

Technology Content and Concepts in Preschool Teaching – A Practice-based Collaboration

Maria Svensson, Pia Williams, Ann-Marie von Otter, Jonna Larsson and Helena Sagar

The purpose with the project is to develop a model for sustainable collaboration between preschool teachers and researchers with a focus on language for teaching technology in preschool. The aim is also to study how teaching can be planned and implemented such that children's opportunities to learn technology interact with the use of technical concepts. The importance of communicating a scientific language and technical words in varied situations has been shown to be important for developing the quality of technology teaching practice as well as the children's language skills. Language research in preschool contexts is well established, however there are few studies where language and technology are combined. This study is emanating from preschool teachers' own questions about technology and language use in preschool. The project includes 12 preschool teachers, four teacher educators and researchers at a University as well as one researcher employed by a municipality. We present results from the first phase of the project which aims to explore technology content and related concepts that teachers express as relevant in preschool based on their experience. Data was collected by semi-structured qualitative, open inter-views that were analyzed using a phenomenographic research approach. Focus is directed toward the technology that teachers associate with an everyday situation in preschool. We identify four qualitatively different ways of experiencing technology including exploring techniques, exploring techniques using artefacts, exploring artefacts as technology, and building and constructing with artefacts. The results also indicate that preschool teachers are aware of the importance of using subject specific concepts, however they express uncertainty about what relevant technology specific concepts are.

Keywords: preschool, technology content, technical language, practice-based research, phenomenography

Introduction

Technology as content in preschool is an emerging field of research that is gaining increasing attention, both nationally and internationally. Studies show that preschool teachers' subject knowledge and didactical competence to approach different parts of technology is of great importance for teaching in preschool (Sundqvist, 2016; Turja, Endepohls-Ulpe, & Chatoney, 2009). A deeper subject matter competence may contribute to preschool teachers' development of professional self-efficacy and more positive attitude towards technology. Consequently, this may lead to an increased number of teaching opportunities, extended didactical experiences in approaching children's questions about technology, and the development of teachers' subject knowledge. Research shows that preschool teachers lack a developed understanding of technology as content in a preschool context (Sundqvist, Nilsson, & Gustafsson, 2015). This may add to uncertainty among teachers in regards to using and teaching about adequate technical concepts, which can have a negative effect on their ability to create opportunities for children to learn technology (Thorshag & Holmqvist, 2018). Dialogues and communication about technology and nearby concepts, between children and preschool teachers in varied situations, has proven to be an important aspect for high quality teaching, which requires good knowledge of relevant technical concepts (Fox-Turnbull, 2010). This paper is part of a project with the purpose to develop a practice based collaborative model, where researchers and preschool teachers work together with a focus on language for teaching technology in preschool, and to study how teaching in preschool can be planned

and implemented such that children's conditions for learning technology interact with the use of technical concepts. In the current paper we present results from the first phase of the project. Focus is directed towards how preschool teachers describe their experience of technology related situations in preschool and concepts that represent this content. This is related to research question: *How are technical concepts expressed in preschool teachers' talk about teaching technology?*

Background

The study is firmly rooted in the challenges and needs of the profession, as it is based on preschool teachers' own questions about technology and language in their own practice. In-service preschool teachers, researchers and teacher educators collaborate in designing and analyzing teaching sequences, which the preschool teachers implement as part of their ordinary practice. Through the preschool teacher's co-investigative role, the study's interest and relevance to the profession is ensured, thus contributing to bridging the gap between the research field and practice.

A central part of preschool teachers' work is to consciously lead, challenge and direct children's attention to a specific content (Jonsson, Williams & Pramling Samuelsson, 2017; Larsson, 2016), as the Swedish preschool curriculum clearly points out content areas such as language, mathematics, technology and science. The intention is to make preschool more learning oriented and of higher quality (Swedish National Agency for Education, 1998 /2018). Previous studies show that it is of great importance to utilize children's previous technical knowledge and experiences in the teaching practice (Mawson, 2013). It is necessary that preschool teachers have adequate knowledge of technology to be able to provide support and build on children's prior knowledge. They also need to have the competence to integrate everyday situations in communication around technical concepts in play as well as learning. Research points to the importance of organizing play- and theme-based activities to create good conditions for teaching and all children's learning of technology (Larsson, 2016; Stables, 1997).

