Technology and Gender in Early Childhood Education: How Girls and Boys Explore and Learn Technology in Free Play in Swedish Preschools

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The preschool is the first institutional context that Swedish children meet in their lives, and it therefore plays a very important role in the Swedish welfare state. As of 1998, preschools were part of the public school system and the first curriculum was then adopted. In the new curriculum for the preschool (2010) technology is emphasized as one of the most significant pedagogical areas to work with. In many countries the preschool age is seen as an important time for laying the foundations for interest in and knowledge about technology, since it is believed that the children's curiosity comes naturally. It is thus seen as a crucial age to get both boys and girls interested in technology. Although research on technology education in the preschool is lacking to a great extent, existing research largely confirms these views. The aim of this paper is to investigate how girls and boys explore and learn technology in free play in two Swedish preschools. The empirical study is inspired by an ethnographic approach and is based on qualitative data collected through observations and informal talk with children and teachers. Two preschools with children one to five years old were chosen for the study.

Today's society places high demands on the individual in terms of ability to acquire understanding of and knowledge about technology. One of the visions of the 2010 Governmental committee *Teknikdelegationen* was a Swedish society that provides all its citizens with the competence needed to understand, profit by and influence the development of an increasingly complex and technologically advanced society. Hence the committee emphasized that knowledge about technology must be disseminated early on, already in the preschool, and technology should be an important feature throughout the education system (Teknikdelegationen, 2010, p. 26-27). A clear majority of Swedish children now attend the preschool, although it is not mandatory. The preschool is consequently the first institutional context that Swedish children meet in their lives, and it therefore plays a very important role in the Swedish welfare state. As of 1998, preschools were part of the public school

system and the first curriculum was then adopted. In the new curriculum for the preschool (2010) technology is emphasized as one of the most significant pedagogical areas to work with.
In many countries the preschool age is seen as an important time for laying the foundations for knowledge about and interest in technology, since it is believed that the children's curiosity comes naturally (Axell, 2012). It is thus seen as a crucial age to get both boys and girls interested in technology. Although research on technology education in the preschool is lacking to a great extent, existing research largely confirms these views (see, for example, Parker-Rees, 1997).

The aim of this paper is to investigate how girls and boys explore and learn technology in free play in two Swedish preschools. The empirical study is inspired by an ethnographic approach and is based on qualitative data collected through observations and informal talk with children and teachers. Two preschools with children one to five years old were chosen for the study.

Previous research

There is a scarcity of technology education research concerning the early years, so here we present the few studies we have found that relate to our study, that is, primarily studies which connect play and gender to the learning of technology in early childhood. These studies concern both preschools and schools, since children aged three to six years can be either in the preschool or the school depending on country and school system.[1]

Fleer (2000) claims that there is little knowledge about how small children work when in technological learning contexts. In her article she presents a pilot study about the planning, making and appraising of technological activities by children three to five years old in a child care centre in the Australian Capital Territory. The study indicates that children as young as three years can engage in oral and visual planning when making things from materials, although it was difficult for most of them to use their plans for making constructions; the making did occur but the children often copied each other rather than following their designs (Fleer, 2000. Cf. Fleer, 1992; Hope, 2000). Milne (2012) is also of the view that children at the age of five can be taught some design capabilities, but that "it could be further enhanced by taking note of the focused but less structured practices of early childhood with a greater focus on child initiated play and fewer constraints posed by artificially posed tasks" (p. 11).

Tu (2006) investigated science environments in 20 preschool classrooms in the USA. He concludes that preschool teachers mostly organised activities that were unrelated to science but that around 13% of the activities were related either to formal or informal science education. According to Tu this low degree of science education in preschools both has to do with lack of science-related materials in the classrooms and teachers' unawareness of how to create science activities in daily preschool life.

Turja *et al* (2009) present an overview of an analysis of early childhood education curricula in six countries, and they conclude that the curricula do not offer much guidance for technology education in the early years. However, there are activities that can be utilized to boost technology education: "Play is highlighted as a fundamental way of learning seldom studied in the context of technology education" (Turja *et al*, 2009, p. 353). The authors take Mitcham (1994) as their starting point and assert that activities associated with technology might be transformed into roles that children can try out when playing – for instance, the roles of designer/inventor, manufacturer, mender, consumer/user etc. Turja *et al* (2009) also expound on various types of play, of which the best one for technology education seems to be the *functional play* where "children acquire knowledge of objects, materials and physical phenomena, and learn to master the use of tools and techniques through explorations and rehearsals" (p. 360). In short, it becomes possible for children to practice advanced technological activities and roles through creative play.

