NORSMA 12

Nordic Research Network on
Special Needs Education in Mathematics



CONFERENCE PROGRAMME NORSMA 12 2026

Nordic Conference on Special Needs Education in Mathematics

October 28–29, 2026, Oslo, Norway



Program and book of short abstracts of the NORSMA 12 Conference 2026

Held in Oslo, University of Oslo, 28–29 October 2026

Editors: Anita Lopez-Pedersen, Anita Movik Simensen, Olaug Lona Svingen

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NORSMA 12 CONFERENCE 2026:

DEIA: Diversity, equity, inclusion and access in mathematics

Welcome to NORSMA 12, the Nordic Conference on Special Needs Education in Mathematics. The conference deals with important questions about mathematics and special needs education in the Nordic countries. The theme of NORSMA 12 is "Diversity, equity, inclusion and access in mathematics." This theme reflects the challenges of cultivating classroom practices that create mathematical learning opportunities for all. We hope that NORSMA 12 will be an opportunity for the community to engage in this theme and reflect on the research and practice connection in our field.

Presentations and discussions are organized in themes and target groups. Themes include identification and teaching students in special needs in mathematics, strategies to prevent and intervene, teacher qualifications, and national policies on special needs and mathematics education. Target groups include children, adolescents, adults, and students.

The conference will be fertile ground for inspiration and co-learning across Nordic countries is provided, as education in the Nordic countries shares some similarities, but also differences. In addition, perspectives from outside the Nordic countries will be presented and discussed.

We welcome all participants to join us in Oslo. Thank you to all the participants, authors, presenters, keynote speakers, panelists, reviewers, members of the scientific and organizing committees, the university's staff, volunteers, and everyone else whose efforts have made the conference possible. We wish you a pleasant and rewarding conference experience.

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CONFERENCE PROGRAMME

Wednesday 28.10 (Day 1)	
8:00–8:45	Registration and morning coffee
8:45–9:00	Opening (Aud. 1)
9:00–10:00	Plenary 1: Astrid M. J. Sandsør (Aud. 1)
10:00–10:15	*Coffee Break*
10:15–11:30	Plenary 2: Bert deSmedt (Aud. 1)
11:30–12:30	*Lunch*
12:30–14:00	Parallel sessions A
14:00–14:20	*Coffee Break*
14:20–15:35	Plenary 3: Rachel Lambert (Aud. 1)
15:35–15:45	Closing of the day and practicalities (Aud. 1)
19:00-	**Conference Dinner** Riviera Restaurant & Bar, Grensen 10

Thursday 29.10 (Day 2)	
9:00–10:30	Parallel sessions B
10:30–10:45	*Coffee Break*
10:45–11:30	Plenary 4: Tonje Amland (Aud. 2)
11:30–12:30	*Lunch*
12:30–13:45	Parallel sessions C
13:45–14:15	*Coffee Break*
14:15–14:45	Panel debate (Aud. 2)
14:45–15:00	Closing of NORSMA 12 & announcement of the host of NORSMA 12 (Aud. 2)

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WEDNESDAY 28 OCTOBER 2026

	Place	Description
8:00–8:45		**REGISTRATION AND MORNING COFFEE**
8:45–9:00	AUD. 1	**OPENING** **Head of Department,** Rolf Vegar Olsen **Organizing committee**
9:00–10:00	AUD. 1	**PLENARY 1** **Social inequality, child care, and schools** by Astrid Marie Jorde Sandsør
10:00–10:15		**COFFEE BREAK**
10:15–11:30	AUD. 1	**PLENARY 2** **Individual differences in mathematical cognition: A Bert's eye view** by Bert deSmedt
11:30–12:30		**LUNCH**
12:30–14:00		**Parallel Sessions A**
	231	**A1** Chair: Heidi Hellstrand 1. Ways for students with intellectual disabilities to interact in mathematics *(Susanne Erlandsson)* Presenter: Susanne Erlandsson 2. Relational competence in avatar-based professional conversations in mathematics: Insights from pre-service special needs teacher education *(Sofia Lindberg, Cecilia Segerby)* Presenters: Sofia Lindberg and Cecilia Segerby 3. Mathematical creativity & mindset: Results and opportunities from Icelandic PISA results *(Ósk Dagsdóttir)* Presenter: Ósk Dagsdóttir 4. Students in mathematics learning difficulties experiences as a basis for didactic development *(Mette Thompson, Troels Gannerup Christensen)* Presenters: Mette Thompson and Troels Gannerup Christensen

(continued on the next page)

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	Place	Description
		Parallel Sessions A
12:30–14:00	233	**A2** Chair: Pernille Ladegaard Pedersen 1. Support for mathematics in mainstream classrooms *(Sirpa Sneck, Maisa Keinänen, Hans Lehikoinen)* Presenter: Sirpa Sneck 2. Adapted teaching in mathematics: A video recorded classroom study *(Fredrik Kristiansen, Julie Lysberg, Wenche Rønning, Anita Lopez-Pedersen)* Presenter: Fredrik Kristiansen 3. Augmented Reality augmentations in early addition activities: An exploratory study *(Vittoria Frau, Germàn Leiva, Eva Eriksson, Pernille Pind, Erik Bjerr)* Presenter: Vittoria Frau 4. Kindergarten teachers' view of mathematical learning opportunities *(Mirjam Harkestad Olsen, Anita Movik Simensen)* Presenters: Mirjam Harkestad Olsen and Anita Movik Simensen
12:30–14:00	AUD. 1	**A3** Chair: Pia Beck Tonnesen 1. The relation between pre-service teachers' math anxiety and math teaching anxiety *(Riikka Mononen, Hans Lehikoinen, Sirpa Sneck, Pinja Tähti)* Presenter: Riikka Mononen 2. Adults' experiences of mathematical learning difficulties and anxiety: links to self-efficacy, self-concept, and learning *(Anni Savikuja, Riikka Sirkkoa, Pinja Tähti, Riikka Mononen)* Presenter: Anni Savikuja 3. Affective factors as a barrier to learning mathematics: Students' perspectives on mathematics difficulties *(Lóa Björk Jóelsdóttir, Pia Tonnesen, Bent Lindthard, Lena Lindenskov)* Presenters: Bent Lindthard and Lena Lindenskov 4. Relational pedagogy and emotions in mathematics: Toward inclusive participation for all learners *(Edda Óskarsdóttir)* Presenter: Edda Óskarsdóttir
14:00–14:20		**COFFEE BREAK**
14:20–15:35	AUD. 1	**Plenary 3:** **Students who Surprise Us; Reimagining Conceptions of Children at the Intersection of Disability and Mathematics** by Rachel Lambert
15:35–15:45	AUD. 1	**Closing of the day and practicalities**
19:00–		**CONFERENCE DINNER** Riviera Restaurant & Bar, Grensen 10

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THURSDAY 29 OCTOBER 2026

	Place	Description
		Parallel Sessions B
9:00–10:30	231	**B1** Chair: Anita Lopez-Pedersen 1. Developmental trajectories of math anxiety and performance from grade 4 to grade 6 *(Johan Korhonen, Anna Tapola, Pinja Tähti, Riikka Mononen)* Presenter: Johan Korhonen 2. Six facets of developmental dyscalculia *(Eivind Kaspersen, Terese A. Wendelborg, Declan Devlin, Trygve Solstad)* Presenters: Eivind Kaspersen, Trygve Solstad 3. Early predictors of whole number word problems *(Erika Jassuly Chalen Donayre, Silke Göbel, Maria Psyridou, Monica Melby-Lervåg, Arne Lervåg)* *Presenter*: Erika Jassuly Chalen Donayre 4. Identifying students who need extra teaching interventions: Experiences from the development of Norwegian national numeracy mapping tests *(Guri Nortvedt, Henrik Hung Haram, Oksana Kovpanets)* Presenter: Guri Nortvedt
9:00–10:30	234	**B2** Chair: Helena Roos 1. Changes and parallel processes in math anxiety, enjoyment, and boredom *(Hans Lehikoinen, Johan Korhonen, Anna Tapola, Pinja Tähti, Riikka Mononen)* Presenter: Hans Lehikoinen 2. Enhancing students' attitudes towards mathematics: Results from a Danish intervention *(Pernille Ladegaard Pedersen, Lise Dausen, Christian Brix, Bent Sortkær)* Presenter: Pernille Ladegaard Pedersen 3. Developing teaching resources in mathematics for children at risk *(Olaug Lona Svingen, Linda Opheim)* Presenters: Olaug Lona Svingen and Linda Opheim 4. Concrete, pictorial and abstract representations in mathematics teaching: Status and potential *(Bent Sortkær, Pernille Ladegaard Pedersen, Christian Brix, Lise Dausen)* Presenter: Bent Sortkær
10:30–10:45		**COFFEE BREAK**
10:45–11:30	AUD. 2	**Plenary 4: The Context of Children's Mathematical Learning – Parents, Home Environment and Self-Perceptions** by Tonje Amland
11:30 12:30		**LUNCH**

