Preschool Heads' Perceptions of Technology and Technology Education

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Teachers need support in how to organize teaching in technology to meet the preschool curriculum goals. In Sweden, the head of the preschool has a pedagogical responsibility with a task to support teachers and ensure that the work corresponds to national goals stated in the school act and the curriculum. In this paper, we investigate preschool heads' perceptions of technology (RQ1) and of teaching technology (RQ2) as a precondition for their pedagogical responsibility. Data were gathered from two two-hour seminars with five heads of preschool attending a professional development program. The seminars were audio recorded and the recordings were transcribed for analysis. Research question 1 was analyzed using Collier-Reeds categories for Nature of Technology, and research question 2 was analyzed using a conventional content analysis. The heads perceptions of technology varies between individuals having a narrow view of technology as only being artefacts, or a great insecurity entailing not knowing what separates technology from natural science, to a developed and complex view of technology. Regarding the teaching of technology the heads talked about the preschool teachers´ competence, including subject knowledge as a basis for teaching and pedagogical and didactical knowledge and skills. They also discussed content and method for teaching technology, which included the concept of technology, the nature of preschool teaching and a progression through the preschool years. The results also show that the heads believe the characteristics of preschool education demand that the preschool teachers have a high level of subject knowledge.

Keywords: technology education, preschool, preschool heads, perceptions of technology

Introduction

A summary of previous research shows that teachers' limited knowledge and confidence are the main challenges for the organisation and teaching of technology (Jones, Buntting & de Vries, 2013). Also, preschool staff themselves express a lack of sufficient knowledge in technology and the need for support in how to organise teaching in technology to meet the preschool curriculum goals (see e.g. Elvstrand, Hallström & Hellberg, 2018; Öqvist & Högström, 2018). In Sweden, the heads of the preschool have a responsibility to provide such support. They are viewed as pedagogical leaders with a task to ensure that the preschools' work is directed towards the national goals stated in the School Act (SFS 2010:800) and the curriculum for the preschool. In the curriculum (Swedish National Agency for Education, 2018, p. 21), it is stated that the head of the preschool is responsible for "planning, following up, evaluating and developing the education systematically and continuously, thereby promoting increased achievement of goals". The heads are also responsible for making sure that the preschool teachers have relevant competence to plan and perform teaching, and to offer professional development based on existing needs (Swedish National Agency for Education, 2017). To meet these tasks, the heads need to have pedagogical competence as well as knowledge about the pedagogical practice at their preschool, and of the curriculum goals. Some of these goals concern technology and children's opportunities to discover and learn about technology. In this paper, we investigate preschool heads' views on technology and teaching of technology as a precondition for their pedagogical responsibility. The research questions are thus: 1) What is technology to the preschool heads in the study? 2) What is emphasised as important for preschool technology education by these heads?

Theoretical point of departure

As a framework for describing technology we have used the one created by Collier-Reed (2006) in his study of South African 15-year-old pupils. The framework describes technology in five categories: artefacts, the application of artefacts, the process of artefact progression, the use of knowledge and skills to develop artefacts and a solution to a problem. The categories are ordered in a hierarchy from the most simple to the most advanced and complex. We have found, in previous studies, the framework to be applicable for analysing the views of technology among preschool staff (Nilsson, Gustafsson & Sundqvist, 2020; Sundqvist, Nilsson & Gustafsson, 2018).

