What maths do children engage with in Swedish preschools?

Maria L. Johansson, Troels Lange, Tamsin Meaney, Eva Riesbeck and Anna Wernberg analyse the different types of mathematical activities young learners engage in in early years settings.

There is little research on the type of mathematical activities made available either through explicit interactions or incidentally through the provision of physical resources in preschools. Often the school curriculum with its emphasis on number knowledge has driven the research into mathematics at preschools (see Clarke, Clarke & Cheeseman, 2006). However, the abstract nature of number terms can mean that they are more difficult to learn than relational terms such as heavy and empty, (Hore & Meaney, 2008). Yet, preschool teachers may still consider mathematics to be only “sifferskrivning och ramsrakning (writing numerals and reciting counting rhymes)” (Doverborg, 2006, p. 7; our translation).

Consequently, although the Swedish preschool curriculum, implemented in 1998 (Skolverket, 1998), included mathematical topics, such as measurement, shape, space and time, there is uncertainty about whether Swedish preschool teachers introduced children to the full range of these ideas.

The data for our research came from a private preschool in a large city in the southern part of Sweden. We had asked to film situations which involved mathematics. Filming was undertaken with different classes/groups over several days in November and December, 2011. Altogether, there were about eight hours of filming, which involved children engaging in activities both indoors and outside.

Categorising mathematical activities

Although not acknowledged, the mathematical ideas highlighted in the revised Swedish preschool curriculum are based on Bishop’s (1988a; 1988b) six categories of mathematical activities (see Utbildningsdepartementet, 2010). Bishop saw these categories as universal for any culture and labelled them as mathematics, with a small “m”. The discipline of Mathematics, which he capitalised, included specific versions of the six activities and thus was one kind of mathematics. Bishop’s six categories, therefore, have a different background and focus than the topics often connected with school mathematics, although there is some overlap. The categories were:

- **Counting.** The use of a systematic way to compare and order discrete phenomena. It may involve tallying, or using objects or string to record, or special number words or names.
- **Locating.** Exploring one’s spatial environment and conceptualising and symbolising that environment, with models, diagrams, drawings, words or other means.
- **Measuring.** Quantifying qualities for the purposes of comparison and ordering, using objects or tokens as measuring devices with associated units or ‘measure-words’.
- **Designing.** Creating a shape or design for an object or for any part of one’s spatial environment. It may involve making the object, as a ‘mental template’, or symbolising it in some conventionalised way.
- **Playing.** Devising, and engaging in, games and pastimes, with more or less formalised rules that all players must abide by.
- **Explaining.** Finding ways to account for the existence of phenomena, be they religious, animistic or scientific. (from Bishop, 1988a, p. 182).

By using Bishop’s six categories as the basis of the preschool curriculum, the focus could be on the mathematics that forms the children’s experiences and interests, which could be considered as small-m mathematics, rather than on what they do not have of school mathematics, considered to be more closely connected to big-m Mathematics.

Instrumental or pedagogical purposes

An issue in this research was whether the teacher and/or the children needed to recognise their interactions as mathematics or whether it was sufficient for us, as mathematics education researchers, to do so. We chose to circumvent the discussion by distinguishing between instrumental and pedagogical tasks. In examining interactions between parents or preschool teachers and their children, Walkerdine (1988) considered instrumental tasks to be those which focussed on achieving a specific aim and included mathematical components only to achieve that aim. On the other hand, pedagogical tasks had the main...
What maths do children engage with in Swedish preschools?

The purpose of teaching children about mathematics. Consequently, we classified the activities according to Bishop’s six categories and whether the tasks had a pedagogical or an instrumental purpose. To do so, we tightened the definitions so that if the main focus was on the mathematics, we classified the activity as pedagogical. When the mathematics was incidental then the activity was classified as instrumental.

In the next sections, we describe 12 activities and why we considered them to represent Bishop’s six categories, with the two different purposes. Many times, one activity seemed to have features of several categories, both in relationship to the mathematics and its purpose. Hence, even with our tighter definitions, not all activities could be easily classified.

**Counting: Instrumental**

In an outside activity, the teacher had the children pretend to be magpies and collect five leaves to place in hoops which were their ‘pantries’.

<table>
<thead>
<tr>
<th>Björn:</th>
<th>Jag kan ränka, en, två, tre, fyra, fem.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lärare:</td>
<td>Fem, bra! Nu har ni fem stora löv i ert skafferi.</td>
</tr>
</tbody>
</table>

The focus of the activity was for the children to find five leaves. However, the child initiated counting aloud and it seemed that it was to help the child know that they had completed the task appropriately. Consequently, we decided that the purpose for the counting was instrumental to the child making sure that he had enough leaves.