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THURSDAY 29 OCTOBER 2026		
	Place	**Description**
12:30–13:45	**231**	**C1** Chair: Edda Óskarsdóttir 1. Profiles of number processing and arithmetic fluency in grades 3 to 8 *(Heidi Hellstrand, Santeri Holopainen, Pekka Räsänen, Anu Laine, Johan Korhonen, Pirjo Aunio)* Presenter: Heidi Hellstrand 2. Impact of a short whole class intervention in multidigit arithmetic on low achieving students' flexibility and adaptivity *(Pernille Bødtker Sunde, Lóa Björk Jóelsdóttir)* Presenter: Pernille Bødtker Sunde 3. Differences in experiencing math anxiety's dimensions between different mathematical skill groups *(Kati Pyörälä, Hilma Halme, Hans Lehikoinen, Johan Korhonen, Riikka Mononen)* Presenter: Kati Pyörälä
12:30–13:45	**234**	**C2** Chair: Riikka Mononen 1. The lived experience of dyscalculia: (special)pedagogical meanings across students, teachers, and evaluators *(Helena Roos, Ann-Louise Ljungblad)* Presenter: Helena Roos 2. Designing inclusive mathematics futures with avatars - strengthening special education teacher training *(Cecilia Segerby, Sofia Lindberg, Helena Roos, Daniel Östlund)* Presenters: Cecilia Segerby, Sofia Lindberg and Helena Roos 3. FOMAVA, a new Danish forum – aims and structure Exchanges between research and practice in an ongoing Danish forum (FOMAVA) *(Bent Lindhardt, Lena Lindenskov, Pia Tonnesen. Lóa Björk Jóelsdóttir)* Presenter: Bent Lindhardt
13:45–14:15		**COFFEE BREAK**
14:15–14:45	AUD. 2	**PANEL DEBATE** Johan Korhonen, Bert De Smedt, Edda Oskarsdottir, Rachel Lambert Moderator: Anita Lopez-Pedersen
14:45–15:00	AUD. 2	**Closing of NORSMA 12 & announcement of the host of NORSMA 12**

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KEYNOTES

Social inequality, child care, and schools

(Professor Astrid Marie Jorde Sandsør)

WEDNESDAY 28 OCTOBER 09:00–10:00 (Auditorium 1)

Abstract

Why do educational achievement gaps persist, and what can we realistically do about them? This keynote examines growing concerns about social inequality in children's learning and development, drawing on research on child care, schools, and educational policy. I discuss recent evidence on widening achievement gaps, the challenges of interpreting trends in educational inequality, and the implications for policy and practice. A particular focus will be on how we know what we know: how causal evidence is generated, what policy evaluations can and cannot tell us, and how researchers can identify the effects of educational interventions in complex real-world settings. Drawing on my research and my work in the Norwegian Expert Commission on the role of childcare, schools, and after-school programs in promoting social equality and social mobility, I consider what policies and practices might be most likely to promote more equitable opportunities and outcomes for children in the Norwegian context.



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KEYNOTES

Individual differences in mathematical cognition:

A Bert's eye view

(Professor Bert deSmedt)

WEDNESDAY 28 OCTOBER 10:15–11:30 (Auditorium 1)

Abstract

Developmental literature has revealed a wide variety of factors that correlate with individual differences in mathematical cognition. In this talk, I will review the research we have done over more than a decade on this topic. This work highlights the critical role of domain-specific skills. Originally centered around magnitude processing, it has become increasingly clear that these domain-specific skills encompass a wide variety of symbolic numerical skills. I will review studies on these specific abilities in typically developing children, children at risk for math difficulties and children with exceptionally high mathematical skills and I will elaborate on the (early) assessment of these specific abilities. I will also discuss intervention work as well as studies that have examined the causal impact of schooling on these domain-specific skills.



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KEYNOTES

Students who Surprise Us; Reimagining Conceptions of Children at the Intersection of Disability and Mathematics

(Dr. Rachel Lambert)

WEDNESDAY 28 OCTOBER 14:20–15:35 (Auditorium 1)

Abstract

In this talk, Dr. Lambert will share data from her studies of neurodiverse adolescents in their mathematics classrooms, including how these students' mathematical abilities were perceived by teachers and by themselves. Framing her talk as about students with mathematical difficulties who "surprise" their teachers, Dr. Lambert will explore how our field constructs students through deficit models, the impact on individual students and teachers, and the role of pedagogy in how students are constructed as mathematically able, or not.



KEYNOTES

The Context of Children's Mathematical Learning – Parents, Home Environment and Self-Perceptions

(Postdoctoral Researcher Tonje Amland)

THURSDAY 29 OCTOBER 10:45–11:30 (Auditorium 1)

Abstract

Children's mathematical learning does not happen in isolation – it is embedded in a context that includes the learning activities in the home environment, parents' own abilities and the self-perceptions that children develop as learners. Untangling these factors means looking at what parents do at home, their own number skills, as well as how children's beliefs about their own competence relate to learning over time. This talk draws on two longitudinal studies of Norwegian school children. In one, we followed first- to second graders with difficulties in early numeracy and literacy, examining associations between academic self-efficacy and performance in math and reading, including differences related to parental math difficulties and gender. The second study examined the home numeracy environment and its relative contribution to children's math development when parents' mathematical skills were also taken into account. Findings across the two studies will be discussed in light of developmental stages in mathematical learning, and equality in school systems and gender.



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PARALLEL SESSIONS A1:

WEDNESDAY 28 OCTOBER 12:30–14:00

Room 231

Chair: Heidi Hellstrand

1. Ways for students with intellectual disabilities to interact in mathematics

Susanne Erlandsson
Linnaeus University, Växjö, Sweden

INTRODUCTION

This presentation focuses on an educational design research study conducted in Compulsory Schools for Students with Intellectual Disabilities (ID). The study examines how teacher–student interactions can promote students' understanding and their ability to solve mathematical tasks.

In mathematics education within this context, several elements are important for supporting students' participation and understanding, including visual supports, auditory and verbal prompts, and sign-supported communication. In addition, providing student feedback and allowing sufficient wait time (time delay) are crucial, as they enable students to formulate their responses (Klang, Östlund, & Andersson, 2023; Schnepel & Aunio, 2022). Research also highlights that gestures and bodily interactions (embodiment) can play a significant role in supporting mathematical understanding (Ferrara, 2014; Hord et al., 2016).

Research question

- How does the teacher-student interaction promote understanding and the ability to solve a mathematical task?

METHOD

The study was conducted in three Swedish Compulsory schools for students with ID, primarily mild ID. The design of the study was an iterative process of micro-design cycles (Prediger, Gravemeijer, & Confrey, 2015).

Data were collected through joint planning sessions involving teachers and video-documented lessons and audio recordings. The analysis focused on the interaction between students and the teacher.

The interactions were analysed using conversation analysis (Hutchby, 2019), which focuses on turn-taking (Stivers, Sidnell, & Stivers, 2012) and how conversations unfold through verbal and embodied communication (Ferrara, 2014). The excerpt below is an example of interactions.

11 KAL: **<ehummm.>**
(0.3) @**(0.7)**
@ KAL holds up four fingers
6.10 #3



12 KAL: **@aup?**
@KAL starts working on the ipad

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In this sequence, the student uses pseudo-words and his fingers to visualise the number four.

ANALYSIS

The teacher and the student interact through words, gazes, gestures, and embodied actions. The teacher also uses pauses that allow the student to think and solve the task. Answers are also elicited through embodied elicitation techniques and deliberately incomplete utterances. When the student provides an answer, the teacher gives positive feedback. When the student seeks confirmation from the teacher, the teacher meets the student's gaze. Between the teacher and the student, there are some expected and accepted ways of interaction. With support for the student's different communication languages, interaction occurs, and the student solves the task. According to the theory of conversation analysis (Hutchby, 2019), this is an example of an interaction that does not consist solely of words (Ferrara, 2014).

References

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2. Relational competence in avatar-based professional conversations in mathematics: Insights from pre-service special needs teacher education

Sofia Lindberg & Cecilia Segerby
Kristianstad University, Department of Special Education

Abstract

This study examines how pre-service special needs teachers manifest relational competence in avatar-based professional conversations focused on mathematics education. While virtual simulations are known to support the development of teaching practices and relational skills (Berg et al., 2023; Lindberg, 2025), and to strengthen teachers' self-efficacy and instructional decision-making in mathematics (Samuelsson et al., 2022), less is known about how relational competence is enacted in professional conversations addressing mathematics-related dilemmas.

The study is conducted within a course on professional conversations in a Swedish special education teacher education programme. Nine participants engage in simulated dialogues with an avatar representing a colleague, focusing on dilemmas related to mathematics learning, support, and inclusion. Data consist of video-recorded interactions, and the analysis draws on the Relational Competence Model (Aspelin, 2018) based on Scheff's (1997) theory of social bonds. A qualitative thematic analysis (Braun & Clarke, 2022) is used to examine how participants attend to mathematical dilemmas while managing relational aspects such as listening, negotiating meaning, and responding to emotional expressions. The results show that students often begin with an exploratory and structuring approach, but tend to shift relatively quickly toward a solution-focused orientation.

Emotional responsiveness is present, but varies in depth and in the extent to which it is integrated into the conversations. Three themes have been identified: (1) exploratory and structuring communication, (2) a shift toward solution focus, and (3) emotional responsiveness. These themes interact in a pattern in which communicative clarity and action orientation are prominent, while emotional and relational exploration is afforded more limited space.

Communicative competence, differentiation competence, and socio-emotional competence are all present in the students' conversations, but are manifested to varying degrees in the interactions. Communicative competence appears particularly strong, especially in the initial phases of the conversations, whereas differentiation competence emerges as the most complex and challenging to sustain. Socio-emotional competence is clearly visible, but often remains relatively superficial. The results therefore indicate that the development of relational competence in professional conversations is not only a matter of acquiring communicative techniques, but also of cultivating a nuanced sensitivity to when and how these are used in relation to the conversational partner.

These findings highlight the need for teacher education to more explicitly support the development of relational competence, particularly the ability to sustain exploratory dialogue, deepen emotional attunement, and balance between being supportive and being in charge.

References

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3. Mathematical creativity & mindset: Results and opportunities from Icelandic PISA results

Ósk Dagsdóttir
University of Iceland

Abstract

Creativity has been a guiding pillar for education in Iceland for over a decade according to the Icelandic curriculum (Ministry of Education and Children, 2024). It is supposed to be fostered across subjects and in all school live. Mathematical creativity can be fostered through open ended problems, patterns, interdisciplinary work, visual representation and social engagement (Khalid et al., 2020; Nadjafikhah et al., 2012; Shriki, 2010). Although many teachers want to focus on creativity in mathematics they face challenges such as lack of adequate time to prepare, too large group sizes and not enough experiences with creative learning in mathematics.

