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# Early Years Mathematics: Introduction to TWG 13

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## Introduction

The Early Years Mathematics working group shares scholarly research revolving around mathematics for children aged 2-8. This includes different areas of mathematics and attention to how mathematics is approached implicitly and explicitly by children and teachers alike. The broad age range affords attention to several transitions within preschool, and from preschool to the early grades of primary school. At each CERME-conference (since CERME 6), the working group on early years mathematics has spent time considering differences in Europe (and outside Europe) regarding the organization of preschool and the cultural approaches of different countries to education at this young age. Some countries have one preschool curriculum for children aged 1-5 (6), while others distinguish between nursery and preschool. The number of children attending preschool in different countries also differs greatly, with consequences for transitions. As an example, Norway has one preschool curriculum and 91.8 % (ages 1-5) and 97.1 % (ages 3-5) of children attended kindergarten in 2018<sup>1</sup>.

Prior to the conference in Utrecht, paper and poster authors were requested to prepare and send to the leaders a brief text outlining the main points of their contribution. This helped the leaders plan the discussions and presentations, and served as a basis for this introduction. Each of the 22 papers were allocated 30 minutes for presentation and discussion. For each paper, an author of a different paper was requested in advance to prepare questions and comments for the paper presenters. The seven posters were also briefly presented in a group session, followed by a group discussion in a one-hour session.

The number of participants in TWG13 in Utrecht was greater than the number of participants in previous years. In addition to participants from Europe, there were also stimulating contributions from outside of Europe (Japan, Canada, and Malawi). In total, 38 participants from thirteen different countries attended the working group (see table below).

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<sup>1</sup> Published on the website by The Norwegian Directorate for Education and Training <https://www.udir.no/tall-og-forskning/statistikk/statistikk-barnehage/tall-og-analyse-av-barnehager-2018/barnehager/> (the website is currently written only in the Norwegian language)

Country	Number of papers	Number of posters	Number of Participants
Canada	1		1
Germany	5	3	10
Greece	2		2
Israel	1		1
Italy	1		1
Japan	1		1
Malawi		2	2
The Netherlands			1
Norway	6		10
Poland	1		1
Sweden	3	1	5
Spain	1		1
UK		1	2
<b>TOTAL</b>	<b>22</b>	<b>7</b>	<b>38</b>

## A variety of topics

Several contributions to TWG13 concern classical, but indeed crucial areas in early years mathematics, such as numbers and arithmetic skills. Björklund and Runesson consider children's way of experiencing numbers, and found evidence of six different ways children can experience numbers. Bjørnebye investigates children's ability to synchronize multiple representations of numerosity in the embodiment of a counting-on-strategy. He argues that bodily experiences could support early appropriation of a counting-on strategy. Lüken highlights the role of finger use during numerical considerations, and considers how the role and use changes over time. Sprenger and Benz consider children's ability to perceive and use structures in sets. They argue that eye-tracking, as a data collection instrument, together with observations, provide strong insight into the two processes of perception and determination of the cardinality of sets of objects. Bakos and Sinclair consider the role of a digital app on the development of children's multiplicative awareness. In particular, they consider the relation between bodily movement and mathematical meaning-making. Bakos and Sinclair found two primary gestures used by children which they discuss. Müller and Tiedemann report from an ongoing study which focuses on children's development of conceptual subitizing, while Bruhn looks at first graders' creative processes when working on arithmetical open-ended problems. Tzekaki and Papadopoulou consider different levels of generalization that children can

develop in arithmetic learning by systematically adopting teaching approaches with relevant tasks and discussion.

Another branch of studies considers approaches that facilitate children's learning of mathematics during the early years. Grimeland and Sikko study children's development of mathematical literacy in a second-grade classroom working with play-coins in an inquiry-based setting. Inquiry-based settings are also the frame for the study by Skoumpourdi. However, her study is related to another area of mathematics – plane geometrical shapes. Skoumpourdi found that cooperative exploration, discussion, and justification processes were fostered in the inquiry-based setting. Pettersen and Volden look at the transition from mathematics in kindergarten to school mathematics. They argue that inquiry-based mathematics education was found to be helpful for children's ability to remember and recognize mathematical activities across the transition.

