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Introduction to the papers of TWG25: Inclusive Mathematics Education – challenges for students with special needs

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Introduction

The Thematic Working Group 25 “Inclusive Mathematics Education – Challenges for Students with Special Needs”, established for CERME11 in 2019, was running for the second time at CERME12. The scope and focus of TWG25 covers research about special educational needs (SEN) and inclusion, in the intersection of mathematics education research and special education research. Since this scope is broad, the TWG-papers comprised grades 1-12, teacher professionalization and teacher education programs, types of inclusive settings in mathematics, concepts and models for instruction and subject matter didactics, special educational needs and child characteristics, and content related decisions for inclusive mathematics education.

During CERME12, TWG25 had 34 participants from 12 countries (Europe, also Brazil, Canada and the US) who presented 17 papers and 7 posters. The first session was spent on aims and objectives of this TWG and an exchange of overarching issues of the situation of SEN mathematics education in the different represented countries. In the following TWG-sessions, two up to four papers were presented each time, under an overarching theme. The three main fields were:

General papers, conceptual models, research review

Focus on teacher education, pre-service and in-service teachers

Focus on classroom, teaching and learning situations, different school levels

Moreover, poster authors were asked to identify the connection to papers in the initial session in order to include all participants. Posters were about inclusive education and collaborative instruction focusing on pre-service, general and special educators (Dibbs & Boyle) and their different roles (Scherer & Rolka). They also covered specific interventions for supporting students with difficulties in learning mathematics (Larmann & Ludwig), proposed a structure that should facilitate development of teaching materials for inclusive classrooms (Novotná & Moraová), presented ways of supporting special-needs children in the context of probability (Jaschke) and discussed diversity in relation to digitalization (Ludes-Adamy & Viermann), as well as affective and mediational suitability (Blanco et al.) in relation to a specific inclusive program.

In detail, the sessions were arranged according to the following thematic focal points:

Session 2: General papers, conceptual models, research review

This theme includes discussions of prior research regarding conceptual models as well as inclusive models for special educational needs in mathematics.

Helena Roos & Anette Bagger: Explicit instruction and special educational needs in mathematics in early school years

Marzia Garzetti, George Santi, Heidrun Demo & Giulia Tarini: The interplay between theory and practice in the development of a model for inclusive mathematics education

Karine Millon-Fauré, Patricia Marchand, Claire Guille-Biel Winder, Teresa Assude, Jeanne Koudogbo, Laurent Theis & Mathieu Thibault: Preventive support scheme for mathematics learning: possible ways to provide aid before and after the class session

Session 3: Focus on teacher education, pre-service and in-service teachers

This theme includes discussions of how framework conditions such as teacher education, specific teaching, cooperation between professions and steering documents influence inclusive mathematics teaching.

Tabea Knobbe, Christof Schreiber & Michaela Timberlake: Cooperation of mathematics teaching and special education – seminar concept and experiences

Jennifer Bertram & Petra Scherer: Pre-service teachers' beliefs and attitudes about teaching in inclusive mathematics settings

Michael Gaidoschik: "Individual Educational Plans" for "dyscalculic" students in primary schools of South Tyrol: A questionable law, poorly implied

May Ron Ezra & Esther S. Levenson: Perceptions of mathematical creativity among math teachers in special education classrooms

Session 4: Focus on classroom, teaching and learning situations, primary level

This theme includes discussions of specific interventions in the inclusive mathematics classroom to enhance learning of every student. The focus of research could be the learning environments, the students' learning processes, or teachers' acting.

Yola Koch: Working with objects of representation in practical contexts on length in inclusive classrooms

Uta Häsel-Weide & Marcus Nührenbörger: Inclusive math practices in primary school

Marie-Line Gardes, Céline Hugli, Jasinta Dewi, Ludivine Hanssen & Michel Deruaz: Evaluation of a computer-based learning program for students with mathematical learning difficulties

Carina Gander: "Counting with all children from the very beginning": One attempt to promote early arithmetical skills based on part-whole thinking

Session 5: Focus on classroom, teaching and learning situations, primary and lower secondary level

Also in this session, the papers and discussions focused on specific interventions in inclusive mathematics classrooms, with a special view on more advanced content such as problem solving or early algebra.