Technology as a concept has a central position in this project and discussions about and understanding of technology inspires and guides the work. Technology is a wide-ranging concept that could be difficult to grasp, especially since there is not one specific definition, despite all the attempts which have been made. A way to "unpack" technology as a concept is, as according to Kline (1985/2003), as four different ways in which technology may be understood: 1) artefacts – non-natural objects, manufactured by humans, 2) sociotechnical systems of manufacture – all the elements needed to manufacture an artefact, the complete system such as input, people, resources, process, economy etc., 3) knowledge, technique, know-how or methodology – information, skills, processes, and procedures for accomplishing a task and 4) sociotechnical systems of use – using combinations of artefacts and people to accomplish tasks that humans cannot perform unaided by such system. Another way of describing technology, widely used in Swedish technology education, is Mitcham's (1994) fourfold characterization of technology as volition, knowledge, actions and objects, as an orientation towards action aiming at a particular outcome.

Another important aim of this project is to develop a teaching practice which enhances children's language in the field of technology, such that the children get a good knowledge base for and interest in communicating their ideas and thoughts about technology and various technical solutions. People learn to use social and subject specific languages by communicating in various contexts; the functions of the language are linked to social practices, interests, norms and values (Gee, 2014). In order to participate in a subject area, such as technology, children need access to the language used in the discourse. Languages are used in different ways in different discourses (Barton, 2007). Children in preschool have different experiences of technology specific words and may need to learn new words and concepts to think, communicate and discuss technology. The language is a dynamic, social activity where people are active and committed to creating meaning. In order to participate in different social contexts, knowledge of the sign systems used in specific contexts is needed; "To be literate is to be confident in the literacy practices one participates in" (p. 185; Barton, 2007).

Theoretical frame and method

This study is framed in phenomenography and variation theory which emphasizes that the situation and phenomena are intertwined and at the same time different (Marton & Booth, 1997). Individuals experience phenomena, here the technology that preschool teachers associate with an everyday situation in preschool, in different ways; ways that are modified and developed through the situations in which we experience the phenomenon as such. This is linked to what is discerned in the situation, to what becomes an internal horizon (experience of the object as such) and an external horizon (how the object is separated from the environment). The difference between these is related to the view of the object and the individual's consciousness of the same. Carlgren and Marton (2000) emphasize the importance of teachers' awareness of the variety of understandings that exist in relation to a content. This may be understood as an aspect of preschool teacher competence.

Initially, data is collected by semi-structured interviews (see Appendix 1) with twelve preschool teachers in two preschools; six preschool teachers from each preschool. The preschool teachers had between 4.5 and 36 years of experience. Two researchers participated in the interviews, one interviewing and one listening and supporting with the technical equipment. All interviews were recorded and transcribed verbatim. The study's design is related to the ethical requirements outlined by the Swedish Research Council (2017). The teachers were informed about the research aim of the project, the anonymity requirement and that they could refrain at any time from participation in the research.

The interviews followed a piloted interview-guide, which was produced in collaboration between the researchers and tried out on an external preschool teacher. In order to gain a shared experience between the preschool teacher and the researchers, each preschool teacher was asked to bring a photo from an everyday preschool situation which they related to technology. The interview started with a discussion around technology in the chosen situation. The situations ranged from outdoor to indoor activities and involved children from one to five years old.

The researchers individually made an initial analysis of how the preschool teachers express that they work with technology content and technical concepts. In the subsequent analysis the researchers sought distinct differences across the units of interview excerpts. The emerging tentative categories were tried out and scrutinized by the whole group of researchers after which the transcripts as a whole were revisited. Thus, the interviews were transformed from full-length transcripts to a set of focused units of interview excerpts related to the research questions.

Results

The analysis resulted in four categories which are qualitatively distinct from each other and two dimensions of variation. The dimensions of variation provide a framework for the categories in organizing the interview extracts as per to the preschool teachers' understanding of technology and what they put in the foreground when they talk about technology: techniques and/or technology. In this study we understand techniques as a particular way of doing things, where you need to learn a special skill, for example using paintbrushes in a specific way to create a certain pattern. We define technology as the knowledge needed for solving a problem or meeting a desire that someone has, for example developing an artefact that could be used to open a can.

