



Examining how technology is presented and understood in technology education: a pilot study in a preschool class

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Abstract

The aim of the research is to examine how technology is communicated in technology education in relation to humans, society and nature in preschool class. According to the Swedish curriculum for preschool class, pupils should be given the opportunity to explore, ask questions and discuss technology and how the choices of people affect sustainable development. Teachers make different choices about, for example, content and what they do and do not say. These choices have an impact on how pupils perceive technology as part of the world and are called companion meanings. In terms of data, sound recordings and field notes from four technology lessons in a preschool class were used. The data was analysed, with focus on what types of companion meanings emerge in conversations between teachers and pupils. The analysis of companion meanings was based on two themes: Subject Language and Subject Focus. The results of this study demonstrate that pupils learn companion meanings of various types: for example, technology is something positive and unproblematic. Other types of companion meanings gave the pupils opportunities to reflect on how the technical choices of humans affect nature. Different kinds of companion meanings offer different ways for pupils to relate to the surrounding environment.

Keywords Technology · Preschool class · Companion meaning · Technology education · Humans · Society · Nature

Introduction

The Swedish curriculum for preschool class describes how teaching should help with the “development of the pupils’ interest in and knowledge of nature, technology and society, by giving them the opportunity to explore and pose questions on and discuss phenomena and relations in the world at large” (Swedish Agency for Education 2011/2016, p. 20). The educational program should also cover content such as how “different everyday choices people make can contribute to sustainable development” (Swedish Agency for Education, 2011/2016, p. 20). Technology is constantly evolving and changing, making it difficult for

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individuals to understand how different technological systems and artefacts are designed and how they work. Yet to be able to use the technological systems and artefacts that form part of our everyday life, we do not always need to know how they work or how they are designed. Since technology is constantly changing, it is also difficult to know what knowledge will be needed in the future to be able to work with technology. As such, it is uncertain what knowledge pupils will need in the future and what skills schools should be teaching them (von Wright 1993). This article discusses how technology is communicated in technology education in preschool class and highlights what types of companion meanings appear in technology education, especially in those contexts where technology relates to humans, society or nature. The relation between humans, society, nature and technology has been described as significant in several previous studies (for example, Blomdahl 2006; Grimvall 2013; Pavlova 2009; Ropohl 1997).

Companion meanings

Teachers, textbooks and curricula shape different content and teaching methods. Furthermore, Englund writes that “teaching is a kind of moral and social action implying different forms of choices” (Englund 1998, p 207). The choices teachers make can be either predetermined or not predetermined (Englund 2004). According to Östman (2015), it is not possible to teach subject knowledge without at the same time teaching about the subject. For example, pupils are taught “what knowledge is and what kind of knowledge is worth knowing, and whether they can master it. They are taught how to regard themselves in relation to both natural and technologically devised objects and events” (Roberts and Östman 1998, p. ix). Roberts and Östman (1998) call these value judgements *companion meanings*. Others have stated value judgements to be collateral learning and meta learning. Östman (1998) distinguishes between two value judgements: the relative and the absolute. Relative value judgements are those that are expressed in relation to an action. Pupils learn some of these companion meanings while learning subject content, and while learning this, they also develop a certain way to observe the world. The type of teaching content determines the type of companion meaning, Östman (1998) describes three companion meanings; Nature Language, Subject Focus and Curriculum Emphasis. Klasander (2010) investigated how education related to technological systems has been dealt with in schools. He used three similar categories of companion meaning: System Language, Educational Focus and Curriculum Emphasis. Klasander (2010) describes four different kinds of System Language: the ontological language, the epistemological language, environmental language and the control language. The ontological language is described as a language where the technical system is treated as something that exists without it being problematised and where the technology is same as artefacts. The epistemological language is based in what we know about technology and how this knowledge has been established. Environmental language has a greater focus on the surrounding environment: this language is biocentric and holistic, and includes ethical aspects regarding technology. The control language is to a larger extent characterised by engineering terminology. Companion meanings in the teaching area Subject Focus affect the relationship between humans and the surrounding environment worldwide, as well as what is important for the pupils to learn. Östman (1998) has divided the Subject Focus into two areas: (1) Introduction into Science and (2) Learning from Science. The companion meaning that follows the Curriculum Emphasis is described by Östman (2015) as ideas of how knowledge should be perceived. The article further discusses

what type of companion meanings, in relation to humans, society, nature and technology, the pupils are asked to consider in their learning. Several previous studies investigated the appearance of companion meanings in teaching (Almquist et al. 2008; Cherryholmes 1988; Klasander 2010; Lundqvist et al. 2009).

