TABLET COMPUTERS ON TRIAL: A TRANSFORMATIVE FORCE IN EDUCATION?

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ABSTRACT

In this paper we present the results of an evaluation study of a development project for the introduction and use of tablet computers (iPads) at the lower secondary level in Nordlinga school, a compulsory school in Reykjavík. In the study, we assess the impact of the use of tablet computers on instruction and students' learning in grades 9 to 10, and on school development in Nordlinga school. First results show that that the project came to a good start, despite some differences that the school had with city administrators and technical problems in the beginning. Most students brought their tablet home and used it for formal, as well as informal and non-formal learning. The introduction of tablet computers enabled access to a variety of software for learning, tools and games. It stimulated communication and collaboration. Products of learning increasingly involved multimedia elements and networking. The study indicated increased satisfaction, interest and independence of students in learning, development of individualized learning strategies, increased student engagement and an improved use of class time. Teachers felt that the use of tablet computers stimulated their professional development and enhanced their work satisfaction. Parents were generally supportive of the use of tablet computers and considered it important that the school could continue to invest in new technologies for learning. Indications were of insufficient availability of learning materials in Icelandic and a start of co-configuration of partners to remedy the situation. The evaluation revealed some weaknesses, challenges and opportunities for further development.

KEYWORDS

Tablet computers, mobile technologies, school development, 1:1 pedagogy

1. INTRODUCTION

In 2012 Nordlinga School in Reykjavík Iceland started use of tablet computers (iPads) in teaching and learning. This pioneering development project was initiated by a team of teachers in the school who planned the project and involved collaborators from the Reykjavík municipality, the National Centre for Educational Materials (NCEM), Apple, and University of Iceland. The project's duration is January 2012 through June 2013. One cohort of students completing their 9-10th grade (15-16 year old) each got a personal iPad for learning in school and at home, which was used in most subjects (Icelandic, English, Danish, Social Science, Natural Science and Math). The authors of this paper are evaluating the project and have published an interim report (Jakobsdóttir et al., 2012) after the first semester. Additional data has been gathered in the second semester. An emerging picture of this case will be presented here.

During the past years financial difficulties have affected the Icelandic educational system in various ways. In many schools, for example, funding has been severely cut regarding purchases of computers (Jakobsdóttir et al., 2013). At the same time the fast development of mobile technologies, including tablet computers and smart phones, has opened up new and interesting avenues which schools and educational systems across the world have started exploring with the hope of enriching and improving teaching and learning for their students. Private ownership of mobile devices has increased, but the educational system appears to be lagging behind in mediating technical knowledge and competences, with many schools limiting students' options in this respect and even preventing them from using social media and mobile technology at school.

The background to the project connects historically with the establishment of Nordlinga School. As a new school it was entitled to equipment budget, but had to seek approval and delivery from the centralized ICT center of the city. The headmaster instructed teachers to make a 'wish-list' and teachers opted for iPads tablet

computers introduction in the 9th grade, to be assessed in 2 years time, when the students would complete their compulsory education. The City of Reykjavík rejected the request and this delayed the start of the project. The schoolmaster gave it full support, as did Apple and other partners that showed an interest in the project. The teachers' vision was based on the school curriculum 'to provide every individual with learning conditions, so that he or she may, on their own terms, develop and thrive, and graduate from the compulsory school as an independent, strong, but not least, a happy individual' (Norðlingaskóli, 2012b). The teachers had already experimented with making digital learning materials and sound books, with the intention to make learning more interactive and individualized, in accordance with student needs. To counteract the rejection from the city center teachers blogged about the problem (Pétursson, 2011), this along with headmaster's support seemed to turn the tide, as Apple consequently decided to loan a few iPads to teachers and the NCEM offered to provide learning materials as PDFs. The city and its IT Centre then decided to come aboard and provide their expertise in digital technologies and system management. The school later purchased the tablets for the project. The University of Iceland – School of Education was consequently invited to join as a research partner. A formal agreement was made for a three-semester collaboration.