Creativity was assessed in PISA for the first time in 2022. Although assessing creativity can be challenging the tasks presented focused on students' ability to generate diverse and original ideas as well as their capacities to evaluate and improve ideas. The assessment was based on written and visual expression along with social and scientific problem solving through open tasks with no single correct response.

Icelandic students scored under the OECD average in creativity, although some students scored higher. The Icelandic students generally scored higher with the written expression then the visual, social and scientific tasks. This shows that there is a need for an even greater focus on creativity in Icelandic schools. In mathematics education in Iceland tasks with one correct answer are highly used both in classrooms and in national tests.

According to the PISA assessment mathematical ability is declining in Iceland with very few scoring above the OECD average. Close to half of Icelandic students suffer from mathematical anxiety according to the test which can really hinder learning. At the same time about half of the students have a fixed mindset and belief that intelligence is unchangeable. According to PISA mathematical anxiety and fixed mindset correlate.

The Icelandic national curriculum emphasizes equality and the importance of meeting the needs of all students in an inclusive educational model (Ministry of Education and Children, 2024). It is therefore very important to develop an atmosphere of growth mindset where students believe that everyone's ability and intelligence can improve with effort and resilience. Reaching policy makers, schools and teachers around this is of great importance so that students can flourish and reach their full potential.

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4. Students in mathematics learning difficulties experiences as a basis for didactic development

Mette Thompson 0(Helsingør Municipalit) and Troels Gannerup Christensen (UCL University College)

Abstract

Based on a Master's thesis conducted at Aarhus Universitet (Christensen & Thompson, 2025), this study explores how teachers can promote participation for students in mathematics learning difficulties (MLD) by drawing on students' own experiences of mathematics teaching and learning. While research in mathematics education has traditionally focused on cognitive deficits and performance, students' lived experiences, emotions, and perspectives are often underrepresented. This study addresses this gap by positioning students' voices as a foundation for didactic development.

The project is grounded in a Design-Based Research (DBR) framework, enriched with elements from Arts-Based Research (ABR). Empirical data were generated through focus group interviews with lower secondary students and teachers. Within the focus group interviews, students engaged in creating visual representations of their experiences using LEGO, enabling the articulation of perspectives that are difficult to express verbally.

The analysis is structured around three interconnected dimensions: (1) experiences related to mathematics as a subject, (2) experiences connected to students' emotions and identity as mathematics learners, and (3) experiences related to the social environment and classroom culture. The findings reveal a gap between teachers' intentions and students' experiences. Students often perceive mathematics as abstract, fast-paced, and focused on individual performance, leading to frustration, self-doubt, and withdrawal. Emotional responses such as anxiety, shame, and a sense of failure play a central role in shaping participation.

Based on these insights, a prototype for a teacher workshop was developed and iteratively tested. The study contributes with (1) empirical insights into students' experiences of mathematics education, (2) a concrete didactic design supporting teacher reflection on participation, and (3) emerging design principles for participation-oriented mathematics teaching.

The findings highlight that fostering participation requires attention not only to students' mathematical learning, but also to students' emotional experiences, identity, and sense of belonging. The use of aesthetic and multimodal representations proved particularly effective in supporting teacher engagement with students' perspectives. By integrating student experiences into iterative design processes, the study contributes to the development of more inclusive and responsive mathematics education.

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PARALLEL SESSIONS A2:

WEDNESDAY 28 OCTOBER 12:30–14:00

Room 223

Chair: Pernille Ladegaard Pedersen

1. Support for mathematics in mainstream classrooms

Sirpa Sneck, Maisa Keinänen, Hans Lehikoinen
University of Oulu, Finland

Abstract

The prevalence of mathematics learning disabilities is estimated to be 5%–7%, and an additional 10%–15% experience persistent low achievement (Zhang et al., 2020). Finnish children and adolescents continue to perform at a moderate level by international standards, but their performance has declined relative to previous years, and there is particular concern about the growing number of low-performing students (OECD, 2022; Von Davier et al., 2024).

Partly in response to these concerns, the recent Finnish Basic Education Act from 2025 aims to address the decline in performance by emphasizing the role of teaching arrangements that create appropriate conditions for learning as well as access to group-based forms of learning support for all learners. The support should primarily be provided within the student's regular classroom. This study examines how teaching arrangements and group-based learning support are implemented in mainstream classrooms among students aged 9–15 years. The study focuses on four key areas: a) teaching arrangements, such as co-teaching and flexible grouping; b) explicit instruction and digital and concrete visualization; c) differentiation; d) activity-based instruction.

The study addresses the following research questions: 1) How common are use of digital and concrete materials for visualisation, flexible grouping, differentiation, activity-based instruction, and other forms of learning support, and how are they implemented? 2) Are co-teaching or the presence of a special education teacher associated with the implementation of these forms of learning support? 3) How is grade level associated with different forms of learning support?

The data for the study are collected through structured classroom observations of 50–100 mathematics lessons conducted in multiple schools in 2026. The digital observation protocol was developed based on Finnish and international research and was piloted in 2025 (n = 32). The structured data will be analysed primarily using quantitative methods while the open-ended responses will provide complementary qualitative insights.

Preliminary analyses indicate that 70% of teachers utilised digital visualization in instruction, whereas concrete manipulatives were used less frequently. Differentiation was provided for both lower- and higher-achieving students; however, only 20% of teachers assigned differentiated homework. Co-teaching was implemented in 18% of lessons, and a teaching assistant was present in 27%. Further analyses will be conducted, and potential implications for classroom practice will be discussed.

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2. Adapted teaching in mathematics: A video recorded classroom study

Fredrik Kristiansen, Julie Lysberg, Wenche Rønning and Anita Lopez-Pedersen
Nord University

Abstract

Students who are low performers in mathematics or who have specific difficulties with mathematics face significant risks related to academic achievement, future employment prospects, and overall well-being (Fuchs et al., 2008; Rivera-Batiz, 1992). Adapted education, as a central principle for addressing this challenge, applies across the student spectrum, from those receiving individualized support to those in regular classroom instruction (Hansen and Hanssen, 2021). This encompasses students with developmental learning disorder in mathematics (ICD-11, 2025), low performers representing the lowest 25 percent (Fuchs, Fuchs, and Prentice, 2004), and broader student populations. Explicit instruction is recognized as essential for students struggling with reading, writing, and mathematics, with The Council for Exceptional Children identifying it as a high-leverage practice (McLeskey et al., 2017).

This study investigates how experienced mathematics teachers in elementary classrooms implement explicit instructional practices. Video-based in-classroom studies offer a systematic approach to examining teaching across subjects, grades, and diverse learning environments (Klette, 2023). Video analysis provides a rich foundation through repeated viewing and captures actual classroom interactions, revealing what truly occurs rather than relying solely on field notes or participant recall (Jordan & Henderson, 1995).

Methods

Data were collected between fall 2024 and spring 2025 through strategic sampling of experienced elementary mathematics teachers in northern Norway. Three teachers, two from third grade and one from fourth grade, participated from different schools representing varied classroom contexts. Two cameras captured 16 hours of footage from regular mathematics lessons. This article focuses specifically on lesson introductions preceding individual student work.

Analysis

Initial analysis of the video data focuses on teachers' explicit instructional moves through a framework based on teaching behaviors that define explicit instruction (Vaughn & Fletcher, 2021). Five analytical categories were developed: (1) clarity of goals, (2) structured and sequenced delivery, (3) modelling and scaffolded support, (4) connecting and revisiting prior knowledge, and (5) responsive teaching and feedback. Video clips of instructional introductions were coded for the presence and quality of each category, revealing patterns in how experienced teachers enact explicit instruction in mathematics.

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3. Augmented Reality augmentations in early addition activities: An exploratory study

Vittoria Frau*, Germàn Leiva*, Eva Eriksson*, Pernille Pind, Erik Bjerre
*Aarhus University

Abstract
This paper presents a pilot study on an Augmented Reality (AR) prototype designed to complement existing early mathematics materials for basic addition activities. Building on the concretepictorial–abstract approach (Problem!, 2023) and research on arithmetic strategies (Ostad, 1997, 2008), the work investigates how AR augmentations affect children's use of physical manipulatives (numicons, dice, equation cards) from the RoS/Kuffert Plus intervention programme (Pind & Bjerre, 2014), and their reliance on symbolic representations. Through participatory design (Bødker et al., 2022) with mathematics education experts, and principles of educational design research (McKenney & Reeves, 2014), a two-part system was developed: a head-mounted display for the child providing augmentations, and a tablet interface for the tutor that mirrors the child's view and controls task parameters. The research question is how AR can support children in developing calculation-based strategies while avoiding an overreliance on digital cues.

THE STUDY

In a within-subject pilot study (Charness 2012), ten second-grade children (ages 7–8) completed four addition-related tasks using the physical materials from the RoS/Kuffert Plus programme (Pind & Bjerre, 2014) in two conditions: with AR augmentations (see Fig. 1), and with only the physical materials. Children's experience was captured through Smileyometer ratings of fun, excitement, perceived difficulty, and willingness to continue (Read, 2008), supplemented by short interviews and qualitative interaction analysis of video data. Children reported very positive experiences in both conditions, but excitement was significantly higher with AR, and most participants stated that they preferred the AR activities or liked both equally.

