving skills could be strengthened: “*In history class, I have used tablet devices for problem-solving tasks.*”

The open-ended answers further highlighted the ways that teachers were using tablets to teach knowledge content, to integrate knowledge content and skills, and as an assessment

tool. However, tablet-based activities primarily involved searching for information, showing videos, and giving presentations. Collaborative projects and research experiments via tablets, as well as support in developing problem-solving skills, remain surprisingly low.

### Differences in Perceived Pedagogical Opportunities and Actual Pedagogical Use

The data suggest that the teachers' perception of the pedagogical opportunities and pedagogical use of tablets seem to focus on the benefits for facilitating active teaching and learning and motivating learners (Figure 1), whether perceived or actualized. More than half (56%) of the informants had used tablets for motivating students, and 86% of the informants indicated expectations that tablet use would have motivational benefits. Using tablets to facilitate active teaching and learning was reported by 52%, and 82% of the informants considered the tablets suitable for this. These two pedagogical uses received the highest concurrence among respondents in both perceived and actual use data.



**Figure 1.** Measured differences in perceived pedagogical opportunities and actualized pedagogical applications reported by the teachers.

The Wilcoxon signed ranks test shows that the differences between actual use and the perceived opportunities are statistically highly significant ( $p < .001$ ) in all pedagogical uses except learning knowledge content, which was just significant,  $p < .01$ . See Table 3 for the complete results. An interesting deviation between the identified potential and actual use can be observed within the purposes of supporting communication skills (-37%,  $z = 7.825$ ,  $p < .001$ ), independent learning (-49%;  $z = 8.910$ ,  $p < .001$ ), and support for low-performing students (-38%;  $z = 7.608$ ,  $p < .001$ ) items.

In a few cases, the responses indicate that some teachers held a more negative opinion of the actual use in a particular application as compared to the perceived benefits (see Table 3). For example, in regard to improving learning outcomes, 9 teachers of the 169 who had used tablets in trying to improve learning outcome did not view it as suitable for that purpose. The same is true for the 8 teachers who did not confirm its suitability for supporting collaboration, and the 18 who did not perceive the benefits for teaching knowledge content, despite having used the tablet for those purposes.

**Table 3.** Wilcoxon Signed Ranks Test Statistics for Perceived Pedagogical Opportunities and Actual Pedagogical Uses Reported by the Teachers.

Pedagogical Use	Perceived > Actual	Perceived < Actual	Perceived = Actual	<i>z</i>	<i>p</i>
Strengthening the individual learning experience	59	7	103	-6.401	.000
Increasing learning motivation	57	3	109	-6.971	.000
Facilitating active teaching and learning methods	54	0	115	-7.348	.000
Strengthening problem-solving skills	56	2	111	-7.091	.000
Strengthening communication skills	67	2	100	-7.825	.000
Strengthening collaboration	33	8	128	-3.904	.000
Integrating knowledge and skills	52	7	110	-5.859	.000
Improving learning outcomes	43	9	117	-4.715	.000
Supporting low-performing students	69	4	96	-7.608	.000
Supporting gifted students	65	2	102	-7.697	.000
As an assessment tool	47	2	120	-6.429	.000
Learning knowledge content	42	18	109	-3.098	.002
Supporting Independent learning	88	3	78	-8.910	.000

Note.  $N = 169$ ;  $z$  = difference from standard deviation,  $p$  = significance of the difference.

## DISCUSSION AND CONCLUSIONS

In this paper, we discussed findings derived from investigating the perceptions related to the perceived pedagogical opportunities of using tablets and the actual pedagogical practices of teachers in schools using tablets as part of their educational practices. The surveyed teachers considered tablets a normal part of school activities, and viewed them as long-term devices for learning. The subset of teachers who had already used tablets in the classroom, in particular, realized the potential of the devices. Based on the teachers' answers, it seems that, at least in Finnish schools, tablets are expected to enrich and improve teaching in multiple

ways. The opportunities to utilize tablets in education appear almost limitless, as noted by Respondent 147: *“Only the teacher’s own imagination can bring restrictions.”*

Nevertheless, the teachers stated that the student-to-device ratio at the moment is too low, and thus limits their ability to implement new or different pedagogies. The low ratio is perhaps one significant reason why current tablet use has primarily involved basic or technology replacement tasks, such as searching for data/information, showing videos, and giving presentations. This finding is also consistent with that of Grant and Barbour (2013), who reported that teachers believed the iPad could have many potential classroom uses but the student-to-device ratio was limiting. As a result the teachers in that study described ways of employing the tablets that were practical rather than innovative. Heinrich (2012) also saw the one-to-one scheme as very important for the successful deployment of tablets.

