Theses of Doctoral (PhD) Dissertation

Tablet Supported Learning Environment In Primary Schools

Institution-level Implementation and Integration, Pedagogical-Methodological Background and Impacts On Students

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The aim and topic of the thesis

The technological changes of the current fourth industrial revolution may have a major impact on strategies to support education. New technologies include 3D printing, robots, ubiquitous computing, big data and mobile devices (Szűts, 2020). Based on the latter, mobile technology could represent a significant change and impact on global education trends. Of the mobile devices, smartphones and tablets have recently emerged as the most prominent; international trends in 2015 indicating the general integration of tablets (Johnson et al., 2015). Accordingly, there has been a gradually growing interest in the use of tablets and mobile applications for educational purposes, especially in public educational institutions (Major, Haßler and Henessy, 2017). Among mobile devices boundary was blurred over time, the differences between tablet and smartphone shrinked narrower and narrower, and both device have become used for both everyday life as well as teaching and learning. The continuity of mobile device use for education was also confirmed by the shift to emergency distance learning (ERE) due to the COVID-19 epidemic in 2019. Smartphones and tablets not only had a significant proportion of the devices used for (digital) learning, but sometimes they were the only available devices for learning purposes (Fodor et al., 2020).

In line with the trends presented, tablets have been introduced in a number of educational institutions abroad as well as in Hungary; some of the initiatives were also studied with various researches (see Clarke et al., 2014; Haßler, Major and Henessy, 2015; OECD, 2015). These

studies have generally focused on the use of tablets at the institutional level, the pedagogical-methodology used with tablets, and the impact on students. Researches exploring institutional-level initiatives (mostly pilot) have shown the conditions of adoption, infrastructure development, teacher training, as well as the benefits and difficulties of tablet-supported education. The studies on the pedagogical-methodological background found that positive changes in pedagogical practices included mainly learner-centred, innovative approaches and project-based learning methods. For the forms of work used in classrooms, individual and pair work were more common (e.g. Yeow, 2012), taking advantage of the interactivity provided by tablets, but several studies (e.g. Clarke and Svanaes, 2014; Goodwin, 2012; Kongsgården and Krumsvik, 2016; Samsung, 2015) emphasised the benefits of group work and increased collaboration. Research on the effects on learners has been mostly conducted on small samples, but these studies have confirmed the positive effects of tablets on learning and teaching (Haßler, Major and Henessy, 2015). Positive results mainly include increased motivation, more creativity, development of ICT skills of learners, and personalised learning (see Clarke and Svanaes, 2014). Hungarian researches according to the impact of ICT tools on student achievement are ambivalent. On the one hand, research findings confirmed that tablets had a positive impact on student performance (Kis-Tóth, Borbás and Kárpáti, 2014; Samsung, 2015), motivation (Czékmán, 2017), and that students were better able to collaborate with their peers (Samsung, 2015). On the other hand, some

of the researches have highlighted the distraction of tablets and the difficulties of switching between digital and traditional devices (Gulyás, Nagyné and Racsko, 2015).

Even though many educational institutions attempting to use tablets, only a few researches have focused on the process of institution-level integration of new devices, the pedagogy associated with them, and the effects they may have. As confirmed by Savas (2014), much more researches are needed within different disciplines to clarify the role of tablets in education and to measure their effectiveness. Due to the dynamics of technological development, the institution-level integration of tablets and the practice of their use in classrooms is not well developed; thus, researches have difficulties in keeping pace with the ever-changing environment and conditions (Savas, 2014). Particularly, there is a lack of researches which comprehensively examines the impact of the use of mobile devices (especially tablet) supported learning environments at institutional level.

Therefore, in our thesis, we aim to comprehensively investigate the use of tablets in primary education. Our doctoral research series thus aims a comprehensive investigation of the tablet-supported learning environment in primary education. The research is divided into three main thematic pillars; *the first pillar* examines the circumstances and process of institutional implementation and integration, aiming to explore the conditions (infrastructural conditions, framework conditions, human conditions). *The second pillar* of the research investigates on the one hand the digital competence of the teachers

involved in the research (general digital competence, mobile device usage competence), and on the other hand the pedagogical-methodological background of tablet usage in the classroom with the aim of exploring the impact of tablets on pedagogical activities (forms of work, methods, didactic objectives). *The third pillar* of the research will investigate the cognitive and affective impact of tablet-assisted instruction on students, measuring changes in students' learning outcomes (knowledge levels) in foreign language (English) and mathematics, and other impacts on students' attitudes towards the tablet-assisted learning environment and their learning with tablets at school and at home.