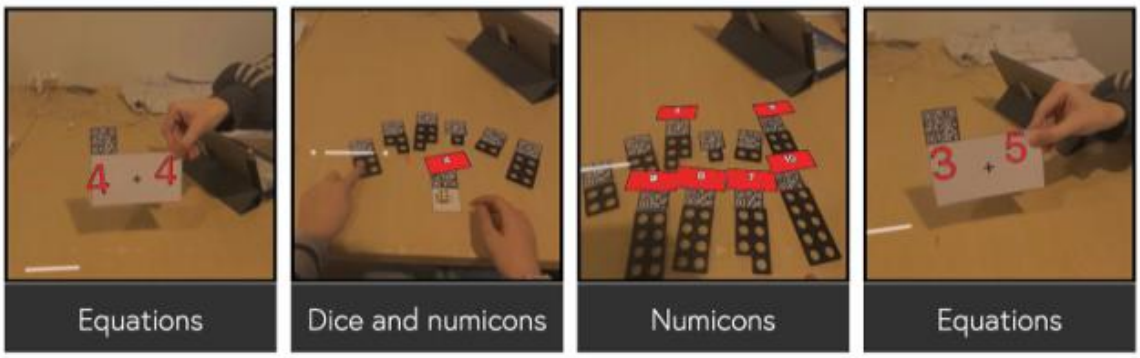


Fig 1: Overview of the three types of tasks from the AR view. Solving addition equations (1, 4), matching dice outcomes with numicons (2), and matching numicon shapes with their corresponding numbers (3).

EFFECTS ON STRATEGIES AND INTERACTION

Analysis of interaction patterns showed that AR reshaped children's arithmetic strategies. In the non-AR condition, several children counted holes in numicons to identify requested numbers, indicating reliance on counting-based strategies. In contrast, counting behaviour was largely absent in the AR condition; some children waited for augmentations to appear and used these symbolic cues to guide their responses. Episodes of hesitation were particularly visible when augmentations appeared with a slight delay or were spatially offset from the corresponding manipulative, highlighting how temporal and spatial properties of AR influence how children connect symbolic and concrete representations.

IMPLICATIONS FOR AR IN MATHEMATICS EDUCATION

The study points to a key design implication for education in mathematics: AR augmentations must be carefully integrated so they strengthen, rather than replace, children's engagement with manipulatives. Design directions include tighter spatial alignment, adjusted timing of augmentations, and stronger coupling between digital feedback and embodied actions (for example, revealing numerals only after grasping a numicon) to support robust links between concrete and symbolic forms. As a small, exploratory pilot without learning outcome measures, this work offers baseline evidence and raises questions for future research on how AR can be tailored to children in longer-term interventions.

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4. Kindergarten teachers' view of mathematical learning opportunities

Mirjam Harkestad Olsen and Anita Movik Simensen
UiT The Arctic University of Norway

Abstract
We report findings from examining kindergarten teachers' discussions about what counts as mathematical learning opportunities. Our work is inspired by research addressing the importance of teachers providing mathematical learning opportunities for all learners (Heyd-Metzuyanim, 2013; Roos, 2019). Mathematics in Norwegian kindergartens "is about discovering, exploring and creating structures and helps the children to understand relationships in nature, society and the universe" (Framework Plan for kindergartens, 2017, p. 53). We are interested in kindergarten teachers' discussions about mathematical learning opportunities. From these discussions, we hope to learn more about how kindergarten teachers can cultivate mathematical learning opportunities for learners at risk of developing mathematical learning difficulties.

The discussions we have analyzed took place as part of a course at university level about mathematical difficulties. Our methodology is informed by a diamond ranking activity described by Clark (2012). The teachers were presented with 38 pictures and were asked to collectively select nine pictures and organize them from the least to the greatest mathematical learning opportunities (see Figure 1).

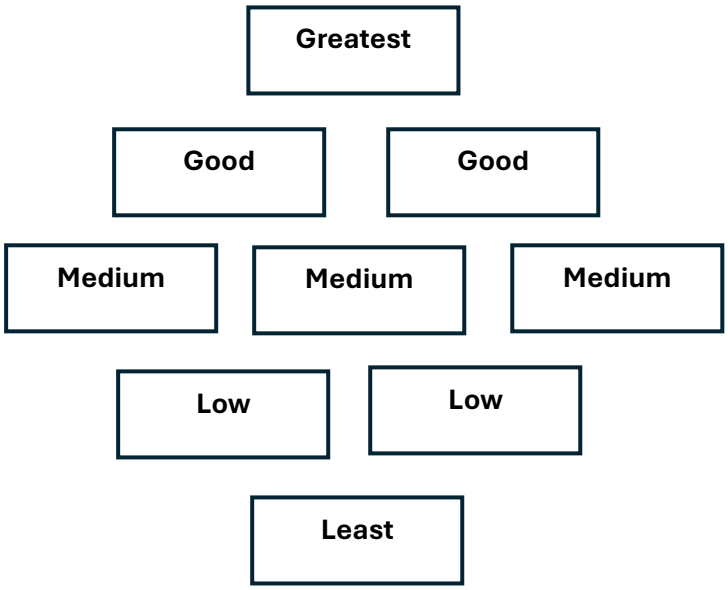


Figure 1: The diamond ranking structure.

Our analysis has mainly focused on the conversations between the teachers when they have discussed which pictures to choose and how to organize the chosen ones.

The findings show that the teachers emphasize the importance of 1) a teacher being present to facilitate mathematical learning situations and 2) learners having the opportunity to engage in mathematical learning activities. However, the teachers are not operationalizing their own role in cultivating mathematical learning opportunities. To take our analysis further, we would like to discuss some excerpts from our data with colleagues interested in supporting learners struggling with mathematics.

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PARALLEL SESSIONS A3:

WEDNESDAY 28 OCTOBER 12:30–14:00

Room Auditorium 1

Chair: Pia Beck Tonnesen

1. The relation between pre-service teachers' math anxiety and math teaching anxiety

Riikka Mononen[1)], Hans Lehikoinen[1)], Sirpa Sneck[1)], and Pinja Tähti[2)]
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Abstract

Research on math anxiety has focused heavily on students (Li et al., 2021), and there is a scarcity of studies that have investigated whether pre-service teachers experience math anxiety and anxiety in teaching math (however, see e.g., Patkin & Greenstein, 2020). Math anxiety has been treated as a one- or multidimensional construct; however, nowadays it is common to divide it into cognitive and affective dimensions, referring to worry concerning one's performance, and negative emotions aroused in math-related situations, respectively (Tähti et al., 2025). Math teaching anxiety refers to anxiety associated with real or perceived deficits in teaching math (Peker, 2009). Prior research has found that pre-service primary school teachers experience higher math anxiety compared to students from other fields (Artemenko et al., 2021). Especially in primary grades, class and special needs teachers need to teach mathematics, regardless of whether they have a specific interest in it. Therefore, a student may be taught mathematics by a teacher who themselves experiences math anxiety and is not comfortable in teaching it, potentially having negative consequences for students' learning of math.

This study investigated pre-service teachers' math anxiety and math teaching anxiety (MTA). Finnish pre-service teachers (n=113, females 90.3%) answered the Mathematics Anxiety Scale for Teachers (MAST) (Ganley et al., 2019), measuring their math anxiety (affective, cognitive, and social/evaluative dimensions) and MTA. Only those participants who had some prior math teaching experience (n=81) completed the MTA part of the survey. A confirmatory factor analysis confirmed a four-factor structure for the MAST. Using a regression analysis, general math anxiety explained 67.8% of the variance in MTA, however, only the cognitive dimension of math anxiety was statistically significantly associated with MTA (β=0.838). Our results underline that it would be important to provide pre-service teachers, who experience math anxiety and MTA, ways to mitigate their anxiety already during the teacher training. Less anxious teachers might enjoy more their math teaching, which in turn, might have positive results in their students' math learning.

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2. Adults' experiences of mathematical learning difficulties and anxiety: links to self-efficacy, self-concept, and learning

Anni Savikuja[a], Riikka Sirkkoa[a], Pinja Tähti[a] and Riikka Mononena[a]
[a]Special and Inclusive Education, University of Oulu, Finland, [b]Department of Education, University of Helsinki, Finland

Abstract
Mathematical skills are essential in everyday life and in academic and professional settings. Technological development in societies requires mathematical skills on par with literacy. Meanwhile, many adults struggle with mathematics, and only one in four has adequate skills. Some individuals experience math anxiety, which is typically linked negatively with math skills. Both mathematical learning difficulties and math anxiety have been found to affect individuals' math self-efficacy and self-concept negatively. This study examines how adults' mathematical learning difficulties and math anxiety have affected and continue to affect their self-concept, self-efficacy, and learning in mathematics. The study gathers qualitative experiences from adults (n=9) about their mathematical learning difficulties and math anxiety from childhood to adulthood. Specifically, this study aims to answer the following research question: How did mathematical learning difficulties and math anxiety experienced by adults affect their math self-concept, self-efficacy, and learning?

Data were collected through interviews and were analysed thematically. By analysis, five themes were found describing the relation of mathematical learning difficulties and math anxiety to math self-efficacy, self-concept, and learning. Themes were 1) self-doubt in mathematics, 2) getting negative feedback from others, 3) comparing oneself to others, 4) negative feelings, and 5) avoidance of mathematics. Through these themes, self-efficacy and self-concept in mathematics had been hampered, and learning mathematics had become difficult. Notably, the avoidance of mathematics overlapped with all the other themes. Hereby, this study supports the view that math anxiety and low math performance reinforce one another, avoidance playing a key role in this connection. Our study brings a new perspective as it investigated adults qualitatively. Results indicate the importance of math teachers` support for those students who have mathematical learning difficulties and math anxiety. Further, the findings highlight the importance of developing the training of mathematics teachers so that mathematical learning difficulties and math anxiety are also at the centre of their studies. These learning challenges may have a negative, long-lasting effect on an individual`s life concerning education, employment, and overall life enjoyment. Also, one of the implications of this study is that the participants wished that some institution could offer training in basic math skills for adults. They viewed that as a possibility for a second chance to learn mathematics.