This research shows that teachers most often used tablets for motivating learners, facilitating active teaching and learning methods, and teaching knowledge content, with the first two being primary. This parallels results from the SITES 2006 (Kankaanranta & Puhakka, 2008) and the learning games and virtual worlds study by Linnakylä and Nurmela (2012), both which found that ICTs were used mainly for motivating students and building subject knowledge. Perhaps the reason behind the use of tablets in support of knowledge content is that tablets enable easy and quick information searches from the Internet. Additionally, the use of tablets for facilitating active teaching and learning methods seems promising for encouraging students who are not used to face-to-face collaboration. Of course, the reason why tablets currently may not be used as tools for differentiation or independent learning in Finland may be that there are not enough devices available. This emphasizes the importance of the one-to-one scheme.

The present study indicates that the main driver for the decision to adopt tablets in an educational context seems to be the initiative of the individual teacher to change the way students learn and how he/she teaches, to change his/her pedagogies. The evidence presented here suggests that tablets already are having a positive, although limited, impact on teaching. The teachers pointed to the potential of tablet use in the classroom that reflected the ambition to move from teacher-centered teaching to learner-centered learning. This is consistent with the finding of Burden et al. (2012), who reported that teachers mainly used tablets as a substitute for existing technology but had aspirations to transform their pedagogical practices. For this reason, teachers are potential agents of change. This innovative pedagogical thinking was reflected in the comment by Respondent 38: *“Tablet devices have activated teachers to think about pedagogy in a new way and [have] brought a new dimension to teaching.”*

One key finding of this study is that, in the Finnish context, the actual use of tablet technology in schools was much lower than what the teachers estimated as the potential benefit. Thus a significant gap currently exists between perceived and actual use of tablets in regard to pedagogical benefits. One approach toward addressing this gap would be to consider means to support innovative learning practices and their position within both the prevailing school cultures and the national guidelines for education (cf. Hobson, 2012; Norrena, 2013). Although the infrastructure and technical support for the appropriation of ICTs currently exist, and many teachers are aware of them, perhaps the problem is simply a lack of clear and tangible support by national educational guidelines. Should such vision and goals become concretized into clearly articulated guidelines and resource frameworks, the gap between what could be and what is could be bridged within living classroom practice.

The pedagogical surroundings in which tablets are used should be prioritized and emphasized, but not only for tablet technology. For the teachers' benefit and the students' positive development, the national educational guidelines should guarantee an environment that respects the rapid pace of technological development and the quickly evolving conventions and skills originating beyond the classroom. By achieving this goal, the teacher—the primary pedagogical designer and implementer—would be better able to establish innovative practices that neither neglect or misuse ICTs nor isolate learning from the added value of ICTs in the classroom.

The negative difference between the perceived usefulness and actual use was most notable in regard to the objectives of improving learning outcomes and supporting collaboration. Such a differential in our results provides a valuable complementary angle for seeking new directions for pedagogical transformation in primary and secondary education, not only in Finland, but elsewhere. The scope of our survey data does not allow us to assess the nature and background of these discrepancies in detail. However, when evaluating learning outcomes, one cannot and should not exclude an examination of the context of the technological application, that is, the pedagogy and the learning task. Important questions to be investigated include

- What were the learning tasks?
- How were learning tasks constructed in order to benefit learning? and
- What are the key factors introduced to the learning process that actually may impede learning specific content in a particular context?

Answering such questions is necessary because not every learning objective necessarily benefits from the tactile interface of the device, or from any other pedagogical consideration or innovation.

From the perspective of classroom collaboration, the results could lead one to consider the fact that the tablet is not being manufactured or marketed specifically for the school context; the tablet is a *de facto* personal device. This reality might contribute to the narrow pedagogical views. For example, while the data indicate that teachers emphasize the need for one-to-one device availability, the tablet's predisposition as a truly mobile, lightweight, tactile, and visual device perhaps could be viewed more broadly in the school context as, perhaps, a one-to-four enabler, where the tablet is viewed as a baton or physical object of shared activity. Following this line of thought, and aiming for enhanced support for collaboration and intensified interaction, the pedagogies suggested by notions such as a self-oriented learning environment (e.g., Mitra & Negroponte, 2012) might take a more central stage in pedagogical design.