Methods

In the first pillar of our research, we examined the integration and implementation of tablets at institutional level. Thus, our research questions concerned (1) the infrastructural conditions of institutions using tablets for educational purposes, (2) the framework conditions (the conditions provided by the educational institution that enable the use of digital pedagogy) and (3) the human conditions. Data collection was carried out through an online self-completion questionnaire, which included both quantitative and qualitative elements. Our research was conducted among primary schools (N=145) that regularly used tablets in their learning and teaching processes during and before the data collection period.

In the second pillar of our research, we mapped teachers' mobile device usage background as well as their level of digital competence (general digital competence and mobile device usage competence) and its changes during the research. On the other hand, we explored the impact of tablets on pedagogical activities and teachers' attitudes towards tablet-based education. Accordingly, our research questions focused on (1) the mobile device penetration and mobile device usage frequency of the teachers involved in the research, (2) their general digital competences, (3) their mobile device usage competences. The research also sought to answer questions on (4) the characteristics of didactic objectives, working methods and methods used in classrooms, (5) the additional time teachers spent on tablet use, and (6) the benefits and challenges teachers perceive in TSLE. Our research assessing teachers' mobile device use and digital literacy used an experimental design involving an experimental (tablet) group and a control (non-tablet) group with pre- and post-tests. For this purpose, we used a self-completed online questionnaire with the IKER (Integrated Infocommunication Reference Framework) self-assessment tool. To investigate the pedagogical-methodological background of TSLE, a longitudinal descriptive study was carried out using a self-designed, paper-based questionnaire, including both qualitative and quantitative elements. Teachers' attitudes towards tablet-based teaching were assessed qualitatively, using data from open-ended questions of the online questionnaire and from the focus group interview. The sample of the second pillar of our research included nine primary schools of a

metropolitan School District; a total of 29 teachers from the nine educational institutions participated, 15 of them with only experimental groups, 9 with only control groups and 5 with both. The pedagogical-methodological background of the teaching lessons was analysed on the basis of a total of 1283 questionnaires, which included 799 tablet lessons and 484 control non-tablet lessons.

In the third pillar of our research, we investigated the impacts of the use of tablets for educational purposes on students (cognitive (intellectual) and affective (emotional) domains). Thus, our research questions focused on students' (1) mobile device usage background, (2) changes in their foreign language proficiency and elementary numeracy skills, and (3) motivation and attitudes towards learning. We used a quasi-experimental design in our research with students. In the experimental design, we administered pre- and post-tests to assess learners' foreign language proficiency levels and their mobile device usage background. To assess the students' foreign language proficiency level, we used the Language Proficiency Test developed by the MTA-DE Foreign Language Education Research Group, which measures the language skills of 5th and 6th grade students in accordance with the Common European Framework of Reference for Languages (CEFR). For mathematics, the methodology and measurement tools used in the National Measurement of Skills and Abilities (Országos készség- és képességmérés) were applied. The total number of students who completed both the pre-test and the post-test was 653, and the number of groups was 36. The experimental group – using a tablet – included

403 students (22 groups), while the control group – using traditional teaching tools – included 250 students (14 groups). Foreign language (English) proficiency was assessed in the 5th-6th grade (n=279) and elementary numeracy in the 4th grade (n=374).

We used Microsoft Office Excel 2016 spreadsheet and SPSS version 22 of the mathematical statistics software, as well as Voyant Tools text analysis software to process the data of our research.