Technology education for young pupils: research and studies

With the launch of a new curriculum in Sweden in 1980, technology as a subject became compulsory in Swedish primary school. Despite this, there are few teachers and preschool teachers educated in this subject area. This has meant that teachers and preschool teachers have different views on what content the subject should include (Bjurulf 2008; Norström 2014). Norström (2013) also found in his study that teachers had different views on what technological knowledge is and that teachers lacked the language needed to be able to talk on the subject. Further, studies on pupils' technology learning have highlighted their lack of language skills related to technology (Björkholm 2015). Lemke (1990) argues that it is when we put together words that are comprehensible by formulating questions, by arguing and by discussing that we learn to speak using Subject Language. To develop younger children's technology-related language, Axell and Hallström (2013) argue that education should connect to the technology that exists in children's everyday lives. One prerequisite for this, however, is that preschool teachers have knowledge of and use technological concepts. Folque and Siraj-Blatchford (2011) show in their study on children's learning in preschool that children engaged in group interaction have more opportunity to reflect, more experience with different types of reflections and more opportunity to use their language and reasoning skills.

According to Gyberg and Hallström (2009), it is a challenge for all of us to understand the relation between technology and humans. They argue that we need to understand the relation between technology and humans in relation to the well-being of Earth and to prevailing global injustices (Gyberg and Hallström 2009). One way of dealing with such challenges can be to construct teaching situations that allow pupils to reflect on technology as a social and cultural phenomenon (Blomdahl 2006). Such an approach may mean that pupils are given the opportunity to reflect on the origin and functions of technology and on how technology affects and is affected by humans, society and nature, which is part of what is examined in this study. There have been studies on the relation between technological development and society, and in these two views become apparent: two different views have been expressed: one view implies that technology has a life of its own; the other view suggests that the human, social and cultural world are what shape technology. Regardless of view, pupils need to have the chance to reflect on their own choices in relation to technology and thus to be dominant over technology (Axell, 015). Technology education can therefore be said to be about human living conditions (Heidegger 1974). The Swedish preschool class curriculum describes the importance of giving pupils the opportunity in their learning to "develop knowledge of how the different choices people make can contribute to sustainable development" (Swedish Agency for Education, 2011/2016, p. 20). This means that pupils in preschool classes also need to be afforded the opportunity to take a stand and to make choices on issues that concern their everyday lives. For pupils to understand the world and to make active choices based on the implications of technology for society, several researchers emphasise the importance of their encountering the knowledge and processes that create these technologies (Dakers 2006; De Vries 2006; Axell 2015). Heidegger

(1974) believes that humans through modern technology perceive nature to be an obvious resource that they can exploit, but that humans should instead see nature as something that has its own value. Heidegger (1974) argues that there is a risk of seeing nature as nothing more than a resource.

Younger children or pupils often associate technology with different artefacts (Mawson 2013), but education that emphasises artefacts as being technology can limit what pupils learn about technology. In contexts where technology is seen as being artefacts, it may be perceived as being separate from humans, which means that technology can only be influenced by using it, by misapplying it or by not using it (Svensson 2011). Teaching that focuses on technical systems and that allows younger pupils to implement technological processes makes it possible to target their attention on broader social and environmental issues (Blomdahl 2006; Mawson 2013; Svensson 2011). The term technical system refers to complex systems such as transport systems; however, a car and the headlight of the car can also be regarded as a technical system (Klasander 2010; Svensson 2011). In addition, Svensson (2011) argues that teaching that emphasises technical systems instead of individual artefacts affords pupils the opportunity to learn about technology that appears to be an integration of artefacts, processes, rules and humans.

De Vries (2005) points out that technology can be defined in many different ways. Technology can be an object, a system or a process that results in the modification of the natural world to meet human needs and wants (Elvstrand et al. 2018). Ropohl (1997) divides technology into different kinds of technological knowledge, technological laws, functional rules, structural rules, technological know-how and socio-technological understanding. Of these types, the socio-technological understanding is interesting for this study because it deals with the relations between technology, society and nature. In other contexts, technology has also been described as a cultural product since technology evolves as a result of new generations learning the technology from previous generations (Sundin 1991) or as an approach that affects our way of thinking and acting (Gyberg and Hallström 2009).

