

**TSG 37: Research on Classroom Practice at Secondary Level (Class: A)**

**Session 1 (14:30-16:30 Beijing time (UTC+8), July 13)**

1. Time: 14:30-14:40

An Overview and Introduction to the TSG 37: TSG37 Team members

2. Time: 14:40-14:50

Title of the Paper: A large-scale study of teachers' practices in algebra

Author: **Julie Horoks\***, Julia Pilet\*, Brigitte Grugeon-Allys\*, Sylvie Coppé\*\*, Marina De Simone\*\*

Institution: \*LDAR:UPEC, \*\*FAPSE :UNIGE. France

Abstract: We present the design of a questionnaire, requested by the French Ministry of Education, to survey secondary school teaching practices in elementary algebra. We present the theoretical and methodological framework used to build the questionnaire and characterize teachers' practices, linked to their students' learning. We then give some results obtained by analysing more than 1200 teacher's answers.

3. Time: 14:50-15:00

Title of the Paper: Teaching Functions Using RME Approach to Improve Students' Perceptions of Mathematics Learning and Learning Functions

Author: Ayse Kaya & **Fatma Aslan-Tutak**

Institution: Bogazici University, Turkey

Abstract: The present study examines how Realistic Mathematics Education (RME) approach was used to improve teaching and learning of functions and to develop positive perceptions of mathematics learning and learning functions. In this paper, we focus on the development and implementation of instructional sequences about the function concept based on RME approach. In this respect, participants' knowledge of functions and perceptions of mathematics learning were investigated before and after the instruction. Findings of this study show that RME based instruction has positive impacts on development of students' knowledge of functions. Also, it is found that there were significant changes in the results of some perceptions after the RME based instruction, but not all perceptions of mathematics learning that participants hold. On the contrary, findings related to perceptions of learning functions revealed that participants overemphasize RME approach in their learning of functions.

4. Time: 15:00-15:10

Title of the Paper: Teachers Promoting Student Interaction: What Happens When Teachers Enter a Mathematical Discussion?

Author: **Marie Aasa Viktoria Sjöblom**, Paola Valero, Clas Olander

Institution: Malmö University, Stockholm University, Malmö University, Sweden

Abstract: This paper presents results from an educational design research study on how teachers can promote student-to-student interaction in mathematics. In three design cycles, a group of four teachers have examined how they can engage all students in small group discussions for mathematics learning. By using the Inquiry Co-operation Model by Alrø and Skovsmose (2004) as a way of looking at qualities in mathematical conversations, teachers wanted to find out what they could do when entering an ongoing small group discussion to promote students to actively take part in the learning processes. By video recordings of what happened before, during and after a teacher entered a group conversation, teachers could analyze and refine their own actions in order to better support students' work. Results showed that it was important that teachers purposefully asked mathematical questions to all students in a group, as well as having a purposeful planning of their instructions and actions when entering a group discussion.

### Discussion (15:10~15:20)

#### 5. Time: 15:20-15:30

Title of the Paper: The LEXICON Project: Seeking a Structure for the Australian Mathematics Teachers' Professional Lexicon

Author: **Carmel Mesiti**, David Clarke and Jan van Driel

Institution: University of Melbourne, Australia

Abstract: The professional lexicon of Australian mathematics teachers is a collection of terms by which teachers name the objects and events that constitute their professional classroom activity. In this paper we report an attempt to seek structure for the diversity of the 61 terms of the Australian Lexicon. A class of experienced practising teachers was invited to arrange these terms into groups and to give these clusters of terms a name. This paper examines the process that was adopted to determine a structure and the resulting organisational categories employed to communicate the lexical terms of the Australian Lexicon.

