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Student teachers' definitions of the concept “teaching mathematics in preschool”

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This article reports on how a group of preschool and primary student teachers define the concept “teaching mathematics in preschool” in the beginning of their studies. The background for this pilot-study is the recent change in the Swedish curriculum, which means a shift from play-based to more teaching oriented activities, and the actual Swedish debate on the role of teaching in preschool.

Keywords: Young children, Teaching, Learning, Mathematics, student teachers, preschool.

Introduction.

In 2011, a new national curriculum for Swedish preschool was implemented. In this text, and also in the previous curricula for preschool, the concept of teaching is not discussed. Instead of that, the guidelines for preschool teachers highlight the learning opportunities that should be provided to children, and these indicate indirectly what kind of mathematics preschools should provide to children (Swedish National Agency for Education, 2011). The concept of teaching is however used in the Swedish educational act (SFS, 2010:800). According to Öqvist and Cervantes (2017), this was the first time the concept of teaching was used in a steering document for preschools in Sweden. On the other hand, it seems to be important for preschool teachers not to work in the school-like way and, hence, they tend to avoid using the word “teaching” to describe their professional work (Hedefalk, Almqvist, & Lundqvist, 2015).

In Sweden, there is an ongoing discussion about what teaching in preschool means (Rosenqvist, 2000; Doverborg, Pramling, & Pramling Samuelsson, 2013; Hedefalk, Almqvist, & Lundqvist, 2015; Jonsson, Williams, & Pramling Samuelsson, 2017). Palmér and Björklund (2016) provide an overview of eight Nordic articles which show a large diversity of aims and goals within preschool mathematics. There is not a common understanding or view of what teaching in preschool is, could or should be. Quite recently, this question was raised when the Swedish National Agency for Inspection (2017) reported that there is a lack of teaching in the Swedish preschools and that there is uncertainty about what the concept teaching in preschools is. This debate is our primary motivation for the present study.

Secondly, according to Clarke, Clarke and Cheeseman (2006), the research into mathematics in preschools has often been driven by the school curriculum with its emphasis on number knowledge. Researchers have investigated various aspects of children’s learning of mathematics and numerous theories concerning children’s mathematical learning exist. Yet the everyday of the teaching of early mathematics has received much less attention in Nordic countries (Saebbe and Mosvold,

2016; Vallberg Roth, 2018).

A third motivation for this study is the fact that the views and beliefs of student teachers (and teachers) affect the way they plan their teaching, what kind of materials they use, and their performance in mathematics during their teacher studies (Wilson & Cooney, 2002; Tossavainen, Väisänen, Merikoski, Lukin, & Suomalainen, 2015). Hannula (2002) emphasises, in his widely applied framework for analysing individuals' attitude towards mathematics, the role of expected consequences and relating the attitudes to personal values. So, by surveying prospective preschool and primary teachers' views of the teaching of mathematics for small children we hope to get knowledge about their personal values and what they expect the outcome of their own mathematics education during teacher education and mathematics education in preschool will be.

Theoretical perspective

Benz (2016) synthesised the professional competences needed for supporting children's early mathematical thinking. These competences are also important for teacher education and hence can contribute to the understanding and the impact of beliefs on the teaching of mathematics. She specified three categories of competences found in previous research: (a) content knowledge, pedagogical content knowledge, and knowledge of children's development, (b) action competencies, and (c) attitudes and beliefs. In this article, we will focus on the third point, the attitudes and beliefs. These play an important role when it comes to providing learning opportunities for children in mathematics in preschools. Indeed, teachers' view of what counts as mathematics and what mathematics teaching for young children is have a remarkable effect on their everyday practice.

Hannula (2002, p. 30) defines attitude as a category of behaviour that is produced by different evaluative processes which concern emotions, values and expectations. These processes are influenced by the social setting and former experiences. In the present paper, we are interested especially in students' values and expectations.

Concerning the beliefs, we use the following definition: "...teachers' pedagogical beliefs refer to pedagogical attitudes and values such as educational goals and norms, the definition of their own pedagogical role, beliefs about developmentally appropriate practices, as well as the educational goals of preschools" (Anders and Rossbach, 2015, p.308). More specifically "mathematics-related beliefs, which include the implicitly and explicitly held subjective conceptions about mathematics education, the self as a mathematician, and the social context, i.e., the class-context" (Op't Eynde et.al. 2002, p.14). In this paper, we focus on the explicitly held subjective conceptions about teaching in mathematics education.

