

MATHEMATICS – DIDACTIC CONTRACTS IN SWEDISH PRESCHOOLS

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The aim of this paper is to show how preschool teachers interpret the goals set for mathematics in the Swedish curriculum. A didactic perspective has been used to understand what mathematics for young children is according to preschool teachers' interpretations and how the goals are transformed according to the examples preschool teachers use to illustrate their points. In relation to the interpretation of the curriculum and the didactical questions, I will try to highlight the expectations that preschool teachers have of children and mathematics. To define and understand what these expectations are, I will introduce to my study the concept of didactic contract as a metaphor. My use of a didactic contract does not imply that I am importing the general theoretical framework of the theory of didactical situations. Instead I use some of the elements of the didactic contract in order to focus on expectations.

Key words: Preschool, mathematics, curriculum, didactic contract.

INTRODUCTION

Mathematics for young children is not a new concept. In the 1850s Friedrich Fröbel developed educational “gifts” including geometric building blocks and pattern activity blocks, to encourage children to sort and discover similarities and differences, examine, analyse, compare, reduce, increase, and share. Fröbel has influenced Swedish preschools with a teaching approach where playing and imagination are important to a child's learning (Ahlberg, 1994). Early in the twentieth century, Maria Montessori also developed a series of activities to help children come into contact with mathematical concepts. However, in Sweden the focus on mathematics was lessened, instead playing, creating and building were emphasised. Around 1950, primary school teachers started to question whether or not it was good for preschoolers to learn how to read, write and learn mathematical skills (Vallberg-Roth, 2011). In 1987, the two foci were connected when it was determined that children at preschool should learn mathematical concepts through creativity and working with concrete materials. The reasoning was that they would further develop and consolidate their mathematical concepts both linguistically and by perceiving shapes and numbers through both play and work (Socialstyrelsen, 1987).

National and international comparisons have emphasised mathematics in recent years. For example, several studies (OCED, 2010), show that students in both Europe and the United States, have difficulties in being accomplished in mathematics. Consequently, attention has turned to preschools. The Swedish government believes that the preschool has not fully made

use of children's desire to learn (Cabinet Office, 2010). According to Tallberg-Broman (2012), there is a paradigmatic shift today in Sweden. A new vision of children, parenting and the school's mission is emerging. Preschool teachers have to lead the children in their meeting with current and future increasingly complex reality and the requirements of preschool teachers' professional skills have increased (Persson & Tallberg-Broman, 2002).

In 2011, a revised preschool curriculum was introduced, in which the goals for children's mathematical development were made much clearer in both scope and content. Currently preschools should strive to ensure that each child develops, expresses and uses his or her understanding of space, shapes, location, direction, sets, quantity, order, number concepts, measurement, time and change. Further each child should develop his or her ability to reflect, test solutions, and present and follow reasoning (National Agency for Education, 2010).

THE REVISED CURRICULUM FOR PRESCHOOL

In the mission of Swedish preschools, caring, education and learning form a whole. Although the focus on caring is unchanged, there is more focus placed on learning and knowledge (Vallberg-Roth, 2011). The purpose of the revision to the curriculum was to develop the quality of education and to strengthen the pedagogical work (Cabinet Office, 2010). The National Agency for Education was commissioned by the Government (Cabinet Office, 2010) to make proposals for clarifying and supplementing some goals, as well as clarifying preschool teachers' responsibility for the curriculum in the preschool. How children are to create, explore and use mathematics is not specified in the curriculum, as it is a goal-oriented document without suggestions on how to teach. According to the curriculum learning should start from children's development, experiences, interests and circumstances and take place in a playful manner. The objectives are formulated as goals for the preschool to strive towards. There are no goals for the children to achieve because preschoolers should not be assessed based on established standards and should not be compared to anyone other than themselves.

AIM AND KEY QUESTIONS

According to Doverborg and Pramling-Samuelsson (2011), everyday life at preschool provides many opportunities for children to perceive basic mathematical concepts; but teachers may not have sufficient knowledge about early childhood mathematics to be able to take advantage of these opportunities. Some preschool teachers prefer to focus on language and literacy where they feel safe; hence, they have no time for mathematics (Lee & Ginsburg, 2009). The purpose of my project is to study, how some preschool teachers who work with mathematics talk about the revised mathematics goals and how they transform and implement mathematical outdoor activities for children aged 4-5 years. In this paper I discuss the first part of my project, which investigates the research question:

- In what way do preschool teachers talk about and transform the national goals for mathematics in preschool?

I conducted interviews with preschool teachers in order to investigate how they discuss, and interpret the national curriculum goals for mathematics, and how they transform their interpretations. The concept of transforming is influenced by curriculum theory (Lindensjö & Lundgren, 2000).

