

## TSG39 Agenda

TSG 39: Language and communication in the mathematics classroom

**Session 1** : 14:30-16:30 Beijing time, July 13<sup>th</sup>

**1. Time: 14:30 – 14:40**

Title of the Paper: Meeting the challenges of research language and communication in mathematics education

Author(s): **Jenni Ingram**, Marcus Schütte, Fengjuan Hu, Máire Ní Ríordáin, Tran Vui

Institution(s): University of Oxford, UK; Technical University of Dresden, Germany; Capital Normal University, China; University College Cork, Ireland; Hue University, Vietnam

Short abstract of the paper:

*ICME-14 will bring together researchers from around the world and TSG 39 will include a range of researchers from different countries, theoretical perspectives, methodological approaches and with different foci. At ICME-13 Judit Moschkovich made four recommendations for research on language, interaction and communication in mathematics education and in this paper we return to these recommendations to explicate additional challenges that researchers in this TSG have faced as they seek to address these recommendations.*

**2. Time: 14:40–15:05 (Invited lecture)**

Title of the lecture:

Name: Krummheuer, Götz

City: Kassel, Germany

Short abstract of the lecture:

### **3. Time: 15:05–15:20**

Title of the Paper: Lifeworld connections in mathematics education - unquestioned, indispensable, and undefined?

Author(s): Elisa Bitterlich

Institution(s): Technische Universität Dresden, Germany

Short abstract of the paper:

*Within the mathematics classroom, connections to the everyday world are frequently used to catch the pupils' attention and to foster their understanding. Presumably, especially in primary school they are used with the aim of building bridges between the familiar 'everyday world' of the pupils and the more formal and abstract 'world of mathematics'. The presented study examines how language use looks like in situations with a lifeworld connection and to what extent this might have an impact on the pupils' supposed opportunities to learn. Within this paper, the focus is on the meaningfulness of the lifeworld connection and the assumed learning opportunities. Based on the interpretative paradigm of interpretative classroom research, interactional analyses of selected passages of everyday mathematics lessons will illustrate how mathematical classroom discourse is affected through the use of lifeworld connections and in what extent this could have an effect on the learning of mathematics.*

### **4. Time: 15:20–15:30**

Title of the Paper: The threshold of multiple representations for students to discover possible solutions for communicating their new ideas in integrated closed-open approach

Author(s): Vui Tran

Institution(s): Hue University, College of Education, Vietnam

Short abstract of the paper:

*The integrated closed-open approach shifts students from remembering formulas and procedures to answer textbook exercises to students asking questions which create an active environment in communicating mathematics. This integrated closed-open approach is really relevant to classroom mathematics teachers in implementing the lesson plans with the mathematics taxonomy of solving mathematics problems from closed to open: reproducing knowledge, applying regular procedure, complex procedure, without learned procedures, open ended (Tran, 2018). Students need to get the threshold of multiple representations to discover possible solutions for communicating their new ideas in integrated closed-open approach. This paper presents Grade 12 high school Vietnamese students' performance their communication of inductive process and deductive process in learning the applications of derivative and integral in closed-open situations related to distance and velocity. The result shows that if students get through the threshold of multiple representations, they will have more new ideas to communicate in the classrooms.*

**5. Time: 15:30–15:40**

Title of the Paper: The practice and examination of opportunities to translate representation through problem-solving

Author(s): Kunihiko Shimizu

Institution(s): Bunkyo University, Japan

Short abstract of the paper (20 lines maximum):

*The purpose of this research was to practice lessons based on hypotheses and examine opportunities to translate representation through classroom teaching. The research hypothesis was that children will be proactive in their use of diverse mathematical representations when they have questions and explorative in learning problem-solving. The classroom practice involved high school students' learning of the triangular ratio, in which the learning objective was to find the formula of the area when a pair of corresponding angles and the included side are given. Based on this classroom practice, the process of representation was translated by exploring student questions, while students' feelings concerning their approach to mathematics were also important. Further, as students' inquiries deepened, their representation gradually became more sophisticated, and in the process, along with trial and error, a process of returning to representing thought was seen.*