#### 6. Time: 15:30-15:40

Title of the Paper: The Lexicon Project: Understanding the Universality and Applicability of the Czech Teachers Professional Lexicon

Author: **Jarmila Novotná**, Alena Hošpesová, Hana Moraová, Iva Žlábková

Institution: Charles University, University of South Bohemia, Charles University, University of South Bohemia, Czech Republic

Abstract: The paper summarizes two researches of applicability of the Czech Lexicon of mathematics focusing on two environments (technology-supported and CLIL) in secondary mathematics lessons. It gives a brief description of the process of development of the Czech Lexicon. This description should help the reader understand the presented research. Attention is

paid to those terms that are missing in the Lexicon but are needed for the description of the two selected types of lessons (technology-supported and CLIL). The study shows that the Czech Lexicon, although constructed for teaching mathematics, can be used in other settings. The only terms that are missing are those that are specific for the particular area. As the Czech Lexicon is an open system, they can be easily added. What is more, the missing terms point at those areas of these specific mathematics lessons that need more attention of the teacher as they use other activities and interactions than those used in a typical lesson of mathematics.

7. Time: 15:40-15:50

Title of the Paper: Technical Vocabulary of Japanese Mathematics Teachers: The Japanese Lexicon in the Tradition of Lesson Study

Author: **Yoshinori Shimizu**, Yuka Funahashi, Hayato Hanazono

Institution: University of Tsukuba, Nara University of Education, University of Tsukuba

Abstract: The Japanese tradition of Lesson Study has created a teaching community in which observation and discussion of teaching are integral parts of professional practice with particular lexical terms of specific significance. The current study aims to identify and organize the terms and phrases that Japanese teachers use to describe the phenomena of the school mathematics classroom. We created a lexicon of 76 terms and their extensive descriptions through an electronic survey for a national validation to examine how familiar the terms were for the mathematics teachers in Japan. The role of writing lesson plans as vehicles for sharing pedagogical terms is discussed and an evolving nature of lexical terms has appeared through the process of analyses.

Discussion (15:50~16:00)

8. Time: 16:00-16:25 (Short Oral Presentations)

- Title of the Paper: inquiry-based learning in the mathematics classroom: insights from a case of two Lessons

Author: Cheng Lu Pien\*, **Cynthia Seto\*\***, Lee Ngan Hoe\*, Wong Zi Yang\* , June Lee\*

Institution: \*National Institute of Education \*\*Academy of Singapore Teachers

Abstract: The purpose of this descriptive study was to examine teachers' implementation of an inquiry-based learning approach in the Singapore secondary mathematics classrooms. A detailed analysis of two secondary mathematics lessons, where inquiry-based learning was used, were conducted. Three themes that evolved from our inductive analysis are (i) communication (ii) cognitive conflict and (iii) connection. These three themes inform our development of a framework to guide the implementation of inquiry-based learning approach for its pedagogical potential to be fully realized in the mathematics classrooms.

- Title of the Paper: The Practice of Project-based Mathematics Extended Curriculum at Secondary Level

Author: Dan Shen

Institution: Ningbo No.7 Middle School, China

Abstract: Project-based Mathematics Extended curriculum can provide enough time and space for students to practice, explore independently and communicate cooperatively. Every semester, a week-long curriculum activity is arranged. Teachers are the guiders. Students choose the activity options by themselves. They collect information through the network and the library, produce the material results and courseware display, and cooperate in division of labor. In this curriculum, they can experience the close relationship between mathematics knowledge and life.

- Title of the Paper: The Implementation of Project-based Learning (PBL) in Middle School Mathematics Classroom in Malaysia and South Korea

Author: **Abdul Halim Abdullah** & Bomi Shin

Institution: Universiti Teknologi Malaysia, Malaysia, Chonnam National University, South Korea

Abstract: Project-based learning (PBL) is one of the pedagogies that highly recommended to be implemented in mathematics classroom. This study aims to compare its implementation in middle school mathematics classroom in Malaysia and South Korea. A total of 71 Malaysian mathematics teachers and 51 South Korean mathematics teachers were involved in this study. Three of them from each country were then interviewed in order to get details information that may explain the quantitative findings. The results showed that the percentage of South Korean mathematics teachers who carried out PBL was higher than the percentage of Malaysian mathematics teachers who implemented it. Both educational systems encourage the implementation of various learning strategies including the PBL which are clearly stated in the mathematics curriculum documents of both countries. However, this study finds that more mathematics teachers in South Korea are doing so.