Studies on younger pupils are increasing, and more technology education is becoming available (Axell and Hallström 2013; Björkholm 2015; Davis et al. 2002; Twyford and Järvinen 2000). However, the focus of many studies has been on children's learning of technological constructions, such as technological functioning or understanding of technological principles; fewer studies have focussed on how teachers and pupils talk about the origin and function of technology, and what different companion meanings in relation to humans, society, nature and technology pupils are asked to consider in their learning. This study intends to contribute to the debate on the content of technology education for younger pupils.

Using suitable pedagogy for teaching technology education in the preschool

The didactic triangle and its three corners represent the teacher, the pupil and the content, and describe how the content takes shape in communication between teachers and pupils (Hudson and Meyers 2011). The content can also be interpreted differently depending on various perceptions and traditions with regards to teaching, as well as the purpose of teaching. By communicating the content with others, the participants get to share each other's feelings and ideas, and also get an opportunity to reflect together. Indeed, Dewey (1997) believes that communication with other participants extends and changes the experience.

From pragmatic and socio-cultural perspectives, learning is seen as situational. It can be said that activities such as teaching always take place within a context (Lave 1996). Since contexts are always different, previous experiences need to be transformed to create meaning in new contexts. Dewey and Bentley (1949) start with the encounters and actions that take place in current teaching situations, where the experiences of participants are reactivated and transformed in new contexts. Consequently, contexts and experiences have an impact on what companion meanings are created. The perspective thus means that the contexts and experiences that are made visible in teaching are important for what pupils are given the opportunity to learn. This assumption—that being, that the content of teaching can be interpreted differently depending on variation in content and implementation—is important in this study. Different teaching contexts offer pupils different companion meanings (Englund 2004).

Research methodology

Aim and research questions

The aim of the research is to gain knowledge in terms of technology education as a school subject in preschool class. More specifically, the main focus is to examine how technology is communicated in technology education in relation to humans, society and nature in preschool class.

Research questions

1. What types of companion meanings between humans, society, nature and technology are communicated in technology education in preschool class?
2. What consequences can some of these companion meanings have for what pupils in preschool class are given the opportunity to learn about technology?

Method

In this study, technology education is the focus. In the class there were two preschool teachers, and 15 pupils aged either 6 or 7. The teachers participating in the study were chosen based on the fact that they teach in preschool classes in the fields of science and/or technology. Teachers and pupils agreed to be recorded (sound) during lessons, and the school's headmaster/headmistress, teachers, parents and pupils were informed as to the purpose of the study, and informed consent was obtained from the participants. The recommendations of the Swedish Research Council (2017) in terms of information and consent, the right to discontinue participation, anonymity and confidentiality were followed. Furthermore, all concerned parties were informed that the names of individuals or schools will not be stated in the publication. All personal data was processed according to the General Data Protection Regulation (GDPR 2016). The study was conducted as an observation study in a preschool class. The observations were made in the spring of 2017.

The context of the study

At the first two observation sessions, the purpose of the teaching was to help pupils make sense of what technology is, and this began with pupils and teachers discussing the origin and function of technology. They sat in a circle, and the teachers used the word “technology” and encouraged the pupils to talk about their experiences. At the third observation session, the purpose was to make sense of technical systems and how people in the Stone Age cooked food. As part of this, teaching was conducted outdoors in a nearby forest, where teachers and pupils built a cooking pit and a hut. At the fourth observation session, the object was to reflect on what technology is and to document this information. The pupils sat in the classroom at their benches, and the documentation was both shared on a large sheet of paper and documented by the pupils individually in smaller notebooks. In this study, the context was therefore technology education in a preschool class.

The teaching was documented using field notes and sound recordings. There were six lessons on technology, of which four were observed. The observations were conducted in the preschool class over a period of 2 weeks. The duration of the observation sessions varied from between approximately 2–5 h. In the four lessons in which the observations were conducted, three took place in the classroom and one took place in a nearby forested area. Observations totalled 660 min, and transcriptions were made thereafter.