**6. Time: 15:40–15:50**

Title of the Paper: Tau Ke: a software solution for capturing multiple representations of pangarau (mathematics) language

Author(s): Piata Allen

Institution(s): University of Auckland, Australia

Short abstract of the paper:

*For over 100 years, subjects such as mathematics in Aotearoa New Zealand have been taught exclusively in English as a consequence of English only schooling policy. As a result of this and many other assimilationist policies, by the late 1970s the indigenous language, te reo Māori, was considered an endangered language. In response, Māori speaking communities initiated Māori immersion schooling (Māori-medium). In order to teach mathematics in the vernacular, there has been rapid development in the past 30 years of the specialised pāngarau (mathematics) register. The register is now in common usage in pāngarau classrooms across Māori-medium settings, but generally restricted to the school domain where many students and teachers are second-language learners of te reo Māori. This study identifies the affordances of digital technology that address both the conceptual and linguistic challenges faced by Māori-medium teachers and students.*

**7. Time: 15:50–16:00**

Title of the Paper: The effects of using a modified Frayer Model to teach mathematics vocabulary to junior-form English learners in a Chinese medium-of-instruction secondary school

Author(s): **LI Wing-kwan**, Simon S. Y. CHAN

Institution(s): The University of Hong Kong

Short abstract of the paper:

*Since the implementation of the fine-tuned medium-of-instruction policy (MOI) in 2009, Language Across the Curriculum (LAC) has been operated in Hong Kong secondary schools. Most Chinese-medium-of-instruction (CMI) schools adopt LAC at word level for non-language subjects. However, relatively little is known about how graphic organisers can help CMI students improve their academic vocabulary. The present study was set in a CMI school in which the Frayer Model was modified according to the multi-semiotic nature of Mathematics language to help thirty-three junior-form students to learn Mathematics vocabulary more effectively. The findings show that they had positive perception of the model. Meanwhile the study has shed insight into how the model impacts on students' learning of other subject-specific vocabulary.*

**8. Time: 16:00 – 16:15**

Title of the Paper: It always equalled an odd number: observing mathematical fluency through students' oral responses

Author(s): Cartwright, Katherin

Institution(s): The University of Sydney, Australia

Short abstract of the paper:

*A student's fluency in mathematics is often judged solely on their written number work. Mathematical fluency incorporates choice and use of flexible, efficient and appropriate strategies, and the ability to explain and justify thinking. When explaining or justifying, analysis of oral or written responses is necessary in gaining a picture of a student's mathematical fluency. Illustrations of mathematical fluency drawn from students' oral interactions on a mathematical task during group work are reported on in this paper. Students who displayed mathematically fluency used high modality words, mathematical language, and causal connectives to share explanations and justification of their thinking.*

**9. Time: 16:15–16:30**

Title of the Paper: Achieving meaningful statistics classroom learning through bilingualism and multilingualism: a case of selected grade 10 students in Marikina city

Author(s): **Mary Jane A. Castilla** and Catherine P. Vistro-Yu

Institution(s): University of Santo Tomas and Ateneo de Manila University, Phillipines

Short abstract of the paper:

*Recognizing language as a “master tool” (Engestrom, 1993) and as “tool of tools” (Cole & Engestrom, 1993), the present study examined the linguistic interactions that took place in a Statistics classroom. As part of a bigger study that analyzed Statistics classroom activities using the framework of the second generation Cultural Historical Activity Theory (CHAT), this paper focused on the unique features of Statistics classrooms in the Philippines. In particular, it considered bilingualism and multilingualism as a potential primary CHAT construct rather than just an artefact that mediates the attainment of learning outcomes as it recognized the specific contexts of Filipino learners. It looked into how the varying roles of students’ alternating use of the Filipino and English languages combined with their mathematical language contributed to the students’ participation in the activity. A major finding revealed that language, particularly for bilinguals and multilinguals, played a prominent role in the students’ achievement of learning goals and made the learning more meaningful.*

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**Session 2:** 19:30-21:00 Beijing time, July 14<sup>th</sup>

**10. Time: 19:30–19:45**

Title of the Paper: Discourse as the place for the development of mathematical thinking through an interactionist perspective