Our research questions are:

- (i) *How do student teachers describe mathematics teaching in preschool in the beginning of their university studies?*
- (ii) *Are there differences between the different groups of students, and if there is, how can they be described?*

The study

This study aims to investigate student teachers' beliefs about the concept of teaching in mathematics education for young children, specifically in preschool. In order to do that, we collected data from three different groups of students by using a printed questionnaire. The participants of the study (N=94) represent Swedish university students from three different teacher education programs. The first group studies (N=27) to become preschool teachers, the second (N=42) to lower primary teachers (Swedish classes F-3) and the third group (N=25) to upper primary (Swedish classes 4-6) teachers. All of the respondents were in the beginning of their university studies and had therefore not yet taken any mathematics courses contained in their university program.

The motivation for including these three different groups is the fact that the primary teachers continue the work of the preschool teachers, so, it is important to see if they share the same ideas and goals related to mathematical education. Another reason for the three groups is that we want to see whether students' views on teaching arise during the teaching education programme or are they based on their earlier beliefs. Therefore, we need to examine whether or how these groups' views differ from one another already in the beginning of university studies.

The first part of the questionnaire surveyed the participants' educational background concerning mathematics. In the second part, the participants were asked to make a concept map of their definition of mathematics education in the Swedish preschool. The third part contained a set of statements related to teaching of mathematics for young children with the seven-point Likert-type scales. In this article, we focus on the participants' concept maps i.e. the second part of the survey. The task was presented in the questionnaire as follows: "The definition of mathematics teaching in preschool: Spend a few minutes on reflecting teaching mathematics to young children and what it brings to your mind. Then, using a concept map, define what mathematical teaching in preschool education in Sweden should in your opinion be. Focus on the essential features, more detailed questions follow on the next page."

The students then provided concept maps where they had a centre of the map and then added essential features of the question around this centre. Using a concept map may provide other information about teachers' views and beliefs than open questions and Likert-type scale questions. This method is mostly used for investigation concept understanding (Rosas & Kane, 2012) and, hence, we found that it might be a way also to investigate beliefs and views on the concept of teaching mathematics in preschool since this is in line with the definition and focus of the paper, the conceptions about teaching of mathematics. When analysing the students' concept maps we realised that they often had more features of a mind map than a concept map. According to Davies (2011), one important difference between a mind map and a concept map is that a concept map has a hierarchical structure with several levels. This was not the case with these students, most of their maps had only one level.

We used content analysis in order to find the essential categories of sub-concepts that occur in the

students' concept maps. The analysis focused on qualitative differences in students' values and expectations. It did not however take into account at what levels in the concept maps these sub-concepts were mentioned. The categories were derived purely from the data, i.e., the words found in the maps are grouped and after the grouping the categories are defined. When it comes to the written answers (a few students gave a written response instead of drawing a concept map), they were added to the categories after the grouping of the words.

Result

In this section, we first present the categories found in the concept maps and then give examples of different categories and their content. Secondly, we discuss the differences or similarities that can be seen between the three different groups.

The following categories were found in the concept maps: Motivation, Methods for teaching, Children-centred, Everyday, and Content.

Motivation is the first one of these categories. Here we have words like fun, enjoyable, meaningful, play based, play, inspiring, interesting and creative. We interpret these words as describing how mathematics teaching should be for young children. They focus on feelings as a tool for motivation. We also attached play and play-based to this category even though they could be placed also in the category methods for teaching.

The category *Methods for teaching* also answers the question how mathematics teaching should be for young children, but with a focus on the organization of the teaching or learning rather than the motivational aspects. Here we find words like practical, concrete, concrete materials, games, digital tools, mathematics in all activities, variation, exploration and group work.

The next category can also be seen to answer the question how, but it focuses on children and their world. Therefore, we call it *Children-centred*. Here we find words like draw on children experiences, on the child's level, and suitable level.

Everyday is another category putting a child in the centre. In this category, we find words like everyday situations, connect to the everyday, connected to reality and use the everyday.

Content is the last of the categories and here the students have given examples of mathematical content that the children should meet in the preschool. Here are words like numbers, counting, shapes, develop concepts, space, symmetry, geometry, arithmetic, problem-solving and sorting. This category is not analysed in detail here due to limited space but it is of interest for further investigations.

	Motivation	Children-centred	Everyday	Methods for teaching	Content
Preschool N=27	17 64%	12 44%	4 15%	5 19%	17 63%
Lower Primary	26	7	9	16	18

N=42	62%	17%	21%	38%	45%
Upper Primary	7	1	3	11	21
N=25	28%	4%	12%	44%	84%

Table 1: Distribution of the categories for each group

In Motivation, we have few (7) response from upper primary student teachers, and of these seven, six mentions play. On the other hand, play is not mentioned at all by the preschool student teachers, this is surprising given that play as a base for learning is a foundation for the Swedish curriculum for preschool. For the preschool student teachers, we have 17 responses and for the lower primary student teachers we have 26 responses in this category. To conclude this category seems to be important for preschool student teachers and for lower primary student teachers.

