

TSG Agenda

TSG 4. Mathematics education for students with special needs Class B

Session 1 19:30-21:00 (UTC + 8) Tuesday July 13

19:30-19:35 Welcome to the TSG

1. Time: 19:35–20:00

Title of the Paper:

Mathematics learning difficulties? The impact of a constructivist oriented approach to intervention for young learners who struggle the most

Author(s):

Gervasoni, A. and Roche, A.

Institution(s) (to school/department/research center) and Country/Region:

Monash University, Melbourne, AU

Short abstract of the paper (20 lines maximum):

The Extending Mathematical Understanding (EMU) approach provides supplementary support for Grade 1 (6-year-old) children who struggle the most in their classrooms when learning mathematics. These short-term supports are provided by specialist teachers who use reform-oriented constructivist teaching approaches. The longitudinal progress of 255 students who accessed Level 3 EMU support in Grade 1 was monitored annually from 2016-2019 in four whole number domains. As an illustration of the results, their progress in multiplication and division from Grade 1 to Grade 2 was twice the typical growth for all students in their cohort. On average, in the two years following the intervention, these children's learning was maintained, but further growth in multiplication and division was minimal. This finding demonstrates that progress for young children who struggle to learn mathematics can be accelerated and their new learning maintained. Further research is needed to provide insight about how classroom environments in the years following such an intervention can best provide the opportunities necessary to extend children's mathematics learning further.

2. Time: 20:00–20:10

Title of the Paper:

Conceptual model-based problem-solving computer tutor for elementary students struggling in mathematics

Author(s):

Yan Ping Xin, Soo Jung Kim, Bingyu Liu, Qingli Lei, Shuang Wei, Wudong Wang, Sue Ellen Richardson, Signe Kastberg, Yingjie Chen

Institution(s) (to school/department/research center) and Country/Region

Purdue University, USA

Short abstract of the paper (20 lines maximum):

The purpose of this study was to explore the impact of a web-based computer tutor, Conceptual Model-based Problem-Solving (COMPS) program that emphasizes mathematical model-based problem solving, on the performance of elementary students with learning difficulties in mathematics (LDM).

3. Time: 20:10–20:20

Title of the Paper:

Interventions in micro-spaces for learners with mathematics difficulties

Author(s):

Robyn Ruttenberg-Rozen, Ann LeSage

Institution(s) (to school/department/research center) and Country/Region:

Ontario Tech University

Short abstract of the paper (20 lines maximum):

Interventions for learners experiencing mathematics difficulties are often thought of as actions or prescriptive strategies that a mediator or a more knowledgeable other implements to create change. Instead, in this paper we explore interventions as collaborative and with tension within small temporal spaces or junctures, micro-spaces, where access to mathematics becomes possible. At the foundation of this micro-space intervention is the notion that knowledge and understanding are recursive and fluid, not linear, entities. We use data from an intervention study with grade 5 learners (age: 10/11) experiencing mathematics difficulties to illustrate the notion of interventions within microspaces.

Time: 20:20–20:30 Discussion

4. Time: 20:30–20:40

Title of the Paper:

An inclusive child's enactment to a task in dynamic geometry environment

Author(s)

Shajahan Haja-Becker

Institution(s) (to school/department/research center) and Country/Region

University of Saarland, Saarbruecken, DE

Short abstract of the paper (20 lines maximum): This paper explores the enactment of an inclusive child (Joy- pseudo name, age 10, Grade 4) reported with upper plexus

paralysis while solving a tool-based task designed by a primary pre-service teacher (PST) in a computer based dynamic geometry environment. Aim of the study is to find out: 1) how PSTs task created conditions for fostering Joys enactment with dynamic geometry tools and 2) how Joy solved the task using his sensorimotor schemes. Analysis of the data (PSTs assignment, interview and screen recording of Joys work with the task on computer) showed that Joy accomplished the task partially enacting with dynamic geometry tools. Implications to develop compatible gestures and embodied meanings for dynamic concepts in dynamic geometry learning environment in inclusive settings are discussed.