Previous research and scrutiny

In our previous studies, based on research circles, where we used Collier-Reed's categories to analyse preschool staff's self-reported technological activities in preschool, we found that technology is addressed as the application of artefacts, the use of knowledge and skills to develop artefacts and solutions to problems, with the application of artefacts being the most commonly occurring category in the activities (Nilsson et al., 2020; Sundqvist et al., 2018). The absence of the category technology as artefacts is unproblematic because the artefacts are included in the second category. However, the process of artefact progression seems to be invisible in the preschool teaching reported. But, when describing technology generally the preschool staff included technology as artefact progression and they explain this difference with a progression in teaching (Sundqvist et al., 2018). The staff explain that the children need to be introduced to the names and functions of the artefacts before advancing to the more complex aspects of technology. Indeed, among the activities with the older children, the five and six-year-olds, more complex aspects in the form of using knowledge and skills to develop artefacts and creating solutions to problems were observed. Thus, these preschool staff show they have a complex understanding of what technology is, and that they adjust the content of technology education according to the age of the children. At the same time, several studies identify a more narrow view of technology among preschool staff (Elvstrand et al., 2018; Sundqvist, Nilsson & Gustafsson, 2015) and that the activities they initiate and teach often address technology on a simple level, whereas activities regarding the more complex aspects of technology are often initiated by the children themselves (Nilsson et al. 2020).

Other research has also found the application of artefacts to be described as common content in preschool technology education, mainly as children using everyday artefacts, but sometimes as discussions about the adequacy and application of the artefacts for different purposes (Sundqvist & Nilsson, 2018). Other aspects described by preschool staff included in technology education is problem solving (Sundqvist & Nilsson, 2018; Öqvist & Högström, 2018), construction (Elvstrand et al., 2018; Sundqvist & Nilsson, 2018) and teaching children what technology is (Sundqvist, 2019; Öqvist & Högström, 2018). In Öqvist and Högström's (2018) study the participants said they taught the concept of technology by attaching the word 'technology' to artefacts. Teaching children the concept of technology by labelling artefacts and situations as technology was expressed as important by several of the participants in Sundqvist's study (2019). However, in the observations of the practice no such teaching could be seen. Also, preschool staff sometimes teach other areas and call it technology. For instance, technology gets mixed up with natural science (Campbell, 2010; Sundqvist, 2019), and using digital technologies is viewed as technology education even if the focus is something other than technology (Sundqvist, 2019).

Preschool technology education has also been scrutinized by the Swedish Schools' Inspectorate (2016, 2017). Some of their findings are in line with previous research. Their main critique is that there is little involvement and guidance from the preschool staff. They critiqued that technology is mainly addressed by children using different technological artefacts and engaging in building activities on their own. They conclude the preschool staff need to challenge children to explore artefacts and develop their ability to

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construct (Swedish Schools' Inspectorate, 2017). In addition, Öqvist and Högström (2018) found that when children were exploring artefacts and asked questions about the workings of the artefacts, the preschool staff avoided these questions because they could not answer them. The Swedish Schools' Inspectorate (2016) also critiqued the fact that when technology was taught by the staff, it was as a separate activity, not integrated in everyday preschool practice. They mentioned mealtimes and hall situations as appropriate for conversations and for challenging children's ideas, but that these opportunities seemed to be overlooked by the staff.

From the previous research presented, as well as the scrutiny from the Swedish School's Inspectorate, we conclude that there are areas preschool staff seem to need extra support in, in order to develop their technology teaching towards the national goals. For the heads to be able to provide this support, they first need the ability to see these shortcomings in their practices. Our assumption is thus, they need a developed view on both technology and the preschool´s pedagogical mission.

Method

Data were gathered from a professional development programme for preschool heads in one Swedish municipality. It was part of a larger PD-programme, also including preschool staff, aiming to develop technology education in the municipality´s preschools. Five heads participated in the programme. The intention was to develop the heads' knowledge about technology and preschool technology education. It consisted of four seminars, two hours each. For this study, audio recordings from the first two seminars were used. In these two seminars, the heads were asked about their views on technology and preschool technology education and this was discussed among the participants. The audio recordings were transcribed. After going through all the transcripts, statements in which the heads' views on technology and preschool technology education were made visible were analysed. Research question 1 was analysed using Collier-Reed's (2006) categories for Nature of Technology, which have shown to be applicable for analysing the views of Swedish preschool staff (see Nilsson et al., 2020; Sundqvist et al., 2018). Research question 2 was analysed using a conventional content analysis (Hsieh & Shannon, 2005) to inductively create categories that describe the heads' views on preschool technology education. Both analyses were performed by the first author. The results of these analyses were then handed over to the second author who acted as a scrutinizer and verified the results by comparing the analysis to the data. As a result of this, one adjustment was made to one of the categories from the conventional content analysis.