2. THEORETICAL FRAMEWORK

Improved access to the Internet, learning materials and information has gone hand in hand with increased availability of new technologies and this has encouraged a steady development in blended learning, where net-teaching and face-to-face teaching is interwoven. A recent report gives an overview of several teaching models that have been evolved in USA at the primary and secondary levels (Staker, 2011) and it indicates a rapid development in mobile learning with digital equipment. Bonk predicted that an increased emphasis will also be put on production of content for these devices, piping for the content, and school culture that emphasizes participatory learning (Bonk, 2009). Initiatives of co-design of learning materials (Jenkins, 2012) and sharing of open content (OER Commons, 2012) is now an open path for educators to follow, in open learning networks (Rudd et al., 2006) where participants cooperate on creation of new meaning and knowledge. Recent developments in mobile and distance learning have caused a blur of the boundaries of learning in and out of school. Siurala (2006) has distinguished between formal education, informal learning and non-formal learning:

Formal education: institution-based, structured, hierarchically and chronologically graded, teacher/trainer-centered education which emphasizes objectivity of knowledge, memorizing and aims at certification.

Informal learning: learning in everyday life, which does not aim at certification but where a diversity of actors each with their own intentions imposes meanings on the learner.

Non-formal learning: learner-centered and practice-based learning process which emphasizes intrinsic motivation, social context of learning, and the usefulness of knowledge, and aims at identity growth, social change and integration into society. Learning is voluntary, involves conscious educational aims and may be credited. (Siurala, 2006).

The informal learning happens daily without any specific objectives, but the non-formal learning is being initiated by the learner and is driven be inner motivation, with objectives set by the individual. Blurring of boundaries in learning (formal, informal or non-formal) may enable individuals to reach out, disseminate his/her experience, knowledge or skill and to learn from others. The term participatory learning 'involves exploring information and concepts within a community of learners who all engage in making and discussing through enquiry'... 'Sharing knowledge from aspects of their lives'... making the discussion more meaningful and relevant (Jenkins, 2012). Learning environments are increasingly characterized by participatory, interactive practices (Kumpulainen et al., 2010).

Collaborative approaches take on different forms and are described in terms like, interagency, multiagency or partnerships (Lloyd et al., 2001). Loyd et al. describe different levels of collaboration further:

Interagency working: more than one agency working together in a planned and formal way, rather than simply through informal networking (although the latter may support and develop the former). This can be at strategic or operational level.

Multiagency working: more than one agency working with a client but not necessarily jointly.

Multiagency working may be prompted by joint planning or simply be a form of replication, resulting from a lack of proper interagency co-ordination. As with interagency operation, it may be concurrent or sequential. In actuality, the terms 'interagency' and 'multiagency' (in its planned sense) are often used interchangeably.

Joined-up working, policy or thinking refers to deliberately conceptualized and coordinated planning, which takes account of multiple policies and varying agency practices. (Lloyd et al., 2001).

In the case of Nordlinga school the formal contract entered into signals the arrangement of interagency working, both on a strategic and operational level. Warmington et al (2004) term this collaboration as co-configuration: 'a form of work oriented towards the production of intelligent, adaptive services, wherein ongoing customization of services is achieved through dynamic, reciprocal relationships between providers and clients. For resolving tasks crossing of boundaries are often necessary, as are changes to structures or removal of hindrances that impede development. Lloyd et al. quote recommendations of a 'Making it happen action team' on ways of overcoming professional, organizational and cultural barriers and identify three types of barriers:

Structural and functional barriers – fragmentation of public services because of range of organizations involved in their delivery; agencies structured around the services to be delivered rather than the areas or groups served.

Process barriers – inflexibilities caused by the financial procedures of agencies; the processes of some central government funding which encourages short-termism and forced partnerships.

Cultural barriers – each profession, each organization can have their own way of doing things and their own sometimes ill-informed views of the other organization and professions with which they deal.

The interagency working can contribute to building quality study environments, but barriers can easily impede or prevent development towards this aim. In the case of the Nordlinga school project the balance between interagency working efforts and barriers confronted will impact the quality and results of the co-configuration.

3. METHOD

In this evaluation study, data were gathered with quantitative and qualitative method. Participants included: Students in one whole cohort. There were 20 girls and 9 boys in the first semester (spring 2012) of the project and 21 girl and 9 boys the following year. There were also teachers and support staff (grade 8 to 10). In the first semester 4 men and 4 women, and the same core group with some changes the following semester (fall 2012). Of the eight there were six teachers teaching Icelandic, math, English, social studies and science, but teachers of art, crafts and sports for this cohort did not take part in the first phase. The teachers were in the age group 26-45 years, most of them with teaching experience of 4-6 years and ICT experience of 1-6 years. In addition, representatives of the collaborating institutes and companies (two from NCEM, one from Apple, three from the Reykjavík municipality) participated in the study. Table 1 gives an overview of the methods used to gather data for the evaluation study. Six graduate students assisted in the data gathering and analysis. A research and evaluation of apps was carried out in march/April 2012 during the first semester, using the Walker-Schrock rubric (Schrock and Walker, 2011) and again during the second semester, in November.