Furthermore, according to Turja *et al* gender stereotypes seem to be created as early as the age of three, which can be seen in the preschool when boys choose cars or typical male roles, and girls

1 For a recent, important overview of primary technology education, see Benson & Lunt, 2011.

pick dolls and typical female roles. It is therefore recommended, for instance, that boys and girls should, as far as possible, have equal access to activities and material, which should also be gender-neutral. Building and construction, either organised or in free play, should be made in social contexts that do not discourage boys or girls from participating (Turja *et al*, 2009, p. 363).

Mawson (2010) discusses the changing conception of the word "technology" of seven children during their first six years in school (age five to ten) in New Zealand. There was only one child who could say anything about what technology is when he started school. When the interviewer asked "What does it (technology) mean?", he answered "You can make stuff". As the other children experienced technology within the school context they also acquired a view of what technology is although it was poorly developed. Furthermore, Mawson shows that the girls found it more difficult to pin down what technology is compared to the boys. It is not clear why the girls were more uncertain in their understanding of the concept, but one explanation, according to Mawson, could be that the girls seemed to have a broader, more contextualized view of technology. They seemed to view technology in a wider context than the questions they had to deal with in the study. On the other hand, the girls had a more narrow conception in the sense that they did not see technology as planning to "develop new things" to the same extent as the boys, while both sexes ageed that "technology is making plans to solve problems" (Mawson, 2010, p. 3-8).

Mawson (2010) also shows that the children connected technological progress more to artifacts than to systems, which may be due to the heavy emphasis on designing and making products. Mawson relates the children's answers to the question "what does the word technology mean to you?" to their experiences of school technology (cf. Skogh, 2001), although this does not seem to have substantially developed their understanding of technology. This deficiency was due to a number of factors, for example, the lack of a planned progression for and teaching of the subject technology as well as the lack of understanding of the concept of technology among teachers. The children generally had a positive attitude towards technology, particularly the boys, but especially the girls were ambivalent regarding the value of technology for society (Mawson, 2010, p. 10; Cf. Mawson, 2007).

Theory and methodology

The study takes as one of its starting-points the framework of the sociology of childhood (James & Prout, 1990). One assumption in the sociology of childhood is that childhood is understood as a social construction. This means that childhood as a phenomenon varies over time and in different contexts. In this perspective it is also important that childhood cannot be separated from other variables like class, ethnicity and gender. It is also crucial to study children's relations with each other and to study children's living conditions in their own right (Prout & James, 1997).

This also means that even young children are to be taken seriously in technology education; children play an active role when engaging with science and technology and they do it in their own way(s). As a way of highlighting this in the analysis we use the term *childish science*, which was recently introduced as a conceptual tool for exploring the mutual relations between science, technology and children. Koch *et al* (2011) defines three strands of criticism toward traditional science education in which this term can be useful: 1. children's life worlds are understood through their imaginaries of science, 2. children develop their own sense-making through specific cultures, social relations and rationalities, and 3. specific materials and technologies represent, communicate and translate knowledge in relation to children's practices. Even though the concept applies to the school we believe that it is equally, perhaps even more, useful in a preschool setting of free play where the children's own initiative dominate (Koch, Sørensen & Levidow, 2011).

In the interpretation and analysis of the empirical material we use a theoretical model for understanding technology and technological activity taken from Mitcham (1994), adapted for the specific needs of this study. Mitcham's model and definition of technology and attitudes towards technology are probably the most generally accepted today within technology education and the philosophy of technology. Mitcham's fourfold description of technology is employed to identify

various aspects of technological activity and learning in the children's free play; technology as *volition, knowledge, activity* and *object*. Technology as *volition* comprises the will, wishes and intentions that start the technological activities, and *knowledge* consists of the skills and knowledge necessary to perform these activities. Technological *activities* are performed to reach a goal or fulfil wishes, either by designing and making or using technology. *Objects*, i.e. technological artefacts, are used in technological activities or are a result of these.