Ethical considerations

The research was conducted in line with the criteria for good research practice formulated by the Swedish Research Council (2017). The participants were informed of voluntary participation, confidentiality and use of data. Further, they consented to being audio-recorded for research purposes.

Results

What technology is according to the preschool heads

In their descriptions of technology, the heads include all Collier-Reed's categories except for one: the process of artefact progression. Thus, they speak of technology as:

- artefacts, e.g. "scissors and zippers and such" and "the dishwasher"
- the application of artefacts, e.g. "to know how this thing works and how they [the children] can use it, that they dare to try it out in different contexts"
- using knowledge and skills to develop artefacts, e.g. "engineering" and "eye measure can also be a kind of skill in technology"
- technology being the solution to a problem, e.g. "or, as I said, a need to be met, and then you invent a tool for that".

They all express some level of uncertainty regarding what is considered as technology. First, some explicitly say they need help to, for instance, separate technology from natural science. Second, it is visible when they discuss what can be considered as technology in different teaching situations and they ask: When exploring the dishwasher, how can that be considered technology? Or a baking activity, is that technology? They also discuss the difference between technology and technique, which is the same word in Swedish, and some have difficulty separating the two.

Preschool heads' focus on preschool technology education

The conventional content analysis resulted in two categories with two and three subcategories, respectively. The categories are first presented in Table 1 and then further described in the text below.

Table 1. The categories outlining the focus on preschool technology education

The preschool teachers´ competence	*Content and method for teaching technology*
Subject knowledge as a basis for teaching	The concept of technology
Pedagogical and didactical knowledge and skills	The nature of preschool teaching
	A progression through the preschool years

The preschool teachers´ competence

The preschool teachers´ competence to teach technology runs like a theme throughout the data. The heads believe it is their responsibility to provide professional development to ensure the staff have the competence they need. The heads do this by organising seminars and workshops and by using preschool teachers who already possess this specific competence to support their colleagues in different ways. The heads also emphasise the importance of their own knowledge about technology in order to support the staff.

Subject knowledge as a basis for teaching
Preschool teachers need knowledge about technology and what technology is in order to teach children. The preschool teachers' subject knowledge affects what content is taught, how it is taught and how technology thereby is characterised and presented to the children. Preschool teachers need to recognise what the term technology includes and in order to teach technology in a holistic way, for instance, departing from a problem to solve, they need to be sure about what technology is. The heads see the teachers' insecurity in the subject as a hindrance to engaging in problem-solving activities with children and to explore the questions children show interest in. In parallel, the heads recognise that the staff cannot have knowledge about everything therefore preschool staff should also dare to engage in the unknown, explore with the children and learn together with the children.

Pedagogical and didactical knowledge and skills
The participants speak of theoretical knowledge that the preschool teachers can learn through the professional development provided by the heads. But they also talk about the importance of preschool teachers possessing the ability and skills to use this theoretical knowledge in teaching situations with the children. They talk about having the skills to inspire, engage and make children curious about the content that is taught.

Content and method for teaching technology

The concept of technology

The children need to know what technology is. In relation to the common view that technology is computers and machines, they need to widen their concept of technology, in order to perceive themselves as technological persons and build their technological confidence. For this, the preschool staff need to use the word technology in relevant situations with the children. However, the heads believe their staff are not doing this today.

The nature of preschool teaching

The heads emphasise the integrated and holistic nature of preschool teaching. They somewhat turn against the "technology-corners" that exist in several preschools and say that technology cannot be restricted to a corner; it must be taught in the projects, in spontaneous everyday situations and outside. However, they realise the "technology-corners" are probably a starting point, a way for the preschool teachers to approach the subject and that when they feel more secure, the way they teach technology will change. They also recognise that teaching planned and organised by a preschool teacher is valuable. Not all teaching can start from spontaneous opportunities or children's questions, because the entire curriculum cannot be taught in spontaneous situations and because not all children ask questions. Situations and teaching may sometimes need to be staged.