Initially, teachers and students confronted some minor technological hindrances (firewall, wireless connection, saving of data) that were quickly resolved. Teachers managed the systems of communication and used Gmail and Facebook to organize communication with students and parents, but the content produced on the tablet computers was not saved on the city's systems. Instead the school made use of the iCloud and took charge of arrangements of learning materials and student project work. Care was taken to introduce the computers and teaching plan to both students and parents, whose majority supported the project from the start. Teachers also created a separate Facebook group and a website to be able to inform those interested regularly about the project and to disseminate their experience and new ideas (Pétursson and Gudmundsdóttir, 2012). The ICT Centre's management chose low spec iPads that did not have possibilities of a 3G connection, without consideration to future use and school policies. The decision was taken, it seemed, without much consideration to school policy or students and teachers' needs.

Table 1. An overview of the study procedure: Time of data gathering during 2012.

Semester	Months	Participants	Method
1	March	29 students	Nine group interviews
	April		(2-4 students per group, girls and boys separately)
	April	6 Teachers (subjects),	One group interview
	April	Head teacher, special ed. teacher	Two individual interviews
	April	All students and teachers	Two observations, school visits with video recordings
	April	Students (10 students 33%)	Software (apps) survey and evaluation
	May-June	6 Representatives from three collaborating parties (Reykjavík, Apple, and NCEM)	One interview per institute/company involving one to three persons
	June	Parents, students and teachers*	Surveys based on EUN (European Schoolnet, 2012)
2	November	30 students	30 individual interviews with video recordings and photographs (screen shots)
		All students and teachers	Observations during four school days during one week included video recordings.
	November	Five Teachers (subjects)	One group interview

*Parents of 21students (72%) participated in the parent survey, 14 students (48%) in the student survey, and 5 of 7 staff members (71%) who were teaching during the spring semester.

4. RESULTS

4.1 Participation – for Teaching and Learning

The teachers used a variety of tools and software, but none of them used game devices or games. They employed "flipped teaching" (Techsmith, 2012) and collaborated on making their own teaching/learning material, employing new tools, like Teacher's Pal, iBook Author, Educreations and various productivity tools. Teaching plans included both individual tasks and collaboration projects and various learning tools were used to assist students to plan their own learning. Teachers put emphasis on peer learning and learning from their students. Teachers also established partnerships with individuals and agencies outside the school. The majority of the teachers indicated in a survey that they were very keen on taking part in the project. They were active in seeking out events relating to professional development and tablet computer use, as well using social media to further their cause.

Teachers at Nordlinga school all agreed on that their school organization was well suited to teaching with tablet computers. This was in contrast with the results of the European Schoolnet survey on use of laptop computers, where only 64% of teachers agreed to this. The Icelandic teachers were, on the other hand, unsure, or disagreed with, that the school offered enough support for harnessing the tablet computers, while 56% of the European teachers agreed to this. Teachers felt that the use of tablet computers in Nordlinga school contributed to their satisfaction at work and stimulated their professional development. They considered their work more productive and diverse than before.

Teachers noted an increased student interest, independence and engagement in learning. They also noticed acceleration of learning processes, increased efficiency of students, which relied partly on the steady feedback that the use of tablet computer enabled. Problems mentioned were students' time control difficulties in the beginning, as well as their insecurities, when new technologies and learning methods were employed. The tablet computer made their work easier, as it enabled personalized learning, and "flipped-teaching" method gave more time to attend to the needs of each student and attend to problem solving in class. The teachers also mentioned improved teacher-student communication and among themselves, e.g. on learning designs and plans. Various other benefits and development possibilities were mentioned, e.g. creating own learning materials and even new apps.