DIDACTIC PERSPECTIVE

Based on the purpose of this study, I will use a didactical perspective. Didactics are focused on the content of education in general, while subject didactics focus on education in relation to specific subject content (Kroksmark, 1987). I use the Central and North European tradition of didactics which highlights the theory and practice on the basis of what should be taught, how to teach and why in this manner (Gundem & Hopmann, 2002). Traditionally preschool in Sweden does not have activities divided into subjects. They work with themes and subject integrated activities. Care, education and learning should shape the activity according to the curriculum (National Agency for education, 2010), but how this fits in with subject didactics is not self-evident. The use of the term “subject didactics” may affect preschool activities but preschool needs a language that can make visible and problematise the new mission (Thulin, 2011). Integrative didactics has been customary in preschool in Sweden. When care, education and learning form a whole, there is a good possibility for implementing a changed knowledge mission in preschool according to Thulin (2011). Thulin believes that preschool teachers perception of their mission is problematic in practice because focus is on care and education and what should be learn is not clear. To make mathematics visible in preschool, I consider it is important to be able to talk about subject didactics. In Swedish preschools when children help to set the table, for example, languages, play, mathematics, care and education are mixed together. The preschool teacher should be able to focus on mathematics, even in such contexts, in order to better assist children in understanding mathematical concepts. It is not certain that one learns languages in the same way as one learns mathematics; but in the case of younger children, subject didactics focuses more on meaning-creation and investigation rather than children learning a given amount of knowledge (Lundgren, Säljö, Liberg, 2010).

In this paper I will limit my study by focusing on the didactic questions *what* and *how* in order to highlight the teacher interpretation of the institutional decisions and the examples they give to illustrate their interpretation. By *What* I mean the interpretation of what mathematics is for young children according to the teachers’ understandings of the Swedish curriculum for preschool. When the teachers talk about how they interpret the mathematical goals they also give examples to illustrate how they transform these goals into practice. The preschool teachers’ interpretation and implementation may improve the expectation they have of the children and teacher. To highlight the expectations that preschool teachers have on children, teachers and mathematics in relation to the interpretation of the curriculum, *what*, and the example they give, *how*, I will introduce the concept of didactic contract as a metaphor in my study (Brousseau, 1998; Wedege & Skott, 2006).

DIDACTIC CONTRACT AS A METAPHOR

The concept of didactic contract was used originally in situation theory and was introduced by Guy Brousseau. Brousseau (1998) has studied what happens between teacher, students and learning object in a mathematical situation and how the teacher's expectations of the students and the student's expectations of the teacher affect mathematical learning. He introduced the

concept of didactic contract in 1978 to illuminate a potential cause of students failure in mathematics (students, who have difficulty understanding the mathematics, or are completely indifferent to mathematics but who succeed in other subjects); he defines it as the entire teacher's behaviour expected by the student and the entire students' behaviour expected by the teacher. This contract comprises all the rules which determine- partly explicitly, but mostly implicitly- what each partner of the educational relationship will have to manage and which will be, in one way or another, responsible to the other (Brousseau, 1988). Brousseau (1998) claims that the expectations of both teachers and students affect the learning of mathematics.

Brousseau's use of didactic contract focused on mathematics in school. What is defined as mathematics is not obvious at preschool in Sweden, (Doverborg & Pramling-Samuelsson, 1999); since the mathematical objectives in the Swedish curriculum are for preschools and not for children, how mathematics should be communicated to children is even more vague. To negotiate a didactic contract with children, the preschool teacher needs to define what mathematics for young children is and how it can be communicated. Although the curriculum can give a hint of what it is, it is the preschool teacher's responsibility to interpret and transform the mathematical goals. How the preschool teacher interprets a text will be affected by a variety of factors. Preschool teacher's personal experiences, knowledge and ambition affect, for example, the interpretation of the mathematical goals (Hopmann & Riquarts, 1993). The preschool teachers' interpretation of what mathematics for young children is and how it can be communicated to the children will affect the rules of a didactic contract and what the expectation will be on children, teachers and mathematics. These expectations are transformed into invitations to action that are didactic invitations and offer immediately a didactic contract (Mercier, 1997). In this paper I will use some elements of the didactic contract in order to see how the expectations on children, teachers and mathematics are related to the interpretation of the mathematical goals. I will not investigate the children's expectations on teachers and mathematics and I will not consider how children learn mathematics. The focus is on the teachers expectations according to their interpretations.

METHOD

The empirical material for this paper consists of interviews with two preschool teachers. The preschool teachers do not work in the same preschool, but they are interested in mathematics for young children and are working actively with mathematics in a group consisting of four-and five year old children. The interviewees, Åsa and Susan have been working for twenty two years and nine years, respectively, as a preschool teachers. Both have attended mathematics courses at the university after taking their examination, since mathematics was not a part of the program at that time of their initial education. To answer my research question, I interviewed the teachers individually. In order to be flexible, allow the follow-up of an idea, and ask supplementary questions (Bryman, 2008), the interviews were semi-structured.