Discussion (16:25~16:30)

**Session 2 (19:30-21:00 Beijing time (UTC+8), July 14)**

1. Time: 19:30-20:15 (**TSG Invited Plenary Talk 1**)

Title of the Paper: Studying Instructional Quality in Mathematics: The Need for Content-specificity and Other Open Challenges

Author: Charalambos Y. Charalambous

Institution: University of Cyprus, Cyprus

Abstract: The last two decades have seen a plethora of classroom observation frameworks and instruments developed to conceptualize and capture instructional quality. In this paper, I underline the importance of studying instructional quality through content-specific lenses (in addition to generic lenses), in order to avoid obtaining partial delineations of this quality. I first substantiate this thesis with reference to four arguments; then, I discuss three challenges related to studying instructional quality through classroom observations that need to be addressed to move the field forward.

2. Time: 20:15-21:00 (**TSG Invited Plenary Talk 2**)

Title of the Paper: An Approach Of Mathematics Teaching And Learning Based On Activity Theory: Principles And Examples Of Results

Author: Aurelie Chesnais

Institution: Université de Montpellier et Université Paul Valéry de Montpellier, France

Abstract: This paper aims at presenting a theoretical framework based on an activity theory and designed to investigate the mathematics learning and teaching process in classrooms, in particular the questions related to the logics of teachers' practices and the way they impact students' learning. After presenting the theoretical principles of the framework and its methodological consequences, its use will be exemplified on a specific study. This study aimed at investigating how the relationships between the sociocultural background of students and their mathematics achievement get constructed within the mathematics classroom.

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**Session 3 (14:30-16:30 Beijing time (UTC+8) , July 17)**

1. Time: 14:30-14:40

Title of the Paper: A Multi-stage Attempt At Narrowing the Gap Between Contemporary Mathematics and High School Mathematics

Author: **Nitsa Movshovitz-Hadar**, Ruti Segal, Karni Shir, Atara Shriki, Boaz Silverman, Varda Zigerson

Institution: Technion – Israel Institute of Technology, Israel

Abstract: In many countries, the school mathematics curriculum does not go beyond the 18th-century mathematics. Any attempt at solving the problem of bridging this gap must consider the hierarchical nature of mathematics, as well as students' limited background, and teachers' time constraints. Our solution consists of periodically interweaving Mathematics-News-Snapshots (MNSs), in the high school mathematics curriculum. More than 20 MNSs – ready-to-deliver short descriptive PowerPoint presentations of recently published mathematical results – are currently available (see <https://MNS.org.il>), and more are under construction. This paper is aimed at sharing our solution and the multi-stage study that accompanied the examination of its classroom implementation in Israel. It includes an overview of three teacher preparation models and some results of our classroom implementation follow-up studies.

2. Time: 14:40-14:50

Title of the Paper: Puzzle-based Class Format to Foster Students' Mathematical Oral Production and Exchange

Author: **Luca Agostino**, Bruno Durand, Laetitia Sonia-Doucet, Dimitri Zvonkine Varda Zigerson

Institution: Laboratoire de mathématiques de Trappes Espe d'Evry, UEVE, Laboratoire de mathématiques de Versailles, UVSQ, CNRS, France

Abstract: In the context of the Villani-Torossian mission, mathematics laboratories were opened in some French secondary schools. Their aim is to drive teacher formation and carry on research on topics linking mathematics and didactics. Located in a disadvantaged area, the Lycée Plaine de Neauphle in Trappes (Paris suburb) focuses the research of its laboratory on the role of oral practices in mathematics lessons. If the orality of mathematics is not wide-spread in French didactical practices, nevertheless teachers working in the schools of this specific city have a real expertise on the subject. In fact, they often use oral practices as a way to capture students attention. In this paper we present the results of the observation of one pedagogic action in terms of mathematical improving and we conclude about the impact of a Student-to-Student mathematical speech.