The students already had some experience with new technologies and the group had considerable differences in social and learning status. They expressed confidence with mobile technologies in the survey and 86% of them had an additional access to a laptop computer at home. Students participated in a short course delivered by Apple and were encouraged to bring their ideas on learning and tablet use to the table. They could choose their own apps. The use of the tablet computers was voluntary and all students, except

one, preferred to use them. They received one lesson each week on mobile technologies, where a teacher also introduced new apps. The ownership of the computer was transferred to the students and all except one computer were in good order, by the end of term. A contract was made with parents on home use. Interviews with students indicated an increase in self-directed learning and an active participation in choosing their own learning content and tools. Home use appeared to decrease the need for playing games at school and using social media websites during school hours, but provided opportunities for home study. Students indicated in interviews that it was relatively easy to get support from peers and teachers on issues of use of the tablet computers and learning.

The AppStore and Open Source depositories offered a great variety of learning content, learning software, games and tools. A third of students participated in a survey on apps they used (43 apps recorded in march/April) and this was mirrored against learning material on offer from NCLM, school schedule and national reference timetable (Ministry of education science and culture, 2012). It revealed shortages of learning content in the Icelandic language, specifically, in some disciplines, such as the arts and vocational studies, and an increase in the availability and use of lesson/learning planning tools and productivity tools. The evaluation, using the Walker-Schrock rubric showed relatively high scores for curriculum connection/relevance, user friendliness and student motivation, but lower on other features.

Students resolved their tasks, not so much with texts and images, as before, but increasingly, with various media tools and expressive interpretation. The students were asked about which learning environments and tools they used. The results are shown in Figure 1. The answers indicate that the students use learning software of choice nearly as often as they use digital textbooks, and an array of tools, games and other digital resources. It is also noticeable that their use of communication tools, games, social media websites and collaboration tools is on a similar level, both in and out of school.

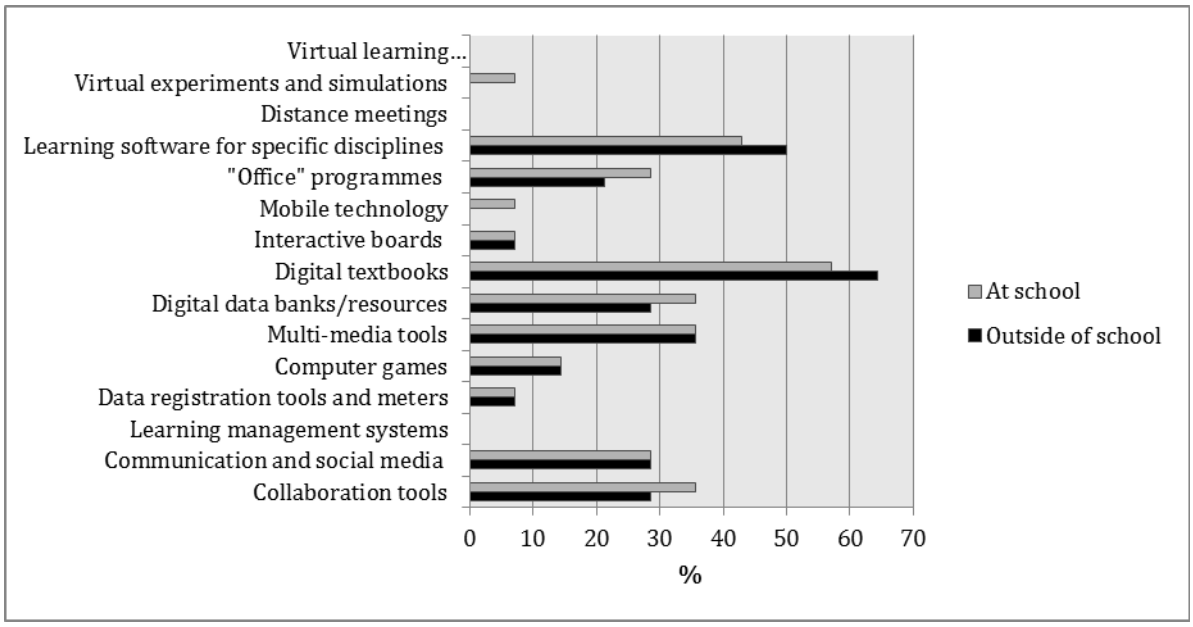

Figure 1. Students' use of tools and learning environments, in and out of school.