**Counting: Pedagogical**

In contrast to the previous activity, in this exchange a child’s miscounting of some jars became the focus for the teacher.

<table>
<thead>
<tr>
<th>Mia:</th>
<th>En, två, tre fyra, fem sex, sju. Sju.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lärare:</td>
<td>Sju … Lena, vill du räkna alla burkarna tillsammans?</td>
</tr>
<tr>
<td>Lena:</td>
<td>[pekräknar] En, två, tre, fyra, fem, sex, sju, åtta. Åtta.</td>
</tr>
</tbody>
</table>

By asking another child to also count the jars, the teacher seemed to want to contrast the two answers and thus problematise the first count. Although the original counting was child initiated, the teacher’s intervention changed the purpose of the activity. However, when the child changed her answer to eight, the teacher did not pursue her pedagogical goal.

**Measuring: Instrumental**

When playing outside, two children described their mittens using a range of different measurement terms.

<table>
<thead>
<tr>
<th>Leo:</th>
<th>Nu är dom varma.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lärare:</td>
<td>Är dom varma?</td>
</tr>
<tr>
<td>Bo:</td>
<td>Mina vantar är, är tjocka.</td>
</tr>
<tr>
<td>Lärare:</td>
<td>Är dom där borta?</td>
</tr>
<tr>
<td>Bo:</td>
<td>Och varma.</td>
</tr>
<tr>
<td>Lärare:</td>
<td>Är dom varma där?</td>
</tr>
<tr>
<td>Bo:</td>
<td>Och tjocka, tjocka och varma, dom tunna [vantar] är inne.</td>
</tr>
</tbody>
</table>

For the children, the warmth of their mittens is something to be discussed. This is an occasion, where the purpose of the activity is not to solve a problem or to learn mathematics, but to make comments. We, therefore, considered the use of measurement terms to be part of providing the descriptions. Consequently, we classified the activity as being instrumental. However, the teacher’s questions suggest that she may have wanted to focus more on the vocabulary.
Measuring: Pedagogical

After a child had filled a bucket up with sand, the teacher asked what he wanted to do next. In so doing, the amount of sand and how heavy it was came into focus.

| Lärare: Vad ska vi göra nu med hinken? | Teacher: What shall we do now with the bucket? |
| Lärare: Flatten den? .. Så vad betyder det? | Teacher: Flatten it? .. So what does that mean? |
| Viktor: Vända. | Viktor: Turn |
| Lärare: Vända den? Hur ska vi göra det då? | Teacher: Turn it? How do we do that then? |
| Lärare: Ska vi prova, ska du prova? Oj, var den tung eller lätt? | Teacher: Shall we try, shall you try? Oh, was it heavy or light? |
| Lärare: Tung. Hur ska vi då göra det? Hur ska vi kunna vända när den var så tung? Har du nåt förslag? | Teacher: Heavy. What shall we do then? How shall we turn it when it is so heavy? Have you some suggestions? |

This was a difficult activity to categorise. In the interaction, the focus became the relationship between the amount of sand in the bucket, the sand’s volume and how heavy the sand was. However, the child’s wish to turn the bucket upside down suggests that the mathematics was incidental rather than the main focus. The teacher queried the child about his interpretation of what he was doing, but it was the child who came up with the solution of emptying some sand out of the bucket. It may have been that it was only the teacher who recognised the pedagogical point of highlighting the relationship between the heaviness and the volume of the sand as well as trying to extend the child’s ability to explain their thinking.

Locating: Pedagogical

Whilst playing outside, one toddler climbed onto a bench and walked back and forth along it. The photograph shows the child requesting assistance to get down by raising her arms to the teacher. When the teacher did not immediately pick the child up, the child clambered down after first gauging how far she had to go. Exploration of space is a feature of location activities. Although there was no teacher actively involved, we consider that locating was the main focus of the activity and so it had a pedagogical rather than instrumental purpose. She was developing a sense of ‘on’, ‘along’, ‘above’, ‘up’ and ‘down’, which at later date could be given verbal labels. Further research is needed to explore how non-verbal experiences are connected to being able to talk about them.

Locating: Instrumental

As the photograph shows moving toy vehicles around involves children locating, themselves, other objects and the vehicle. The mathematical activity of locating, thus, is instrumental for achieving the aim of keeping the truck moving.