3. Time: 14:50-15:00

Title of the Paper: Developing Students' Metacognitive Practice: A Systematic Approach

Author: Low Leng, **Ang Yue Hua**, Lee Ngan Hoe

Institution: Academy of Singapore Teachers, Yusof Ishak Secondary School, National Institute of Education, Singapore

Abstract: When students are stuck in learning mathematics, they feel frustrated and tend to give up with these four words: “I can’t do it”. Students need to be able to make that transition from “I can’t” to the proactive “How can I?” To do this, they need to think about why they are stuck, what’s frustrating them and what they would need to get unstuck. This involves the development of metacognitive skills in the teaching and learning of mathematics.

Metacognition, one of the components of the Singapore Mathematics Curriculum Framework, or thinking about thinking, refers to the awareness, monitoring and regulation of thought processes, and involves the selection and use of problem - solving strategies (Ministry of Education, 2020, p17). This paper discusses a case study of a teacher in using the Problem Wheel (Lee, 2001), to guide students systematically to develop their metacognitive skills during problem solving.

### Discussion (15:00~15:10)

4. Time: 15:10-15:40

### Questions and Answers: Poster Presentations

- Title of the Poster: Teachers’ Reasons to Change Their Teaching Practices. Author (Institution): Brigitte Johana Sanchez Robayo (Virginia Tech)
- Title of the Poster: Logical Problems and Solutions in Mathematical Teaching. Author (Institution): FANG Junbin (Wenzhou University), JIN Qionglin(Wenzhou University), WU Liancheng (Wenzhou University), FANG Ming (Hangzhou Dagan Middle School)
- Title of the Poster: Instruction on Altitude Enriched with Sociomathematical Norms and Technology Integration Author (Institution): Ezgi Senger Altintas and Fatma Aslan-Tutak (Bogazici University)
- Title of the Poster: A Study on the Blackboard Writing Behavior of Math Teachers in Senior High School. Author (Institution): Han Wang, Wei Tan, Jian Lu (College of Teacher Education, East China Normal University)
- Title of the Poster: Data literacy-minded teaching of topics in functions. Author (Institution): Jian Wan (No. 2 High School of East China Normal University)
- Title of the Poster: The Relationship of the Students’ Math Anxiety to the Teachers’ Classroom Instructional Practices. Author (Institution): Sikeme Raphoka (Mabathoana High School), Moneoang Leshota (University of Witwatersrand)
- Title of the Poster: Proposal for a Lesson Plan to Create a Video of Students Explaining a Math Problem that They Made. Author (Institution): Chiharu Kanamori (Shibaura Institute of Technology Junior and Senior high school), Katsuhiko Shimizu (Tokyo University of Science)
- Title of the Poster: The Didactical Contract, its Effects and Causes: Where are They Revealed? Author (Institution): Deissy Milena Narváez Ortiz (Universidad Distrital Francisco José de Caldas)

### 5. Time: 15:40-16:20 (Short Oral Presentations)

- Title of the Paper: Learning Situation Analysis: Problem, Focus and Method

Author: Yu Hongyu

Institution: Teacher Education College, Nanjing University of Information Science & Technology, China

Abstract: There have been some studies about learning situation analysis, and the studies are focused on learning situation analysis in teaching. The paper indicates the problems of learning situation analysis in teacher development direction, textbook compilation and teaching, illustrates the problems with specific cases, put forward four focuses of learning situation analysis, and then elaborates some useful methods.