Raja Herold-Blasius & Benjamin Rott: Low-achieving secondary students learn mathematical problem solving – A longitudinal, qualitative video study

Ángeles Chico, Inmaculada Gómez & Nuria Climent: Problem-solving by students with Asperger's Syndrome

Ann-Kristin Tewes & Marcus Schütte: The mathematical support format reproduction

Francesca Gregorio: The role of examples in early algebra for students with mathematical learning difficulties

Session 6: Focus on classroom, teaching and learning situations

This theme includes discussions of how to create engagement in inclusive mathematics classrooms to enhance learning and participation of every student.

Amanda Queiroz Moura: Inclusive landscapes of investigation in mathematics classrooms with deaf and hearing students

Silvia Baccaro & Annalisa Cusi: A teaching methodology focused on the use of a videogame: analysis of the engagement of students with special educational needs

Introductory discussion – overarching issues of inclusion

Mathematics education needs to embrace the diversity that exists in mathematics classrooms to be able to meet every student. This implies that heterogeneity with respect to language, culture and abilities needs to be acknowledged (Bishop et al., 2015). This requires an accommodation in the mathematics classroom to enhance every student's learning. To be able to embrace the diversity and to meet the needs in a democratic education for all, where students with different languages, cultures, abilities and skills are educated together, inclusion is used as an overarching notion for support (Bishop et al., 2015). Though, often the notion of inclusion has been connected to special education rather than to a democratic education overall (Allan, 2012).

If we define the concept of inclusion in a *mathematics education* context, it implies to look for ways enabling us to meet the diversity in the teaching of *mathematics*. In Europe (and also around the globe) the way “inclusion in mathematics education” is defined and used is very different (Roos, 2019). Some countries and cultures connect inclusion very tightly to special education and disabilities, while others have moved towards meeting diversity on a more overarching level, connected to a democratic and equitable education. This also depends on the national governing documents. Even so, there are many challenges for inclusive education in school and research (Kollosche et al., 2019).

Mathematics education at every school is expected to create inclusive classrooms, with lessons where every student receives appropriate support and challenge. Here, the teachers' competences and those

of other professionals are crucial. In turn, this puts pressure on the teacher education to be able to equip teachers for their mission regarding inclusive mathematics teaching (Krainer, 2015; Scherer, 2019). Although there exist big differences in different countries, the need of preparing both pre-service and in-service teachers for inclusive mathematics education is recognized in all countries. The discussions in TWG25 showed the need to recognize different strategies to support pre-service and in-service teachers' processes of inclusive mathematics teaching. If teachers are better prepared for teaching in inclusive classrooms and have models and methods to make it work, education can be able to meet and value diversity (Askew, 2015).

During many sessions in TWG25, both 2019 and 2022, the question of how we understand inclusive education in mathematics was discussed. What does "inclusive education" mean in different countries? What is the role of stakeholders in different countries? How do we apply inclusive education to different cultural and national settings, and what are sufficient strategies on organization, classroom and individual level? These questions are reflected upon in the overarching themes that emerged from the discussions of TWG25, and described below.

Overarching themes of TWG25

Research in the field of inclusive mathematics covers a wide range, and several trends in mathematics education were presented in the papers of TWG25. All papers focus on some aspects of mathematics teaching and learning in relation to SEN and deserve due attention. During the sessions, the following points were discussed, especially how they are linked with each other.

What do we understand as „inclusive maths education“, which theoretical perspective do we have/propose?

Within TWG25, it was agreed that it is important to have a broader discussion about inclusion, also from a theoretical point of view. In addition to bringing *solutions*, it is important to ask *questions* about what inclusion means, about the (no) need of labels for students, about the characteristics of students with special needs and other aspects of research not intended to directly provide something applicable in the classroom, but with consequences on classroom practices. Without a focus on theory, it is not possible to have deep enough discussions and propose good enough solutions.

