Exploring the Use of Digital Tablets in Preschool Technology and Science Education

Anna Otterborn, Linköping University, Department of Social and Welfare Studies, Norrköping, SE-601 74, Sweden, +46738390691, anna.otterborn@liu.se

Konrad Schönborn, Linköping University, Department of Science and Technology, Norrköping, SE-601 74, Sweden, +4611363609, konrad.schonborn@liu.se

Magnus Hultén, Linköping University, Department of Social and Welfare Studies, Norrköping, SE-601 74, Sweden, +4611363241, magnus.hulten@liu.se

Abstract The availability of digital tablets in preschools has increased significantly in recent years. Literature suggests that these tools can enhance students' literacy skills, as well as improve student collaboration. Society is becoming increasingly digitized and the Swedish preschool curriculum includes technology and science as priority areas of learning. Preschool teachers' knowledge is of utmost importance in helping carrying out this mandate. Since there have been few studies on the use of digital tablets in preschool technology and science education in a Swedish context, there is an urgent need to explore the role and influence of digital tools as teaching tools, in an effort to exploit the potential pedagogical opportunities offered by digital technology. The current study investigates what features and aspects of digital tablet technology preschool teachers use to teach technology and science in preschools. Preschool educators throughout Sweden responded to an online survey consisting of 20 closed and 6 open items that probed teachers' use of digital tablets. Results show that programming, invention, construction, creation, entrepreneurship and designing with the support of digital tablets are emerging technology education activities in preschool. This finding is in line with a revised Swedish curriculum to be completed in 2018. Teacher scaffolding in conjunction with different digital tablet applications could help to develop children's ability and confidence to invent, program, create and design. Future work will consist of conducting interviews with preschool teachers to obtain a deeper understanding of the themes that emerged from the survey.

Keywords: Digital tablets, preschool, technology education, science education, iPads, digital tools, educational technology

Introduction and Aim

The availability and use of digital tablets in preschools has increased significantly in recent years, both in Sweden and around the world. While computers have mostly become tools used by preschool teachers for administrative purposes, digital tablets have in a short time become an integrated part of pedagogical practice at preschools, accepted and used by both preschool teachers and children. Prensky (2001) talks about a generation of "digital natives", children who have grown up in a digital world and that have adapted to a digital language. Through more accessible digital tools such as tablets, children are exposed to and interact with digital technologies at an earlier age than ever before.

The use of digital tools in education has been a hot topic in education over the last decades, and the availability of these tools in educational contexts has increased significantly (e.g. Neumann & Neumann, 2014). Although there is a strong push toward an increased use of technology in schools, not least from governmental mandates, more empirical work is needed on investigating the actual influences and effects of newly emerging technologies as pedagogical tools. For example, there are signs that the potential benefits of digital technology are not merely "a given". One example of this is shown in the PISA findings, where ICT use at school and at home has been shown to share a negative correlation with scores in science and mathematics (Spiezia, 2011). In Sweden, a country which has a very high use of ICT - Swedish boys demonstrate the highest use of ICT of all PISA participants - this correlation has been flagged as a potential problem (Skolverket, 2015). The developing use of digital technology in preschools is not only affected by new and more accessible technologies and software, but also by preschool teachers and children's own incorporation of these new tools in daily preschool activities. National and international curriculum policies also highlight digital technology and digital literacy. Sweden has recently engaged in a national overhaul of regulations concerning the use of digital technology in education, and a revised national preschool curriculum with increased emphasis on digital literacy is expected in 2018 (Utbildningsdepartementet, 2017). The current status of the role of digital tools in the Swedish preschool system carries with it both high expectations as well as being in a state of development.

This study aims to contribute to current developments in this area by investigating what features and aspects of digital tablet technology preschool teachers use in Swedish preschools, with particular focus on uses related to children's learning of technology and science. Preschool educators in different parts of Sweden responded to an online survey consisting of 20 closed and 6 open items that probed teachers' use of digital tablets. By conducting this study we aim to gain an understanding of how digital tablets can be used in order to support preschoolers' learning of technology and science.