Results

When examining the tablet learning environment at the institutional level, it was found that the average number of tablets exceeded the average class sizes in three quarters of the institutions, so 1:1 access could not be achieved in many institutions. In terms of the average age of the tablets, three quarters of the schools were in an optimal situation, but some were using outdated equipment. Although the average internet bandwidth for tablets was adequate, nearly half of the schools did not reach the critical value we expected. On the positive side, however, four fifths of the institutions surveyed had full wireless internet coverage. Institution-wide tablet use was provided in two-thirds of the institutions surveyed; schools in the capital and in rural areas were more likely to provide tablet use, while urban schools were less likely. Opportunities to use tablets in different subjects were mainly provided for subjects taught at higher timetables. Presumably, in these subjects teachers had more time to experiment with the tablets than in subjects with lower number of lessons. Institutional regulation for scheduling tablet usage

were in place in three-quarters of schools; in half of the schools, prior verbal consensus agreement was the most common. In addition to descriptive analysis, a deeper analysis of the data was conducted to examine the factors influencing teachers' frequent use of tablets. Of the conditions examined, the strongest correlations were found between the institutional framework and the digital competence of teachers to use tablets frequently. Also human and infrastructural conditions, as well as the number of years that the educational institution had been using tablets for educational purposes affected the teachers' attitude towards regular tablet usage.

When looking at teachers, it became apparent that the majority of them had their own notebooks, tablets and smartphones; some of the notebooks and tablets were provided by the educational institutions. In terms of daily use of devices, it was found that mobile devices were used by teachers for the shortest time at school, but the duration of this use increased among the study group during the period of the research. Teachers' overall digital competence was predominantly at IKER1 and IKER2 levels. In the study group there were improvements in the areas of "communication", "problem solving" and "ICT safety" during the study period, but also some regression was noticeable in the area of "digital content creation". In terms of teachers' mobile device usage competence, it was also found that the strongest areas were "Internet, online communication" and "device management", while the weakest area was the use of "mobile devices for educational purposes". Even

though the post-test results showed improvements in all competency areas, the area of educational use was still below the average of 2.

The results of the pedagogical-methodological analysis of the lessons confirmed that the structure and the pedagogical-methodological background of the tablet-based lessons differed somewhat from the traditional lessons. In the case of didactic tasks, the emphasis in the tablet lessons was less on the processing of new knowledge, and the teachers tended to focus on the repetition of knowledge already learned, for which they used the tablets for longer periods of time. In the tablet lessons, the time spent on monitoring and assessing pupils was reduced. This could either mean that teachers did not exploit the potential of digital tools or the use of these tools shortened the duration of these didactic tasks. As we have already seen the reduced time on the transfer of new knowledge in case of the didactic tasks, it was not surprising that teacher-centred methods were also less important during tablet-supported lessons. There was also a decrease in the time spent on methods based on teacher-student collaboration, but an increase in the time spent on learner-centred methods, as we had previously expected. Presumably, in the tablet-based lessons, the teachers' focus was on student activity and the use of tablets was also predominantly in these methods. Not surprisingly, there was less time for frontal work, but also less time for group work. It is possible that, on the one hand, teachers were trying to use the mobile devices with 1:1 and therefore did not organise group work in advance, or on the other hand, they may not have been aware of digital solutions that could support online

(collaborative or cooperative) group work. In our research, the average preparation time was just over 11 minutes, but there were significant differences between teachers. In lessons where tablets were used more, the preparation time for the lesson was also longer. As time progressed in our study, the extra time did not decrease for either English or mathematics.

Some of the responses from our qualitative study highlighted that, although the tablet learning environment was implemented in all cases, there were challenges in the beginning that required teachers' flexibility and organisational skills. In several cases, responses highlighted the need for a reliable internet connection to use the tablets, otherwise the lack of such a connection could lead to lessons being cancelled. Positive pedagogical-methodological feedback included the possibility of differentiating lessons and the possibility of assigning personalised tasks. On the negative side, however, the use of tablets was not always integrated into the curriculum and the use of mobile devices in the classroom was not sufficiently supervised. The impact on pupils was largely positive, with the majority of teachers noting an improvement in pupils' knowledge in both English and Mathematics. It was also highlighted that pupils were more motivated and more willing to work in lessons, which led to an improvement in both their behaviour in lessons and their attitude to learning. The negative responses from teachers mainly mentioned the limited impact of the tablet environment and the low progress made by unmotivated pupils.

In the third pillar of our research, we looked at students. In terms of students' mobile device usage, we found that students mainly had access to smartphones, tablets and notebooks (laptops). Changes over the study period showed that access to mobile devices increased for tablets as schools started to use the devices frequently. The duration of daily use of mobile devices showed that pupils in the study group spent a significant amount of time using mobile devices. By their own admission, they used the devices predominantly – due to their age – for playing games, but the most important type of usage in our research, the learning, was the least frequently used activity.