The category Children-centred seems to be important for the preschool student teachers but not so important for the other groups, only one of the upper primary student teachers has a word in this category, and there are only few words from the lower primary student teachers and then even less for the upper primary student teachers.

Surprisingly, Everyday does not have that pattern. Here the lower primary student teachers have the mode while preschool student teachers and upper primary student teachers only have 4 and 3 responses, respectively.

In Methods for teaching, the preschool student teachers have few words in this category and they all say variation. This is in contrast to lower primary student teachers group where they have 16 and upper primary student teachers have 11 and gives a variety of methods.

Content is the largest category overall and seems to be important for all the groups, and it will be a subject to a separated analysis later on. It is the only category that is almost the same in all three groups and almost all student teachers have words in this category.

One important thing that was noticed in the analysis was the fact that the students had different words in the centre of their concept maps. The formulation of the task mentioned explicitly “The definition of mathematics teaching in preschool” and from this expression the students had chosen different centre words for their maps. This may have had an impact on the concept maps and, hence, it is important to present the different centerwords as well. They are: mathematics, mathematics learning, mathematics teaching and mathematics in preschool. The remaining 19 students either does not have a centre word, have written a short text describing, or it is not obvious what the centre word is.

	Mathematics	Mathematics in preschool	Mathematics learning	Mathematics teaching
Preschool N=27	7 26%	3 11%	9 33%	1 4%

Lower Primary N=42	8 18%	17 39%	0	14 32%
Upper Primary N=25	9 39%	6 26%	0	1 4%

Table 2: Concept map centres across the student groups

As we can see in Table 2, only one of the student teachers for preschool has written about mathematics teaching. This is not surprising since we know from previous research that this is typical for in-service preschool teachers (Hedefalk, Almqvist, & Lundqvist, 2015). So, the fact that the same pattern appears for upper primary student teachers is more interesting. On the other hand, none of the primary student teachers has used the mathematics learning in their centre. The lower primary student teachers have focused on mathematics in preschool or mathematics teaching and the upper primary student teachers on mathematics and mathematics in preschool. The difference between the groups is noticeable and can only partly be explained by the fact that they have started their studies. They are, as mentioned before, in the beginning of their studies and have not yet taken the mathematics course.

Discussion

As mentioned above, this is just a pilot study with a relatively small group of students, and the results discussed in this article are only due to an analysis of one of the parts of the survey. The next step would be to investigate how these results are connected to the students' responses to the statements measures on a Likert-type scale; some preliminary results have been reported by Tossavainen, Johansson, Faarinen, Klisinska and Tossavainen (2018). Nevertheless, the above results give us an overview of what prospective preschool and primary teachers expect mathematics education in preschool to be and what they value in the teaching of mathematics for small children.

One point that needs to be addressed here is that the students had chosen different words in the middle of their concept maps. The formulation of the task mentioned explicitly “The definition of the teaching of mathematics in preschool” and it seems that, from this expression, the students have chosen different centre words for their maps. This may have impacted the concept maps and, hence, it is important to present the different subcategories as well. They are: mathematics, mathematics learning, mathematics teaching and mathematics in preschool. The fact that most students have mathematics learning as the concept centre is compatible with previous research (Hedefalk, Almqvist, & Lundqvist, 2015) but a new finding is that this view is already present when they start their studies at university. Similarly, it is surprising that their concept centres differ already at this stage.

The lack of the word *play* in the preschool student teachers' concept maps is another point is worth more investigations. One way to interpret this is that, for this group of students, play is so obvious that it does not have to be mentioned, yet this is not self-evidently supported by our data.

The fact that the lower primary student teachers seem to have a broader view than the other groups

would be even more evident if we studied the students' concept maps at individual level.

To answer our research questions, the three groups of students give different descriptions about what teaching in mathematics in preschool is, and they focus on different parts of the teaching of mathematics. We can say that they in fact have different pedagogical beliefs and expectations regarding at least what mathematics teaching should be in preschool, how it should be provided, and also which focus the teachers should have. The category Content gives us some indications of attitudes and values regarding their educational goals. Since this category is shared by all groups and is the largest one, we can conclude that this is an important base for all the teachers' pedagogical beliefs. The categories Everyday and Children-centred give information regarding expectations and values concerning the teachers' pedagogical role. Here the focus for the preschool student teachers is on the child and the focus for the lower primary student teachers is on the everyday. These are not so important for the upper primary student teachers, and this could possibly be explained by the fact that they have not thought about the pedagogical role of the teacher since they will not teach themselves. Methods for teaching and Motivation give information about attitudes and values about appreciated practices. These can be found in all the groups but with different focus. For the preschool student teachers, the focus is on motivational issues and, for the primary student teachers, on the methods. This is one of our main results since it gives us information about the preschool student teachers' beliefs that teaching in preschool is not their main interest but they prefer to focus on other parts of the educational practice.

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