Analytical framework

After the data was transcribed, it was chronologically compiled by placing transcripts and field notes from the same lessons next to each other. It was then read through several times to ensure a clear understanding. As a first step, the “institutional dimension of the content of meaningfulness”—that is, the purpose of the content—was noted (Quennerstedt 2008, p. 91). The data was analysed through repeated readings so that attention could be paid to patterns and regularities in terms of both teachers’ and pupils’ actions. In such a way, the content is given focus in the teachers’ and pupils’ actions, and the content of their discussions could be given focus. Two purposes of the teaching were identified: one was to develop pupils’ knowledge about the origin and function of technology, and the other was to develop pupils’ knowledge about the role and function of nature in technology. In the next step, the decision was made to study the relation between humans, society, nature and technology. The only conversations that were given focus were those that related to the purpose of the teaching. Several statements made by the teacher that link technology to humans, society or nature were highlighted. For example, the teacher posed the questions, “Why do you think this is technology?” and “How does it help us?” These two questions highlight the relation between technology and humans. A reading of the material allowed for the identification of different relations.

In order to study what companion meanings (Roberts and Östman 1998) in relation to humans, society, nature and technology the pupils were presented with, I asked two questions to the collected data, “What was said?” and “How was it said?”. As a result of the teacher’s two questions (“Why do you think this is technology?” and “How does it help us?”), the pupils could, for example, see that technology was something helpful and good. What was said and how it was said was compared to previous studies—for example, those by Roberts and Östman (1998), Östman (2015) and Klasander (2010). In the analysis companion meanings on *Subject Language* and the *Subject Focus*. Through *Subject Language*,

students are given the chance to learn specific ways of understanding the world. In the analysis, this theme of companion meanings has been inspired by three of the four types that are described by Klasander (2010): the System Language, the *Ontological Language*, where technology is defined as something that exists and that is unproblematic and described as artefacts; the *Epistemological Language*, which is based on what we know about technology and how technical knowledge is created; and the *Environmental Language*, which focuses on the environment and which has a biocentric and holistic view—this also includes ethical aspects of technology. In addition to these three language types, teaching that involved more *Everyday Language* was analysed. *Everyday Language* means when technology being described in which everyday words were used and everyday experiences were described.

Companion meanings in the teaching area of *Subject Focus* is about our approach to the world and the importance of pupils learning about the relation between humans, society, nature and technology. Östman (2015) divides the Subject Focus into two sections, and this has been inspirational for this study. The two sections are (1) *Introduction to Technology*, which is about how pupils could have an understanding of what technology is in relation to humans, society and nature; and (2) *Learning Through Technology Development*, which is about what the pupils should have an understanding of; how they can work with technology; and what relations exist between technology development and humans, society and nature.

Reliability and validity

The study is qualitative and its approach, therefore, needs to be well described. To strengthen its reliability and validity, transcripts and field notes were read numerous times. Further, how the analysis was conducted and which terms (such as companion meanings, Subject Language and Subject Focus) were considered in relation to previous studies of teaching contexts.

Analysis and results

This study exemplifies different companion meanings and different relations between, humans, society, nature and technology in technology education in preschool classes. This companion meanings and relations is exemplified in two parts: first, pupils are taught about the origin and function of technology; second, they are taught about the role and function of nature in technology.

The origin and function of technology

Below, some of the occasions in which the pupils and teachers talk about the origin and function of technology are exemplified, as well as what companion meanings are created in their conversations. The first lesson began with teachers and pupils sitting in a circle and one of the teachers asking the pupils if they knew what technology was. Thus, the objective of the teaching can be described as being the identification of what technology is. The teacher began the class by letting the pupils talk about their experiences with technology. Pupils listed various items that they considered to be technology: LEGO, aircraft, cars and so on. When the pupils had finished talking about their experiences, the teacher gave

examples of different objects that he/she felt were examples of technology. The teacher suggested, for example, that the pen that one of the teachers was holding was technology, and another teacher suggested that the shirt she was wearing was technology. When the teacher stated that the shirt was technology, pupils provided arguments as to why the shirt was technology: one argument was "It keeps you warm". Identifying the shirt as technology seemed to challenge pupils to reflect on why something was technology. Without a shirt, the teacher would get cold: as such, the shirt affected the teacher's quality of life. Teachers and pupils made the generalisation that the shirt was technology and that the teacher represented people. As such, a relation between humans and technology was highlighted. In this way, the pupils' reflection could be generalised into a companion meaning where technology is something that helps people. The term was also used later by the teachers to help pupils identify technology.