Below, the categories are presented, defined and illustrated by interview excerpts. Since no single excerpt fully captures one category, several excerpts have been chosen to illuminate the main thrust of the categories, especially in terms of the meaning and structure of the understanding of the technology that preschool teachers associate with an everyday situation in preschool.

The four categories of the preschool teachers' descriptions, logically related and qualitatively distinct from each other, are:

Exploring techniques

Exploring techniques using artefacts

Exploring artefacts as technology

Building and constructing with artefacts

Exploring techniques

In this category technology is related to techniques where children use their body to investigate events and situations in their environment; the best way to climb a chair, how to get the swing to move and how to roll down the hill as fast as possible. It is an investigation of a natural phenomenon such as speed and friction.

Well, it's technology almost all the time, swinging and rolling on slopes and so, yes, much is technology. (L5)

This is us on the hill [pointing at the photo] and I had an idea that we can scroll down the hill and compare ... Do you have any special technique? Is it faster if you roll in some special way? How does it feel if you scroll things up the hill, ..., making a contrast? (L1)

In this category, the preschool teachers' understanding of technology represents a skill. When they are asked about technology concepts that they relate to these situations, they mention verbs; to roll, to slow down, to overturn and to get stuck.

Exploring techniques using artefacts

In this category technology is various situations in which children use artefacts as brushes, balloons and magnetic building blocks to learn different techniques. In the excerpts preschool teachers describe technology in two different situations where children paint.

Yes, but I think of this [pointing at the photo with children using balloons as a tool when painting] with push and force depending on how hard you push, how big the imprint and technique of mixing colors and what happens then and what happens if I spin the balloon and so on. (L2)

I probably think more about technology when it comes to mixing color [looking at a photo where children are painting with different paintbrushes], in my mind, ... not that we used technology as a tool but more just the technique of mixing color, that's where I'm in my mind. (L6)

There are also indications of an awareness about a difference between technological artefacts and techniques.

In another situation, perhaps more planned in the painting room, where brushes are used as a technical aid or a corrugated board or something to draw a color. You can use technology and it becomes a mixture of what can be linked together, what happens as technology and as technical tools for mixing color ...(L6)

In comparison with category A, excerpts in this category indicate an understanding of technology as something more than techniques in which the body is used to investigate natural phenomena; artefacts are introduced and seem to have an important role in the situation.

Exploring artefacts as technology

Excerpts in this category indicate that technology situations are related to technological artefacts, rather than techniques. The focus is on the function of the artefacts and how children investigate these functions. In the excerpts two situation are in focus. In the first one a child is holding a fruit bowl and the preschool teacher describes this as an artefact with a function. In the second one the preschool teacher describes everyday situations where children explore artefacts to try to understand how they work.

Mm, yes, because I think, it is a little technology just to be able to carry around and offer the fruit in a bowl, so that you do not drop the fruit, something like that. It's a little unclear to me what to think about technology. (L5)

There is a lot of technology that small children do. It can be a button, a lamp button, it is really fun to push and put out, push and put off, it can be done twenty times. They roll cars, they drive them on different things. They use the material in different ways on the elements and on the window frames and so on. (H2)

Compared to category A and B, category C includes a movement from understanding technology situations as techniques to an understanding of technology as the development and use of artefacts for specific functions.

Developing constructions using artefacts

To build and construct an artefact or a system is understood by some of the preschool teachers as involving technology. There are also examples of how preschool teachers express their understanding of the possibilities for children to learn about principles for constructing when using a specific materials/equipment for example magnetic building blocks.

Yes, because they love to build with these magnets, [magnetic building blocks]. They build so many different things, ... roads, different ... platforms for airplanes ... animals, they have built turtles. Everything is possible to build with them. They learn that the building must be stable (hesitates), yes, and that, they have to have a foundation and sometimes they need a drawing. (H5)

...you can develop it a lot, especially with these magnets [magnetic building blocks] in how they build oh ..., you can have a foundation on which it can stand and if it falls you can talk to the children about how to make it more stable and so on. So, there's a lot to work on with technology around this. (H1)

In this category preschool teachers associate to other technology concepts than in previous categories for example platform, stability and joining. The most significant difference from the previous categories, is that preschool teachers here relate technology to artefacts and systems that can be used for development. In that way we interpret a potential for relating technology to problem solving activities where children investigate, construct, explore and evaluate artefacts and systems.