5. Time: 20:40–20:50

Title of the Paper:

The effect of schema-based instruction on the resolution of addition problems by a student with autism spectrum disorder

Author(s):

I. Polo-Blanco, S. Van Vaerenbergh, M. J. González, A. Bruno

Institution(s) (to school/department/research center) and Country/Region:

University of Cantabria (Spain)

University of La Laguna (Spain)

Short abstract of the paper (20 lines maximum):

In this study, the effectiveness of a SBI instructional approach to improve the mathematical word-problem-solving performance of a student with autism spectrum disorder (ASD) was examined using a case-study design. After seven intervention sessions, adapted to the students' educational needs, he improved his problem-solving performance of one-step change additive word problems in two dimensions: the comprehension of the problem statement and the attainment of the correct numeric solution. In particular, the student abandoned his first strategies based on the situation model of the problem and showed evidence of having developed the mathematical model. Additionally, the student generalized the acquired skills to two-steps word problems and the achievements remained 4 weeks after instruction. The implications of these findings for teaching problem-solving skills to students with ASD are discussed.

Time: 20:50–21:00 Discussion

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Session 2 19:30-21:00 (UTC + 8) Wednesday July 14

1. Time: 19:30–19:40

Title of the Paper:

Emergent technological practices of middle year students with mathematical learning disabilities.

Author(s):

Alayne Armstrong

Institution(s) (to school/department/research center) and Country/Region

University of Regina, Canada

Short abstract of the paper (20 lines maximum):

This exploratory case study describes the emergent technological practices of middle years students with mathematics learning disabilities (MLD) in using and adapting their use of personal electronic devices for supporting their academic mathematical needs. Videotaped semi-structured interviews are currently being conducted with middle years students in two western Canadian urban centers, with 14 interviews now completed. Early findings suggest that although the participants rely heavily on the guidance of family and teachers in their use of technology, some are beginning to use bootstrapping strategies to adapt technological practices to better suit their academic interests and needs.

2. Time: 19:40–19:50

Title of the Paper:

Introduction to probability in an inclusive setting – insights by a student with learning difficulties

Author(s)

Nadine Da Costa Silva

Institution(s) (to school/department/research center) and Country/Region

Ruhr University Bochum, Bochum, DE

Short abstract of the paper (20 lines maximum):

Learning on a common subject is seen as fundamental for inclusive education. However, it is still unclear how to design individual learning sequences while maintaining a common subject in order to offer students the chance to benefit from diversity in cooperative learning. This contribution focuses on a learning environment which introduces seventh grade students to probability using the frequentist interpretation. Based on data from a pre-study, the insights into probability by Yasim, who is a student with difficulties in learning mathematics, are going to be presented.

3. Time: 19:50–20:00

Title of the Paper:

Preparing teachers for mathematics and special education consultations. A collaboration across four continents

Author(s):

Sarah Van Ingen, Samuel Eskelson, David Allsopp, Steffen Siegemund, Anna-Sophia Bock, Vera Lúcia Messias, Fialho Capellini, Ana Paula Pacheco Moraes Maturana, Di Liu

Institution(s) (to school/department/research center) and Country/Region

University of South Florida, USA

University of Northern Iowa, USA

University of Wurzburg, Germany

Universität Hamburg, Germany

São Paulo State University, Brazil

East China Normal University, China

Short abstract of the paper (20 lines maximum):

This paper describes an international team of teacher educators/researchers from four countries that collaborated to develop a method of preparing preservice mathematics and special education teachers to consult with each other to address the mathematics learning needs of K-12 students with special education needs within inclusive classrooms. Researchers from Germany and the United States present case summaries of findings from implementations in their countries, and researchers from Brazil, China, Germany, and the United States collaborate to analyze the implementations. The paper concludes with international perspectives about implications for preparing preservice teachers for mathematics-specific consultations in various contexts.