Teacher: Why do you think it is technology? How does it help us?

During one teaching session, the teacher used a more historical perspective regarding technology and showed a picture of a girl from the Stone Age using a stick as a tool to sow seeds in the soil. The teacher read a short text to the pupils about how people of all ages have found usable tools and how people will find new tools in the future. The teacher gave examples of how humans developed different agricultural tools and how this development made work simpler for us, from the Stone Age to today.

Teacher: This girl uses a stick as a form of technology to plant seeds in the ground. Then they [humans] thought a bit more and realised that they could use a cow to pull things with. Using a cow was a lot better than using a stick to scratch in soil, and then someone came up with the tractor. (...)

The story provides a context in which pupils and teachers together reflect on what people did before the invention of different everyday objects.

Teachers: People have always invented good tools and will continue to invent new tools.

During the reflection, several companion meanings became apparent. The first described humans as both inventors and users of tools. The term "tools" became almost synonymous with technology. Another companion meaning described how technology has always influenced the lives of humans and how human living conditions will change in the future through the development of new technology. Further, the technological development was described as key to increasing the standard of living for humans and that humans' need for life improvement is the driving force behind technological development. With the conversation highlighting the fact that humans have always come up with new technology, there is again a companion meaning regarding technology and technological development as part of social tradition.

In technological education, teachers break down what distinguishes technological objects from non-technological objects. For example, a teacher shows a picture on the wall of a number of objects, some technological, some not. The teacher explains to the pupils that they will now discuss which of the objects are technological and then draw a ring around these objects. Pupils suggest that they start with the picture that represents a mobile phone. The teacher asks the pupils to explain why the phone is technology, and they explain that the phone is technology because it can send messages at times of trouble. The teacher returns to the historical perspective and asks the pupils how people sent messages before the phone was invented.

Teacher: But before we had phones, what did you do when you were in trouble? And if someone you knew far away was in trouble, there was no point screaming – not unless you first travelled a long distance. So, we can agree that the phone makes such situations easier to manage; for example, you may need to make a phone call to say you are sick.

The conversation then continues about the technological object visible in the picture, and the teacher challenges the pupils to reflect on what people did before the invention of such everyday objects as the key, hammer and zip. The conversation again shows that technology is something that helps humans. Further, with the teacher asking questions about what humans did before the development of the technology being discussed, the example of technology is placed in a context where it is part of social development and where it is also described as being something that fills a human need. Thus, there is a companion meaning where people and society depend on technology to deal with certain challenges. In this way, pupils gain a historical perspective on social development and companion meanings that demonstrates that technology has a positive impact on humans and society as well as on the way in which living conditions have changed.

Summary of the results

The conversations between teachers and pupils depict several relations: some of these are between humans and technology or humans, society and technology, and some are between humans, nature and technology.

From the analysis of conversations, some companion meanings became obvious. These companion meanings were thereafter categorised into two themes: Subject Language and Subject Focus. The theme Subject Focus was then divided into two sub-themes: (1) *Introduction to Technology* and (2) *Learning Through Technology Development*.

The language used in the conversations can be characterised foremostly as an *Ontological Language* but also, be it to a lesser extent, as an *Everyday Language*. *Ontological Language* is used on several occasions, such as when technology is described as something that exists or something that has always existed together with humans. Other examples of usage of *Ontological Language* is when there is a change to technical tools over time, without any connection to other technical systems or components. One occasion, when there is a change to technical tools over time, it is also expressed in a relatively unproblematic manner: for example, that it is humans that are thinking and creating solutions—consider the use of a cow instead of a stick. In this example, the technology meets the need of the human to process and use nature, or soil, in a more efficient way. Technical development is, in such a way, a tool for humans' welfare, while nature is described as being something that humans need to master and dominate over. The division between humans, society, nature and technology appears in this context as something unproblematic. In the analysis of the Subject Language in the teaching, it is also revealed that the teaching includes *Everyday Language*, foremostly in subjective experiences: the shirt keeps the teacher warm or the pupils are asked to consider what they could do if they found themselves in trouble and were without a phone.