- Title of the Paper: A lesson Design Model to enhance Students' Activities with Examples

Author: **Mayumi Kawamura**, Kazuya Kageyama, & Masataka Koyama

Institution: Hiroshima University, Japan

Abstract: This paper addresses a mathematics lesson through students' activities with examples. The purpose of this study is to make a lesson design model of school mathematics to enhance students' activities with examples. Using the model, teachers can plan classes and explain students' activities. Employing a methodology of qualitative study, we were able to observe changes in the activity of the students that were categorized into three classes: operation, reflection, and application. As part of our study, we planned a mathematics lesson design model that dealt with a logarithmic function and conducted experimental classroom lessons in a high school setting. As a result of the qualitative analysis of the students' performance, it was confirmed that the students were able to successfully recognize and apply the examples that were intended in the modified version of lesson design model. The modified model helps educators analyze students' activities and plan more efficient instruction for students' learning in a mathematics classroom.

- Title of the Paper: Re-visiting Instructional Explanations: How Might The Organisation of a Lesson Contribute to an Explanation

Author: Vasantha Moodley

Institution: University of the Witwatersrand, South Africa

Abstract: This paper proposes an expansion of an instructional explanation as not only pertaining to the content of a lesson but to also encompass how a teacher co-ordinates elements within a lesson to show connections and coherence of mathematical ideas within and between different parts of the lesson. I illustrate this by exploring a teachers introductory lesson on quadratic equations in a grade 10 class that was observed and video-recorded. I present a preliminary report on how he organised his lessons to provide a network of connected mathematical ideas. In doing so, I hope this report will contribute towards the further

development of the theory of instructional explanations that in turn may advance the practice of teaching.

- Title of the Paper: Anthropological Perspective On Japanese Mathematics Teachers' Professional Knowledge Of Board Writing

Author: Yukiko Asami-Johansson

Institution: University of Gävle, Sweden

Abstract: This case study explores the Japanese mathematics teachers professional knowledge of board writing (bansho). The praxeological analysis with the anthropological theory of the didactic shows how the teachers bansho practice is linked to the procedure of the Japanese structured problem solving approach, and how the specific bansho techniques aim to realize the generic educational goals of the learning of mathematics. The paper further speculates the conditions that allow the dissemination of such professional knowledge of the bansho among the Japanese mathematics teachers.

- Title of the Paper: The Implementation of a Set of Tasks for the Development of Spatial Ability in Secondary Schools

Author: **Jarmila Robová**, Vlasta Moravcová

Institution: Faculty of Mathematics and Physics, Charles University, Czech Republic

Abstract: The development of students' spatial ability is important for their future because it is applied in many fields, such as technology, medical science and art. In our exploratory study, we focused on whether and how our set of increasingly difficult tasks can help students of mathematics in Czech secondary schools and pre-service teachers practice spatial ability. We observed what problems students encountered when dealing with these tasks and established the benefits of and obstacles to their implementation into lessons.

Discussion (16:20~16:30)

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**Session 4 (21:30-23:00 Beijing time (UTC+8), July 17)**

1. Time: 21:30-21:40

Title of the Paper: Productive Struggle: A Focus on Sense Making and Connecting

Author: Azita Manouchehri & Reyhan Safak

Institution: The Ohio State University, The United States of America

*Abstract: In this article, we illustrate instances from discussions in an 8<sup>th</sup> grade classroom around one task to illustrate the richness of mathematical inquiry that can occur in presence of a focus on collaborative struggle where the teacher and students collectively participated in mathematical discourse. We will highlight specific teacher actions that facilitated students' inquiry. Some of the mathematical connections and ideas may not be immediately obvious even to the teacher, which implies that the teacher herself must be willing to act as a co-learner in the course of students' mathematical sense-making.*

2. Time: 21:40-21:50

Title of the Paper: Promoting Student Questions In Mathematics Classrooms

Author: Melissa Kemmerle

Institution: University of Michigan, The United States of America

*Abstract: Question asking is an important part of the learning process. One of our goals as educators is to encourage students to ask questions that focus on developing conceptual knowledge, but to do this, we first need to better understand the factors involved in student question asking. This study looks in depth at one high school mathematics teacher who promotes rich, mathematical question asking among her students. She does this by creating a safe learning environment, shifting responsibility to learn onto her students, by modeling good question asking, and through explicitly valuing sense-making. This study hopes to help teachers and educators think about how to promote more student questions in mathematics classrooms.*