Author(s): Judith Jung, Marcus Schütte, Götz Krummheuer

Institution(s): Technische Universität Dresden, Leibniz University Hannover, Kassel, Germany

Short abstract of the paper:

*The article considers early childhood mathematics learning from an interactionist perspective. Here, mathematics learning is differentiated into two aspects: the acquisition of mathematical terms and procedures in terms of learning mathematical content, and the development of mathematical thinking in terms of learning to reason. This contribution focuses on the second*

*aspect. Based on interactionist perceptions of mathematical learning, the development of mathematical thinking is described as increasing participation in mathematical discourses. For a more detailed description of these discourses, the so far common focus of interactionist approaches to mathematics learning on the analysis of mathematical negotiation of meaning is expanded to include a description of emerging argumentative and semantic structuring of the mathematical negotiation processes. In the empirical analyses forming the basis of this article, different discourse styles are reconstructed utilizing this theoretical extension, which we call narrative, formal, and narrational discourses. In future research, they will be used as a theoretical basis for the reconstruction of the development of mathematical thinking.*

### **11. Time: 19:45–20:00**

Title of the Paper: Language-responsive support of meaning-making processes for understanding multiplicative decomposition strategies

Author(s): **Annica Baiker** & Daniela Götze

Institution(s): TU Dortmund University, Germany & University of Siegen, Germany

Short abstract of the paper:

*Multiplicative thinking involves the ability to coordinate composite units flexibly. Furthermore, it is fundamental for the understanding of multiplicative decomposition strategies. Specific phrases that are typically used in classroom discourse for talking about multiplicative situations and tasks (e. g., ‘3 times 4’) might inhibit such meaning-making processes because they do not address the idea of unitizing. In the study presented in this paper, three second grade primary school teachers joined a teacher program to introduce multiplication in their classes (n=66) language-responsively by meaning-related phrases of unitizing (e.g., ‘6 times 4 means 6 fours’). Another 58 second graders taught by teachers without this teacher program served as the control group. The analyses of a multiplication posttest (after the intervention) and a follow-up test (three months later) showed that the children of the intervention group developed a deeper understanding of decomposition strategies.*

### **12. Time: 20:00–20:10**

Title of the Paper: A study on the evaluating of learning opportunities in mathematics classes of secondary schools based on discourse analysis techniques

Author(s): **Zhihui Chen**, Yuting Tong

Institution(s): South China Normal University, Guangzhou; East China Normal University, Shanghai

Short abstract of the paper:

*With widely spread of the large-scale international academic assessment of mathematics, the development of literacy of young students has drawn public attention in China currently. Especially when the curriculum standard of senior high school was finishing revised, how to cultivate students' ability based on the model of mathematical core competencies through classroom teaching practice are becoming an increasingly urgent issue. For exploring an evaluation method of such instruction in the classroom, we analyze two video-based lessons with different teaching methods for the same course by discourse analysis techniques. Taking the teaching of Cross Multiplication as examples, we try to analyze the quality of learning opportunities in classes based on the characteristics of instructional tasks and classroom interaction between teachers and students. As results indicate, the evaluation model building on the idea of the opportunity to learn is reliable in deeply interpreting how students could benefit from the mathematical tasks and interaction (initiated question-posing & feedback) that teacher provided in the process of teaching. At last, strategies of improving task implement and leading the mathematical classroom dialog for novice teachers are also discussed further.*

**13. Time: 20:10—20:20**

Title of the Paper: Mathematical expression in different languages: The need for systematic description

Author(s): Cris Edmonds-Wathen

Institution(s): Charles Darwin University, Australia

Short abstract of the paper:

*There is a need for a systematic description of the variation in mathematical expression in different languages and the observed or speculated effects of this variation on mathematics education in those different languages. Such a description would decrease the risk of invalid generalizations about languages and mathematics. It would offer opportunities to explore more comprehensively the relationship between mathematics and language, with potential to illuminate mathematical conceptualization. It would also provide guidance for mathematical register development in languages which are new to the formal teaching of school mathematics. A systematic description could be informed by a functional typology approach, utilizing linguistic advances in describing the world's languages according to structural similarities and differences.*