Designing: Instrumental

This photograph shows two girls using sand and twigs to make a mini-garden. Again, the verbal interaction was minimal. One girl focused on building up the sand around the base of the twig whilst the other girl was interested in a broken branch that was connected to the twig and how she could arrange it by moving it around. Bishop (1988b) suggests that
“the essence of designing is transforming a part of nature” (p. 39) and this would suggest that this activity was a pedagogical one rather than an instrumental one. However, we chose to classify this activity as instrumental as the main purpose seemed to be exploring the sand and twigs, with the garden design arising spontaneously from this exploration. This is in contrast to the previous activity, where the child walked along the bench and deliberately seemed to be exploring spatial orientation, suggesting that her purpose was pedagogical.

**Designing: Pedagogical**

When collecting leaves, the teacher asked the children to describe the shape of one of them. This extract is just a small part of the exchange where the teacher prompted the children to use a range of terms to describe the shape.

<table>
<thead>
<tr>
<th>Lärare: Hur många kanter har det?</th>
<th>Teacher: How many edges does it have?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerstin: En, två, tre, fyra, fem.</td>
<td>Kerstin: One, two, three, four, five.</td>
</tr>
<tr>
<td>Lärare: Ja, det är femkantigt.</td>
<td>Teacher: Yes, it is pentagonal.</td>
</tr>
<tr>
<td>Per: Det har en, två, tre.</td>
<td>Per: It has one, two, three.</td>
</tr>
<tr>
<td>Lärare: Det här då? Har det några kanter? Vilken form har detta lövet?</td>
<td>Teacher: This then? Does it have any edges? What shape has the leaf?</td>
</tr>
<tr>
<td>Annika: Det är platt (otydligt) också är den rak.</td>
<td>Annika: It is flat (inaudible) and also it is straight.</td>
</tr>
<tr>
<td>Lärare: Platt och rak ja, vilken form har detta lövet då Annika?</td>
<td>Teacher: Flat and straight so, what shape has this leaf then Annika?</td>
</tr>
</tbody>
</table>

Although she used one of the children’s leaves as the stimuli, the teacher had a clear pedagogical purpose in drawing the children’s attention to different features of the leaf. The activity is not about exploring but about using their mathematical words and understandings to respond to the teacher’s requests for descriptions. The teacher knows the answers to her questions and the expectation is that the children will show what they know. In this way, the teacher ensures that the mathematics is at the centre of the exchange.

**Playing: Instrumental**

The teacher set up a game for determining equivalent sets by first turning the children into magpies and some plastic hoops into nests. The rule of the game was that the children had to fly to nests so that every nest had the same number of magpies.

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>L: Now I change you, hocus, pocus, filiokus, into magpies. All small magpies, here you are, fly into a nest. Where are you moving to Nils? Two magpies that have not moved in. Move in, move into a nest, Hans. Like that, yes, I’m the one to tell the magpies what to do, but are there an equal number in all the nests?</td>
</tr>
</tbody>
</table>

This was a fantasy game that had rules that the children had to follow if they were to participate. At least for the teacher, being magpies was instrumental for achieving the main focus which was on making equivalent sets. However, for some of the children, flying around as magpies was a more important focus.

**Playing: Pedagogical**

On one occasion outside, the teacher arranged the children in a circle. The teacher asked the children to explain how to play a game, where they had to pass a squeeze from hand to hand around the circle.

<table>
<thead>
<tr>
<th>Lärare: Hur går detta till nu Elen?</th>
<th>Teacher: How does this work now Elen?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elen: Det var inte roligt att trycka löst.</td>
<td>Elen: It was not fun to push loosely.</td>
</tr>
</tbody>
</table>
In this activity, the rules of the game were the focus and the discussion of them had a pedagogical purpose to ensure that everyone knew what to do. It may also have been that the teacher had wanted the children to explain the rules but her own comments meant that the children did not feel there was anything for them to explain.

Explanations: Instrumental

When outside, the children collected ice from a frozen puddle and showed it to the teacher. One child stated she would not collect any more ice and the teacher asked why.

Barbro: Nu vill inte jag ta mer is.
Barbro: Now I will not take more ice.

Lärare: Varför då?
Teacher: Why?

Barbro: För jag blir smutsig.
Barbro: For I will get dirty.

Lärare: Blir du smutsig?
Lärare: Do you become dirty?

Barbro: Och kall.
Barbro: And cold.

Lärare: Och kall. Man blir iskall när man tar i is.
Teacher: And cold. One gets ice cold when one holds the ice.

For the child, her explanation was incidental to not picking up any more ice and thus the exchange was classified as instrumental. However, by repeating the child’s answer, the teacher may have had a pedagogical purpose in asking for an elaboration of the explanation.

Explanations: Pedagogical

On some occasions, the teachers gave a specific explanation and this became the focus of the activity. At the beginning of a day of filming, the teacher began by explaining mathematics to the children.


Emma: Du har berättat allt.

