

Topic Study Group 37

Research on Classroom Practice at Secondary Level

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1. Aims of the TSG

The aim of this Topic Study Group was to improve understanding of the research practices, methodologies, results, and supporting theories related to classroom teaching and learning at the secondary level. We intended to promote exchanges and collaboration around the identification and examination of issues of interest to classroom researchers across different education systems with the goal to enhance the quality of research on teaching and learning in secondary mathematics classrooms.

The TSG focused on research related to mathematics teaching and classroom practice at the secondary level. Research on the activities that teachers and students do within the mathematics classroom can involve a variety of methodologies including videography, ethnography, self-reports by participants, scenario-based assessments, first-person research, stimulated commentary by practitioners, simulations, and others. Research on the classroom practice recorded with those approaches involve examination of the interactions among the mathematical content to be taught and learned, the instructional practices of the teacher, or the work and experiences of the students within educational settings. As the report below shows papers presented in the TSG relied on a variety of theories and contributed to the growth of knowledge of a variety of research foci: the mathematics transacted in classroom practice, the complexity of the work of teaching, the roles of teacher and students vis-à-vis the mathematical content at stake, the knowledge used in practice, and more.

This TSG served as an international forum for mathematics education researchers who wanted to disseminate findings and practices from their research on teaching and classroom practice and for practitioners who were interested in learning about how this research was done and on its possible implications for practice. The organizers made a balanced use of the time allocated, with presentations by two invited speakers and

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devoting the majority of the time to the discussion of contributed papers, with the goal to maximize exchanges among participants.

1.1. Submissions

We had 47 submissions from 17 countries (South America: 1; North America: 5; Asia: 23; Europe: 12; Africa: 4; Australia/New Zealand: 2) including two invited talks. Each proposal was reviewed by two members of organizing team. Of those 45 submissions, 30 proposals were accepted as paper presentations, 12 as posters, and 3 proposals were rejected. For paper presentations, 16 papers were assigned for a long oral presentation while 14 papers were for a short oral presentation.

1.2. Sessions

TSG-37 had sessions in four time-slots as follows.

- Session I: 14:30-16:30 on 13th of July
- Session II: 19:30-21:00 on 14th of July
- Session III: 14:30-16:30 on 17th of July
- Session IV: 21:30-23:00 on 17th of July

After a short overview of the aim and topics of the TSG, session I started with three *long* oral presentations (10 minutes) of paper followed by a 10 minutes collective discussion for two rounds. Then, three short oral presentations (8 minutes) were made with a short question and answer time. Generally, paper presentations were grouped based on the similarity of topics presented. Session II was exclusively allocated for two invited lectures. Sessions III and IV also included both long and short oral presentations. In each session, the organizers attempted to facilitate participants' discussion and dialogue in order to identify emerging research questions and themes, alternative approaches, and future research opportunities. A whole group reflection time was taken at the end of Session IV, for discussing some issues and suggestions for the next step of research on teaching and learning in secondary mathematics classrooms.

1.3. Invited talks

We were privileged to invite two prominent researchers in the area of research on teaching and learning in secondary mathematics classrooms. Tab. 1 shows two speakers with the title of the papers. These two invited talks provided TSG participants perspectives on the complexity of teaching and learning in secondary mathematics classrooms and pointed out the need of theoretical frameworks to explore the complexity with describing the quality of instruction in the classrooms embedded in sociocultural contexts for students' learning.

Tab. 1. Invited Talks

Paper and author	
[1]	Studying instructional quality in mathematics: the need for content-specificity and other open challenges. <i>Charalambos Charalambous</i> (Cyprus).
[2]	An Approach of mathematics teaching and learning based on activity theory: principles and examples of results. <i>Aurelie Chesnais</i> (France).

Charalambous^[1] discussed the issues related to capturing instructional quality of teaching and learning in mathematics classroom. He first underlined the importance of studying instructional quality through content-specific lenses, in addition to generic lenses, in order to avoid obtaining partial delineations of the quality. After substantiating the thesis with reference to four arguments, he raised three challenges related to studying instructional quality through classroom observations that need to be addressed to move the field forward.