Method

Study Context and Survey Design

The study was conducted in Sweden with preschool teachers being the target respondents to an online survey on their use and experiences with digital tablets in preschool education settings. The survey was designed to generate information on Swedish teachers' use of digital tablets (e.g. iPads) as educational resources in preschools, with a focus on technology and science education. Designed items included demographic information on gender, age, respondents' preschool

location, level of education, number of available tablets, and teachers' own perceived level of competence in their use. An additional component of the questionnaire asked what programs or "apps" were used, how and why they we used during practice, as well as their opinions about the pedagogical advantages and disadvantages of using tablets in preschool education. A core aspect of the survey design was on the use of tablets in the teaching of technology and science. This included designing items that asked how often tablets were used in relation to technology and science content, what related activities were implemented in praxis, and teachers' views of the pedagogical advantages of, and potential recommendations for, using tablets in these contexts. The items were designed iteratively over a period of four months and involved at least four cycles of revision and refinement between the first and co-authors. A balance between specific and more general questions was sought as well as corresponding implementation of closed and open item formats on a web-based platform. A final step involved piloting the electronic questionnaire with 16 preschool teachers in further pursuit of face and content validity. Following subsequent adjustments, the final survey consisted of 26 items (20 closed and 6 open items, respectively). Interested readers can access the Swedish survey at https://survey.liu.se/Survey/4080/sv.

Data Collection

The survey was activated from November 2016 to April 2017. An invitation to participate in the survey and accompanying link was emailed out by the first author to 700 preschool directors throughout Sweden, who were requested to forward it to respective preschool educators in their district. The survey invitation and link was also communicated on social media platforms that included multiple *Facebook* groups in Sweden such as, "iPads in schools and preschools" and *Twitter*. Aside from exposure on social media, given that each preschool director is responsible for ca. 3 preschools with ca. 15 educators at each school, our estimated potential reach was in the order of 30000 potential survey recipients. The first author monitored the breadth and nature of the received responses as they were obtained, and it was decided that 300 responses would be an adequate sample size for pursuing a reliable analysis (e.g. Nunnally & Bernstein, 1994). The subsequent data subjected to analysis comprised 327 individual survey activations, and serve as the data corpus for this study.

Data Analysis

This paper focuses on analysis of responses to the open-ended item, "*What programs and apps do you use in connection with the use of digital tablets in activities with the children (regardless of subject area)? Please describe how you use this software and why you selected it*". An overall qualitative content analysis procedure was used to treat the data (Mayring, 2000). Half of the responses were randomly selected and read by the first author on three separate occasions, while generating notes of any emerging interpretations. These impressions were used to inform a colour scheme to code the individual responses into inductively developed categories. In pursuit of concordance, the two co-authors performed their own individual category development of a smaller sample of responses. After discussing the overall patterns and themes that emerged, the first author continued to induce subcategories for each identified main category. Lastly, the main categories were described in terms of their respective incidence in the data, and also reflected upon in light of the Swedish preschool curriculum (Lpfö 98/16).

Results

Results of the study are structured by presenting the demographic features of the respondent sample, followed by themes of preschool activities with digital tablets identified in the survey responses to the survey item above (see Method). Lastly, examples of technology education activities with digital tablets generated from the same survey item are described in light of the future Swedish preschool curriculum.

Demographic characteristics and features of survey respondents

Demographics (gender, age and level of education) and context features (preschool location, pedagogical role and number of tablets) of the respondent sample is summarised in Table 1.

Table 1. Demographic characteristics and context features of survey respondents (n=327).

Demographic and Context Features		**Proportion of Sample (%)***
Gender	Female	96.0
	Male	3.4
	Other	0.6
Age	20-30	16.4
	31-40	27.2
	41-50	31.3
	51-60	21.1
	>61	4.0
Pedagogical role	Preschool teacher	76.5
	Childminder	18.1
	Other	5.4
Level of education	Compulsory school	4.7
	Gymnasium (upper secondary)	19.3
	Post-secondary (3 years or less)	21.4
	Post-secondary (> 3 years)	66.8
	Graduate studies	1.2
Preschool location in Sweden	Northern Sweden	13.0
	Central Sweden	43.0
	Southern Sweden	44.0
Available digital tablets	1-2	55.0

	3-4	39.4
	5 or more	6.6

*In some items more than one option could be selected.

Other pedagogical roles mentioned included primary school, Montessori and Reggio Emilia teachers. According to the Swedish National Agency for Education, in 2016, 39% of all preschool pedagogues were in possession of a preschool teacher degree. The agency also reports that there are ca. 46000 tablets in the pre-school system, at an average of 8.2 children per computer or tablet. Furthermore, 23% of staff have access to their own computer or tablet.

Emerging themes of digital tablet activities with children in preschool education

Emergent themes from analysis of the focus item (see Method) are presented in Table 2 below.