**Discussion (21:50~22:00)**

3. Time: 22:00-22:40 (Short Oral Presentations)

- Title of the Paper: English Language Learners Learning Statistics in Multilingual Classrooms

Author: Sashi Sharma

Institution: University of Waikato, New Zealand

*Abstract: The language of statistics can be challenging. All the more so in English medium classrooms for English Language learners who must simultaneously learn English and statistical English, and be able to negotiate between these two. Yet how the challenges can be overcome in*

statistics classrooms, where language is even more important as a medium of instruction, has received very little scrutiny. This article reports on research carried out in three New Zealand largely Pasifika dominated Year-12 classes. Findings from the student interviews indicate that students can benefit from content and language integration. However, more research is needed to explore language issues and the strategies teachers might use in statistics education in greater depth.

- Title of the Paper: A Class for Conceptualizing Lagrange's Four-square Theorem

Author: **Tomohiko Shima** & Minoru Ito

Institution: Kanagawa Gakuen Girls' Junior and Senior High School, Tokyo University of Science, Japan

Abstract: Lagrange's four-square theorem states that a given natural number can be represented by the sum of four or fewer integer squares. While this is a very beautiful theorem in the field of number theory, it is seldom introduced to secondary students. This paper describes a class design through which students can learn to conceptualize the theorem by plotting natural number squares on a two-dimensional lattice plane. The class consists of three parts: In Part 1, the students plot natural number squares across the lattice points; In Part 2, the students combine two of the squares they plotted in Part 1 in order to produce a square that they were unable to plot in Part 1; In Part 3, the students reflect on what they did in Part 2, while also conceptualizing Lagrange's four-square theorem.

- Title of the Paper: Different Learning Opportunities for Students Provided by Teachers in High School Mathematics Classrooms: A Classroom Video Analysis

Author: **Li Changjie** & Lu Yun

Institution: Faculty of Education, East China Normal University, China

Abstract: Opportunity to learn (OTL) is concerned with educational equity and plays an important role in improving teaching and learning. Based on the reasons of the foundation function of mathematics in the emerging subjects and the important influence of learning opportunities to students' mathematics achievement, the current research focuses on the different learning opportunities for students provided by teachers in high school mathematics classrooms. Combining Kurz and Elliot's OTL model and Yu and Cao's Key Teaching Behavior Attention Elements, we finally form a comprehensive analysis framework. By using the classroom video analysis, this article tries to explore the different learning opportunities provided by teachers in time, content and quality dimensions. Aiming to help teachers ameliorate their instructional methods and then provide equal learning opportunities to students.

- Title of the Paper: A Study on Unit Instructional Design Based on Ubd - Taking "Logarithm" Unit as an Example

Author: Xu Wang

Institution: Anhui Vocational and Technical College, China

## TSG37 Agenda

Abstract: This study selected the students of two parallel classes of Grade One in H Middle School (respectively named "Class A" and "Class B") as the subjects, and clarified the teaching of logarithmic units from the occurrence and development of knowledge. It mainly adopt the action research method, combined UbD to carry out logarithmic unit teaching design, and carried out teaching in Class A. It discusses and improves the teaching effect and problems of Class A. Finally, it uses the improved design to re-teach in Class B. Based on the above research, The following four conclusions are drawn: (1) The process of UbD design and implementation mainly includes: determining planning and analysis elements, developing strategies and planning schemes, implementing teaching, discussing and revising, data analysis and constructing models. (2) Propose "SQIP unit teaching mode" with "big situation (S), big question (Q), big idea (I) and big pattern (P)" as the main line.

Discussion (22:40~22:50)

4. Time: 22:50-23:00

Reflections for the Next Steps: TSG37 Team members

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