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3. Affective factors as a barrier to learning mathematics: Students' perspectives on mathematics difficulties

Jóelsdóttir, Lóa Björk[1], Tonnesen, Pia[2], Lindthard, Bent[3], Lindenskov, Lena[4]
[1]VIA University College, [2]Københavns Professionshøjskole, [3]Professionshøjskolen Absalon, [4]Aarhus University, DPU.

Abstract
Within FOMAVA (Forum for Mathematics Difficulties), we investigated emotions as an inhibiting factor for learning among students experiencing difficulties in mathematics, drawing on student perspectives from 27 schools in autumn 2025. The aim of the study was to examine how emotional factors manifest in mathematics education and how they may affect students' participation, understanding, and opportunities for learning. The study is part of a FOMAVA's first annual theme focuses on the psychological dimension of mathematics difficulties – affective factors.

Method
The data consist of qualitative interviews with 107 students in grades 7–9, conducted across the five Danish regions. The students were locally identified by their teachers as experiencing difficulties in mathematics. The interviews were conducted using a semi-structured interview guide that included conversation cards based on both negative and positive emotion expressions. The design of the conversation cards, including the selection of emotion expressions, was informed by Control-Value Theory (Pekrun, 2024). The analysis was conducted as a thematic interpretation of the students' statements, with a focus on the emotional positions that emerged in relation to mathematical demands and classroom practices.

Results
The analysis shows high engagement from the students for contributing to the group conversation. The most prominent negative emotions were confusion, frustration, helplessness, and hopelessness. Confusion was associated with encounters with new concepts, symbols, equations, and text-heavy tasks, especially when subject-specific explanations were not perceived as accessible. Frustration arose when students could not keep up with classwork, did not understand the task, or repeatedly had to seek help. Helplessness was linked to getting stuck after teacher explanations and experiencing delays or a lack of support. It seemed more troublesome for the students to talk about positive feelings, which often revealed short-lived. Relief was particularly associated with completing tests or difficult tasks, while pride and joy emerged when students succeeded with tasks they had expected to fail at, or experienced sudden understanding.

Conclusion
The study suggests that emotional experiences in mathematics play a central role for students with mathematics difficulties. The findings underscore the need for instructional practices that both reduce emotional strain and support students' sense of competence, meaning, and support in mathematics.

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4. Relational pedagogy and emotions in mathematics: Toward inclusive participation for all learners

Edda Óskarsdóttir
University of Iceland

Abstract

Learners at the margins frequently experience mathematics classrooms as spaces of anxiety, marginalisation, and limited participation. While research has traditionally emphasised cognitive and instructional dimensions of mathematics teaching, there is growing recognition that learning in mathematics is fundamentally relational and emotional. This conceptual paper is grounded in the assumption that instruction must support learners' development of positive emotional relationships with mathematics, especially for those pushed to the margins.

Drawing on relational pedagogy, the paper explores how relational pedagogy can reframe our understanding of participation and inclusion in mathematics education. Emotions are conceptualised not as individual traits but as emerging within interactions between students, teachers, and classroom practices. In this perspective, belonging, recognition, and opportunities to contribute become central conditions for engagement. The paper also builds on research demonstrating how instructional practices shape participation structures. For example, students with learning disabilities are often positioned as passive or dependent when instruction privileges teacher modelling and speed, limiting opportunities for sense-making and interaction. In contrast, more conceptually oriented and student-centred approaches can open spaces for reasoning, dialogue, and meaningful participation.

The paper proposes a conceptual framework for relational mathematics pedagogy that integrates three dimensions: (1) emotional safety and belonging, (2) positioning and recognition of students as competent contributors, and (3) responsiveness to diverse ways of thinking. These dimensions are discussed in relation to key pedagogical practices such as task design, classroom discourse, and feedback.

Situated within Nordic traditions of democratic and inclusive education, the paper argues that supporting emotions and relationships is not an "add-on" but foundational to equitable mathematics learning. It concludes by outlining implications for research and practice, particularly the need to examine how relational and emotional dimensions can be systematically integrated into mathematics teaching to support participation and learning for all students.

PARALLEL SESSIONS B1:

TURSDAY 29 OCTOBER 9:00–10:30

Room 231

Chair: Anita Lopez-Pedersen

1. Developmental trajectories of math anxiety and performance from grade 4 to grade 6

Johan Korhonen, Faculty of Education and Welfare Studies, Åbo Akademi University, Finland
Anna Tapola, Faculty of Education and Welfare Studies, Åbo Akademi University, Finland
Pinja Tähti, Special and Inclusive Education, University of Oulu, Finland
Riikka Mononen, Special and Inclusive Education, University of Oulu, Finland

Abstract

Although the negative link between math anxiety and performance is well documented (Namkung et al., 2019), there is a lack of longitudinal studies investigating elementary school students. In the few longitudinal studies that have been conducted, the results concerning developmental change in math anxiety have been mixed. Some studies have reported a decreasing trend (e.g., Sorvo et al., 2019) while other studies have reported a stable trend (e.g., Mononen et al., 2022) in math anxiety development. Consequently, the aim of this study was to investigate developmental trajectories of math anxiety and math performance from grade 4 to grade 6.

Participants were 643 students from 25 schools from one municipality in Western Finland. We followed the students across 5 timepoints from grade 4 Spring to grade 6 Spring. Math anxiety (MA) was measured with the Swedish shortened mathematics anxiety rating scale (Finell et al., 2024). The scale consists of 16 items measuring math anxiety on a 4-point Likert scale. Arithmetic Fluency was measured with the digital Functional Numeracy Assessment – Dyscalculia Battery (FUNA-DB) (Räsänen et al., 2021). There are four tasks measuring arithmetic fluency (AF): number series, single-digit addition, single-digit subtraction and calculation fluency.

Change over time in MA and AF was analysed with latent growth curve modeling This model showed good model fit, χ^2 (300)= 11261.71, p< .001, CFI= .92, TLI= .92, $RMSEA$= .07. Overall MA increased from grade 4 to grade 6 (M_{slope} = 0.013, p < .05) and the variance was also significant indicating individual differences in MA development (SD_{slope} = 0.09, p < .05). Overall AF increased from grade 4 to grade 6 (M_{slope} = 0.51, p < .001) and the variance was also significant indicating individual differences in AF development (SD_{slope} = 0.67, p < .001). The intercepts of MA and AF were negatively related (r = -.44, p < .001) indicating that higher MA was related to lower AF in grade 4. This finding supports existing evidence that math anxiety and performance are concurrently negatively related (e.g., Namkung et al., 2019). Interestingly, the slope factors were also negatively correlated (r = -.23, p < .05). This indicates that MA and AF are developmentally related. This study will advance our knowledge on developmental dynamics between MA and AF in elementary school students across grades 4 to 6.

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2. Six facets of developmental dyscalculia

Eivind Kaspersen, Terese A. Wendelborg, Declan Devlin and Trygve Solstad
Norwegian University of Science and Technology

Abstract
Developmental dyscalculia is a congenital deficit that impairs arithmetic operations. While it is generally accepted that developmental dyscalculia is multi-faceted, it is unclear what the relevant facets are (Moeller et al., 2012).
Performance on different numerical tasks (e.g., discrimination, estimation, and order-processing) is often explained by domain-specific theories. For instance, Bayesian resource-rational models (e.g., Cheyette & Piantadosi, 2020) might explain the psychophysics of human discrimination and estimation, but do not explain order processing. Likewise, serial-scanning perspectives might account for order processing performance (Franklin et al., 2009), but offer little insight into estimation or discrimination.

Here, we discuss a unifying cognitive model of numerical cognition based on a synthesis of results from separate strands of research.

Prior research has shown that dysfunction in each of the six cognitive systems of the model are connected to developmental dyscalculia: (1) pattern recognition (e.g., Geary, 2004), (2) LTMretrieval (e.g., Geary, 2004), (3) working memory operations (e.g., Geary, 2004), (4) spatial numerical representation (e.g., Dehaene, 2009), (5) simple arithmetic (e.g., Kroesbergen & Van Luit, 2003), and (6) adaptive strategy selection (e.g., Torbeyns et al., 2004).

We first show examples suggesting that people draw on the same cognitive processes across tasks such as quantity discrimination, quantity estimation, line estimation, area estimation, and order processing. To illustrate, we discuss evidence that people engage pattern recognition both in the non-symbolic estimation task (e.g., when subitizing small numbers of discrete objects) and in the symbolic order-processing task (e.g., when judging familiar number sequences such as 1-2-3). Also, we show that people often report using similar comparative strategies to estimate different nonsymbolic magnitudes, including numerosity, area, and line-length. Typically, those comparative strategies involve memory retrieval and adaptive adjustment mechanisms (e.g., judging the stimulus as “about twice as much” as some representation extracted from memory).

We next discuss how the facets of developmental dyscalculia may relate to the congenital impairment of any of the six cognitive systems we identified. We emphasize that impairments in each of the facets may arise from a range of factors, including congenital conditions related to developmental dyscalculia and educational limitations related to more general mathematical learning difficulties. For instance, challenges with spatial-numerical representations (e.g., the symbolic number line) can result either from insufficient educational opportunities to develop them or from an innate deficit that disrupts their internalization. Making this distinction explicit is important because the symptoms may be similar, but the most effective treatment will likely differ.

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3. Early predictors of whole number word problems

Erika Jassuly Chalen Donayre, Silke Göbel, Maria Psyridou, Monica Melby-Lervåg and Arne Lervåg

Abstract

Early numeracy skills are foundational for later mathematical development, including word problem solving. Unlike calculation, word problem solving draws on multiple, interacting competencies - numerical processing, language comprehension, and constructing a mental model linking textual and mathematical information- making it a demanding, multidimensional skill. Word problems are prominent in the Norwegian curriculum, yet research on their longitudinal development remains scarce. The present study examined the extent to which early numeracy skills predict the development of whole number word problems over time, and whether these associations hold beyond domain-general cognitive skills.

