



Special issue on mathematics in early childhood education

Tamsin Meaney, Elin K. L. Reikerås* and Camilla N. Justnes

Western Norway University of Applied Science, University of Stavanger and Norwegian University of technology and Science, Norway

*Contact corresponding author: Elin K. L. Reikerås, e-mail: elin.reikeraas@uis.no

Mathematics is an important part of children's daily life. The value of mathematics for young children is reflected in curricula for early childhood in the Nordic countries and consequently, mathematics education courses are included in teacher education for early childhood. However, mathematics in early childhood education is understood in different ways, influenced by both politics and research, and practitioners' approach to the field. As a field of research, mathematics education for young children is fairly new in the Nordic countries. From the early 2000s, an increasing interest in this field can be seen in a corresponding increase in the number of publications. This has also seen a dedicated bi-annual conference on mathematics education for young children being held in Scandinavia three times since its inception in 2012. Since the first special issue on kindergarten mathematics was published in *NOMAD Nordic Studies in Mathematics Education* in 2016, the field has continued to expand in a wide range of directions. The articles in this special issue represent a range of current research that shows some of the different directions and depth of research on mathematics in early childhood in Norway and Sweden. In some article the focus is on finding out what children are able to do by themselves (Sumpter & Hedefalk; Saksvik-Raanes et al.; Fosse et al.) while in others it is on what children can do when teachers provide purposefully-designed activities (Björklund & Palmér). In other articles, the focus is to find out what happens in early childhood centres by interviewing teachers (Pollarolo et al.) or examining progression plans (Böhler). In Vee's article the focus was on

what early childhood preservice teachers considered digital apps could contribute to mathematics for young children, while Ackovic did an investigation of theories to do with early childhood teachers work with the youngest children.

In order to investigate these foci, a range of data are analysed, from earlier research (Ackovic), documents (Bøhler), teacher interviews (Pollarolo et al.), clinical interviews with children (Sumpter & Hedefalk), and data from naturalistic settings (Vee). There is also a variety of data analysis methods used from quantitative analysis of computer collected data about children's number understandings (Saksvik-Raanes et al.), through to deductive categorizing (Björklund & Palmér).

The results from these studies provide information about what is known about young children's engagement with mathematical ideas (Björklund & Palmér), children's number understandings at the beginning of school (Saksvik-Raanes et al.), preservice teachers' views of how digital technologies can be used to engage children with mathematics (Vee), and teachers' understandings about critical thinking and mathematics for children (Pollarolo et al.).

Gunnhild Saksvik-Raanes, Trygve Solstad, and Yvonne Grimeland investigate the number knowledge of five-year-olds through their responses to an online assessment tool. In this quantitative study, they found that many of the 77 children who participated showed more understandings than would have been expected from earlier studies. This suggests that kindergartens may need to ensure that children are provided with more challenging activities, while also acknowledging that some children may need more support. Saksvik-Raanes et al. also advocated for the use of digital assessments as being time efficient method for gaining information about children's number understandings. Their experiences with the digital assessment tool led to them suggesting that children could also be provided with experiences to do with number understandings through digital technologies. However, they acknowledged the need to be respectful of the Nordic approach of learning through play than from direct instruction in the use of digital tools.

In their analysis of an intervention study with 1–3-year-olds, Camilla Björklund and Hanna Palmér problematize Freudenthal's concept of mathematising. 94 videos were taken in three kindergartens of 27 participating children who engaged with their teachers in three purposefully-designed activities. The tasks were developed by the researchers with preschool teachers after observations in the preschools, specifically to provide experiences with different representations of numbers that came from the every day (horizontal mathematising). These games involved movement and had specific rules. Taking the Scandinavian approach in which children's agency within play situations is considered a basis for children's learning, they acknowledge the challenge of developing interactions between teachers and very young children that bring out mathematical concepts. They proposed three conditions for when horizontal mathematising can be achieved. There is a need for children to have possibilities to enact their own agency, to have knowledge of the

structure of the game which enables the children to act independently and for the teacher to have an initial mathematical idea so that the children have the opportunity to see the activity as mathematics.