Table 2. Thematic structure of categories and subcategories of digital tablet activities with response incidence (Incid.) (n=288).

Main category description	**Incid.**	**Sub-category description**	**Example of response**
Science and Technology: Hands-on and active exploration of content.	128/288 (44%)	Science: Plants, animals, sustainable development, physics and chemistry.	"To find out facts about the human body and nature, the tablet is taken to the woods and used to search".
		Technology: Explore technology by creating and constructing.	"Stimulating an interest in programming by using various applications in the subject".
Language: Developing the use of Language in different forms.	144/288 (50%)	Developing spoken and written vocabulary, concepts and symbols.	"Working with linguistic awareness and facilitating reading and writing using the *Bornholm play* app".
		Communicative forms of expression such as artistic creation.	"Using the app *Puffarna*, which allows children to express their feelings through colour and shape".
Mathematics: Engaging and developing maths concepts and skills.	85/288 (29%)	-	"To develop and discover mathematics with the children, different maths applications are used".
Themes: Thematic approaches engaging focused work.	40/288 (14%)	-	"Choosing different applications to work with several children at the same time in larger projects based on the curriculum and the children's interests".
Cooperation and values: Engendering different types of cooperation and democratic principles.	45/288 (16%)	-	"Applications are chosen to promote interaction and socialization, the children work together with the digital tablet and not so much individually".
Fact searching: Engaging applications without a constrained focus.	117/288 (41%)	-	"They are looking for facts about different things with the children".
Critical thinking: Knowledge and tools to strengthen children's critical abilities.	48/288 (17%)	-	"…sit with the children when working with tablets so to discuss and challenge children's thoughts".
Documentation and reflection: Analysing and developing activities by discussing and reflecting together.	156/288 (54%)	Individual documentation and reflection	"Children photograph freely and document alone".
		Joint documentation and reflection	"They do the pedagogical documentation together with the children where the parents also get insight".

Overall, 8 main categories and 6 subcategories emerged from the analysis (Table 2). The main categories were oriented to science and technology, language, mathematics, themes, cooperation and values, factual search, critical thinking and documentation. Subcategories which developed from these were science, technology, spoken and written language, other communication forms, individual and joint documentation and reflection.

Emerging technology education activities with digital tablets in relation to the new preschool curriculum

The Swedish preschool curriculum was revised in 2010, and among other foci, states that "preschool should strive to ensure that each child develops their ability to identify technology in everyday life, and explore how simple technology works, and also develop their ability to build, create and construct using different techniques, materials and tools" (Lpfö 98/16). Formal integration of digital skills into a further revised curriculum is expected to be implemented in 2018. Further elaboration of the data from the focus item (see Method) revealed five emerging areas of activity related to technology education content in conjunction with using digital tablets (Table 3).

Table 3. Examples of technology content areas and related activities with digital tablets and apps at the preschool level.

Content focus	**Examples of activity**	**Example of app or program used**
Programming	Programming real robots that move on the floor by using digital tablet apps.	*Bluebot*
Invention	Children build their own inventions using applications.	*Pettson's Inventions*
Construction and Creation	Look for images and movies of construction to inspire children's building of their own. Also draw them on paper.	*YouTube*
Entrepreneurship	Reflect as well as create movies together with the children where they foster their imagination and creativity.	*iMovie*
Design	Using a WiFi microscope to explore objects. The magnified images allow children to visualize objects at higher levels of detail.	*WiFi microscope together with Ucam*

With the support of teachers and different digital tablet applications, children can develop the ability and confidence to program, invent, and design their own constructions. In discussions with peers and teachers, children discover how different forms of technology work by finding solutions to different technical issues.

Types of scaffolding activities with digital tablets to support and encourage children's learning

Analysis of responses to the focus item (see Method) also revealed various scaffolding activities that teachers use to support children's learning with digital tablets. Yelland and Masters (2007) have described three types of scaffolding. *Cognitive Scaffolding* "aids in conceptual and procedural understanding and involves strategies such as modeling and questioning by the adult", and was revealed in the current study as per the following example response:

> "Make time lapse movies, children paint and photograph every other second with the tablet. Visualize the process, which can lead to many discussions and discoveries about what the children are targeting".

Affective scaffolding "is where the teacher or parent provides positive encouragement to extend children's learning to higher levels of thinking and operating", and was also a feature of responses obtained in the current study, such as:

> "Reading books and "jumping into" the books through the green screen for the children to get one more dimension, in addition to having heard the book, they can also act as the characters in it."