A study of Matsuo and Nakawa consider whether preschool children can improve their understanding of length and area measurement. In particular, their concern is on direct and indirect measurement, as well as measurement by an arbitrary unit. Their findings pinpoint that area measurement is found hardest to grasp, but partly in play-based settings, while direct comparison is easiest. Vanegas, Prat and Rubio characterize the learning trajectory of children aged six to eight years old when acquiring the notion of length measurement. The group also had a contribution by Bräuning that look at children's development of strategies for a combinatorial task and argues for a process-oriented view.

Palmér and Björklund focus on 2-3 years-old toddlers' ability to explore structural elements while playing "hide the toy-dragon", and pinpoint indications of emergent structural awareness among the small children. The inclusion of toddlers, as young as 2 years, within the scope of focus for TWG13 came as a result of the CERME10 conference and as an overall desire to increase insight into children's learning of mathematics (Levenson, Bartolini Bussi, & Erfjord, 2018). Nordemann and Rottmann look at how children's repeating pattern competencies can be fostered by physical activity, and report that development can be found especially for children with learning difficulties in mathematics. Nergård studies five-years-olds children's use of mathematical concepts, and found evidence of such use when they compare, explain and argue about natural phenomena.

Erfjord, Hundeland, and Carlsen characterise the mathematical discourse evolving as a teacher facilitates a mathematical activity for five-year-old children in kindergarten. Their findings indicate that mathematical discourse was characterised by engaging only one or two of the six children in longer periods and children's contributions were often of a non-mathematical nature. Gifford and Thouless address how teachers develop young children's pattern awareness.

Maffia and Mancarella consider children's interpretation of equalities represented through images, and found evidence that relational thinking can be supported when children work with number sentences containing equivalence. Maj-Tatsis and Tatsis look at characteristics of tasks that promote mathematical reasoning among young children. Tasks that required a shift from geometrical structures to numerical ones were found most difficult for children. Wernicke et al. look at social

training of spatial perception and spatial cognition in an ongoing study based on a training program of children in a day-care centre.

In two studies situated in Malawi, Gobede investigates mediation strategies used by early years mathematics teachers and Mandala explores how primary teacher education prepares pre-service teachers to teach early years mathematics. Svensson focuses on pre-school teacher students' ability to capture children's learning of mathematics in activities in preschool while Johansson, Tossavainen, Faarinen, and Tossavainen analyse student-teachers' perceptions regarding teaching mathematics for young children. Johansson et al. found evidence of different pedagogical beliefs and expectations regarding what mathematics teaching in preschool should be. Breive considers the balance between freedom and structure in kindergarten teachers' orchestration of mathematical learning activities. Tsamir, Tirosh, Levenson and Barkai investigated preschool teachers' self-efficacy for teaching patterning, with attention to why teachers report high self-efficacy before the professional program involved. Finally, Vogler focuses on the indirect processes of learning in preschool situations, which may be considered as an opportunity for children to participate and learn in what may be denoted as a "double layer structure" of every day meanings and abstract mathematical meaning".

## **Methodological approaches**

In TWG13, there has been an ongoing discussion regarding methodological approaches to investigating early mathematics learning. These approaches often reflect the culture of educational settings for children. In some countries in Europe, all kinds of testing and even organised activities are considered problematic when it comes to preschool. The role of play, from (total) children initiated free play to strong teacher guided play is another important discussion that has been ongoing in the group (Levenson, Bartolini Bussi, & Erfjord, 2018). In CERME 11, this discussion again arose and emphasised e.g., by Breive, who considered the balance between freedom and structure in mathematical activities for five-year-old children in kindergarten.

Most of the research reported in TWG13 follows a qualitative data collection approach, with interviews or observations, or lesson observations and video data. However, a variety of ways for analyzing the data were adopted such as: cross-case, process oriented, interpretative, and hermeneutical approaches. There are also reports from a few experiments or design research studies, with pre and post examination of children, mainly with interviews and qualitative analysis. There are also a few quantitative approaches, utilizing tests or questionnaires, and one mixed study. These differences reflect the scope of that area of research, and that different kinds of research can contribute differently.

## **Reference**

Levenson, E. S., Bartolini Bussi, M. G., & Erfjord, I. (2018). Early years mathematics. In T. Dreyfus, M. Artigue, D. Potari, S. Prediger, & K. Ruthven (Eds.), *Developing research in mathematics education: Twenty years of communication, cooperation and collaboration in Europe* (pp. 106–114). New York, USA: Routledge.