Inclusive mathematics education is a very complex field with manifold perspectives: Student perspective, teacher perspective, teacher training, etc. The question we should ask is who is it in the system that has special needs – the student, the teacher, the system of education?

It follows from the discussions in the TWG that truly "inclusive mathematics education" is such practice in which every pupil in the classroom is welcome regardless of knowledge, skills and background. One way of achieving it is by paying enough attention to the learning environment, to let pupils work together, collaborate, be active. *Participation* and *inclusion* are strictly connected. A way of achieving this is making suitable learning offers and preparing lessons allowing each pupil to be successful and experience the pleasure of achieving. We should look for ways of engaging all students in standards-based, inquiry-based instruction, but provide structures and support so that all pupils will be successful, without diminishing the cognitive demand of the tasks. No doubt that this is not easy to achieve, but it is what we should be aspiring to.

The challenge takes on additional facets when deafness and the lack of a common (sign) language make communication between hearing and deaf children as well as between deaf children and (mathematics) teachers who are not trained in sign language difficult or at times even impossible. In her contribution, Amanda Queiroz Moura pleads for the establishment of “inclusive landscapes of investigations” with the permanent engagement of sign language interpreters, who have the explicit task of facilitating communication also between hearing and deaf children while they work together on challenging problems. In the discussion, however, it was also questioned whether the “dogma” of joint learning of hearing and non-hearing children might not, under certain conditions, lead to a reduction of learning opportunities for the non-hearing, so that in this case *social participation* might happen at the expense of the *content-related participation* of deaf children.

Genuine inclusion always means both (Roos, 2014; Jung & Schütte, 2017) – and obviously requires a great deal of resources in terms of competent teachers, time, but also technical aids, material, spatial requirements and the like. One important task for future research in inclusive mathematics education might be to provide a more solid empirical basis than we have at the moment for assessing the way in which those inclusive settings, which have been enacted in different nations based on pedagogical convictions and, in the end, *political decisions*, actually prove their worth for the *content-related participation* of children with different learning backgrounds.

What do we understand as „special-needs student“, what (if any) use is it to have „labels“ like „dyscalculic“, how helpful/harmful are national laws/policies in that respect, (how) do we/can we have influence on such laws/policies?

Another subject of discussion was the issue of labelling. In many countries, diagnosing a special-needs child is a process that schools have to perform in order to be allowed to adapt the child’s program and start interventions. As a rule, such diagnoses follow a medical-psychological approach, with deficit-oriented definitions of “disorders” and clear cut-off criteria within standardized testing procedures. This seems to be particularly problematic in the case of “dyscalculia”, given the empirical evidence from mathematics education research that learning difficulties in mathematics may at least to some extent be explained by inadequate instruction (Gaidoschik, 2019), and in many other cases be traced back to insufficient fit between the teaching and the learning requirements of a single child. In such cases, it is not the child that suffers from a learning disability, but rather the school system from disability to offer the child a proper learning environment. Attributing “dyscalculia” may therefore result, on the one side, in maintaining such classroom practices that do no good to any child, and on the other side, in single children's learning difficulties being labelled as consequence of *their individual* dispositions (Gaidoschik et al., 2021).

Of course, under the given circumstances, only such a diagnosis may mean the possibility to have fewer pupils in classroom, a special teacher to cooperate, to give the pupil extra time in exams, to have an assistant for the child. Yet, if the label does not lead to *additional pedagogical resources* that could help to overcome the learning difficulties, it rather has the function to formalize the further treatment of a child defined as presumably permanently not able to learn mathematics at a “normal” level. In the following, this labelling may be very unpleasant for the child as they get an official stamp of not being ordinary, of being different from the others. In some cases, it may result in resignation,

low aspirations, low self-confidence and low level of motivation. The discussion among the TWG participants showed that there is no simple answer to whether such labelling is the right step in inclusive education. While some argued that the label helps the teacher understand the pupil's needs but also may help the pupil gain self-confidence seeing that they do not perform badly because they would be "stupid", but because of a diagnosis that is not their fault, others argue that a truly inclusive classroom with truly inclusive practices is ready to support every learner whatever their special needs are.