Finally, *technical scaffolding* refers to how interactive features of the tablet scaffolds the child's learning and facilitates understanding and problem solving skills, support also obtained in the survey responses, which included:

> "In the app *Pettson's Inventions* the child will help to complete innovative inventions. At different levels of difficulty."

The data indicates that teachers use digital tools to scaffold problem solving. In this approach, the teacher shows the children that there are many ways of solving problems, which encourages children to tackle new tasks and take risks.

Discussion and Implications

Since survey responses were from throughout Sweden, the results serve as a representative snapshot of the current status of digital tablet activities in Swedish preschools. A salient aspect of the responses highlight the possibility of cooperation, participation, co-investigation as well as co-discovery together with children. One advantage of the digital tablet is that while children document a phenomenon as part of a technology activity, the tablet provides a platform for active reflection, which may promote the child's focus on the task at hand. Results also suggest that in combination with scaffolding, teachers encourage children to conduct various technology activities with digital tablets that include simple robot programming, which could support logical thinking and problem solving abilities (see Yelland & Masters, 2007). In addition, using digital applications in construction and design activities could stimulate inventive and entrepreneurial skills and feed children's natural curiosity. The data also indicates that digital tablets may support the development of verbal literacy (Neumann & Neumann, 2014).

Although the study indicates that digital tablets could support preschool learning through various activities, potential disadvantages of using tablets also requires future attention. As mentioned, one example of this is shown in the PISA data, where both positive and negative scores are associated with digital tools in school (The Swedish National Agency for Education, 2015). One

possible source for this finding is the notion that digital tools are 'fragmented communicators', and children do not read traditional books to the same extent as previous generations, which may induce a less nuanced language ability (Rosén, 2011). There is also a need to find a trade-off between *digital literacy* and *content-specific technology knowledge*, and to clarify how pedagogues talk about each of these aspects in preschool education praxis. Sundqvist (2016) sheds light on *content knowledge* in technology with teachers' examples such as, "the purpose of the technology, what parts different objects consist of and how they are assembled, and about different technical systems, such as how water gets from a lake to the tap and how it is cleaned on the way there". Future work will comprise analysing the entire corpus of survey responses, followed by conducting interviews with preschool teachers to attain a deeper understanding of the emergent themes from the survey.

References

Mayring, P. (2000). *Qualitative Inhaltsanalyse: Grundlagen und Techniken*, (7th edn.) Weinheim: Deutscher Studien Verlag.

Neumann, M. M., & Neumann, D. L. (2014). Touch screen tablets and emergent literacy. *Early Childhood Education Journal, 42*(4), 231-239.

Nunnally J. C., & Bernstein I. H. (1994). *Psychometric Theory*, New York: McGraw-Hill.

Prensky, M. (2001). Digital Natives, Digital Immigrants Part 1. *On the Horizon, 9*(5), 1-6.

Rosén, M. (2011, 24 november). *Datorer får barn att läsa mindre* [Video file]. Retrieved from https://www.youtube.com/watch?v=xkVcn0ZmpMg

Skolverket (2015). It-användning och elevresultat i PISA 2012. *Fokus på, 2015*(3), 1-4.

Spiezia, V. (2011). Does Computer Use Increase Educational Achievements? Student-level Evidence from PISA. *OECD Journal: Economic Studies, 7*(1), 1-22.

Sundqvist, P. (2016). *Teknik i förskolan är inte något nytt, men idag är vi mera medvetna om vad vi kallar teknik: Personalens beskrivningar av teknik som innehållsområde i förskolan* (Licentiate thesis). Mälardalen Studies in Educational Sciences, 24.

Swedish Media Council (2015). *Småungar & medier 2015. Fakta om små barns användning och upplevelser av medier.* Stockholm: Statens medieråd.

Swedish National Agency for Education (2016). *Curriculum for the Preschool Lpfö 98 Revised 2010 Translation into English of The Curriculum for the Preschool, Lpfö 98, 2016*.

Swedish National Agency for Education (2016). *IT-användning och IT-kompetens i skola (Utvärderingsavdelningen).* Stockholm: Skolverket.

Swedish National Agency for Education (2017). Retrieved from https://www.skolverket.se/laroplaner-amnen-och-kurser/

Utbildningsdepartementet (2017). *Uppdrag om en översyn av läroplanen för förskolan*. U2017/01929/S.

Yelland, N., & Masters, J. (2007). Rethinking scaffolding in the information age. *Computers & Education, 48*(3), 362-382.