Teacher: Yes, through the mitten like Emma does. There you can probably press a little harder. Can you tell everybody what to do? For all have probably not participated […] Do you hug with both hands at once? Press with one hand? One does not press at any time, right? How does it work then?

Emma: You have told us everything.

This explanation was not instrumental in achieving another purpose but was the main focus. However, the children would not have learnt what features constituted an explanation from simply listening to the explanation. This is in contrast to the pedagogical playing task where, from listening to the teacher’s instructions, the children would have learnt about the need to follow rules to play a game. In our data set, there were no examples of the children being introduced to the features of an explanation. On the other hand, there were many occasions, such as the pedagogical measuring task, where the teacher’s questions prompted the children to provide or elaborate on an explanation. Thus, the children may have learnt implicitly what the features of an explanation were.

Conclusion

The study indicates that these children had opportunities to engage in different mathematical activities. Our expectation was that we would see many activities involving learning to count. Although counting did feature, it was not the only activity that the teachers provided. Nevertheless, categorising the activities was more difficult than we had originally anticipated. Many activities seemed to have more than one mathematical focus and often it was difficult to be certain whether the activity was an instrumental or pedagogical one. In some cases, the teacher and the child may have had different perspectives. When the children described the warmth of their mittens, they may have wanted simply to open up a discussion about it.
What maths do children engage with in Swedish preschools?

with the teacher. On the other hand, the teacher may have had a pedagogical purpose in asking questions that not only continued the conversation, but kept the focus on measurement terms, about thickness and warmth. Both the child and the teacher also used terms, such as “over there” and “inside”, suggesting that a minor mathematical theme was location. Generally, pedagogical tasks were directed by a teacher but this was not always the case. In the pedagogical location activity, teacher involvement was minimal and the child was the one who structured the activity so that the focus was on location. It may be that activities with both pedagogical and instrumental purposes support children to become aware of and use mathematical language.

Our difficulties in categorising the activities bring us back to the question of who is doing the classification and for what purpose. It may be that we need to think carefully about our reason for doing the classification and how our choices will influence what we can discuss when trying to describe the mathematics in preschools.

Maria L. Johansson: Luleå Technical University, Troels Lange and Tamsin Meaney: Bergen University College, Eva Riesbeck and Anna Wernberg: Malmö University.

References


The attached document has been downloaded or otherwise acquired from the website of the Association of Teachers of Mathematics (ATM) at www.atm.org.uk

Legitimate uses of this document include printing of one copy for personal use, reasonable duplication for academic and educational purposes. It may not be used for any other purpose in any way that may be deleterious to the work, aims, principles or ends of ATM. Neither the original electronic or digital version nor this paper version, no matter by whom or in what form it is reproduced, may be re-published, transmitted electronically or digitally, projected or otherwise used outside the above standard copyright permissions. The electronic or digital version may not be uploaded to a website or other server.

Any copies of this document MUST be accompanied by a copy of this page in its entirety. If you want to reproduce this document beyond the restricted permissions here, then application must be made for express permission to copyright@atm.org.uk

**ATM is a not for profit professional teaching association. The majority of funding used to produce and prepare the MT journal is procured through our membership subscriptions.**

Mathematics Teaching does not seek to conform to an 'official' view on the teaching of mathematics, whatever that may be. The editorial board wishes to encourage contributors to express their personal views on the teaching and learning of mathematics.

ATM is an association of teachers in which everyone has a contribution to make, experiences and insights to share. Whether practical, political, philosophical or speculative, we are looking for articles which reflect on the practice of teaching mathematics. We aim to publish articles that will be of interest to the breadth of our membership, from the Foundation Stage to Higher and Further Education; as well as a balance between those derived from research and from practical experience. Submitted articles are accepted for publication based on their clarity, topicality, the extent to which they reflect upon knowledge and understanding of mathematics teaching and learning, and their contribution to inspiring further development and research.

Join ATM at any time and receive twelve months of membership, including instant access to member discounts and resources. Spread the cost and pay in ten monthly instalments.

**Membership Includes:**

- Five copies of the ATM journal Mathematics Teaching (MT)
- A 25% discount on all shop items
- Considerable discounts at the hugely popular annual ATM conference
- Electronic access to thousands of online MT journal articles
- Access to all online member-only resources
- Professional support and enrichment – being part of a community where ideas are generated and shared
- Regular ATM e-newsletters, containing current news and activities
- A network of local branches offering regular meetings
- Accreditation - ATM is proud to offer members the opportunity to apply for the CMathTeach Designation, making ATM membership the route to Charted Mathematics Teaching status
- Influence and having a voice - eligibility to vote on resolutions that shape the direction of ATM