In general, the teachers typically are ambitious and open to changing their pedagogies with tablet use, and this should be encouraged. The Finnish teachers in this study highlighted the perceived pedagogical opportunities of tablets in the classroom, although many of these have not yet been utilized. Our goal is to continue this research by further elaborating on and investigating the technological, pedagogical, and contextual use of tablets in schools (e.g., through interviews about and observations of learning environments with tablets). And, although our research in this paper is focused on the teacher, we emphasize that the student perspective also is needed to recognize and actualize the full potential of tablets in formal learning. The outcome of these streams of research would facilitate innovative teaching and learning for the future.

## ENDNOTES

1. IEA is the abbreviation for the International Association for the Evaluation of Educational Achievement.
2. SysTech is the acronym for The Systemic Learning Solutions project, a collaborative network of Finnish and international research institutes, companies, and piloting environments that seeks to develop educational products for both the education system and the work environment.

## REFERENCES

- Bransford, J. D., Brown, A. L. & Cocking, R. R. (Eds.). (1999). *How people learn: Brain, mind, experience, and school*. Washington, DC, USA: National Academy Press.
- Burden, K., Hopkins, P., Male, T., Martin, S., & Trala, C. (2012). *iPad Scotland evaluation* (final evaluation report). Faculty of Education, University of Hull. Retrieved November 1, 2012, from <http://www.janhylen.se/wp-content/uploads/2013/01/Skottland.pdf>
- Chan, T.-W., Roschelle, J., Hsi, S., Kinshuk, K., Sharples, M., Brown, T., Patton, C., Cherniavsky, J., Pea, R., Norris, C., Soloway, E., Balacheff, N., Scardamalia, M., Dillenbourg, P., Looi, C.-K., & Milrad, M. (2006). One-to-one technology enhanced learning: An opportunity for global research collaboration. *Research and Practice in Technology Enhanced Learning*, 1, 3–29.
- Creswell, J. (2003). *Research design: Qualitative, quantitative, and mixed methods approach* (2<sup>nd</sup> ed.). Thousand Oaks, CA, USA: Sage.
- Finnish National Board of Education. (2011). *The curriculum*. Retrieved October 28, 2012, from [http://www.oph.fi/english/curricula\\_and\\_qualifications/basic\\_education/](http://www.oph.fi/english/curricula_and_qualifications/basic_education/)
- Finnish National Board of Education. (2013). *Oppimisympäristöhankkeet* [The learning environment projects]. Retrieved November 29, 2013, from <http://www.oph.fi/oppimisymparistohankkeet>
- Futuresource Consulting. (2013). *Mobile computing in schools achieved 29% growth in 2012*. Retrieved November 29, 2013, from <http://futuresource-consulting.com/2013-04-mobile-computing-in-schools.html>
- Grant, M. M., & Barbour, M. K. (2013). Mobile teaching and learning in the classroom and online: Case studies in K–12. In Z. Berge & L. Muilenburg (Eds.), *Handbook of mobile learning* (pp. 285–292). New York, NY, USA: Routledge.
- Heinrich, P. (2012). *The iPad as a tool for education: A study of the introduction of iPads at Longfield Academy*. Kent, UK: Naace.
- Hennessy, S., Ruthven, K., & Brindley, S. (2005). Teacher perspectives on integrating ICT into subject teaching: Commitment, constraints, caution, and change. *Journal of Curriculum Studies*, 37(2), 155–192. doi:10.1080/0022027032000276961
- Hobson, A. (2012). Reality aftershock and how to avert it: Second-year teachers' experiences of support for their professional development. *Cambridge Journal of Education*, 42(2), 177–196.
- Iloäki, L., & Rantanen, P. (2007). Intensive use of ICT in school: Developing differences in students' ICT expertise. *Computers & Education*, 48(1), 119–136. doi:10.1016/j.compedu.2005.01.003
- International Data Corporation. (2013). *Tablet shipments forecast to top total PC shipments in the fourth quarter of 2013 and annually by 2015, according to IDC*. Retrieved November, 29, 2013, from <http://www.idc.com/getdoc.jsp?containerId=prUS24314413>
- Kankaanranta, M., & Norrena, J. (2010). *Innovatiivinen opetus ja oppiminen. Kansainvälisen ITL-tutkimuksen pilottivuoden päätulokset ja ensituloksia Suomesta*. [Innovative teaching and learning: Main results and initial finding of the international ITL research based on the pilot year]. Jyväskylä, Finland: The Agora Center, Jyväskylän yliopisto.
- Kankaanranta, M., Palonen, T., Kejonen, T., & Ärje, J. (2011). Tieto- ja viestintätekniikan merkitys ja käyttömahdollisuudet koulujen arjessa [The role and applicability of ICTs in school]. In M. Kankaanranta