In the analysis of Subject Focus, the section entitled *Introduction to Technology* plays a big part. The analysis about how pupils should have an understanding of what technology is in relation to humans, in the teaching means that pupils could gain an understanding of that technology is something positive, which helps humans. The approach also means that technology is viewed as something that solves problems, and that different technical tools,

such as a mobile phone or a tractor, solve and have solved problems within society. In this context, technology is viewed as a tool for human welfare and as something that humans and society depend on. The conversations involve discussion of how pupils need to understand that technology affects the quality of life of humans and brings about changes within society. As such, the pupils are given the chance to understand that technology has developed throughout history and will continue to do so in the future, and as a result, society and the lives of humans will change in the future. An analysis of the section *Learning Through Technology Development* makes it apparent that ideas about technology are evolving in human minds. The conversations do not highlight other ways of developing technology or, for example, what is meant by working towards solving problems.

The role and function of nature in technology

In the teaching sequence about what distinguishes technological objects from non-technological objects, teachers and pupils also discussed the images showing non-technological objects, such as various plants and animals. The conversation began with the pupils suggesting that the ladybug is technology. The teacher clarifies, in this context, that technology is what humans have invented. Humans are thus emphasised as being the inventors of technology and in the conversation, technology is generalised as being everything that humans have ever invented. In such a way, animals and plants are described as being examples of non-technology: the companion meaning indicates that technology is not nature. The teacher continued:

Teacher: We can actually find ideas in nature. Think about nature. There are flowers that stick to you. And from that idea, we develop something like Velcro from plastic or fabric. So, you see, nature can lead to technological development.

In the continued teaching sequences, more companion meanings are created by the teacher: these suggest that nature can act as an inspiration for human development of technology, but that technology is developed by humans. The teacher gives the example of how burdock may have inspired the invention of Velcro.

In one of the teaching sessions, one of the teachers brings a stick to the classroom, and the teacher first puts the stick on the floor and asks pupils if the stick is technology. When the pupils answer no, the teacher picks up the stick and, holding it in an empty saucepan, begins to stir. The teacher once again asks the pupils if the stick is technology. The teacher thus creates two contexts in which pupils can reflect on the question as to when an object from nature is or is not technology.

Teacher: Is the stick now technology? Why is it now technology? Because I use it like a tool now. This stick that was lying there was not technology until I picked it up and made it into a tool that I moved around in the pot, and then it became technology.

In another teaching session, pupils present different technological kitchen items, and in conjunction with their presentation, teachers and pupils reflect on whether or not the objects are still technology if used for other purposes than the one for which they are intended. According to the teachers, it is still a question of technology when, for example, a garlic press is used to squeeze modelling clay or when a person uses a stone to hit a nail. The definition of what is technology depends on who the user is. As such, a companion meaning is that an object is only technology when it is used by a human and not, for example, an animal. Here, there is a difference between the objects mentioned earlier in this

article: for example, LEGO and the shirt are considered technology even when they are not being used by humans. Technology is thus not described merely in terms of different objects; rather, an object must be used by a human, even when it is sourced from nature, if it is to be considered to be technology. Another point of view that emerges is that objects from nature can serve as a technological resource.

One of the teaching sessions takes place outdoors in a nearby forest. At that time, pupils and teachers build a cooking pit and a hut. They make a fire to heat rocks for the cooking pit. After this, they dig a large pit into the ground to serve as an oven. When the rocks are hot, they are moved to the pit where the food, which in this case is fish with spices, has been placed, and the pit is covered with moss and rocks. Before constructing the cooking pit, pupils and teachers watch a film about how people in the Stone Age constructed cooking pits. The film serves as a model for the design of the cooking pit, while the cooking pit serves as a technical system in which heat flows, and both people and nature are included as part of the technical system. The building of the hut is also outdoors in the forest with material from nature like dry twigs. The pupils first sketch the design of the hut, and in their planning, the pupils and teachers discuss different materials that can be used to construct the roof. The pupils suggest in their sketches that they should seal the ceiling using moss, while the teacher suggests that they use a tarpaulin.

Teacher: In the past, we took moss from the woods, but nowadays we're not allowed to pick a lot of moss or break off branches to build a hut. We'll find another solution.