**14. Time: 20:20—20:30**

Title of the Paper: A comparative study on teaching language of algebra classroom between novice teachers and expert teachers taking linear equation in one unknown as an example

Author(s): WANG Si-kai YE Li-jun

Institution(s): Jing Hengyi Teacher Education College of Hangzhou Normal University

Short abstract of the paper:

*Teaching language directly affects the effect of mathematics classroom teaching. From the perspective of pragmatics, we compare teaching language of algebra teaching between the novice teacher and the expert teacher, and obtain some conclusions about the use of two teachers' teaching language. Then we get the inspiration that teachers how to optimize their teaching language in the classroom teaching.*

**15. Time: 20:30–20:40**

Title of the Paper: Interactional obligations for collective argumentation in pair and group work

Author(s): **Rachel-Ann Böckmann** and Marcus Schütte

Institution(s): Leibniz Universität Hannover; Leibniz Universität Hannover, Germany

Short abstract of the paper:

*From an interactionist perspective, learning of mathematics can be described as the increasingly autonomous participation in processes of collective argumentation. This study aims at describing empirically within student interactions which interactional obligations for bringing forth warrants or backings within collective argumentations emerge. Specifically for this research, children were filmed when learning collaboratively in multi-age groups, as it increases the diversity of the learners abilities and therefore helps to contrast various interactional obligations at work within collaborative learning situations. Besides describing three interactional obligations – contradictions, mistakes and certain types of questions – changes in interpreting interactional obligations within an interaction are shown.*

**16. Time: 20:40–20:50**

Title of the Paper: How pre-service primary teachers engage in language responsive mathematics teaching while working on a scriptwriting task

Author(s): **Victoria Shure**, Bettina Rösken-Winter

Institution(s): Humboldt-Universität zu Berlin, Germany

Short abstract of the paper:

*Integrating academic language development into mathematics instruction is a challenge for most mathematics teachers. Such language-responsive mathematics teaching can be distinguished with respect to language demands on the word, sentence, or discourse level.*

*Regarding the latter, practices encompass explaining meaning or reporting procedures. Utilizing the methodology of a scriptwriting task, we examine how pre-service teachers address language difficulties to support students in gaining mathematical reasoning competencies. Twelve pre-service primary teachers participated in the study, with six regarded as “low performers,” having a score of sufficient on the course exam and six as “high performers,” scoring excellent or very good. “High performers” were found to have a propensity for engaging students on the discourse level and “low performers” focused more on the word or sentence level. The outcomes of pre-service mathematics teachers’ scripts are discussed with implications for future teacher education.*

**17. Time: 20:50–21:00**

Title of the Paper: Support Systems as intersubjective processes between Teachers and Students

Author(s): Ann-Kristin Tewes

Institution(s): Leibniz Universität Hannover, Germany

Short abstract of the paper:

*The aim of the study is to reconstruct different support systems between students, primary school teachers and special needs education teachers in order to reconstruct the potential effects of these support systems for the participation in inclusive mathematic lessons. On the basis of an interactionist view on learning and with the perspective that learning is an intersubjective process between individuals in the zone of proximal development, a support system is also located between the participants of the interaction and is seen as an intersubjective process which is designed together. The main focus of this paper, on a theoretical level, is to locate support systems between the individuals as a dialectical process and, on an empirical level, to reconstruct a special support system between a teacher and a student with special needs.*

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**Session 3:** 21:30-23:00 Beijing time, July 17<sup>th</sup>

**18. Time: 21:30–21:55 (Invited lecture)**

Title of the lecture:

Name: Beth Herbal-Eisenmann

City:

Short abstract of the lecture:

**19. Time: 22:00–22:15**

Title of the Paper: Epistemic (In)justice in mathematical communication between teachers and students

Author(s): Lauren Hickman McMahan

Institution(s): University of Michigan – Ann Arbor, USA

Short abstract of the paper:

*Teacher-student communication is crucial for mathematics teaching and learning, and it has the potential to perpetuate or challenge injustices faced by students from marginalized groups. Epistemic injustice is a form of injustice in which an individual is wronged specifically in their capacity as a knower (Fricker, 2007). In this paper, I describe two forms of epistemic injustice offered by Fricker—testimonial and hermeneutical. Using an example from practice, I consider how such injustice can manifest in teacher-student communication about mathematics, and I discuss features of mathematical knowledge and skill required to do epistemic justice for children in their interactions with teachers.*