The preschools that are included in the study are located in two small communities in the same municipality. They show no major differences in staff composition, children's socio-cultural and economic background, or group size.

To analyse and interpret my data, I have used a hermeneutic approach (Bryman, 2008). My understanding is based partly on my experience as a preschool teacher, partly from theoretical perspectives and from prior research where a notion of the preschool teacher's approach to mathematics for younger children is highlighted.

INITIAL RESULTS

In this paper I will concentrate on some of the mathematical concepts Susan and Åsa talk about. In my initial analysis, I find two initial didactic contracts that I will develop. One of the contracts is child initiated and mathematics is perceived with the body. One of the other contracts is teacher initiated and mathematics is school mathematics only easier. Susan and Åsa talk about how important they think it is to start with concrete material in order to help children to understand but they seem to have a different idea of how to communicate mathematics and they have different expectation of children.

Perceive mathematics in the relation body-material:

Susan believes that young children should perceive mathematics with their body. When she talks about mathematics she says:

“When they are young it is important, from the beginning, to get the feeling of mathematics. What you learn with the body stays in your head.”

She illustrates with an example:

“Walking a tightrope around a square sandpit - they get the conceptual perception. They go around the sandpit and understand the surface of it. This surface would then be smaller if they were to walk around on a park bench.”

Mathematics in child initiated situations:

When children are playing in the forest and Susan notices that they are counting something she goes to find out about their thinking and tells them how she is thinking. However she does not want to tell them how it should be. .

“I see something here: there are three. What do you see?” “It is not, I am right! No - it is based on what they see.”

Susan does not want the children remember what the teacher tell without understand the mathematical concept. Susan does not want to answer the children's questions and thus give them the right answer.

“It gives them nothing to go in and tell them to pick up five sticks and count all of them together: 1, 2, 3, 4, 5. It's not me who should control or teach this.”

Instead of teaching children, Susan wants to look for an answer together with the children. Susan seems more interested by the process of finding an answer than by the answer itself.

“I don't ask yes or no questions and I do not want these answers from the children - this will not develop children or the activities we do. Instead, you can do research together with them and ask questions that challenge the children's thinking and encourage their willingness to learn.”

Susan tries to communicate mathematics based on the children's interests. She tells about how she will find out what the children are interested in.

“We have small notepads where we write down children's comments. Today we wrote down five math sentences from the children that we heard. We start from them ... so we can see the interests of the children.”

Sometime Susan can offer an activity to the children but it is based on what she believes belongs to the children's interest areas. For instance she took the children on a number hunt.

“We can go on a number hunt. I may say, “Five has disappeared! Where is five? “Five could be the number five, or it may be a symbol for five, for example, five cars, the number of the street, or something similar.”

Susan also says that the children are very excited about treasure hunting. They will draw a treasure map, look for a treasure and communicate about positions and orientation:

“A treasure map is enormous fun. ... Every child likes to look for treasure, and mathematics is very clear and visible to the children when looking for treasure.”

Expectations:

Susan expects the children to control the situation by showing interest in something; thereafter, she will help them to go further by asking questions. In this way they will do the research together. Susan expects the children to be active with their bodies and explore their surroundings, and she says they have to learn in their own tempo; and playing is more important. Susan explains that mathematics should be incorporated into a theme; she expects the children to show interests and the teacher to be aware of their interests, following them up in a theme where mathematics content will be included.

Perceive mathematics by finding the correct answer:

Åsa believes that mathematics at preschool is the same as mathematics at school just easier.

“When I was at primary school, we worked a lot with mathematics ... It was for slightly older children, but I have had the great advantage of take it down to the younger children's level here.”

Åsa works often with fractions and patterns because she has seen that children at school had difficulty understanding fractions and patterns. She says that children can understand if they can follow the entire process concretely from the beginning to end. She will ask children how to divide fruit or clay, for example, so that every child receives a piece:

“Everyone will get a bit and there were eight children. ... ‘How can everyone get a piece? Yes, we have to share! How shall I share? Yes, in the middle. And then how do I share? Yes, you have to share one more time. ... It’s four, then it’s four quarters.’” They were four years old, these children, and a little boy says, ‘you had to share every of these four quarters one more time because you will get eight pieces and then everyone will get one eighth. ‘Four years! But it’s because it’s so concrete.’”

Å sa gave this example for working with patterns:

They had to collect leaves and pinecones. Then, we lay every other; thereafter, we went ahead and lay three. We did patterns: “sticks, leaf, and pinecone! What will come now? Sticks, leaf, and pinecone!”

