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Introduction to the papers of TWG 13:

Early Years Mathematics:

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Introduction

Thematic Working Group 13 focuses on the mathematics learning of 2–8-year-olds. We acknowledge that this learning may take place in kindergarten, preschool, primary school, and other less formal settings. We pay attention to how mathematics is approached implicitly and explicitly by children and teachers, and other responsible adults. A wide range of topics is covered in TWG13, spanning different areas of mathematics and different theoretical and methodological approaches. This wide span is a characteristic feature of TWG13, a feature that has been documented at other conferences as well (e.g., the POEM conferences, see Carlsen et al., 2020) and by Levenson et al. (2018).

Overview

Thirty-six participants from fifteen countries presented 22 papers and 3 posters in TWG13 during the CERME12 conference. These were organized into eight themes, namely: theoretical frameworks, toddlers' education, teachers' actions and training, curriculum and inclusion, analyses of children's activities, measurement in early years mathematics, literature overview, and prospective teachers' education. Each session was devoted to one of these themes and contained paper and poster presentations, followed by a discussion on the presentations, as well as a general discussion on questions related to the theme of the session. Next, we present the main questions related to each theme and the main outcomes of the discussions that took place.

Theoretical frameworks

Two papers were presented in this session, by Wernberg and Johansson, and by Kleven. The questions discussed were related to the possibility and the plausibility of a 'unified' theory, used to provide a holistic view of a learning situation. The discussion led us to acknowledge that theories cannot be static; they need to be continuously developed and adapted, e.g., by empirical studies. Especially when analyzing kindergarten activities, it is difficult to restrict oneself to only the children, the adult, or the activity, since they are all interwoven. Therefore, several frameworks can be useful to grasp this complexity; these frameworks could be the part of a network of theories.

Additionally, qualitative and quantitative methodologies could be used complementarily, in order to reach well-verified theories.

Toddlers' education

Three papers were presented in this session, by Cooke, by Palmer and Björklund, and by Vanegas, Giménez and Prat. The questions discussed related to the outcomes of studies on toddlers' mathematical learning and on the limitation of such studies. We firstly observed that studies on toddlers' mathematical learning are becoming more frequent in TWG13. Additionally, we agreed that the analysis of the mathematical activities of such young children raises questions on whether and what kind of mathematics is actually involved in those activities. By not having access to the verbal utterances of these children, the risk of over-interpretation may be high. We also agreed on the importance of engaging or collaborating with preschool teachers, since their expertise and experience might be crucial in understanding the toddlers' ways of expressing themselves.

Teachers' actions and training

Three papers were presented in this session, by Erfjord, Carlsen and Hundeland, by Barkai, Levenson, Tsamir and Tirosh, and by Anantharajan. The questions discussed were based on the premise that teachers in early childhood education must make many choices related to mathematical activities, materials (books), drawings, etc. These choices may be influenced by their beliefs or their curiosity to learn more about children's thinking. So, we discussed the factors that affect these beliefs and these choices and whether professional development can affect them. We concluded that teachers in early childhood education often have quite stable beliefs, much dependent on their subject-specific knowledge, e.g., beliefs about teaching and learning arithmetic may be different from those about geometry. Similarly, teachers with a problem-solving view on mathematics may highlight different counting strategies, while teachers with an instrumentalist view encourage fixed algorithms. Moreover, teachers' mathematics anxiety may occasionally lead them to resources with immediate use, e.g., a textbook or a worksheet.

Curriculum and inclusion

Three papers were presented in this session, by Henriksen, by Højsted and Rasmussen, and by Lange, Lembrér and Meaney. There was also a poster presented by Walla. The questions discussed were focused on the challenges and the benefits of comparing mathematics curricula from different countries, but also on achieving inclusion. We agreed that considerable differences concerning the role of curriculum in early years mathematics exist among different countries. Therefore, comparing curricula may be quite challenging. The same is the case with the use of textbooks, since most countries do not use textbooks in kindergarten. This, combined with a non-explicit curriculum on mathematics, may in turn lead to a reduction of mathematical activities in kindergarten. We also agreed that the issue of equity is not solely an issue for the mathematics classroom but affects all school subjects.