A progression through the preschool years

Some content is identified as appropriate for the youngest children in preschool, to prepare them for activities of more advanced levels of technology. Getting to know materials and tools and learning how to handle them are highlighted as content appropriate for the youngest children. Developing the motor skills needed to handle tools is important. For instance, they will need this knowledge in order to engage in building projects. Also, in order to explore artefacts and how they work, they first need to familiarise themselves with them.

Discussion

This is a qualitative study aiming at exploring and understanding the views of five preschool heads. Thus, no generalisations can be made. Rather, the results provide a picture from one municipality, giving an indication of how preschool heads view technology and technology education in preschool.

The results of this study show that the views on technology in this small group of heads largely mirror the views of preschool staff shown in previous research (Elvstrand et al., 2018; Sundqvist et al., 2018; Sundqvist et al., 2015): it varies between individuals having a narrow view of technology as only being artefacts, or an insecurity entailing not knowing what separates technology from natural science, to a developed and complex view of technology. However, contrary to some preschool teachers, none of the heads talked about the historical aspect of technology: technology as artefact progression (Collier-Reed, 2006). The heads themselves accentuate that preschool teachers need to have a developed view of technology in order to teach it to the children. One head said that as it is now, it is a bit of a lottery for the children if they get a preschool teacher with sufficient knowledge in the subject. Concurrently, the heads need the same in order to support their staff, and as it seems, it is a bit of a lottery for the staff if they have a head with this knowledge. Previous research indicates the historical aspect of technology is not taught in preschool (Sundqvist et al., 2018; Sundqvist, 2016). This study indicates, if we want this aspect of technology to be taught, we probably cannot expect the heads to push for it.

One of the matters critiqued by the Swedish Schools Inspectorate (2016), that when technology was taught by the staff it was as a separate activity, is addressed by the heads. They say their staff design parts of the preschool environment for exploring technology, so-called "technology corners". As the Inspectorate, they mean this is not the way of preschool education. However, they believe it is a way for

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the staff to handle the subject while they do not yet possess the sufficient knowledge in technology to see the opportunities for teaching technology in everyday situations. This shows an assumption that one of the characteristics of preschool teaching, to use spontaneous everyday situations as teaching opportunities, demands a high level of subject knowledge from the preschool teachers, higher than what is needed for performing teaching that is planned in advance.

The fact that the heads´ staff do not, according to the heads, have an advanced view or a high level of understanding of technology affects the teaching, what and how they teach. The heads think it is important to teach the concept of technology, but they do not believe their staff do this. Of course, for teachers to teach a concept so that the learners develop their understanding, the teachers need a developed understanding themselves. Öqvist and Högström (2018) showed how the preschool teachers in their study taught the concept by adding the word technology to technological objects when these were used by the children. This shows the children that technological objects are to be understood as technology. However, for the children to perceive themselves as technological persons and build their technological confidence, as the heads suggest, a wider concept of technology should be taught. Previous research shows children engage in technological activities of using knowledge and skills to develop artefacts and creating solutions to problems (Sundqvist et al., 2018). When talking to the children about these activities, the preschool teacher could apply the word technology to them, thereby describing them as technological activities. Of course, this is only possible if the preschool teacher sees these activities as technology. And further, the heads should see these activities as technology in order to support their staff.

To summarise, the heads in this study show their understanding of both technology and technology education, including the pedagogical mission for the preschool. They describe how the characteristics of preschool education demand that the preschool teachers have a high level of subject knowledge, which they believe their staff do not have. In parallel, not all the heads have this knowledge, meaning they probably cannot define what is lacking in their staff's technological knowledge. However, from the way their staff teach the subject, they do see the need for professional development in this area, which they provide in different ways.