Schoolwork was taking preference, but interest areas, planning own learning and sports were also high on the agenda. Students were also asked in the survey if they used the tablet computer to learn about something that did not relate to schoolwork. Around 50% indicated that they sought information on their interests, 42,9% said they tried to develop skills that related to their leisure interests and a third indicated an interest in current affairs, looking for in-depth information on school tasks or on subject not taught at school.

Students were also asked about the impact tablet computer use had on certain issues relating to schoolwork. The results can be seen in Figure 2. These responses indicate that students seem to enjoy schoolwork more than before and that individualized learning is taking hold. It also seems to have positive effects on various aspects of learning and engagement.

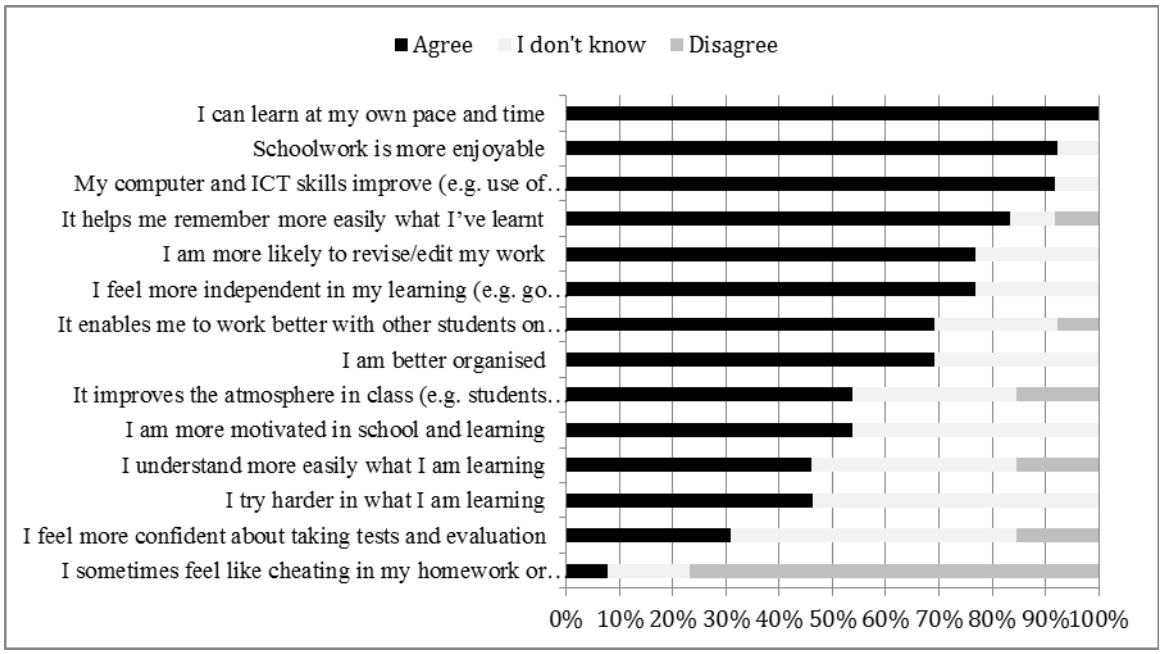

Figure 2. Student's opinion on the effect of using tablet computers

Parents were positive towards the school applying 1:1 pedagogy and 71% thought that the school should continue to invest in new technologies. They took interest in their children's computer activities and 43% of students said that they discussed the use of the tablet computer with their parents at least once a week, 14% almost every day, 14% rarely or never (21%). Relatively many in the student group said that they had helped adults in their family to use the tablet computers (64%). Around 38% of parents indicated that they would like more information on the use of the tablet computers with their children, or on technical matters or support from the school (14%). 92% of parents acknowledged that their children were more proficient in using digital technologies, could learn at their own speed (90%) and that their children's' interest and participation in learning had increased (90%). Neither parents nor their children reported many negative issues relating to the use of tablet computers, but some parents worried about ergonomic issues and a few students said that hand-writing was difficult and complained about eye-pain.