The conversation between teachers and pupils is about how nature would be affected by pupils and teachers picking enough moss to seal the ceiling. The pupils are given a context in which they have discussions with the teacher, in which they are able to reflect and in which they are able to make choices in relation to how picking moss affects nature. In the conversation, there are thus companion meanings in which nature is seen as a resource as well as something significant and with a value in its own right. The construction of the cooking pit also leads to several discussions that deal with different choices and their consequences. In this context, a companion meaning is revealed that demonstrates that technology is not only an object but rather a technical system, and humans are part of the system when they make different choices.

The last technology lesson focused on pupils' reflection on what they had learnt and what they had done in the technology lessons. The teacher summarises the pupils' reflections on a large piece of paper. Here, the lesson on technology ends, and technology is defined, in general terms, as something we use, something that humans invent and something that becomes technology as a result of how we use it.

Summary of the results

To summarise, in the above educational situations, relations are revealed in the conversations between technology and nature, between humans, nature and technology, and between humans and technology.

Through an analysis of the Subject Language, the *Epistemological Language*, *Environmental Language* and *Everyday Language* are revealed. The conversations are partly based on the *Epistemological Language*: what we know about technology and how we can develop our knowledge about technology by viewing humans as the subject—that is to say, humans are inspired by nature and develop technology, while nature and technology in this context are described as the object. By choosing to use an object as a tool, humans create

technology. No one disputes the fact that other species can use, create and develop technology. *Environmental Language* is associated with the conversations between pupils and teachers regarding the choices of material when building a cooking pit and a hut. In this context, nature is considered a subject—something with its own values and needs. Nature is in focus and humans can affect it negatively through their choices. The pupils are here asked to consider how they can build without negatively affecting nature. As such, the divide between what is human, nature and technology is problematised when the pupils are asked to build the pit and hut without affecting nature in any way. The analysis of the Subject Language makes even the subjective experiences understandable when *Everyday Language* is used and where the teacher demonstrates technology by using a stick from nature to stir the contents in a pan, and where the pupils plan and construct a cooking pit and a hut, build a fire, dig and collect sticks. These subjective experiences make the pupils view technology as a system that includes parts. The experience also demonstrates that some of the parts are, to some extent, problematised in conversation about the heat of the stones and the size of the pit that are significant factors for the technical system to work.

From an analysis of the section entitled “Introduction to Technology”, several companion meanings emerge about pupils’ understanding of technology: first, they view nature as separate from technology and then as a resource. Teachers’ approaches reveal that technology has a strong association to humans as inventors and users. The tools manufactured by humans are described as technology, while objects not manufactured by humans are only described as technology when used by humans. Another approach means that humans perceive nature as having its own value and that this affects the choices they make with regards to technology. Here, there is a conflict between the choice of material and the consequences of that choice for the environment. As such, there appears to be a conflict between technology and nature. Humans appear to be those who see the conflict and those who have the ability to act. The conversation about choices of material allows pupils to develop an understanding of technology. When they used a tarpaulin for the roof of the hut, they do not affect the environment. In this example, nature is the local environment that could be affected negatively. Whether or not the tarpaulin has a negative effect on the global environment is not discussed.

Subject Focus, *Learning Through Technology Development*, helps pupils develop an understanding of technology and technical systems developed by humans, and about how humans sometimes require inspiration to be abler to develop technology. Pupils receive an introduction to a technology when they sketch the hut. And construct the technical system and its various parts. These parts are discussed and problematised with a focus on the choice of material, and the way in which and the point at which they should be joined in order for the system to work.

Discussion

This study focuses on how technology is communicated in technology education in relation to humans, society and nature in preschool class. It especially examines what types of companion meanings between humans, society, nature and technology are formed in the teaching. By highlighting these, this article aims to contribute to the debate on the choice of content in technology education for younger pupils.

In their teaching, teachers both consciously and unconsciously include or exclude information by what they do and do not say, or in the way something should be or should not be

said (Östman 1998). This means that the teaching of subject content always includes companion meanings. Usually, these companion meanings are not highlighted in the classroom, which means that the pupils are left to comprehend these on their own (Östman 1998). It is important, therefore, to highlight as these can form the basis of moral and political debates (Östman 2015). Östman (2015) uses the gender equality debate to exemplify where companion meanings in textbooks are highlighted. In this study, companion meanings regarding the human need for technology and the human influence on nature can be viewed as moral and political issues. Such companion meanings need to be problematised in teaching, which could enable pupils to consider their own role, as producer and consumer, in relation to technology, technical development and nature.

