SIMILAR BUT DIFFERENT - INVESTIGATING THE USE OF MKT IN A NORWEGIAN KINDERGARTEN SETTING

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Over the last decades, a lot of research regarding the professional knowledge of mathematics teachers in school has been conducted. Far less research has been done concerning the professional knowledge of kindergarten teachers, and there is little evidence regarding what kind of mathematical knowledge for teaching that is needed by kindergarten teachers. This paper analyzes a case study from a Norwegian kindergarten and discusses how the tasks of teaching that have been observed in this kindergarten setting differ from a school setting. Based on the analyses, we suggest that part of the theoretical framework has to be adjusted in order to be used in a kindergarten setting.

INTRODUCTION

In the last decades, a lot of research has been conducted in order to learn more about the mathematical knowledge that mathematics teachers need in their teaching practice and the impact of such knowledge (e.g. Ponte & Chapman, 2006). Researchers agree that knowledge is important (e.g. Hiebert, Gallimore, & Stigler, 2002), and some suggest that there is a connection between the teachers’ mathematical knowledge and the students’ results (Hill, Rowan, & Ball, 2005; Baumert et al., 2010). So far, most of the research has focused more on teachers in elementary and middle school.

Based on results from several studies, Ball and her colleagues (e.g. Ball, Thames, & Phelps, 2008) present a framework of mathematical knowledge for teaching (MKT). According to such a framework, mathematics teachers need a combination of content-specific knowledge and pedagogical content knowledge in order to facilitate learning of mathematics. Although their framework has been developed from studies of mathematics teachers in elementary and middle school (in the U.S.), it is tempting to suggest that kindergarten teachers also need some kind of MKT in their practice. When reviewing the literature, however, attempts to investigate the kind of mathematical knowledge that kindergarten teachers need has so far been scarce. Lee (2010) is one of very few examples, but her focus is on pedagogical content knowledge, and she does not mention the MKT framework. Carlsen, Erfjord and Hundeland (2010) have investigated the competence of kindergarten teachers in a sociocultural view (and so have others), but they did not in any way build upon or relate to the MKT framework. In this paper we use a case study from a Norwegian kindergarten as a context for a first attempt to investigate some possibilities and limitations of using the MKT framework as an analytical tool in a kindergarten context. The following research question has been formulated:

What are the similarities and differences between the “tasks of teaching” of mathematics teachers in school and those of kindergarten teachers?
THEORETICAL BACKGROUND

Before going into the MKT framework in more detail, it is important to clarify a few issues related to the Norwegian kindergarten context. As identified in Starting Strong II (OECD, 2006, chap. 3), there is often made a distinction internationally between two main traditions in early childhood education. The Nordic countries (including Norway) and some countries in central Europe are often placed within what is referred to as a social pedagogy tradition in early childhood education. Within such a tradition, kindergartens are viewed as institutions where a broad concept of pedagogy is used, and a combination of care, upbringing and learning is emphasized (ibid.). The other main tradition is referred to as the pre-primary tradition, and within this tradition, kindergarten is viewed as an institution which has a main focus on preparing the children for school. Within the social pedagogy tradition, free play is emphasized, whereas kindergartens in countries with a pre-primary tradition often have a stronger resemblance with traditional schools (ibid.). Such differences are important to have in mind when discussing the use of the MKT framework in a kindergarten setting.

Another important aspect when discussing Norwegian kindergartens is related to a particular political initiative. In 2009, the Norwegian Government decided (through law regulations) that all children (1-6 year olds) should have the right to go to kindergarten (Kunnskapsdepartementet, 2009). As a result, a number of new kindergartens opened. This massive of kindergartens did not lead to a corresponding expansion of kindergarten teachers, and several municipalities still experience a severe lack of educated kindergarten teachers. At the same time, the knowledge and competence of the kindergarten teachers was strongly emphasized by the Government (ibid.). Norwegian kindergartens are thus faced with a huge challenge, and in this connection it is appropriate to approach the question of what kind of mathematical knowledge these kindergarten teachers need.