Å sa explained how she introduces location:

“We work a lot with, location in different ways. We have stumps where we meet when we have our outdoors day. Sometimes when we are waiting, I ask ‘Can you stand behind the stump? Can you stand to the right of the stump? Stand in front of? Stand on?’”

Å sa likes to introduce small competitions where she asks questions and the children try to answer.

“Should we have a competition? And prize is - everyone gets a prize – ‘the prize is a sandwich if you respond correctly.’... Then I can be quite advanced – ‘What is nine plus two?’ and you know someone understands it, ‘Please, there will be a prize, please take a sandwich’, and the youngest are asked what is $1 + 1$ and sometimes they need a little help: perhaps, $1 + 1$ (shows with the fingers).”

“A surprising number of children actually manage the abstract idea because we’ve previously worked with so many concrete ideas - . they have internal images.”

Å sa explain that children must have fun and they know they will get a sandwich anyway. She tells that they have done lot of concrete activities before.

Perceive mathematics by justifying the choice and follow reasoning:

Å sa states that it is important for children to know how to justify their answer in order to understand what mathematics is about. She says that nothing is right or wrong, but children should justify their decisions; she introduces situations where the children have to pick up two things that they believe are related and justify their choice:

“They may say, ‘I think these are related because they are yellow and they are made of plastic.’ It is to describe - they learn to describe ... with words, shapes, sizes, colours and materials. They may feel like the scissors and fork work well together because they are both made of metal. ... When you have done that many times, the children are challenging themselves. ... It is also a way to follow their level of reasoning.

Åsa explains that she has cards and a big picture with number on it. The children can pick a card and put it on one number of their choice:

“If the card is a picture of a cake and three candles, the children can choose what image they prefer and they may put it wherever they like; someone put it on the number one because it’s one cake, and someone else put it on the number three because it’s three candles. There is nothing that’s right, nothing is wrong and they decide, but they have to justify their choice.”

Expectations

Åsa initiates a great many activities, and she is expecting the children to be interested in and pay attention to her instructions. She says she will challenge the children with teacher initiated mathematical situations. She does not expect the children to show their interest in mathematics because they do not yet know what they are interested in when it comes to mathematics. She expects the teacher to create an interest in mathematics. Åsa seems to have high expectations on the children’s possibility to understand abstract mathematics if the teachers give them the opportunities to do so. She used to tell the children that not all the children at school may master what they already can in preschool.

SUMMARY

Since the mathematical goals in the Swedish curriculum have no method instructions, it opens possibilities for several didactic contracts. In the analysis of the two interviews, Åsa and Susan interpret the mathematical goals differently, leading to two separate ways of transforming the goals into practice. They have different expectations on the relation of children-teacher-mathematics.

For Susan, mathematics is about number concepts, shape, size, differences, but she does not expect the children to understand the concepts. Susan believes that children need to feel mathematics with their body by walking a tightrope; feeling the distance; seeing the forms, the colours and the number; and their understanding will come when they are mature enough. The didactic contract that Susan offered to the children is based on learning by doing - she will communicate mathematics by offering opportunities to explore. All the activities have their starting - point from the children’s interests. Susan seems to have faith in the ability of children to seek knowledge and learn from each other. She expects the children to take an active part in the planning of the activity by showing and sharing their interests with each other.

Åsa believes that mathematics for children is about learning to recognise and name shapes, and understanding fractions and patterns - children should pay attention to differences and justifies your choices. She works with concrete materials, but the mathematical concepts she uses are sometimes abstract. The didactic contract Åsa offered is based on cognitive skills; the preschool teacher communicates mathematics by initiating situations where the children will understand mathematical concepts when they follow the instructions and try things practically. Åsa believes that when children have been following every step of a process, they will get mental images, and they will be able to think abstractly. She tries to give the children an interest in mathematics.

CONCLUSION

Preschool teachers have a very important role to play in order to help children come into contact with mathematical concept. Early research conveys a very pessimistic vision of preschool teachers' knowledge about mathematics for young children and means that preschool teachers are unsure about how to communicate mathematics with children (Perry & Dockett & Harley, 2007). Many preschool teachers believe that children learn all the time and from everything (Björklund, 2007). At preschool, children can discover mathematics when teachers have created an educational environment, have taken a step back and have let the children play. Free play can provide a useful foundation for learning; however, in order to build a structure on the foundation of their informal mathematics, children need a teacher's guidance (Hildebrandt & Zan, 2002).

The initial results of my first interviews show that these two preschool teachers are very confident about what mathematics is and how it should be communicated, but their interpretations of the curriculum are different. Their beliefs about mathematics for children and how it should be communicate differ from one another and lead to different didactic contracts. How this didactic contract will unfold in practice and how the children will react to it will appear in the analysis of my second interview, which is about how preschool teachers planned a mathematical outdoor situation, and in my video, where preschool teachers are shown implementing the situation.

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