Time: 20:00–20:15 Discussion

4. Time: 20:15–20:25

Title of the Paper:

Criteria used by teachers to identify students with difficulties in learning mathematics

Author(s):

Shemunyenge Taleiko Hamukwaya

Institution(s) (to school/department/research center) and Country/Region:

University of Turku, Finland

Short abstract of the paper (20 lines maximum):

The paper reports findings from a study exploring the criteria teachers use to identify students as having difficulty in learning mathematics based on teacher's knowledge. The single participant in this study was a Namibian high school mathematics teacher who identified three eleventh graders as having difficulties in learning mathematics. The teacher participated in a semi-structured interview. The analysis revealed that the

teacher used four criteria: asking low-level questions, low achievement in school assessments, math anxiety and not participating in class. These results seem suggest that there are multiple criteria teachers use to identify learning difficulties among students. The paper contributes to the understanding of teachers' knowledge of students.

5. Time: 20:25-20:35

Title of the Paper:

Becoming a mathematician: The role of learning environments in the identity narratives of mathematics students with learning disabilities

Author(s) (with the presenter name in BOLD if more than 1 name here):

Juuso Nieminen

Institution(s) (to school/department/research center) and Country/Region:

University of Eastern Finland + Deakin University, Australia

Short abstract of the paper (20 lines maximum):

The literature on students with learning disabilities is scarce in higher educational research, and it barely exists in the field of university mathematics education. Also, there has been a recent call to move towards understanding mathematical identities of students with intellectual disabilities through socio-cultural frameworks. In this report, these research gaps are addressed through examination of the identity narratives of six university mathematics students with learning disabilities. The focus of the present study is on a synthesis made based on six narrative analyses; a further discourse analysis was conducted in order to identify the role that the students gave to different elements of their learning environments for their identity construction process.

6. Time: 20:35-20:45

Title of the Paper:

Tactile drawings and 3-D objects: two keys to geometry for a blind student in an inclusion university course for preservice K-8 teachers

Author(s):

Patricia Baggett

Institution(s) (to school/department/research center) and Country/Region:

New Mexico State University

Short abstract of the paper (20 lines maximum):

In this paper several lessons that were studied in a Spring 2019 university course, Geometry for Preservice K-8 Teachers, in which a congenitally blind student was enrolled, will be described. It was the first time that the instructor had ever had a blind student in a geometry course. In the lessons, we will show how good-quality 2-D tactile drawings that the student could feel, and 3-D objects and their 2-D nets made from cardstock that she could manipulate, fold, and tape or weave together, helped her participate successfully in the class. Other important elements of the class will also be

discussed: help from the university's Student Accessibility Services Office; assistance provided by a mathematics graduate student who partnered with the blind student in class; and the roles of the sighted students who also provided supports. Anonymous evaluations of the course at the end of the semester and lessons learned by the instructor will also be discussed.

Time: 20:45-21:00

Discussion

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Session 3 21:30-23:00 (UTC + 8) Friday, July 16

1. Time: 21:30–21:55

Title of the Paper:

Arithmetical achievements of children with Trisomy 21 supported on geometrical basis.

Author(s):

José Ignacio Cogolludo-Agustín, **Elena Gil Clemente**, Ana Millán Gasca

Institution(s) (to school/department/research center) and Country/Region:

University of Zaragoza, Spain

Roma Tre University, Italy

Short abstract of the paper (20 lines maximum):

Children with Trisomy 21 have difficulties transitioning from a basic understanding of counting and cardinality to more advanced arithmetic skills. This is commonly addressed by resorting to the mechanical use of algorithms, which hinders the acquisition of mathematical concepts. Some authors have recently proposed a shift in the focus of learning from arithmetic to more fertile fields, in terms of understanding, such as geometry. In this paper we show that the good performance these children show in some geometrical tasks, involving primitive objects and relationships, can be applied to design learning activities that exploit crucial connections between elementary arithmetic and geometry: comparison greater than/order among points, addition of numbers/segments, and unit fractions/geometrical ratio. The qualitative research carried out with a group of seven children with Trisomy 21 from 8 to 12 years old yields some preliminary results on the power of geometry to improve children's understanding of arithmetic concepts.