The focus in research concerning teacher knowledge has shifted from using the number of courses or study points as an indicator (e.g. Begle, 1979) in order to document teachers’ apparent lack of understanding about the mathematics that their students are supposed to learn (Cooney, Shealy, & Arvold, 1998), to a focus on the many facets of teachers’ mathematical knowledge for teaching (e.g. Ball et al., 2008). A large proportion of the research that includes the latter focus builds upon Shulman’s (1986) conceptions of the different aspects of teachers’ professional knowledge. His model originally distinguished between seven different kinds of knowledge, whereas three of those had a subject-related content: pedagogical content knowledge, content knowledge, and knowledge of curriculum. Shulman’s model has lately been developed further by Ball and her colleagues at the University of Michigan (e.g. Ball et al., 2008). They present a content specific model for teachers’ mathematical knowledge for teaching.
Figure 1. Aspects of MKT (from Ball et al., 2008, p. 403).

These researchers have had a particular focus on the so-called work of teaching, and as a result of their studies, a list of some distinct and important tasks of teaching was proposed [2]. Although these tasks of teaching have been identified by studying mathematics teachers in school, it is interesting to investigate whether or not kindergarten teachers are faced with the same tasks in their work. We discuss this in the context of a shopping game in a Norwegian kindergarten, and we focus on a selection of tasks that appeared relevant for this particular context.

METHODS

The context for the study is a group of 3-year old children in a Norwegian kindergarten. Mary is the main kindergarten teacher in this class, and she does not have an approved education as kindergarten teacher yet. The reason for selecting Mary and her group as a case in this connection, is that we believe that analyses of her teaching practice can be used as a starting point for identifying the MKT that kindergarten teachers need, and which she appears to be in the process of developing. Hiebert, Gallimore and Stigler (2002) argue that practitioner knowledge along with professional public knowledge provide a knowledge base for the teaching profession, and this argument can be used as rationale for our selection of case as well.

In a larger context, Mary and her group had been part of a developmental study for about half a year at the time of this case study. During that year, a number of visits had been made to the kindergarten by the main researcher in order to discuss, plan and evaluate learning activities with the kindergarten teachers.

The data we analyze here is from an activity where Mary decided to stimulate the development of the children’s concept of number and counting in the context of a shopping game. In addition to video recordings of the actual activity and field notes,
data were gathered from audio recording of interviews and discussions with Mary in connection with the planning and evaluation of the activity.

The recordings of audio (and video) were transcribed, and these transcripts were analyzed through content analysis (e.g. Kvale, 1996) with MKT as a theoretical lens.

RESULTS

When the interview starts, Mary and the researcher have a little discussion about their last project. In that project, their focus had been on figures and shapes, and now they want to shift their focus towards numbers and counting. The children had already made experiences with numbers (or numerals) in relation to emergency numbers (somewhat equivalent to 911, only there are three different in Norway). They had talked about these numbers and linked them with photos of an ambulance, a police car and a fire engine respectively. Mary starts elaborating on her ideas and thoughts so far, and a discussion about the new project evolves. Mary does not want to leave their previous focus on shapes and figures completely behind, but she still wants to shift her main focus somewhat. She discusses this with the researcher:

Researcher: Yes. Mmm. Then I think it sounds reasonable that you choose something [an issue] that you really [want to] spend time on.

Mary: Yes, because I observe that, when we have spent so much time on circles and triangles, then they manage it! And then ... then we know that we should spend some more time on other things [issues] as well. And then ... no, I think that the counting [in itself], that [issue] we manage to connect with most [of our activities], both in songs, books, in assembly - well, we simply count all kinds of [objects]. Then we’ll be able to manage it.