Method: We followed 252 Norwegian children (126 girls; mean age 5.5, SD = 0.29) annually for eight years, from preschool through Grade 6 (T1: Dec 2017–Apr 2018; T7: Jan–May 2024). Latent growth curve models assessed contributions of domain-general skills (working memory, language, nonverbal IQ), phoneme awareness, and domain-specific numeracy skills (approximate number sense, number comparison, early numeracy) from kindergarten and, Grade 1 arithmetic to the intercept and slope of word problem performance. As a linear trajectory did not fit the data, slope loadings for Grades 2–5 were freely estimated, capturing nonlinear growth.

Results: Working memory and arithmetic in Grade 1 predicted children's initial word problem performance. Approximate number sense (ANS) significantly predicted growth from Grade 1 to Grade 6, even with domain-general skills and other numeracy measures included. This effect was robust across model specifications, from domain-general predictors alone to models with domain-specific skills and arithmetic ($\beta = 0.30–0.32$, all $p < .05$). As the design is observational, findings are best interpreted as predictive rather than causal, though the longitudinal structure rules out reverse causation. Theoretical and practical implications are discussed.

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4. Identifying students who need extra teaching interventions: Experiences from the development of Norwegian national numeracy mapping tests

Guri Nortvedt, Henrik Hung Haram and Oksana Kovpanets
University of Oslo

Abstract

The Norwegian national numeracy mapping tests are formative assessments designed to identify students who may benefit from remedial teaching. In addition, the assessments should provide teachers with information about what students can do, which should help them plan teaching interventions. Norwegian national mapping tests in numeracy were first developed in 2008 for grade 2 in primary school. Later, they were developed for grades 1 and 3. The tests were paper-based and administered by the class teacher. In 2018, Norwegian national authorities decided to replace these tests with digital ones. The digital grade 1 test was first conducted in the 2022 spring, and the grade 3 test in the 2022 autumn. The test construct consists of three main areas closely related to one another: counting, number concept, and simple arithmetic. The selection of the areas is based on research literature on early mathematical numeracy, and the items in the assessment test for 3rd grade are also based on the competence goals in the Norwegian national mathematics curricula for grade 2. Both tests consist of two parts. All students are supposed to complete Part 1. About 70% of them do well enough that it is clear they are not lagging behind in mathematics and do not need extra teaching interventions. These students do not take Part 2. About 30% of students move on to Part 2, and about 20% of all students are identified as lagging behind in mathematics. Drawing on lessons from test development, this presentation aims to discuss challenges in designing items that effectively measure specific aspects of the numeracy construct to identify students who struggle. Furthermore, it will explore the benefits of a digital format when assessing the same or, in some cases, other aspects of the construct, using examples for each case. The discussion will also include strategies implemented to minimize the influence of construct-irrelevant factors, such as students' reading comprehension, digital skills, or students' age, on numeracy test outcomes.

PARALLEL SESSIONS B2:

TURSDAY 29 OCTOBER 9:00–10:30

Room 234

Chair: Helena Roos

1. Changes and parallel processes in math anxiety, enjoyment, and boredom

Hans Lehikoinen[1], Johan Korhonen[2]. Anna Tapola[2], Pinja Tähti[1], Riikka Mononen[1]
[1]Special and Inclusive Education, University of Oulu, Finland
[2]Faculty of Education and Welfare Studies, Åbo Akademi University, Finland

Abstract
Mathematics-related achievement emotions play a central role in students' engagement and learning (Forsblom et al., 2021; Pekrun, 2006), yet little is known about their developmental dynamics during late elementary school. In particular, it remains unclear how these emotional trajectories relate to one another over time, whether they follow similar developmental patterns across students, or whether they vary as a function of factors such as mathematics performance or gender.

In this study (N = 319), we examined the developmental trajectories of mathematics anxiety, enjoyment, and boredom from Grade 4 to Grade 6, as well as their associations with gender and mathematics performance. A preliminary series of latent growth curve models indicated overall unfavourable changes in mathematics-related emotions across Grades 4 to 6: enjoyment declined over time, whereas anxiety and boredom increased. Parallel process models showed that rates of change in emotions were interrelated: students who showed faster declining enjoyment tended to show faster increases in boredom and anxiety. Higher initial mathematics performance was related to more favourable emotional profiles at the start of the study, including lower anxiety and boredom and higher enjoyment. Notably, higher performance was also associated with a steeper decline in enjoyment over time, suggesting that initially more engaged students do not necessarily remain so in the later primary school years. Regarding gender differences, girls exhibited a significantly steeper increase in math anxiety over time compared to boys. No significant gender differences were found in enjoyment or boredom trajectories. Together, these findings highlight the complex emotional dynamics underlying mathematics learning across the upper primary years and underscore the importance of supporting all students' achievement emotions to sustain both performance and engagement over time.

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2. Enhancing students' attitudes towards mathematics: Results from a Danish intervention

Pernille Ladegaard Pedersen, Lise Dausen, Christian Brix & Bent Sortkær
Teacher Education, VIA University College, Aarhus, Denmark

Abstract

Students' attitudes towards mathematics play an important role in their mathematical development (Chen et al., 2018; Dowker et al., 2019; Hwang & Son, 2021). While this applies to all students, low-performing students tend to demonstrate particularly negative attitudes towards mathematics (Jóelsdottir & Østergaard, 2024; Kjeldsen et al., 2024). Whether students' mathematical difficulties lead them to develop a negative attitude toward mathematics, or whether it is their pre-existing attitude that contributes to the emergence of such difficulties, is a multifaceted discussion. Hence, this study pays particular attention to studying the attitudes of low-performing students. We designed a three-year intervention with an intensified focus on: (1) problem solving; (2) the use of concrete, iconic, and abstract representations; and (3) a slowed-down and more coherent curriculum. The intervention was implemented in 105 schools (54 treatment, 51 control) from Grade 4 to Grade 6. Using a translated and revalidated version of the Attitudes Towards Mathematics Inventory (ATMI) (Pedersen, et al.; 2026), we examine whether the intervention has a positive impact on low-, average and high performing students' attitudes towards mathematics. The three student groups were formed based on their national mathematics test scores, using the 25th quartile as the cut-off point to distinguish the lowest- and highest-performing students. Preliminary findings indicate positive and statistically significant effects for two of the four ATMI dimensions—self-confidence and motivation—among low-performing students (See Figure 1). No statistically significant effects were found for the remaining dimensions, value and enjoyment.

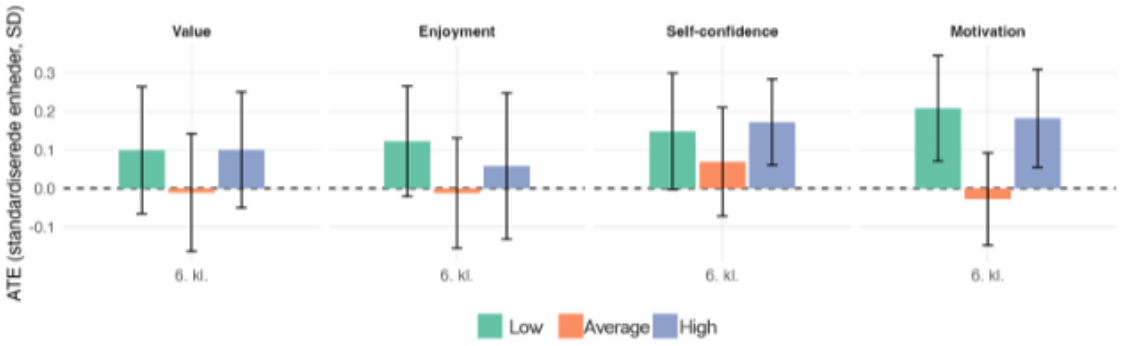


Figure 1The impact of TRACK on the various domains of Attitudes Towards Mathematics.

In the presentation, we elaborate on the three main characteristics of the intervention and discuss how these may interact with students' attitudes towards mathematics.

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3. Developing teaching resources in mathematics for children at risk

Olaug Lona Svingen[1] and Linda G. Opheim[1,2]
Norwegian Centre for Mathematics Education, Norwegian University of Science and Technology[1] and University of Agder[2]

Abstract

We will in this presentation give examples of teaching resources in mathematics that have been developed for children at risk. These resources are part of a larger project led by the Norwegian Centre for Mathematics Education, where the main aim is a one-day seminar on intensive instruction in mathematics where we bring together teachers and educational and psychological counselling service to discuss and develop our knowledge about students at risk. We provide a variety of resources in the aftermath that can be used by teachers in their work to meet the requirements formulated in the Education Act §11-3 on intensive instruction. These resources comprise of literature, frameworks, digital resources and various teaching resources.

In this presentation we provide examples of teaching resources that are structured into four phases: concrete, representational, abstract, and summarizing. These four phases are inspired by the work of Witzel et al. (2003) and Sterner (2015). A characteristic of the resources we develop is that we are goal oriented towards specific challenges and strategies children at risk might struggle with. For instance, that a child might be stuck at finger counting when adding instead of making tenths as a strategy. The resources are therefore developed to support teachers to work intentionally with children at risk in developing more effective strategies.

In developing these resources, communication with teachers has been a vital part of the process to meet teachers' needs in the classroom. We have therefore collaborated with teachers who have tested the resources and given us feedback. As researchers we know of many challenges children at risk might have, but we cannot provide solutions without teachers recognizing both the challenges and solutions as useful for them. The research is designed as a multiple case study (Stake, 2006), where the phenomenon to be studied is the teachers' perceptions of the usefulness of the resources we develop. Our intentions are to provide support and resources so teachers can make changes to their teaching which they might not otherwise have the time or resources to do.