Analyses of children's activities

Three papers were presented in this session, by Baumanns, Pitta-Pantazi, Demosthenous, Christou, Lilienthal and Schindler, by Conceição and Rodrigues, and by Vogler, Henschen and Teschner.

There was also a poster presented by Pettersen, Volden and Justnes. The questions discussed were based on the premise that often, a narrow focus is needed when we analyze very young students' mathematical activity. So, we discussed the possibilities for triangulation and for generalization of our results. In our discussion, we acknowledged the context-bounded nature of most research on early years mathematics, which in turn leads to qualitative approaches. We also noted that the culture of assessment in the early years varies across different countries.

Measurement in early years mathematics

Three papers were presented in this session, by Robotti, by Pytlak and Maj-Tatsis, and by Hoth and Fricke. We discussed whether a more general measurement sense is useful, e.g., one that incorporates comparisons of objects, informal measurements, etc. We also considered whether the introduction of standard units or other measurement tools support children's first approach to measurement or their intuitions about measure sense. It was noted that in many countries there are learning trajectories beginning with comparisons and by using non-standard units, while there are also activities on measuring with meters or rulers. We agreed that the use of standard units relies on the ability to identify numbers, while the use of non-standard units relies on an experience which supports the discovery of measuring and contributes to construct the measurement sense. Thus, children's experiences of length comparison as a daily activity and the use of non-standard units give rise to the necessity of standard units.

Literature overview

Three papers were presented in this session, by Flaten, by Maffia and Silva, and by Tzekaki. We discussed what can be learned by literature reviews or syntheses. We also discussed the necessity of reaching consensus on our terminology, e.g., on playful learning, board games, and patterning. We agreed that the field of early years mathematics education is blurred, as is mathematics education in general. This is mainly due to the concepts and methodologies adopted from different research areas, such as psychology or sociology. Therefore, literature reviews and other systematic reviews are very helpful in planning and conducting research, since they allow us to systematize our own approach and to look at a given issue from different points of view. We also agreed on the necessity of consensus on our terminology, regardless of cultural differences. At the same time, we need to be aware that sometimes we observe the same terminology used to describe different aspects of mathematics education, but also different terminology used for the same aspects of mathematics learning. This makes it sometimes difficult to synthesize the results of empirical studies.

Prospective teachers' education

Two papers were presented in this session, by Sabo Junger, Ferme and Lipovec, and by Sala-Sebastià, Breda and Farsani. Given the fact that most, if not all, early years teachers do not have a solid mathematical background, and do not necessarily believe in the importance of problem solving, we discussed two issues concerning teacher training, namely how can prospective teachers' problem solving skills be enhanced and how can their attitudes towards problem solving be changed. In our discussion, we agreed that the terms 'problem', 'word problem', 'task' and 'modeling' should be clarified, in order to assist prospective teachers. We also agreed on the necessity of incorporating problem solving as part of prospective teachers' training, including the

use of various heuristics. This in turn, may assist them in identifying and utilizing opportunities for spontaneous problem solving, which will appear during their teaching. Additionally, it can make them cautious before providing children with too much help during problem solving.

Future directions

From the summaries of each session above, we observe that, besides the growing interest in early mathematics education, there are a number of issues that need attention, also in the future. The various curricula, kindergarten systems, and school systems differ significantly across the European countries. These cultural issues cause difficulties for researchers when comparing, aligning, and reflecting on the research results from different countries. However, the discussions that took place in CERME12 were promising in the sense that a growing understanding and acknowledgement of these cultural differences were emerging. Related to the issue of cultural differences, researchers might focus more on early mathematics education in the family, by asking questions such as: How may parents and other responsible adults provide opportunities for young children to engage in mathematics at an early age? Another issue that emerged was the need for developing systematic research in our field, as a way to cope with the multiplicity of approaches and methodologies. Finally, few studies were concerned with affective issues related to early years mathematics. This might be another avenue for future research.

We look forward to further scientific discussions in future CERME conferences. Several of the participants of CERME12 have attended the Early Years Mathematics group several times in the past. We thus see the contours of a research community across country borders.

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