- (Ed.), *Opetusteknologia koulun arjessa* (pp. 47–76). Jyväskylä, Finland: Jyväskylän yliopisto, Koulutuksen tutkimuslaitos.
- Kankaanranta, M., & Puhakka, E. (2008). *Kohti innovatiivista tietotekniikan opetuskäyttöä. Kansainvälisen SITES 2006 -tutkimuksen tuloksia*. [Towards innovative educational use of ICT: Results of the international SITES-2006 research]. Jyväskylä, Finland: Jyväskylän yliopistopaino.
- Linnakylä, A., & Nurmela, K. (2012). Pelit ja virtuaalimaailmat opetuksessa [Games and virtual worlds in teaching]. In M. Kankaanranta, I. Mikkonen, & K. Vähähyppä (Eds.), *Tutkittua tietoa oppimisympäristöistä. Tieto- ja viestintätekniikan käyttö opetuksessa* (Oppaat ja käsikirjat 2012:13; pp. 24–56). Helsinki, Finland: Opetushallitus.
- Lonka, K., Hakkarainen, K., & Sintonen, M. (2000). Progressive inquiry learning for children: Experiences, possibilities, limitations. *European Early Childhood Education Research Journal*, 8(1), 7–23. doi:10.1080/13502930085208461
- Looi, C.-K., Seow P., Zhang B. H., So H.-J., Chen, W. & Wong L.-H. (2010). Leveraging mobile technology for sustainable seamless learning. *British Journal of Educational Technology* 41, 154–169.
- Melhuish, K., & Falloon, G. (2010). Looking to the future: M-learning with the iPad. *Computers in New Zealand Schools: Learning, Leading, Technology*, 22(3), 1–16.
- Metsämuuronen, J. (2005). *Tutkimuksen tekemisen perusteet ihmistieteissä* [Introduction to research in human sciences]. Helsinki, Finland: International Methelp Ky.
- Mitra, S., Leat, D., Dolan, P., & Crawley, E. (2010). *The self organised learning environment (SOLE) school support pack*. Retrieved from <http://repository.alt.ac.uk/2208/>
- Mitra, S., & Negroponte, N. (2012). *Beyond the hole in the wall: Discover the power of self-organized learning*. New York, NY, USA: TED Books.
- Norrena, J. (2013). *Opettaja tulevaisuuden taitojen edistäjänä: “jos haluat opettaa noita taitoja, sinun on ensin hallittava ne itse”* [Teacher enhancing 21st-century skills: “If you want to teach those skills, you must master them yourself”] (Jyväskylä Studies in Computing, 169; doctoral dissertation). Jyväskylä, Finland: University of Jyväskylä. Retrieved from <http://urn.fi/URN:ISBN:978-951-39-5227-3>
- Oblinger, D., & Oblinger, J. (2005). Is it age or IT: First steps toward understanding the Net Generation. In D. Oblinger & J. L. Oblinger (Eds.), *Educating the Net generation* (pp. 2.1–2.20). Retrieved December 1, 2013, from [www.educause.edu/educatingthenetgen/](http://www.educause.edu/educatingthenetgen/)
- Osborne, J., & Hennessy, S. (2003). *Literature review in science education and the role of ICT: Promise, problems and future directions*. Retrieved December 1, 2012, from <http://hal.archives-ouvertes.fr/hal-00190441/>
- 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), 329–348.
- Philip, D. (2007). The knowledge building paradigm: A model of learning for net generation students. *Innovate*, 3(5). Retrieved November, 29, 2013, from [http://www.ict-21.ch/com-ict/IMG/pdf\\_Philip.pdf](http://www.ict-21.ch/com-ict/IMG/pdf_Philip.pdf)
- Pinnegar, S., & Erickson, L. (2010). Teacher-centered curriculum. In C. Kridel (Ed.), *Encyclopedia of curriculum studies* (pp. 849–850). Thousand Oaks, CA, USA: SAGE Publications, Inc. doi: <http://dx.doi.org/10.4135/9781412958806.n449>
- Richards, C. (2004). From old to new learning: Global imperatives, exemplary Asian dilemmas and ICT as a key to cultural change in education. *Globalisation, Societies and Education*, 2(3), 337–353. doi:10.1080/1476772042000252470
- Roth, W.-M. (2005). *Doing qualitative research: Praxis of method*. Rotterdam, the Netherlands: SensePublishers.
- Schulz-Zander, R., Büchter, A., & Dalmer, R. (2002). The role of ICT as a promoter of students’ cooperation. *Journal of Computer Assisted Learning*, 18(4), 438–448.
- Sefton-Green, J. (2004). *Literature review in informal learning with technology outside school*. Retrieved December 1, 2012, from <http://telearn.archives-ouvertes.fr/hal-00190222/>