We will in this presentation share both examples of resources that have been developed, and what we have learned in the process of this collaborative process with the teachers. This project provides both teaching resources aimed at children at risk, but also greater knowledge of the types of support teachers expresses they need in the mathematics classroom.

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4. Concrete, pictorial and abstract representations in mathematics teaching: Status and potential

Bent Sortkær, Pernille Ladegaard Pedersen, Christian Brix & Lise Dausen Teacher Education, VIA University College, Aarhus, Denmark

Abstract

The use of different representations is described as an important and central part of mathematics education in Denmark (Ministry of Children and Education, 2019; 2025) and other countries (NCTM, 2014). This has been motivated by mathematical didactical research showing how the use of different representations supports student thinking and learning (Kaput, 1987; Goldin, 1998; Bruner, 1966; Duval, 2006). A central point in this research is the use of and link between concrete, pictorial and abstract (hereafter: CPA) representations of mathematical ideas and problems (Hoong et al., 2015). Despite positive results from research and policy promotion, we know very little about the actual use of CPA in mathematical teaching, the use of CPA on different grade levels and how to promote the use of CPA.

On this background, this study answers three research questions: (1) To what extent do mathematics teachers in Denmark use CPA in their middle-school teaching; (2) To what extent are CPA used continuously throughout middle-school (grade 4-6); and (3) Can we support teachers in their use of CPA to promote the use hereof.

To answer these three research questions, we used a systematic minute-by-minute observation protocol to observe 2800 minutes of mathematics teaching in 15 classrooms throughout three years of schooling (grade 4 to 6).

Preliminary results indicate that (1) teachers only use CPA to a very little extent. (2) Teachers use CPA less going from grade 4 to grade 5, and in grade 6 the use of concretes in mathematics is absent. (3) By supporting teachers in the use of concretes through a three-year intervention (providing teaching material, participation in workshops, and access to concretes), teachers used CPA to a higher degree than the group of teachers not participating in the intervention.

At NORSMA, we will present the results and discuss the role of CPA in relation to special needs education in mathematics and will promote the point that the use of CPA is a didactical skill. Consequently, teachers need support and training in the use hereof if CPA should play a larger role in mathematics teaching in the Nordic countries.

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PARALLEL SESSIONS C1:

TURSDAY 29 OCTOBER 12:30–13:45

Room 231

Chair: Edda Óskarsdóttir

1. Profiles of number processing and arithmetic fluency in grades 3 to 8

Heidi Hellstrand[a], Santeri Holopainen[b], Pekka Räsänen[c], Anu Laine[d], Johan Korhonena and Pirjo Aunio[d]
[a]Faculty of Human and Social Sciences, Åbo Akademi University, Vaasa, Finland
[b]Turku Research Institute for Learning Analytics, University of Turku, Turku, Finland
[c]Department of Pediatric Neurology, Helsinki University Hospital, Helsinki, Finland
[d]Faculty of Educational Sciences, University of Helsinki, Helsinki, Finland

Abstract
Number processing (NP) and arithmetic fluency (AF) are considered foundational skills in mathematical learning. For older students, AF is more in focus when identifying and supporting their mathematical learning than NP is. In contrast, NP is more in focus in younger students, as it is seen as a more underlying skill than AF. This study aims to identify profiles of number processing (NP) and arithmetic fluency (AF) among students in Grades 3–8, and to examine how these profiles vary within and across grades. Students' NP and AF were measured using the digital Functional Numeracy Assessment Dyscalculia Battery (FUNA-DB), which was developed to identify students with mathematical learning difficulties (Hellstrand et al., 2024; Räsänen et al., 2021). FUNA-DB comprises two subscales: NP (i.e., number comparison and digit-dot matching) and AF (number series, single-digit addition and subtraction, and mixed addition and subtraction). Analyses are based on a sample of 4,369 students (ngrade3 = 826, ngrade4 = 813, ngrade5 = 584, ngrade6 = 792, ngrade7 = 766, ngrade8 = 588). Confirmatory factor analysis supported a two-factor structure (i.e., NP and AF) in all grades. The number of distinct profiles varied across the grade levels. In grades 3 and 6, three profiles best describe the data, whereas in grades 4, 5, 7, and 9, four profiles best describe the data. The differentiation between profiles was more evident in AF than in NP, especially in grades 7 and 8. This study contributes to the knowledge of co-development in NP and AF.

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2. Impact of a short whole class intervention in multidigit arithmetic on low achieving students' flexibility and adaptivity

Pernille Bødtker Sunde[1,2] and Lóa Björk Jóelsdóttir[1,3]
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BACKGROUND
Developing flexibility and adaptivity in arithmetic is a key instructional goal. Flexibility concerns using a repertoire of strategies, whereas adaptivity involves selecting the most appropriate strategy for a given problem. Both are linked to mathematics achievement, yet low achieving students often rely on restricted, digit-based or backup strategies. Although students across achievement levels can learn number-based strategies (a prerequisite for flexibility), little is known about how low achieving students engage with multidigit strategies and respond to targeted instruction.

This project investigates whether strengthening flexibility and adaptivity supports broader achievement. In a pilot study, we examined whether a brief whole-class intervention can promote flexibility in multidigit arithmetic. This presentation focuses on low performing students: their response to the intervention and how their development compares with higher achieving peers.

METHODS
Across 14 schools, approximately 800 Grade 3 students (39 classes) and 700 Grade 7 students (36 classes) participated in a 10-lesson intervention targeting flexible strategy use in multidigit addition and subtraction (both grades) and multiplication (Grade 7). Lessons included: (1) whole-class number talks, (2) pair-based compare-and-contrast activities, and (3) short number sense games (individual/small group). Pre- and post-tests used a Tri-Phase Flexibility Assessment to measure strategy preferences, flexibility, adaptivity, and accuracy. Half completed the post-test immediately after the intervention and half after a two-month delay.

Intervention effects will be estimated using multilevel mixed-effects regression models controlling for prior flexibility, mathematics achievement, and socioeconomic status, with random effects for classes and schools. Moderator analyses will examine whether student achievement level, teacher practices, and classroom characteristics influence outcomes.

RESULTS
Preliminary findings indicate improvements in flexibility, adaptivity, and accuracy. Adaptivity improves strongly in both grades. Accuracy gains appear larger in Grade 3, while flexibility gains are particularly notable in Grade 7. Variation across classes and schools suggests potential influences of implementation fidelity and perceived effectiveness of components. Ongoing analyses will test whether low achieving students benefit similarly or differently than their higher achieving peers.

DISCUSSION
Early indications suggest that a short intervention emphasizing compare-and-contrast tasks can support meaningful growth in strategy flexibility and adaptivity. The presentation will detail effects for low achieving students and discuss implications for supporting learners with multidigit arithmetic difficulties, contributing evidence on how targeted instructional design may reduce disparities in strategy use and promote more equitable outcomes.

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3. Differences in experiencing math anxiety's dimensions between different mathematical skill groups

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Abstract
Math anxiety (MA) can manifest as tension in situations involving mathematics (Richardson & Suinn, 1972) and it can be divided into cognitive (worry) and affective (emotionality) dimensions (Wigfield & Meece, 1988). Several studies have found a negative relation between MA and mathematical performance (e.g. Barroso et al., 2021; Namkung et al., 2019) but less is known about differences in experiences of MA in different mathematical skill groups.

The aim of this research was to investigate differences in MA across mathematical skill groups in a longitudinal design (two timepoints during one school year). The participants were Finnish fifth grade students (n = 174). Students' experiences of MA (cognitive and affective) were measured with an adapted version of the Mathematics Anxiety Rating Scale - Elementary Form (MARS-E) (originally based on Richardson & Suinn, 1972; Suinn et al., 1988, and further developed by Henschel & Roick, 2017) and their mathematical performance with the FUNA-DB test (Räsänen et al., 2021). Students were divided into three skill groups based on percentiles: low performance (i.e. lowest 25 percentile) average performance, high performance (i.e. highest 25 percentile). Only students with data from both timepoints were included in the analysis.

Descriptive statistics of the variables in the different skill groups are given in Table 1.Repeated measures ANOVA showed that, in both cognitive and affective MA, there was no significant change in MA levels within the different groups over time. However, there was a statistically significant difference between the skill groups in the level of cognitive MA ($F[2, 170] = 3.82$, $p = .024$, $\eta 2p = 0.043$) and a nearly statistically significant difference in the level of affective MA ($F[2, 171] = 3.01$, $p = .052$, $\eta 2p = 0.034$). Post hoc tests, using the Tukey correction, showed that low and high performance skill groups differed both in cognitive MA ($t(170) = -2.76$, $p = .017$) and affective MA ($t(171) = -2.40$, $p = .045$), with higher MA in the low performance group in both dimensions (Figures 1 and 2).

The current research showed that the development of MA is rather similar and stable in different math skill groups during the fifth grade. However, students with low performance in mathematics appear to experience higher MA compared to their peers. Our study confirms that it is important to provide support to students with low mathematical performance, as they are at greater risk to higher levels of MA later on.