**20. Time: 22:15–22:30**

Title of the Paper: Identifying language demands for understanding the meaning of similarity

Author(s): Kirstin Erath

Institution(s): TU Dortmund University, Germany

Short abstract of the paper:

*The paper reports from a Design Research study that aims at developing a language-responsive teaching-learning arrangement for the topic of similarity. Following the macro-scaffolding approach and the call for promoting student participation in discourse practices for enhancing mathematical learning opportunities, language demands on the discourse level are identified along the mathematical learning opportunities. The definition of discourse practices by Interactional Discourse Analysis allows to differentiate discourse practices and*

*thus to grasp the language demands in more detail. The topic of similarity, especially the transition from a dynamic to a static perspective, is linguistically challenging since it is necessary to explain meanings and describe general if-then-relationships.*

**21. Time: 22:30–22:40**

Title of the Paper: Exploring a teacher's enactment of explanatory communication in a mathematics lesson

Author(s): Fatou Sey

Institution(s): University of The Witwatersrand, South Africa

Short abstract of the paper:

*The paper reports on a teacher's enactment of principles of Explanatory Communication (EC), a component of a professional development cultural artefact focused on supporting teachers in establishing quality explanation around mathematical concepts and objects. EC consists of two broad principles for enabling generalisation: Naming - what and how of explanations, and Mathematical justification - why of explanations. Using the Vygotskian notion of mediation, I study a teacher's enactment of these principles to understand how they are constituted in practice to enable the generalisation of an object. The findings suggest that the teacher's interpretation of the principles of EC is motivated by the need to relate the mathematical object to a system of ideas within it, and between related mathematical concepts and representations, in order to enable generalisation.*

**22. Time: 22:40–22:50**

Title of the Paper: Dissent and consensus situation structures in mathematics and computer science learning environments

Author(s): **Peter Ludes-Adamy** and Marcus Schütte

Institution(s): Leibniz-Universität Hannover, Germany

Short abstract of the paper:

*Learning theories in general ask questions about how pupils – or people in general – learn. But exactly how and under which circumstances does the learning of the fundamentally new occur? To focus on this question, learning environments with core topics of mathematics and computer science are examined. Today, computer science is not a topic that is taught in primary schools in Germany. In the focus of digitalization, this topic and its connection to mathematics will play an important role in future curricula, making it an interesting object of investigation. The paper presents an ongoing study that examines, how the topic of computer science connected to mathematics learning can be approached in primary schools and what and how meanings are negotiated. The focus will be on the question, what roles consensus and*

*dissent play in interactional processes of negotiation and how the learning of the fundamentally (Miller, 1986) new occurs in collective argumentation between pupils.*

**23. Time: 22:50–23:00**

Title of the Paper: Quadrilateral woop-de-doo: Language use and geometric property development of two fifth graders in a dynamic geometry learning environment

Author(s): **Candace Joswick** and Michael T. Battista

Institution(s): The University of Texas at Arlington, USA, The Ohio State University, USA

Short abstract of the paper:

*In an inquiry-based classroom utilizing dynamic geometry to investigate quadrilaterals, we carefully trace students' use of everyday, informal, and formal language, and combinations thereof to communicate their developing ideas about the properties of quadrilaterals. In our longitudinal analysis of two grade 5 students' language and geometry concept development, we found their use of the ideophone-like, vague noun "Whoop-de-doo" was an important and supportive way for them to talk about and conceptualize concavity and reflex angles in shapes and the formal geometric properties that distinguish quadrilateral categories. In this brief report, we describe the students' initial application of the term "Whoop-de-doo" in their reasoning about quadrilateral shapes and suggest the significance of our findings for productive classroom discourse.*

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**Note:**

Class A:

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

Class B:

- Session 1: 19:30-21:00 Beijing time, July 13<sup>th</sup>
- Session 2: 21:30-23:00 Beijing time, July 16<sup>th</sup>

- Session 3: 14:30-16:30 Beijing time, July 17<sup>th</sup>