Do we have best practices or proposals for such practices or open questions about how to get to best practices in teacher education for inclusive maths education with a view to collaboration of maths and special education teachers?

A lot of the discussions focused on good as well as bad practices in mathematics classrooms, existing and used in different countries. As Michael Gaidoschik pointed out in his paper, inclusive practices in many countries tend to be tied by demands of the authorities. The school has to create a formal document (which may have different forms in different countries) that defines the methods of work, the objectives, the needs, but all this is rigid and quite formal. In some countries this kind of document or plan is subject to work of the inspection more than what is actually happening in the classroom. This in no way supports good practices at schools. And, as follows from the discussion, research has a responsibility to not just accept what politicians do and how they act and define things, but to always be critical, especially when researching inclusive and special education.

The discussions also focused on collaboration between ordinary mathematics teachers and special teachers, which does not happen in all countries, and special teachers are still very rare in some of the countries. To put it shortly, mathematics teachers tend not to get sufficient training in care for special-needs children and special teachers, in general, do not seem to have sufficient training to understand problems in mathematics. Hence, special teachers need more training in mathematics and mathematics teacher more training in special education. Also the need of close collaboration between special and regular mathematics teachers was part of the discussions and is regarded as one of the topics that should be inquired in more detail in research and on the next CERME.

Following the discussions in TWG25, *collaboration* is at the base of inclusion. This does not refer only to pupil-teacher but also to teacher-teacher and also researcher-researcher as well as teacher-researcher collaboration, where mutual projects of special education and mathematics education will definitely bear fruit. Collaboration and knowledge-sharing between disciplines is what is needed. Effective co-teaching requires sustained professional development in which both (special and mathematics teacher) develop a shared understanding of mathematical development, curricular design and both the challenges and strengths of pupils with special needs. It also requires that teachers have adequate time to plan together. Teacher education programs need to foster collaboration between special education and mathematics education. In turn, research on the mathematical learning of students with disabilities must integrate neurodiversity into research design and implementation.

In the discussions it turned out that a lot of current research focuses on the pupil and his/her activity. However, it is the teacher whose everyday reality is teaching heterogeneous classes with pupils of very different skills and levels. They need to be paid a lot of research attention, looking for ways of

helping them grow more self-confident and less anxious in classrooms. The question the research community should ask is “What training and support does the mathematics teacher need?”

Conclusion and further directions of TWG25

Reflecting on the research presented in TWG25 and on the discussions, diverse issues concerning inclusion in mathematics education and challenges for students with special needs in mathematics exist, and further research is needed. One major question is how to cope with the diversity of research directions and cultural as well as national and international differences. Still, it is interesting to see that even if there are very diverse issues concerning inclusion in mathematics education, there are similarities too, and this could be a chance for national and international exchange and cooperations. In our view, research topics should be better connected and, if possible, transferred. Research findings for specific mathematical topics in the sense of best practices should be reviewed for other topics or for similar topics on different school levels or grades. What are the relevant factors or design elements that work in inclusive classrooms? In what way can we consider both students’ perspective and teachers’ perspective? Also on the teacher education level, apart from specific studies with a detailed focus, the different phases of teacher education programs could be considered in a more general way: Understanding professional development of teachers as a life-long-learning process (e. g. Cedefop, 2015), findings with respect to pre-service teacher education programs should be reviewed for in-service teachers, and should be connected to programs for teacher educators. Mathematics programs for special education and programs for regular teacher education should be reviewed in more detail and checked for common objectives. Only in this way will the necessary cooperation in so called multiprofessional teams be ensured.

In summary, there seem to be opportunities to build a common ground regarding inclusive mathematics teaching and challenges for students with special needs. Looking forward to CERME13 the community has a challenge to build further on the work at CERME12 and build a common ground to address issues within the scope of TWG25.

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