Chesnais^[2] presented a theoretical framework based on an activity theory designed to investigate the mathematics learning and teaching process in classrooms with a focus on the questions related to the logics of teachers' practices and the way they impact students' learning. After sharing the theoretical principles of the framework and its methodological consequences, she exemplified the use of the framework in her specific study. The study aimed at investigating how the relationships between the sociocultural background of students and their mathematics achievement were constructed within the mathematics classroom.

1.4. Paper topics

Of the 30 accepted papers, only 22 papers were able to be presented during the online conference. A list of these papers and authors are included in order of presentation and are organized in Tab. 2 (on the next page).

2. Themes to Topics

A variety of research related to mathematics teaching and classroom practice at the secondary level was presented in the TSG as shown in Tab. 2. The presented papers relied on a variety of theories and contributed to the growth of knowledge of a variety of research foci: the mathematics transacted in classroom practice, the complexity of the work of teaching, the roles of teacher and students vis-à-vis the mathematical content at stake, the knowledge used in practice. Given the variety of the presentations, the classical didactic triangle in which student, teacher, and content form the vertices of a triangle may be useful to conceptualize research topics and themes arose across the sessions, although such conceptualization needs to be extended (Goodchild & Sriraman, 2012).

Tab. 2. List of papers presented

Paper and author(s)
[3] A large-scale study of teachers' practices in algebra. Julie Horoks, Julia Pilet, Brigitte Grugeon-Allys, Sylvie Coppé, and Marina De Simone (France).
[4] Teaching functions using RME approach to improve students' perceptions of mathematics learning and learning functions. Ayse Kaya and Fatma Aslan-Tutak (Turkey).
[5] Teachers promoting student interaction: what happens when teachers enter a mathematical discussion? Marie Aasa Viktoria Sjöblom, Paola Valero, and Clas Olander (Sweden).
[6] The lexicon project: seeking a structure for the australian mathematics teachers' professional lexicon. Carmel Mesiti, David Clarke, and Jan van Driel (Australia).
[7] The lexicon project: understanding the universality and applicability of the czech teachers professional lexicon. Jarmila Novotná, Alena Hošpesová, Hana Moraová, and Iva Žlábková (Czech).
[8] Technical vocabulary of Japanese mathematics teachers: the Japanese lexicon in the tradition of lesson study. Yoshinori Shimizu, Yuka Funahashi, and Hayato Hanazono (Japan).
[9] Inquiry-based learning in the mathematics classroom: insights from a case of two lessons. Cheng Lu Pien, Cynthia Seto, Lee Ngan Hoe, Wong Zi Yang, and June Lee (Singapore).
[10] The practice of project-based mathematics extended curriculum at secondary level. Dan Shen (China).
[11] The implementation of project-based learning (PBL) in middle school mathematics classroom in Malaysia and South Korea. Abdul Halim Abdullah (Malaysia) and Bomi Shin (South Korea).
[12] A multi-stage attempt at narrowing the gap between contemporary mathematics and high school mathematics. Nitsa Movshovitz-Hadar, Ruti Segal, Karni Shir, Atara Shriki, Boaz Silverman, and Varda Zigerson (Israel).
[13] Puzzle-based class format to foster students' mathematical oral production and exchange. Luca Agostino, Bruno Durand, Laetitia Sonia-Doucet, Dimitri Zvonkine, and Varda Zigerson (France).
[14] Developing students' metacognitive practice: a systematic approach. Low Leng, Ang Yue Hua, and Lee Ngan Hoe (Singapore).
[15] Learning situation analysis: problem, focus and method. Yu Hongyu (China).
[16] A lesson design model to enhance students' activities with examples. Mayumi Kawamura, Kazuya Kageyama, and Masataka Koyama (Japan).
[17] Re-visiting instructional explanations: how might the organisation of a lesson contribute to an explanation. Vasantha Moodley (South Africa).
[18] Anthropological perspective on japanese mathematics teachers' professional knowledge of board writing. Yukiko Asami-Johansson (Sweden).
[19] The implementation of a set of tasks for the development of spatial ability in secondary schools. Jarmila Robová and Vlasta Moravcová (Czech).
[20] Productive struggle: a focus on sense making and connecting. Azita Manouchehri and Reyhan Safak (USA).
[21] Promoting student questions in mathematics classrooms. Melissa Kemmerle (USA).
[22] English language learners learning statistics in multilingual classrooms. Sashi Sharma (New Zealand).
[23] A class for conceptualizing lagrange's four-square theorem. Tomohiko Shima and Minoru Ito (Japan).
[24] Different Learning opportunities for students provided by teachers in high school mathematics classrooms: a classroom video analysis. Changjie Li and Yun Lu (China).