The empirical study is based on qualitative data collected by observations of and informal talk with teachers/minders and children inspired by an ethnographic approach (Hammersley & Atkinson, 1995), in two preschools in Sweden. Contact was established with the headmasters of these preschools according to a strategy selection (Bryman, 2001). Both preschools receive children from one to five years old, and neither of them has any special pedagogical ideology, except, of course, for the general directions laid out in the Swedish preschool curriculum of 2010. The staff consists of preschool teachers and childminders working in teams. The preschools are located in the south of Sweden, in one of the larger Swedish municipalities – *kommun*, an administrative division consisting of both rural and urban areas. *Preschool one* is located in a small village in the countryside, and consists of three different departments with a total of 120 children. *Preschool two* is located in an urban area and consists of 20 odd children in each of its departments, in sum 45 children.

The focus of the observations was on the children's "free play", both outside and inside the preschool. The observations also included activities and actions where children, preschool teachers and childminders were involved together. The study is based on fieldwork on nine occasions of two to six hours each in the two preschools. Ethical considerations have been important during the whole research process, in getting access to the field as well as in relations during the fieldwork (Roberts, 2008; Alderson, 2000).

Results

Both girls and boys use technology

The observed situations show that both girls and boys use technology in their daily life in the preschool. They use it both in situations which are planned as technology activities by the preschool teachers and in their free play. When the children play outdoors the central place for relating to technology is the sandbox. Children make sand cakes, they construct roads and transport different kind of materials on these roads. The sandbox is a place which attracts children of all ages in the preschool.

When the children play indoors both boys and girls are occupied with different kinds of construction play. One of the preschools has actively gathered different construction materials aimed at encouraging this kind of play.

At a group level the analysis shows that both what kind of play the children are engaged in and what kind of toys the children use are gender marked. For example, boys play to a higher degree with toys that can be categorized as typical "toys for boys" (cars, cranes etc.).

Construction *as* play versus construction *for* play

Construction play is a common activity among the children in the study. The empirical data indicates that there is a gender difference regarding how children use construction in their play and what purpose construction has for them. We have analyzed this main difference as construction *as* play versus construction *for* play. The observations show that boys more often construct things where the process or activity is central:

> David and Hampus [5 year old boys] are playing in the preschool yard. They are building a little house together with the help of battens. They discuss and negotiate how to make it as strong as possible. They spend much time constructing. During one film sequence they are building the roof. David is at the top and Hampus ... gives him battens. When the roof has been laid the house is finished (field notes).

The above situation shows that for David and Hampus the activity to construct is the main purpose of the play. Construction can be seen as the play itself; the boys are focused upon making the construction as solid as possible, which is why during the play they negotiate about the best building methods. In their play they also use advanced language for their age. For instance, Hampus asks David for a drill pin (*borrstift*).

> Four girls of different ages are playing with battens in the preschool yard. They want to play chute-the-chute and come up with the idea that they can angle the battens against the fence. They then ride the chute made up by the angled battens.
>
> Malin and Ronja [four year old girls] are playing with battens. They use them as tools in making letters (field notes).

One interpretation of this is that for boys the construction is at the centre of their play. When they are finished they tear it down to start all over again, while the girls in the above example build something they want to use. The girls seem to be more interested in technology as an object to use, while the boys favour technology as an activity. The girls are users of technology, while the boys are designers or builders (Mitcham, 1994; Turja *et al*, 2009).

Girls' lack of self-confidence

Generally, boys and girls have positive feelings toward technology, although boys are a little more interested in technology than girls (cf., for example, de Vries, 2005; Mawson, 2010). In our observations, however, we can see that girls and boys approach technology in different ways as regards self-confidence:

> The children work with volcanoes as a theme. The work consists of different tasks, of which the first one is to draw a volcano. The next task is to do an experiment to see how a volcano works. They first make a model of it. Then the preschool teacher asks the children if they want to put baking powder in the volcano. The children then act in different ways in relation to their gender. The boys actively tell the teacher what they want and they also show it with their body language ...The girls think that it is scary and change places so that they can sit at a distance from the volcano (field notes).

In the empirical example above the gender differences between the children are very clear. There are no differences when the children are drawing, but during the experiment, which is also quite a new situation for the children, it is obviously the boys who are the most active. We have seen this pattern on other occasions as well, for example, boys seem over all more self-confident when presenting themselves. They are also more eager to try something new.