2. Time: 21:55–22:05

Title of the Paper:

Intervention based on mathematical thinking improves student outcomes: math disabilities and difficulties

Author(s):

Jessica Hunt and Kristi Martin

Institution(s) (to school/department/research center) and Country/Region

North Carolina State University, USA

Short abstract of the paper (20 lines maximum):

Students with mathematics difficulties and disabilities (MD) show pervasive and consistent difficulties understanding fractions. We investigate the effects of a fraction intervention grounded in trajectories of student mathematical thinking on performance and conceptual growth for 13 students with math difficulties and disabilities over none intervention sessions. Results indicate statistically significant effects of the intervention on performance score on a measure of fraction concepts as a result of the intervention.

Additionally, students evidenced observable improvement of the cognitive operations consistent with conceptual growth over time. Preliminary results support the continued exploration and gathering of evidence toward a new framework for interventions called Small Environments that begins in the teachers adaptive pedagogies that bring forward and respond to students reasoning and learning abilities.

3. Time: 22:05- 22:15

Title of the Paper:

Beyond ability rankings: educational assessment as relational rigor and accountability

Author(s):

Anette Bagger, Alexis Padilla, Paulo Tan

Institution(s) (to school/department/research center) and Country/Region:

Örebro University, Sweden

University of New Mexico, USA

University of Hawaii at Manoa, USA

Short abstract of the paper (20 lines maximum):

In this abstract, we present a way of framing and exploring the body, mind and knowledge beyond taken for granted frontiers. The paper connects to disability studies in mathematics and aims at triggering discussion about inclusive relational equity in research and practice. We draw on frame analysis as a mode of exploring new forms of relational rigor and accountability pertaining to students with and without disabilities.

Time: 22:15- 22:25 Discussion

4. Time: 22:25- 22:35

Title of the Paper:

Mathematics and blind students: the problem of representations

Author(s):

Elisabete Marcon Mello

Institution(s) (to school/department/research center) and Country/Region:

Federal University of ABC-Brasil

Short abstract of the paper (20 lines maximum):

Inclusive education requires changes in teachers practice, and this practice is critical when working with visually impaired students. In mathematics, the use of representations by blind students requires special care, especially in the field of geometry, because to recognize a representation, those who see compare images, the blinds compare formats and this is not always considered properly in education. We will present the first results of a research conducted with blind students in order to

investigate how this student identifies and understands geometric objects and if having the possibility to create their own representation records helps their learning. So that the blind students can draw their representations, we used a product developed and patented by us, called Prancheta de Desenho em Relevô Positiva (Embossed Drawing Board). The study showed us that when the blind student makes his own drawing, creating his record of representation on paper, he effectively appropriates this representation and can use it as a tool to support his cognitive activities.

5. 22:35- 22:45

Title of the Paper:

Mathematics difficulty of students with special needs from the perspective of memory theories

Author(s):

Chi To Lui,

Ida Ah Chee Mok

Institution(s) (to school/department/research center) and Country/Region:

University of Hong Kong, China

Short abstract of the paper (20 lines maximum):

In order to help students form useful representations of the problems for solving word problems, many cognitive strategies have been developed. Two types of cognitive strategies that are commonly used are visual strategy and verbal strategy. According to theories of working memory, not all strategies are effective on helping students with mathematics disability (MD) for some of those students might not have ample working memory capacity (WMC) to execute the strategies. This study analyzed how the verbal and visual working memory capacities of the students affect the effectiveness of 3 different cognitive strategies (verbal strategy, visual strategy and combined strategy) for the students with mathematics learning disabilities. It found that visual strategy is not beneficial to student with lower visual working memory capacities. On the other hand, verbal strategy is beneficial to all student especially for those with lower verbal working memory capacities. The study contributes to how to choose and design better cognitive strategies for MD students.