Mona Vee explored kindergarten preservice teachers' understanding of opportunities for children's cultural formation, which equates to the German term *Bildung* or the Norwegian term *danning*, by analysing their evaluations of digital mathematical apps. Analyses of what the kindergarten preservice teachers perceived as appropriate mathematics for the children and how they should learn it provided insight into what the preservice teachers valued as opportunities for children's *danning*. Vee discussed how early childhood education can be developed so that kindergarten teachers include digital tools in their future practice, by having preservice teachers consider several aspects of evaluating digital apps, which included play and creativity. Vee argues that kindergarten preservice teachers' attention to including different aspects can have an impact on the possibilities for children's *danning*.

Enrico Pollarolo, Natalia Kucirkova, Ingunn Størksen, and Tuula H. Skarstein investigate the attitudes Norwegian kindergarten teachers have towards mathematics and higher order thinking. Interviews with ten teachers in three different kindergartens showed that the teachers recognized mathematics as an important subject area to work with and identified many opportunities to work with mathematics in daily activities. They associated mathematics with problem solving, which previous research emphasizes as an aspect of higher order thinking.

Trude Fosse, Troels Lange and Tamsin Meaney are also concerned with problem solving, and especially the potential of play. They justified their study by reintroducing play into the school's curriculum and thus the need to assess how play has been linked to mathematics in kindergarten. Analysis of kindergarten children's engagement with digital apps and second graders' writing of story problems show how play can occur when children pose problems, and when they try out different solution strategies.

In Lovisa Sumpter and Maria Hedefalk's study, two children, aged 4 and 6, were asked to solve six problems in which biscuits had to be shared between some soft toys. Although the children often used equal sharing, they were also able to engage in sharing that took into consideration other factors. For example, when it was stated that one of the toys was hungry or in need of extra resources, the children were able to share in other ways that showed a concern for the well-being of the toys. In this way, the children showed ethical reasoning about appropriate distribution of resources. The authors noted that this ethical reasoning also involved mathematical understandings around how unequal sharing could be achieved. These understandings were necessary for developing consensus through collective reasoning. Sumpter and Hedefalk highlighted that further research on this topic is needed. They also indicated that the results suggest that distribution problems may result in children engaging in collective mathematical reasoning.

The article by Elena Böhler focusses on the concept of progression and how this appears in the kindergarten's annual plans in the work with the subject, "Number, space and shape." By using qualitative content analysis, she finds a tendency to transition from an orientation towards children's own actions in working with mathematics to an orientation towards knowledge and the learning of concepts (exemplified with shape concepts). The article problematises several features of annual plans, e.g. formulation of tasks according to age groups, prioritisation of mathematical themes and challenges in making continuity visible.

Jovana Ackovic discussed the use of socio-cultural and socio-material theories in analysing the role of early childhood teachers in toddlers' mathematical learning processes. The article summarizes that both socio-cultural theories where the importance of the guidance role and social interaction are emphasized as important and socio-material theory where the facilitating role with an emphasis on learning opportunities that arise in young children's bodily intra-actions with the material environment are central, are perspectives that give different insights into the role of kindergarten staff in young children's mathematical learning processes and a combination of these perspectives will be a good way forward.

This thematic issue illustrates and contributes to the depth and width of what might be involved in the field of early childhood mathematics. These articles illustrate how research on mathematics education in early childhood in the Nordic countries is contributing new and exciting understandings which are different in focus to much of the work undertaken in English-speaking countries. With the vast majority of children attending early childhood from an early age, Nordic researchers are in a strong position to discuss how toddlers engage in mathematical situations. As well, the social pedagogy tradition of Nordic early childhood with its strong emphasis on learning through play provides a context for research that can often broaden understandings about the integration of mathematics into everyday situations. As Nordic mathematics education research in early childhood is further developed, we anticipate that the uniqueness of the context is further utilised to broaden international understandings about this important topic. The articles in this special issue continue the research already done in this area as well as providing a sound basis for future research.

Editors for this special issue

Tamsin Meaney, Elin K. L. Reikerås and Camilla N. Justnes