Partners took on their own supportive tasks, either on school/teachers' demand or encouraged by the collaboration that was formally established with a contract and followed up during the project phases with meetings. The level of involvement differed somewhat; Apple and NCLM paid regular visits to the school, sharing their expertise, support services and learning materials; the City's school division and IT centre's assistance and communication was crucial in the beginning of the project, but seemed to vane later and some of their support offered became redundant. Opportunities for extended collaboration arose, such as on development of content and learning materials with NCLM, but new incentives also surfaced to look for partners, for cooperation on assessment and various learning tasks. NCLM appeared willing to learn from teachers, to learn about their needs and to collaborate on learning materials, teacher guides and learning tasks. According to NCLM representatives most schools currently do not call for digital materials, but they estimated that increased use of tablet computers might call for "interactive digital material – as it was the future".

4.2 School Vision, Curricula and Policymaking

Nordlinga school (Norðlingaskóli, 2012b) puts great emphasis on the school taking advantage of its natural and cultural environment, and that education and welfare of students is a shared task of the home and school, that builds its work on mutual trust, shared responsibilities and reciprocal information exchange. Its school curriculum (Norðlingaskóli, 2012a) emphasizes meeting individual students needs, but also developing social competences, collaboration and team work at school. The school runs a progressive educational policy, wants

to create an encouraging work environment for staff and students alike, and to offer teachers opportunities for continued professional development. The school also emphasizes teaching art and vocational disciplines.

A comparison with Reykjavík city school development plan (Reykjavíkurborg, 2010), and the new main curriculum from the Ministry of Education (Ministry of education science and culture, 2012), revealed that the project's objectives were in good keeping with school vision and curriculum. The national curriculum rests on the following main pillars: literacy, sustainability, health, and welfare, democracy and human rights, equality and creativity. It also advocates distributive responsibilities for schools and teachers, a call to which teachers at Nordlinga school have responded. The research revealed differences between the school vision/national curriculum and objectives of the Reykjavík city's IT center. The national curriculum emphasizes that "school work "needs to be in constant flux" and that "changing circumstances and technical innovation demands changes". It stresses that "cooperation and collaboration are a "key issue in successful school development" and advocates reversal, from centralized governance to distributive responsibilities. Reykjavik city's IT centre, on the contrary, has objectives to go from distributive management to centralizing and uniformity, with the aim to handle complexity and volume and to secure efficiency (Hjörtur Grétarson, 2011). These objectives seem irreconcilable with those of the school and the main curriculum. Interview response indicated potential changes in the IT centre policy, as tablet computers were increasingly used by different professionals in the city services, although economic conditions are hampering renewal of computers in the school system.

5. CONCLUSION

The Nordlinga school's initiative to introducing tablet computers and 1:1 pedagogy can be seen as an attempt to create a learning ecology, where both teachers and students are learning to tackle new devices and learning tools, and where new ways of organization, learning strategies, methods and content are forming for the benefit of education. A strong vision and willingness to collaborate has enabled the teachers and the headmaster to build a framework for supporting progressive school development, to introduce 1:1 pedagogy, as well as a collaborative learning scenarios for students and teachers. Furthermore, it has influenced establishment of interagency working with parents and partners, on the periphery of the school setting. Although the school vision is not entirely compatible with some of the partners, collaboration and an ongoing dialogue has been established to drive the development. Challenges can be observed in keeping a fruitful dialogue and interagency working going, and providing results. Shortage of resources and development of technical infrastructure for the tablet computers could test the collaborative effort. Expansion of the project to include more students and other teachers/peer collaborators, could bring challenging tasks. Developing teaching methods and learning aids for students with special needs is an additional challenge.The largest gain can be seen to be the increased engagement and enthusiasm in students' learning. Several testimonies to this can be noted, such as:

- increased satisfaction, interest and independence of students in learning
- development of individualized learning strategies
- development of informal and non-formal learning, out-of-school activities
- developing networking, communication and collaboration competences
- aquisition of technical competences, multi-media techniques and increased media-awareness
- students' broad choice of software for learning, tools and games

Various opportunities can be observed at this point in the project. One has emerged for developing the partner collaboration further, especially in the field of content and learning tools. Others are less obvious or developed, such as collaboration with software developers, in the field of edutainment and learning assessment. Learning opportunities also exist for using iPads in outdoor teaching and learning, for gathering digital data in fieldwork.

Further research interests surfaced during the course of the project. The most important are self-directed learning of students and teachers and their agency. So are the mechanisms and potential of interagency working for expansions of learning environments and the interplay between developing pedagogy and students progress/results. The results have been positive sofar, but it would be desireable to study long term effects, for example to examine if a potential novelty effect will wear off with time.

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