They keep discussing how the issue of counting appears in different settings, like in games. When playing games, especially board games where dices are used, the children need to count the steps while they are moving pieces along the board. This kind of counting appears to be difficult for the children in Mary’s group, she reveals. In their continued discussion, they focus on the connection between counting out loud and making a one-to-one correspondence, which the children have to master when counting objects. Mary and her colleagues have experienced that the children count asynchronously in many occasions. This particular kind of knowledge, which might be defined as knowledge of content and students/children, appears to be of importance to the kindergarten teacher. In order to be able to support the children’s learning, a kindergarten teacher needs some knowledge about how children develop number sense, counting skills etc. Mary tells the researcher that the children in her group know the numbers 1-3, and some children can even count further, but something recently came up which surprised her:

Mary: Yes, they do! Well, some even manage to count till 10 in both Norwegian and English. But even though he is counting both in Norwegian and English till 10, then I was actually surprised when we were sitting down reading in
that “duck-book” - that counting book - eh ... that counting by pointing, and I didn’t quite manage to connect the dots there. So it became a bit: Oh, [inaudible] that counting by pointing then it went a bit pell mell, so ... and then I was a bit worried based on what I maybe had anticipated, because I expected something [more] from a child who speaks so extremely well! And [he] manages to explain himself incredibly well. But maybe it was ... I hadn’t actually - then I got a bit surprised.

Here, Mary shares her experiences from a situation that emerged when she was reading together with a boy who she believed was really good at counting. He knew his numbers from one through ten in both English and Norwegian, but he still appeared to have problems using the counting as a tool in order to find the quantity. This illustrates a kind of knowledge of content and students/children, and in this example it was a matter of Mary discovering that there was something she did not know about before she experienced this situation.

Mary decides to facilitate the playing of a shopping game in her group, and she intends to use this as an arena to stimulate the children’s further development of counting skills. The children need to figure out how much a certain good costs, count out the correct amount of money, pay for the goods, and possibly receive the correct amount of change if they have paid more than the costs. Mary’s idea was that all of this would provide a nice context for stimulating the children and provide them with rich experiences in relation to numbers, quantity and counting.

The next time the researcher visits the kindergarten, Mary and her colleagues have already started experimenting with the shopping game. They had decided to keep the prices low, and they agreed to represent the prices with a numerical representation along with the correct number of dots. This decision relates to a task of teaching where the kindergarten teacher needs to select the appropriate representation for particular purposes, and the knowledge involved in this process can be labeled as what Ball and colleagues (2008) refer to as knowledge of content and students.

The starting point, based on Mary’s experiences with a particular boy, was a belief that the children would not be so skillful in pointing by counting. When they started playing the shopping game, Mary soon experienced that she had to adjust her goals somewhat:

Mary: No, what has happened is that ... well, before we managed to finish this properly, we were very focused on that counting by pointing. And suddenly then all managed to ... [count] till more than 10. I think there are two - we had a round at an assembly, and then they counted, yes then they counted till more than 10. I think there were two [of the children] who started to shake with the finger at 6.

Researcher: Mmm.

Mary: So, they have managed to come very far with this [already]!
The children were obviously motivated to play the shopping game, and all of a sudden most of them were able to count objects up till 10 and even appeared to understand about the price tags. Then something happened:

Mary: What became a little bit funny, was when [laughs a bit] Kari [a colleague] came to film [laughs a bit more], then they easily understood [about] the prices. They did, that was not a problem. What became difficult [for them] was to count out the correct amount of money. They didn’t manage that ... properly. Then they were ... actually, they were more concerned with those items ... and the shopping part. They were very eager to shop.

The children had rather quickly developed their counting skills, and they were able to count the number of coins they possessed. When they were going to use their counting skills to “count out” the correct amount of money from a larger amount, however, many children struggled.

Mary: But it became difficult when they had - when I had given them some money, and said: “How many [coins] do you have to pick out then?

Researcher: Yes, so finding the correct amount [of money], that was difficult.

Mary: It was a bit difficult in the beginning. Yes, but I don’t think it will take long before they understand that as well.

Researcher: No, because there is a little difference in asking about how many coins there are, and finding ... four coins, in a way.