First theme that arose across the sessions related to teaching a particular content and topics of secondary school mathematics (Robová and Moravcová^[19]; Shima and Ito^[20], Sharma^[22]). Kaya and Aslan-Tutak^[4] for example, proposed the use of RME approach to improve students' perceptions of mathematics learning and learning

functions. Movshovitz-Hadar et al.^[12] presented their research on the instructional materials developed for narrowing the gap between contemporary mathematics and high school mathematics. These studies challenged the long-standing issue of teaching mathematics at secondary school so as to be meaningful and useful to the students. Also, there were reports of the analysis of classroom activities related to the new trends in teaching and learning in secondary mathematics classrooms, such as project-based mathematics extended curriculum (Shen^[10]) and Project-based learning (PBL) (Abdullah and Shin^[11]), inquiry-based learning (Pien et al.^[9]) emerged a new area of exploratory studies.

A second theme that arose across the sessions was related classroom interaction between the teacher and students as well as communication among students (Manouchehri and Safak^[20], Asami-Johansson^[18], Sjöblom et al.^[5]). Also, there were presentations of particular focus on teacher or students. Further, a particular method of developing students' metacognitive practice (Leng et al.^[14]) and "puzzle-based class format" was proposed for fostering students' mathematical oral communications (Agostino et al.^[13]). In this context, the role of example (Kawamura et al.^[16]) and the importance of explanations (Moodley^[17]), and promotion of student's questions (Kemmerle^[21]) in mathematics was emphasized through the empirical studies.

A third theme that arose across the sessions involved the analysis of lexicon, a focus on teachers' use of technical vocabulary that describe activities in mathematics classrooms. Three papers from the same project provided the analysis of lexicon in the different cultural traditions (Mesiti et al.^[6], Novotná et al.^[7], Shimizu^[8]).

Research on the classroom practice recorded with those approaches involve examination of the interactions among the mathematical content to be taught and learned, the instructional practices of the teacher, or the work and experiences of the students within educational settings. Research on the activities that teachers and students do within the mathematics classroom involved a variety of methodologies including both a large scaled study of teachers' practices (e.g. Horoks et al.^[3]) and case studies of lessons and video analysis (e.g. Pien et al.^[9], Li and Lu^[24], Sharma^[22]). Also, for the empirical studies, various methods were used in the study presented in this TSG. videography, ethnography, self-reports by participants, and so forth.

3. Areas for Future Research

At the end of Session IV, the participants had an opportunity of reflecting on the trends and issues in research on teaching and learning in secondary mathematics classrooms based on the presentations and discussion in this TSG. A few potential future research topics were discussed. First, given the complexities of teaching and learning in secondary mathematics classrooms, empirical studies need to capture the quality of instruction with a focus on content and educational values of mathematics taught in secondary mathematics classrooms. Second, classroom interaction between the teacher

and students as well as communication among students need to be examined further in relation to the development of students' mathematical thinking and learning. Third, research on teaching and learning in secondary mathematics classrooms needs to be scrutinized from a "meta-level". That is, an overarching theoretical framework is needed to discuss and integrate findings of empirical studies.

Acknowledgement

The original Chair (Professor Patricio Herbst) and Co-chair (Professor Fabrice Vandebrouck) were unfortunately unable to participate in the TSG due the postponement of ICME-14 caused by the pandemic of Covid-19. They had a major contribution in planning and preparing for the TSG, including reviews of the submitted papers and inviting speakers. We greatly appreciate their initial organization and contributions.

References

- S. Goodchild and B. Sriraman (Eds.) (2012) New perspectives on the didactic triangle: Teacher-student-content (Special Issue). *ZDM-Mathematics Education*. 44(2).