- Sheehy, K., Kukulska-Hulme, A., Twining, P., Evans, D., Cook, D., & Jelfs, A. (2005). *Tablet PCs in schools: A review of literature and selected projects*. Coventry, UK: British Educational Communications and Technology Agency. Retrieved from <http://dera.ioe.ac.uk/1461/>
- Shim, R. (2012). Tablets impact the notebook market: Enter the Ultrabook. *Information Display*, 28(2 & 3), 12–14.
- Tapscott, D. (2008). *Grown up digital: How the Net Generation is changing your world*. New York, NY, USA: McGraw-Hill.
- Tondeur, J., van Braak, J., & Valcke, M. (2007). Curricula and the use of ICT in education: Two worlds apart? *British Journal of Educational Technology*, 38(6), 962–976. doi:10.1111/j.1467-8535.2006.00680.x
- Vesisenaho, M., & Dillon, P. (2013). Localizing and contextualizing information and communication technology in education: A cultural ecological framework. *Pedagogy, Culture & Society*, 21(2), 239–259.
- Volman, M., & Van Eck, E. (2001). Gender equity and information technology in education: The second decade. *Review of Educational Research*, 71(4), 613–634.

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## Appendix

This is an English translation of the online survey distributed to the technology contact persons at 80 schools in Finland during autumn 2012. An asterisk designates items that required a response.

### **Inquiry for teachers at educational institutions**

This inquiry will help identify the use of tablet devices in teaching.

**\*Gender:** Male Female

**Age:** (open field)

**\*Academy [school]:** (open field)

**\*I teach the following levels of education:** Primary school Lower secondary school [middle school]  
Upper secondary school (high school)  
Vocational education University

**\*Are you a** Classroom teacher Subject teacher Other (open field)

**I teach the following subjects:** (open field)

**\*I have worked as a teacher** Less than one year Less than 5 years 6–10 years  
11–20 years Over 20 years

**\*Tablet devices in my school** Used by the teaching staff In shared use by the students  
In private use by students Not used Other (open field)

**How long have you used the tablet devices?** (open field) months

**\*I have used a tablet device in teaching:** Daily Weekly Monthly Less often [than monthly]  
I have not used tablets but I am going to  
I have not used tablets and I do not intend to

### **\*For what purposes do you think tablet devices are suitable?**

Strengthening the individual learning experience

Increasing learning motivation

Facilitating active teaching and learning methods (experiential, experience, research orientation, the relevance)

Strengthening problem-solving skills

Strengthening communication skills

Strengthening collaboration

Integrating knowledge and skills

Improving learning outcomes

Supporting low-performing students

Supporting gifted students

As an assessment tool

Learning knowledge content

Supporting independent learning

Other (open field)

**For what purposes have you used tablet devices** (if you have used the equipment)?

Strengthening the individual learning experience  
Increasing learning motivation  
Facilitating active teaching and learning methods (experiential, experience, research orientation, the relevance)  
Strengthening problem-solving skills  
Strengthening communication skills  
Strengthening collaboration  
Integrating knowledge and skills  
Improving learning outcomes  
Supporting low-performing students  
Supporting gifted students  
As an assessment tool  
Learning knowledge content  
Supporting independent learning  
Other (open field)

**In which subjects and how you have utilized tablet devices?** (open field)

**What types of changes have tablet devices brought to teaching and learning** (if you have used the equipment)?

Diversified ways of working  
Diversified materials  
Facilitating motivation  
Enabling differentiation [of pedagogical activities]  
Facilitating assessment  
Encouraging students to be more active and independent  
Increased collaboration between students  
Other (open field)

**Describe the successful and inspiring situations when the tablet devices were used.** (open field)

**Does the organization help and support you in tablet device use?** Yes No

**\*Have you participated in tablet training?**

Yes, and I have good skills [for using tablets]  
Yes, and I have moderate skills [for using tablets]  
Yes, but I did not receive adequate skills [for using tablets]  
No, our organization has not organized training  
No, I have not been able to participate in training  
No, I have not wanted to participate in training

**Was the nature of the training** (if you were involved in training)? Technical Pedagogical  
Technical and pedagogical

**What party organized the training** (if you were involved in training)? Equipment supplier  
Municipality or institution Other external trainer