When examining the foreign language proficiency of the students, the advantage of using tablets was apparent, but the differences were minimal in most cases. For tablet user students with below average and average proficiency levels, there was no statistically verifiable difference between the experimental and control groups, but students with above average proficiency levels performed better in grammar and reading comprehension. When comparing the subgroups of the experimental groups, it was found that the groups learning with numerous different applications improved more in reading comprehension and their foreign language proficiency level improved more than the groups using only HANNA (digital language teaching application). Comparing the changes in the different proficiency levels, there was no difference between the below average and average proficiency groups, but the above average learners improved their foreign language proficiency more than the control group. The better

results could be due to the opportunities offered by tablets (e.g. interactive tasks, electronic dictionary, instant access to information) and higher motivation to learn.

Our hypothesis H 3.1 on the change in foreign language proficiency level states that "*the change in learners' foreign language proficiency level is greater in the test group than in the control group"*. Based on the statistical tests performed, the hypothesis could not be confirmed (Mann-Whitney U, $p>0.005$).

However, our hypothesis H 3.2 was confirmed, as we hypothesised that *"the change in foreign language proficiency level of students with above average proficiency level is greater for the test group than for the control group"*. Our results confirmed that students in the test group with above-average proficiency levels made more progress (change: 7.81 %p) than students in the control group (change: 2.3 %p; $U=442.5$, $p=0.001$).

For mathematics, the students' development of elementary numeracy skills was at the advanced level in experimental and control groups. At the outcome measure, the students' elementary numeracy skills were at the optimal level, resulting in no statistically demonstrable difference in the rate of progress between students with and without tablets when comparing the rates of change. However, there were some differences between subgroups of the test group. These results suggest that students using the Kisiskola mobile application improved more in the area of addition than their peers using numerous different apps. No statistically verifiable differences were found for students with different levels of

proficiency. Since there was no difference between the test and control groups, it could be stated that we found no evidence that tablet supported learning environment (TSLE) was more conducive to the development of students' knowledge levels in mathematics education.

Our hypothesis H 3.3 on the change in students' elementary numeracy skills states that *"the change in elementary numeracy skills of the students in the study group is greater than that of the control group"*. The level of change measured for the test group was not statistically different from the control group (Mann-Whitney U-test, $p>0.005$), so our hypothesis was rejected.

In our research, we looked at affective domains as well as cognitive domains. The results confirmed that, although there were only small changes in students' knowledge, there were several positive changes in the affective domains. Students' motivation to learn in TSLE was higher in both subjects in tablet-based lessons compared to lessons using traditional learning tools.

According to our hypothesis H 3.4 on learning motivation, *"students' motivation to learn is stronger during tablet-supported lessons than in lessons using only traditional learning tools"*. For English, students' motivation to learn differed in lessons with tablet-based learning tools (mean: 3.87) compared to lessons with only traditional learning tools (mean: 3.56; Wilcoxon test; $Z=-3.615$; $p<0.001$). For mathematics, students' motivation to learn in a learning environment supported by a tablet was also stronger

(mean: 3.91) than in lessons using only traditional teaching tools (mean: 3.42; $Z=-6.798$; $p<0.001$).

Students provided a range of feedback on tablets and tablet-based learning for the open-ended questions. Different areas of impact on learning were mentioned in relation to the benefits of tablet learning. Among the positive effects, several feedbacks mentioned better understanding and more effective learning due to the learning environment supported by the tablet. In addition to the effectiveness of tablets for learning, many more mentioned the impact of the devices on motivation, which in many cases also improved the behaviour of students in class. However, in addition to the many benefits, many also mentioned that tablets sometimes did not enable them to learn as effectively as traditional learning tools. The advantages of tablets as a learning tool were praised by students for their large screen size and their mobility and portability. However, in addition to the advantages, they also mentioned the disadvantages of tablets, such as the difficulty of bringing them into classrooms or the inadequate weight and screen size.

Our extensive research into the use of tablets in the classroom has provided tangible results for the institutions using tablets, as well as teachers and students. We are confident that these results will make an integral contribution to the positive impact of digital pedagogy in schools, both in terms of educational effectiveness and experiential learning.

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List of publications related to the dissertation

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