22:45- 23:00 Discussion

Session 4 14:30-16:30 (UTC + 8) Saturday, July 17

1. Time: 14:30–14:55

Title of the Paper:

A teacher's attitude and approaches to high and low achieving students

Author(s):

Julie Vangsøe Færch, Signe Gottschau Malm & **Steffen Overgaard**

Institution(s) (to school/department/research center) and Country/Region:

University College Copenhagen, Denmark

Short abstract of the paper (20 lines maximum):

This paper addresses how a teacher's attitude towards high achievers and low achievers influences her teaching for these two groups of students. We analyse the teacher Almas different approaches to and attitudes towards the high and low achievers she teaches and identify how this difference comes to the fore in her teaching. We argue that these different attitudes and approaches leads to different learning potential for the high and low achievers.

2. Time: 14:55–15:05

Title of the Paper:

Mathematical Literacy citizenship: deaf and hard-of-hearing experience

Author(s):

Christopher Kurz

Institution(s) (to school/department/research center) and Country/Region:

Rochester Institute of Technology, USA

Short abstract of the paper (20 lines maximum):

This study examines deaf and hard-of-hearing experience in mathematical learning and life applications, according to the literacy citizenship framework. It is connected to the ownership of mathematics and relates to being connected to the world through mathematics. In this phenomenological research study, twenty-one deaf and hard-of-hearing participants shared their mathematical experience from when they were younger all the way through to their post-secondary years. The study findings show a lack of incidental learning, lack of informal mathematics learning, language issues in the classroom, absence of deaf-centric mathematics, and concerns for teacher qualifications in the elementary and mathematics departments. However, some participants expressed the power of mathematics to make changes in their communities, and that is made possible with rich knowledge of mathematical applications and high proficiency in languages, especially of mathematics.

3. Time: 15:05–15:15

Title of the Paper:

Using fingers for arithmetic calculations in children with complex hand anomalies

Author(s):

Caroline Hilton

Institution(s) (to school/department/research center) and Country/Region:

University College London, UK

Short abstract of the paper (20 lines maximum):

There is a considerable amount of research in mathematics education, psychology and neuroscience to suggest that fingers play an important role in the development of early number concepts and early arithmetic. This paper discusses a research project that focused on the development of early number and arithmetic skills in 10 children with Apert syndrome aged between 4 and 11 years, over a 2 year period. Of particular interest was the role of fingers in supporting the development of these skills. Children with Apert syndrome are born with their fingers fused. These fusions are often complex and as a result, even after surgery, children do not always have five functioning fingers. This influences the ways that children with Apert syndrome are able to access the early mathematics curriculum. During the study, most of the children needed support to be able to use their fingers to support them in their work with number and arithmetic. The children were also able to find novel ways of creating finger patterns to ensure that they were congruent with the base 10 number system. The findings suggest that children with Apert syndrome should be supported and encouraged to use their fingers.

4. Time: 15:15–15:25

Title of the Paper:

The variety of mathematical braille notations and their underlying principles

Author(s):

A. van Leendert, M. Doorman, J. Pel, J. van der Steen

Institution(s) (to school/department/research center) and Country/Region:

Royal Visio

Freudenthal Institute, Utrecht University

Erasmus University Medical Center

Short abstract of the paper (20 lines maximum):

Braille readers must be able to read and write mathematical expressions and equations in an appropriate way to become proficient in mathematics. All over the world, braille readers use different notations whose underlying rules are not clear. This study attempted to reveal the underlying rules and explain how these rules support mathematics learning. Twelve mathematics teachers of nine countries who taught in secondary education or at university completed a questionnaire about the mathematical braille notation and contextual factors associated with this notation. The results show that most notations are very close to the graphical notation used by sighted people, to the notation in Excel or to the notation in LaTeX. The notation that braille readers use depends, among other things, on their mathematics level and on the assistive devices they use.

15:25 – 15:40 Discussion

15:40-16:30 Next Steps Discussion

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Class B:

- Session 1: 19:30-21:00 Beijing time, July 13th
- Session 2: 19:30-21:00 Beijing time, July 14th
- Session 3: 21:30-23:00 Beijing time, July 16th
- Session 4: 14:30-16:30 Beijing time, July 17th