References

Campbell, C. (2010). The technological knowledge of early childhood pre-service educators. In *TERC 2010: Proceedings of the 6th Biennial International Conference on Technology Education Research: Knowledge in Technology Education*, Surfers Paradise, Qld.

Collier-Reed, B. I. (2006). *Pupils' Experiences of Technology: Exploring dimensions of technological literacy.* (Doctoral thesis), University of Cape Town, Cape Town.

Elvstrand, H., Hallström, J., & Hellberg, K. (2018). Vad är teknik? Pedagogers uppfattningar om och erfarenheter av teknik och teknikundervisning i förskolan. [What is technology? Preschool teachers' conceptions and experiences of technology and technology education in the preschool]. *NorDiNa: Nordic Studies in Science Education, 14*(1), 37–53.

Jones, A., Buntting, C., & Vries, M. (2013). The developing field of technology education: a review to look forward. *International Journal of Technology & Design Education, 23*(2), 191–212. doi:10.1007/s10798-011-9174-4

Nilsson, T., Gustafsson, P. & Sundqvist, P. (2020). Swedish preschool children's interactions with technology in teachers' self-reported activities. *International Journal of Technology and Design Education.* https://doi.org/10.1007/s10798-020-09613-x

SFS 2010:800. *School act.* Stockholm: Department of Education.

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. [Technology in preschool is nothing new, but today we are more aware of what we call technology: The preschool staff's descriptions of technology as content area in preschool].* (Licentiate Thesis), Mälardalen university, Västerås, Sweden.

Sundqvist, P. (2019). *Förskolans teknikundervisning: vad och hur? [Preschool technology education: what and how?]* (Doctoral thesis), Mälardalen University, Västerås.

Sundqvist, P., Nilsson, T., & Gustafsson, P. (2015). Svensk förskolepersonals beskrivningar av teknik. [Swedish Preschool Staff´s Descriptions of Technology]. *LUMAT, 3*(2), 237–257.

Sundqvist, P., & Nilsson, T. (2018). Technology education in preschool: providing opportunities for children to use artifacts and to create. *International Journal of Technology and Design Education, 28*(1), 29–51.

Sundqvist, P., Nilsson, T., & Gustafsson, P. (2018). Is there a gap to mind in preschool practice when it comes to technology? In A. Jobér, M. Andrée, & M. Ideland (Eds.*), Future Educational Challenges from Science and Technology Perspectives. XVIII IOSTE Symposium Book of Proceeding* (pp. 303–310). Malmö, Sweden.

Swedish National Agency for Education. (2017). *Skolverkets allmänna råd med kommentarer. Måluppfyllelse i förskolan. [The National Agency for Education's general advice with comments. Goal Achievement in preschool]*. Stockholm: Skolverket.

Swedish National Agency for Education. (2018). *Curriculum for the preschool. Lpfö 18*. Stockholm: Skolverket.

Swedish Research Council. (2017). *Good Research Practice*. Stockholm: Swedish Research Council.

Swedish Schools' Inspectorate. (2016). *Förskolans pedagogiska uppdrag. Om undervisning, lärande och förskollärares ansvar. [The preschool's pedagogical task. On teaching, learning and the preschool teacher's responsibility]*. Retrieved from https://www.skolinspektionen.se/globalassets/publikationssok/granskningsrapporter/kvalitetsgranskningar/2016/forskolan-ped-uppdrag/rapport-forskolans-pedagogiska-uppdrag.pdf

Swedish Schools' Inspectorate. (2017). *Förskolans arbete med matematik, naturvetenskap och teknik. [Preschool's work with mathematics, science and technology]*. Retrieved from https://www.skolinspektionen.se/sv/Beslut-och-rapporter/Publikationer/Granskningsrapport/Kvalitetsgranskning/forskolans-arbete-med-matematik-teknik-och-naturvetenskap/

Öqvist, A., & Högström, P. (2018). Don't ask me why: Preschool teachers' knowledge in technology as a determinant of leadership behavior. *Journal of Technology Education, 29*(2), 4–19.

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