The girls as helpers

> A group of children are playing in the construction room. The room is equipped with different kinds of materials with the purpose of stimulating construction games. Two boys [five years old] are playing with blocks. They are talking with each other and decide to build a tower as high as possible. Amanda [five years old] is looking at the boys' play but she does not touch or play with the blocks herself. After a while she starts to serve one of the boys with blocks (field notes).

Turju *et al* (2009) claim that girls generally have a lower self-confidence when it comes to activities which are seen as stereotypically male. They seem to connect failure to their own inaptitude while success is regarded as "luck" whereas boys, on the other hand, couple failure with external variables but success with their own capability. The preschool teachers' understandings of gender

are contradictory in this regard. Some say that they see no difference between the sexes concerning the free play in relation to technology. This is in line with their overall view of gender: "In technology there is no difference between the sexes until we as adults impose our own values" (Nathalie).

Other teachers are of the view that they can detect a difference between what boys and girls play with and how they do it (cf. Turja *et al*, 2009). They exemplify with the fact that boys more often build garages and roads while girls construct objects to do with, for instance, farming:

> Eva: And then I feel that, how should you deal with this, because the boys tend to play together. The boys build and design a lot . . . how can we make it more interesting for the girls? Outdoors it is easier to find solutions, take for instance the sand box . . . In outdoor activities gender makes less difference . . .

In the above quote the teacher describes how technology is easily connected to boys and masculinity, at least when the children play indoors. Nathalie also acknowledges that:

> Since everything is technology then girls also deal with technology, but girls devote themselves to specific activities. There is no buffet [of technological activities] for them.

Discussion

The focus of this paper is technology and gender among children in the preschool, especially in relation to free play where the notion of *childish science* (Koch *et al*, 2011), or rather *childish technology*, is most noticeable. The empirical material is limited but despite this there are interesting findings which are well worth investigating further. We will here discuss some interesting aspects of how girls and boys explore and learn technology in free play in two Swedish preschools. First we look at how boys and girls use technology, and, second, we deal with boys' and girls' different technological vocabulary.

The results show that both boys and girls use technology. In an interesting parallel to Mawson (2010), who shows that girls have more difficulties in defining technology, we can see in our observations that girls use technology in a different way compared to the boys. The girls more often construct *for* play, and by this we mean that they have a special purpose in building something they need in their play. If we use Mitcham's (1994) concepts, they are more interested in technology as *objects* for use than the boys. It is conceivable that technology is seen as an object part of a broader social context of play, thereby making the construction in itself less interesting (cf. Mawson, 2010, p. 3-8). The boys, on the other hand, more often construct *as* play, which means that construction is the main purpose of the play and when it is finished they often start to construct something new. In Mitcham's words the boys engage the most in *technological activities* which are enough in themselves. Technology represents, communicates and translates *knowledge* in relation to both these practices, which means that girls and boys learn to internalize these different approaches to technology (Koch *et al*, 2011; Mitcham, 1994).

It is therefore crucial for the preschool teachers to have a deeper understanding of both gender and technology. With that knowledge they can help children to choose different activities and to support them in their process of learning about technological objects and activities that are not typically associated with their respective gender. Some teachers saw no gender differences at all, whereas some were aware of the different ways boys and girls approach technology. This makes it difficult to "arrange" free play activities where there are equal opportunities for both sexes (Turja *et al*, 2009; Mawson, 2010). Ironically, the very broad notion that "everything is technology", which is contrary to much modern research in the philosophy of technology (see e.g. Mitcham, 1994; de Vries, 2005) opened up the possibility for certain teachers that not only boys but also girls handle technology in their daily lives.

We have not investigated children's understanding of technology by interviewing them, but we can see it when we analyze their conversation during play. There is a difference between boys

and girls when they use technology as some boys employ specific words belonging to a technical vocabulary in their process of building. Both girls and boys interact with each other in a sense of sharing something during their play (Corsaro, 2003). In this interaction process the boys seem more familiar with using words that belong to a technological sphere, for example, "drill pin" or "we must construct a strong road so that the cars can drive on it without breaking it." The children's play is also different depending on where the preschool is located. The children who live in the countryside seem to be involved more in construction than those who live in the urban area, especially in the free play.

However, the previous teaching may also have affected the results of our research, and this needs to be investigated further. This would concern not only the environment more generally but also the way in which the children have been taught and the activities that they have previously undertaken. This, in turn, should be connected to the understanding and confidence of the teachers as well as how they relate to this in setting up activities.[2]

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