Summary

In relation to the research question, *how are technical concepts expressed in preschool teachers' talk about teaching technology?*, the preschool teachers in this study talk about technology situations and concepts ranging from exploring techniques to developing constructions using artefacts. In the first category technology is above all connected to the development of a skill while in the last category technology is related to problem solving activities where constructing, exploring and investigating artefacts are in focus.

Discussion

The results highlight a variation of ways in which preschool teachers express their understanding of technology in an everyday situation in preschool. The teachers put different aspects of technology in the foreground ranging from a focus on techniques as a skill or method to development and construction with technological artefacts. When techniques are in the foreground as in category A, only a limited part of technology appears. As we move through the categories there is a variation from only seeing technology as exploring a technique, towards an integration of artefacts, to in category D, using these artefacts in systems for development. Being aware of different aspects of technology means understanding technology in a more complex and powerful way (Marton & Booth, 1997), which in turn gives the preschool teacher opportunities to talk about, reflect on, and teach technology in a more nuanced way. It is important that teachers' competences embrace both the knowledge of directing children's attention towards a specific learning object of technology, and to be able to adapt to children's perspectives in order to understand their meaning making processes (Sommer, Pramling Samuelsson &

Hundeide, 2010). This implies that the importance of a teacher's ability to relate technology situations to artefacts and systems, as seen in category D, to child related activities where the children play, investigate, construct, explore and evaluate. The ways by which preschool teachers express their understanding of technology are connected to the descriptions of both Kline (1985/2003) and Mitcham (1994), even though, none of the teachers relate to the full picture of technology. Jonsson (2013) accentuated that preschool teachers need a combination of a planned pedagogical awareness, a situational approach and subject matter knowledge, to be able to share children's interests and engage in the object of learning at particular moments in time. Such a teaching practice requests an interactive, communicative and relational learning environment, where children are given opportunities to relate to technical concepts and take part in relevant activities where they can develop existing and creating new knowledge.

In the next phase of this project the result from the study will provide a basis for discussions of the technology concept followed by identification a subject specific concept in relation to teaching situations. Preschool teachers and researchers will collaboratively plan technology teaching sequences, which the teachers will conduct and video-record. The recordings will be evaluated collaboratively by the researchers and the teachers in the purpose of revising the teaching practice as part of an iterative process.

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Maria Svensson is a researcher and senior lecturer in the subject area of technology education at the University of Gothenburg, Sweden. She is also employed as senior guest researcher at Linnaeus University, Växjö, Sweden. She has a background as science, technology and mathematics teacher. She works in teacher education and here research interest is in technology and science education with a specific focus on teaching and learning technological systems.

Pia Williams, professor in child and youth studies at the University of Gothenburg, Sweden. Her research interests are early childhood education, with focus on quality issues and conditions for children's learning and teacher competence. Current research involves quality evaluations in preschool; advancing teacher's professional digital competence and practice centred projects in early education.

Ann-Marie von Otter is a lecturer of subject didactics at the Department of Pedagogical, Curricular and Professional Studies, University of Gothenburg. Her research interests concern teaching and learning in technology, Learning study, the use of digital tools and sustainable development in preschool, elementary school and higher education, with a focus on the development of teacher's didactic skills. She also works for cooperation both nationally and internationally to develop and disseminate technical didactic research

Jonna Larsson is a senior lecturer in pedagogy at the Department of Education, Communication and Learning at University of Gothenburg, Sweden. Her research is focused on STEM and sustainable development in connection to early childhood education, where issues related to high quality teaching and learning are of specific interest

Helena Sagar is head of research and lecturer in the R&D department, Administration for Preschool & Compulsory School, Municipality of Kungälv, Sweden. Her main research interest is in pedagogic entrepreneurship in S&T education in compulsory school. As head of research, Helena has broadened her competence and research interest to include preschool education. Helena teaches S&T in 7–9th grades alongside with research-based professional development work and research.