Mary: Yes, because that was a bit difficult [for them], because they had to pick out that many [coins] when I had given them more, or when I held them [those coins] in my hand and said: “Yes, but now - how many [coins] do you need now in order to pay for that thing?” Then they just wanted to take all the coins. Actually, even though it was 7, and maybe they should only use 4 (...

Mary’s experiences in this situation apparently went beyond the practice based knowledge and experiences that she had made before.

The discussions between Mary and the researcher indicate that counting is a complex activity. To use a context like this in order to facilitate children’s learning, a particular kind of knowledge is needed. In the discussions below, we investigate how the tasks of teaching that Mary face are related to some of the tasks of teaching that were identified by Ball and colleagues (2008) in their studies of mathematics teachers in U.S. schools.

DISCUSSION
In a typical Norwegian kindergarten, there are no mathematics lessons, no mathematics textbooks, no board where the teacher presents anything, and no traditional classroom with desks. The children’s learning takes place in everyday
activities and play situations. As a result, the (Norwegian) kindergarten teachers are faced with challenges that are different from those of mathematics teachers in school. When discussing a possible application of the MKT framework in a Norwegian kindergarten setting, such contextual (and cultural) differences are important to be aware of.

The dialogue between Mary and the researcher has indicated that Mary has some kind of MKT about counting that she makes use of in the context of the shopping game. She relates previous experience from shapes and figures to the new topic of counting. The need for some kind of pedagogical content knowledge (including knowledge of content and students/children in particular) appears evident in this situation. The challenge is to try and distinguish what kind of content-related knowledge (specialized content knowledge in particular) that kindergarten teachers like Mary need. A focus on tasks of teaching is a relevant tool to use when approaching such a challenge.

Mary is also involved in work related to presenting ideas. Mary’s work of teaching is, however, quite different from that of a mathematics teacher in school. In our particular case, Mary introduced an activity that she believed would provide the children with various experiences related to counting. She would not, however, present ideas of counting to a whole group of children in a lecture-like way. Instead, she has to react to challenges as they appear within the context of a play situation. Mason and Spence (1999) propose that the absence of the active knowledge (knowing-to) blocks teachers and students from responding constructively in the moment. In the same way, it is an important feature for a kindergarten teacher to act in the moment and to show awareness in a particular teaching situation. In Mary’s situation, we might refer to this as situated knowledge of responding to the children’s questions. The question she had to respond to, however, was not made explicit from the children, it just appeared from the children’s acting in the play situation.

For a mathematics teacher in school, teaching is often related to a particular textbook or other curriculum material. The teacher presents a mathematical idea to the class, and appropriate examples are used to illustrate or make specific a certain point. A Norwegian kindergarten teacher, like Mary, does not have a mathematics textbook. Instead, she presents a mathematical idea by using examples as they appear naturally in the play situation, and she is trying to facilitate a context in which the children can experience a certain idea. We would suggest that a reformulation is necessary in order for the tasks of teaching to be relevant in a kindergarten context. One suggestion is to merge the two tasks that were originally defined as “presenting mathematical ideas” and “finding an example to make a specific mathematical point” into “facilitating activities that enable children to experience mathematical ideas”.

Another task of teaching that we identify in this case is that of connecting a topic taught with topics from prior years. Several issues appear problematic when trying to apply such a description to the tasks involved in Mary’s practice. Most importantly, she is not teaching the children in a traditional sense, and Norwegian kindergarten
teachers (and educators) often avoid using the word “teaching” altogether. Different topics are covered through experiences from play situations and informal discovery activities, and it is therefore hard to track previously taught topics in Norwegian kindergartens. She facilitates the children’s learning and exploring in a play context. The aims that she has set for the activity are based on her impressions of where the children are in their mathematical development rather than knowledge of previously taught topics. It becomes a challenge for Mary to figure out what kind of informal knowledge the children have previously built in relation to this topic. Oftentimes, they have made experiences in free play (where Mary has not been present), or their informal knowledge have been built from experiences in everyday situations at home or in kindergarten. Whereas a mathematics teacher in school can go back to curriculum materials (like textbooks), previous tests or worksheets, Norwegian kindergarten teachers do not have this possibility. The task of connecting with previously taught topics thus becomes a different task of teaching when compared with that of school teachers.