According to Roberts and Östman (1998), the context is significant in terms of what companion meanings are communicated. The conversation between teachers and pupils in this study is based on different contexts, and technology is described as a social phenomenon (Ropohl 1997), which is important for what pupils are given the opportunity to learn (Blomdahl 2006; Gyberg and Hallström 2009). Some of the contexts introduced by the teachers are, for example, historical context in which pupils are given the chance to compare technology with non-technology and in which pupils and teachers make different choices when building and constructing a cooking pit and a hut. Different contexts allow for different perspectives (Englund 2004) and help pupils visualise different meanings of the relation between humans, society, nature and technology.

The language that is used in teaching is also significant for what the pupils are given the opportunity to learn. The fact teachers use *Ontological Language* and formulate generalisations about what technology is has importance; however, it is also important that pupils have the opportunity together with their teacher to reflect, use an *Epistemological Language* and critically discuss the assumptions and generalisations that appear obvious in the teaching (Dewey 1997; Pavlova 2009). Klasander (2010) implies that teaching in technology needs to incorporate different kinds of language and that these can be viewed as complementing each other. According to the Swedish Agency for Education (2011/2016, p. 20), education in preschool class should also include teaching about "how different everyday choices people make can contribute to sustainable development". In such a way, education in technology also needs to be discussed more critical and be understood in a wider context, where the relations between technology, humans, society and nature are visible (Blomdahl 2006; Grimvall 2013; Pavlova 2009; Ropohl 1997). "Socio-technological understanding is systematic knowledge about the interrelations between technological objects, the natural environment, and social practice" (Ropohl 1997, p. 70). This means that the prosperity of the world and global justice also need to be linked to technology education (Gyberg and Hallström 2009; Pavlova 2009), as this would give pupils the opportunity to use an *Environmental Language* and to discuss ethical aspects, such as whether or not technology is always positive for humans, society and nature. In order to achieve such objectives, the choice of working method may vary, but similar to Axell (2015), the results of this study show that when children or younger pupils and teachers have the opportunity to discuss their own choices in authentic and interdisciplinary teaching situations, they are also able to reflect on the environmental impact and the consequences of human choice.

The Swedish curriculum for preschool class stresses that pupils must be given the opportunity to explore and pose questions (Swedish Agency for Education 2011/2016); however, at the same time, several studies show that teachers lack technology-related language (Björkholm 2015; Norström 2013). As such language, it can be difficult for them to teach technology when it comes to how technology is developed or when it comes to problematising technology. As argued by Lemke (1990), pupils need to learn Subject Language

and definitions so that they can better understand technology. What I, in this study, define as *Everyday Language* is significant since *Everyday Language* concretises, and ties teaching content to the pupils' everyday experiences and the technology that appears in their everyday lives (Axell and Hallström 2013).

Conclusions

This study attempts to show what type of companion meanings are present in teaching in preschool class when technology is related to humans, society and nature. In the results, several types of companion meanings are revealed. The study shows that pupils are mainly shown that technology in relation to humans, society and nature is something positive, obvious and unproblematic. Some companion meanings express how humans can create knowledge about technology. When teachers and pupils are building a cooking pit and a hut, they begin to discuss the different choices that exist and how choices can affect nature. In this case, companion meanings are revealed that include the ethical aspects of technology.

Further, the study seeks to highlight the consequences these companion meanings have on the technology education of children. If the pupils only encounter companion meanings that speak about how something is without including any problematic aspects, then the pupils may perceive technology to be something that has no relation with humans, society and nature, and something that cannot be affected. Companion meanings that allow pupils to reflect on and argue for their own choices can, in contrast, make the pupils see the significance of their own roles as producers and consumers. In this way—and similar to previous studies (Robert and Östman 1998; Klasander 2010)—this study points to the importance of highlighting companion meanings as a means for teachers to organise their teaching in such a way that pupils can reflect on and discuss companion meanings more critically. For example, in these teaching situations, questions arise such as follows: are there conflicts between humans, society, nature and technology? Should we depend on technology as a means to an end? Does technology create a need? Can we improve the quality of our lives without using technology? Are there other motivating factors behind the development of technology, such as economic or environmental factors? Further research is needed so that there can be better understanding as to how teachers can both design teaching situations and also highlight the less-positive aspects of technology.

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