Measurement	FUNA-DB				Cognitive math anxiety				Affective math anxiety			
Timepoint	T1		T2		T1		T2		T1		T2	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Low performance	-0.880	0.344	-1.00	0.398	1.78	0.451	1.85	0.556	1.90	0.548	1.96	0.721
Average performance	0.0562	0.448	0.103	0.464	1.60	0.500	1.69	0.592	1.77	0.610	1.77	0.681
High performance	1.06	0.322	1.07	0.311	1.44	0.332	1.53	0.515	1.57	0.442	1.55	0.501

T1 = timepoint 1, T2 = timepoint 2

Table 1: Desriptive statistics

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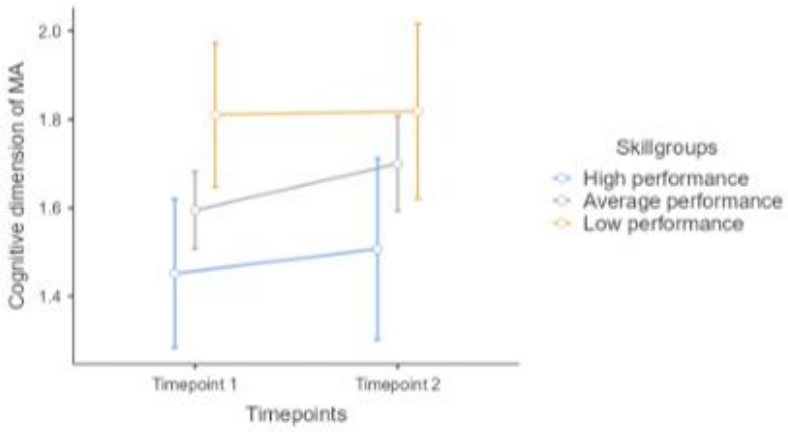


Figure 1: Development of cognitive dimension of MA

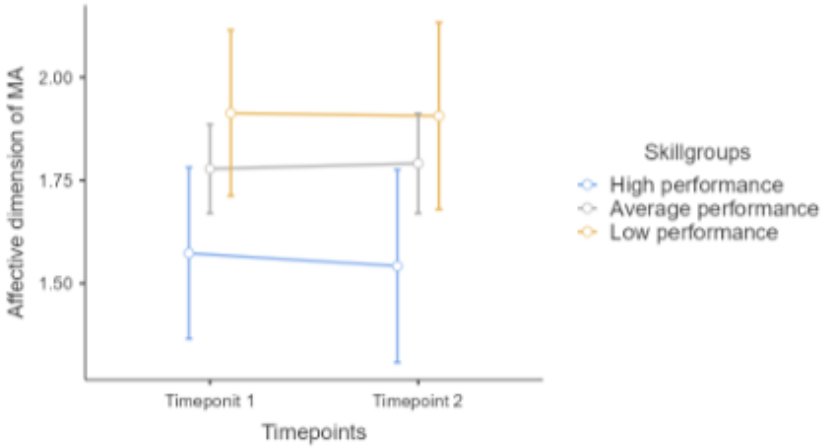


Figure 2: Development of affective dimension of MA

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PARALLEL SESSIONS C2:

TURSDAY 29 OCTOBER 12:30–13:45

Room 234

Chair: Riikka Mononen

1. The lived experience of dyscalculia: (special)pedagogical meanings across students, teachers, and evaluators

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Keywords: Dyscalculia; lived experience; mathematics difficulties; phenomenology

ABSTRACT
International research on mathematics difficulties employs diverse terminology, ranging from broad concepts such as mathematics difficulties to more specific terms including mathematical learning disabilities and dyscalculia. While arithmetic difficulties refer to challenges in basic calculation skills, this study focuses on *developmental dyscalculia* as a specific condition affecting mathematical learning, drawing on Butterworth's (2016) definition.

Mathematical competence is crucial for participation in everyday life, and weak numeracy is associated with long-term negative outcomes in education, employment, income, and health (Parsons & Bynner, 2005). Persistent inequalities in access to high-quality mathematics education have disproportionately affected students with disabilities and low achievement (Gervasoni & Lindenskov, 2011). In response to calls for advocacy and equity in mathematics education (Boaler & Anderson, 2018), this study seeks to deepen understanding of dyscalculia as it is lived and experienced in educational settings.

Adopting a phenomenological approach (Van Manen, 2023), the study explores the following question: *What (special)pedagogical meaning can be discerned in the lived experience of dyscalculia as expressed by students, teachers, and evaluators?*

The methodology involved semi-structured interviews with five dyscalculia evaluators, seven students diagnosed with dyscalculia (aged 13–15), and the seven mathematics teachers teaching these students.

Preliminary findings from student narratives reveal pronounced difficulties in basic arithmetic, particularly multiplication and subtraction, with the number line experienced as especially challenging. Students commonly rely on finger counting and compensatory tools such as calculators, visual supports, and personal formula sheets. An uneven cognitive profile emerges: some students cope with algebraic reasoning while lacking foundational arithmetic skills. Mathematics learning is described as cognitively demanding and emotionally burdensome, often eliciting stress, anxiety, and concentration difficulties. Repeated experiences of failure contribute to internalised negative self-concepts, shame, and a sense of deviance.

Evaluators point to systemic challenges, including political and economic constraints, extended waiting times, and an increasing reliance on private assessments by less experienced practitioners. A significant gap between assessment and educational intervention is identified,

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alongside uncertainty regarding grading practices. Teachers express frustration in meeting students' needs within classroom constraints, highlighting the necessity of mathematics-specific special education expertise, adapted materials, and a slower instructional pace.

Across all perspectives, stigma emerges as a central theme. The presence of knowledgeable, responsive adults who listen to and validate students' experiences is crucial for reducing negative consequences and supporting sustained engagement with mathematics.

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2. Designing inclusive mathematics futures with avatars - strengthening special education teacher training

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Keywords: Avatars; Inclusion; Mathematics special education; relational competence; UDL

ABSTRACT
This contribution presents a tentative project aimed at preparing future special education teachers in mathematics for the complex challenges associated with supporting students experiencing mathematical difficulties. In Sweden, special education teacher training in mathematics is a 90-ECTS advanced programme designed to deepen knowledge of mathematical development and difficulties, while developing students' abilities to analyse support needs, design pedagogical interventions, and guide colleagues in fostering students' learning (Högskoleförordningen (1993:100)).

The project furthers a pilot study in which special education teacher students interacted with avatars representing mathematics teachers in simulated professional conversations concerning students' mathematical challenges. The theoretical framework integrates relational competence (Aspelin & Jönsson, 2019), inclusion in mathematics education (Roos, 2019), and Universal Design for Learning (UDL) (Meyer et al., 2014). Relational competence is used to examine how interpersonal actions and responsiveness are enacted in interactions with avatars. Inclusion is understood as processes of participation in learning and teaching, while UDL highlights how instruction can be designed to provide multiple means of engagement, representation, and expression to meet the needs of diverse learners.

Methodologically, the project employs avatar-based virtual simulations through TeachLivE™ (TLE), a simulation environment shown to effectively support the development of relational competence among future special educators (Lindberg, 2025). Virtual simulations offer an ethically advantageous practice space where students can take pedagogical risks without consequences for real pupils or colleagues. Through authentic and carefully designed scenarios, the project provides opportunities to rehearse difficult professional conversations and reflect on pedagogical decision-making. All simulations will be recorded, analysed, and followed by post-simulation interviews.

The project consists of three interconnected studies. Study 1 involves students conducting an intervention with portraying a student with mathematical difficulties, followed by reflection from relational and inclusive perspectives. Study 2 builds on these reflections as students present and discuss the intervention results in a professional conversation with an avatar representing the student. Study 3 engages students in conversations with avatars portraying colleagues, addressing common dilemmas in mathematics teaching. The project concludes with a synthesis integrating findings across all studies. The aim is to contribute knowledge about how virtual simulations can strengthen relational competence and support the development of inclusive mathematics teaching practices.

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3. Exchanges between research and practice in an ongoing Danish forum (FOMAVA)

Lindhardt, Bent[3], Lindenskov, Lena[4], Tonnesen, Pia[2], Jóelsdóttir, Lóa Björk[1]
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BACKGROUND

International and national surveys indicate declining trends in mathematics performance among lowest performing student groups, despite years of research in special needs education in mathematics, for instance communicated at NORSMA conferences. Surely, no direct way exists from research to classroom practice and vice versa. To address the issue, the journal Implementation and Replication Studies in Mathematics Education was founded in 2021.

In the ongoing project in Denmark, termed FOMAVA, *Forum for Mathematics Difficulties*, the main issue is whether new structural relationships may sketch new exchanges between experiences and knowledge among research(ers), teacher educators, teachers and students in order to empower vulnerable students to actively participate in and successfully learn mathematics in school?

Research questions

The research goal is to provide examples of how voices of teachers and challenged students can be heard and activated in defining existing challenges in practice and how they can be addressed in practice and research, by examining two research question

- Which challenges in practice and wishes for improvements concerning specific themes are articulated by teachers and vulnerable students in FOMAVA?

- Which collaboration channels are formed and sustained in the FOMAVA project at school, regional, and national level to articulate voices of teachers and vulnerable students?

Methods

We are inspired by action research (Dagsdóttir & Óskarsdóttir 2024): in FOMAVA, experts are given the right to define and communicate certain *themes* with associated research, relevant for mathematics difficulties, while students and teachers are given the right to define and communicate important challenges, and their experiences and ideas for possible actions (Källberg & Roos, 2025) (Ableitinger, Anger & Dorner, 2022).

Each theme runs in two half year inquiry cycles. In *first cycle*, experts convey to 27 mathematics counselors theoretical and empirical research findings and instruct them to organize conversations among vulnerable students and among mathematics teacher colleagues on challenges and ideas for how to easy the challenges. A teacher educator from regional University College facilitates *regional* discussions among counselors, sums up, analyses and reports to the experts. On national level, experts sum up and analyse to formulate a preliminary catalogue of actions to potentially ease challenges. In *second cycle*, mathematics teachers in two municipalities select and develop actions into classroom activities, try them out and document observations on their vulnerable students' participation. Project coordinators facilitate teachers' reflective discussion, sum up and report to experts for further analysis and identification of issues to raise awareness upon.

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