Other tasks of teaching (as presented by Ball et al., 2008) are more relevant for describing the work of teaching of Norwegian kindergarten teachers, but the ones discussed above are somewhat problematic.

CONCLUSIONS

When Ball and colleagues (e.g. 2008) proposed their theoretical framework of MKT, they also included a list of common tasks of teaching that were intended to describe the work of teaching of mathematics teachers in school. The research that this framework builds upon was conducted in the U.S. only, but the tasks of teaching as well as the theoretical framework as a whole were still supposed to be of a more universal nature. When trying to apply this framework to describe the professional knowledge of a Norwegian kindergarten teacher, some problematic issues appear. Although the model’s distinction between various aspects of teacher knowledge appears to be applicable in a kindergarten setting, some of the proposed tasks of teaching have to be modified. The main reason is that the work of teaching of a Norwegian kindergarten teacher is very different from that of a mathematics teacher in U.S. Schools.

Whereas mathematics teachers in school are constantly faced with challenges regarding how to present mathematical ideas, the entire concept of presenting mathematical ideas needs to be described differently in order to apply as a description of the work of teaching that Norwegian kindergarten teachers are involved with. Although it can be described as a similar kind of challenge, the way a kindergarten teacher has to use play situations and everyday activities in order to facilitate children’s informal experiences with mathematical ideas is quite different from when mathematics teachers in school attempt to present mathematical ideas to their pupils. Our suggestion is to merge the two tasks that were originally defined by Ball and colleagues (2008) as “presenting mathematical ideas” and “finding an example to
make a specific mathematical point” into “facilitating and using activities and play situations that enable children to experience mathematical ideas”. Similarly, the task of teaching related to connecting a topic taught with topics from previous years also needs some adaptation. For a Norwegian kindergarten teacher, it becomes more of a challenge related to uncovering and building upon the children’s previous informal knowledge and experiences from everyday activities and play situations.

The Norwegian kindergarten belongs to a social pedagogy tradition (see OECD, 2006), and we suggest that some of the challenges with using the MKT model in a kindergarten context might be relevant for other kindergartens and kindergarten teachers within such a tradition. The work of teaching of kindergarten teachers within the pre-primary tradition (ibid.) is probably more similar to that of mathematics teachers in school, and the MKT model along with the proposed list of tasks of teaching might be more directly transferable in such a context. We believe that further research is needed in order to learn more about the tasks of teaching that kindergarten teachers are faced with. Although the MKT model can be used to describe some relevant aspects of the professional knowledge that is needed in a kindergarten setting, vital differences between the work of teaching as well as the tasks of teaching of kindergarten teachers and those of mathematics teachers in school exist. Further studies are needed in order to investigate such similarities and differences, and we believe that special attention needs to be made in relation to cultural as well as situated aspects.

NOTES

1. Our research project has been supported by OLF The Norwegian Oil Industry Association.

2. Tasks of teaching refer to a specific list of challenges that have been identified. The complete list includes: Presenting mathematical ideas, Responding to students’ “why” questions, Finding an example to make a specific mathematical point, Recognizing what is involved in using a particular representation, Linking representations to underlying ideas and to other representations, Connecting a topic being taught to topics from prior or future years, Explaining mathematical goals and purposes to parents, Appraising and adapting the mathematical content of textbooks, Modifying tasks to be either easier or harder, Evaluating the plausibility of students’ claims (often quickly), Giving or evaluating mathematical explanations, Choosing and developing useable definitions, Using mathematical notation and language and critiquing its use, Asking productive mathematical questions, Selecting representations for particular purposes, Inspecting equivalencies (Ball et al., 2008, p. 400).

REFERENCES


