

TSG 31

In-service mathematical teacher education and mathematical teacher professional development at secondary level (Focus on scaling up)

Session 0 (voluntary for team members and presenters)

- 18:15-19:15 Beijing time (UCT +8), Monday, July 12th

Opportunity for participants to ask questions & to try out presenting a ppt.

Session I

- 14:30-16:30 Beijing time (UCT +8), Tuesday, July 13th

1. Time: 14:30—14:50

INTRODUCTION (20 minutes):

The team (Konrad Krainer – Austria, Betina Duarte – Argentina, Youchu Huang – China, Craig Pournana – South Africa, and Talli Nachlieli – Israel) will introduce briefly the schedule of this TSG, the principal objective and some core ideas about scaling up that motivated this proposal. Also, the invited speaker will be introduced.

2. Time: 14:50—15:30

Invited speaker (40 minutes: 30 minutes input, 10 minutes discussion)

INVESTIGATING WHAT IT TAKES TO IMPROVE THE QUALITY OF MATHEMATICS TEACHING AND LEARNING ON A LARGE SCALE

Paul Cobb - 1824

Vanderbilt University – USA

Research on the teaching and learning of mathematics has made significant progress in recent years. However, this work has had only limited impact on classroom instruction in many countries including the US. I report on an investigation in which we collaborated with mathematics teachers, school leaders, and the leaders in several large urban school systems for eight years to investigate what it takes to support improvements in the quality of instruction and thus students' learning on a large scale. Our findings from this work take the form of an empirically-grounded theory of action (ToA) for instructional improvement at scale that spans from the classroom to system instructional leadership and encompasses: curriculum materials and assessments; pull-out teacher professional development; school-based teacher collaborative meetings; coaches' practices in providing job-embedded support teachers' learning; school leaders' practices as instructional leaders in mathematics; and system leaders' practices in supporting the development of school-level capacity for instructional improvement. In discussing the various facets of the ToA, I will also outline a

series of a smaller, embedded studies that we conducted to investigate specific conjectures about supporting school leaders' and coaches' development of more effective instructional leadership practices.

3. Time: 15:30—15:50 (including 5' discussion)

HOW CHINESE MATHEMATICS TEACHERS PREPARE FOR TEACHING COMPETITION IN COMMUNITY?

Chenfei Zhu¹ & Hongbing Wang² – 815, physical

¹Jiangsu Institute of Education Science – China

²East China Normal University-Teaching and Researching Department of Nanjing – China

China has a level-by-level teaching competition system. Every selected contestant teacher from a lower-level competition, together with their community, prepares for a higher-level competition through iterative and incremental preparing sessions. These preparing sessions (shortened as “Session(s)” hereafter) all start with a mock-teaching lesson with randomly selected students and are followed by discussions within the community. As a part of an ongoing research, this paper reports findings from these Sessions through an analysis of 28 interviews. These Sessions share similar features in objectives, procedures, participants, resources, and effects; as they mature, there are changes and trends; all participants improve their knowledge, abilities and beliefs related to mathematics teaching. The process of the Sessions is constructive, resourceful, inspirational, and problem-solving-like. The influence of the Sessions is progressive, productive, transferrable and pointed to all participants' long-term professional development.

4. Time: 15:50—16:10 (including 5' discussion)

LINKING THEORIES AND PRACTICES: UNDERSTANDING TEACHERS' LEARNING IN CHINESE LESSON STUDY THROUGH ACTIVITY THEORY PERSPECTIVE

Wenjun Zhao¹, Rui Ning¹, Xiaoxia Zhang², Chuan Zeng³, Xianjia He³ & Jun Wen³ – 1003, physical

¹Sichuan normal university- ²Teacher (cadre) development center - ³Chengdu Experimental Foreign Language School West Campus – China

Research shows Chinese lesson study is powerful in linking theories and practices in the reform context. However, the mechanism behind such effectiveness is still under-researched. This study contributes to this gap through exploring how teachers learn to use theories to guide their teaching in a Chinese lesson study. Taking activity theory as the theoretical lens, this study identified the contradictions between activity systems of research and teaching, and

how they were dealt with through the lesson study activities. This study can shed light on how teachers learn in lesson study and necessary conditions that support their learning.

5. Time: 16:10–16:30 (including 5' discussion)

SHIFTING CULTURAL CONTEXTS: A PROFESSIONAL DEVELOPMENT PROGRAM TOWARDS COGNITIVELY DEMANDING INSTRUCTION

Talli Nachlieli & Einat Heyd-Metzuyanim - 1461

Levinsky College of Education, Technion – Israel Institute of Technology

This study explored processes of change in teachers' practice as a result of participating in a professional development (PD) for cognitively demanding, discourse-rich, instruction, titled TEAMS (Teaching Exploratively for All Mathematics Students). The TEAMS PD was "imported" from the US to Israel, relying on two programs: "The 5 Practices for Orchestrating Productive Discussions" and "Accountable Talk". Participants included 50 middle- and elementary- school teachers who participated in PD meetings during one school year, and videotaped themselves teaching cognitively demanding tasks. Lessons were coded using a lesson-observation protocol. Individual Growth-Curve Model analysis indicated statistically significant growth in several parameters. We discuss these findings with relation to the challenges of transferring a PD program between two cultural contexts.

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Session II

- 19:30-21:00 Beijing time (UCT +8), Wednesday, July 14th

1. Time: 19:30–19:45 (including 5' discussion)

SCALING UP A MATHEMATICS PROFESSIONAL DEVELOPMENT COURSE IN SOUTH AFRICA AND ITS IMPACT ON STUDENTS

Craig Pournara - 313

University of the Witwatersrand – South Africa

The Transition Maths 1 course was designed for teachers teaching mathematics in lower secondary schools in South Africa, many of whom were under-prepared for this task. Following the initial pilots, a quasi-experimental study showed evidence of promise that the intervention could impact student attainment. The intervention was scaled up and has now been completed by more than 150 teachers from approximately 80 schools. A recent quasi-experimental study provides further evidence of impact at student-level although this impact

is not necessarily evident in the year immediately following course completion, suggesting a delayed impact of PD on students.

2. Time: 19:45—20:00 (including 5' discussion)

ACTION LEARNING: A TOOL TO HELP TEACHERS PROMOTE SELF-REGULATION (SR) IN STUDENTS

Tamsyn Margaret Terry - 525

University of Canberra – Australia

This study explored how action learning processes contribute to teachers' understanding and practice of self-regulation (SR) in secondary mathematics classrooms. Three constructs of SR, cognitive, metacognitive and motivational informed this study. Ten secondary teachers participated in this study during 2019. They reported that action learning was key in building teacher understanding of SR and improved pedagogical approaches that enhance student SR. Observations of their classroom behavior confirmed the targeted impact on the classes.

3. Time: 20:00—20:15 (including 5' discussion)

COLLABORATION BETWEEN MATHEMATICS AND SPECIAL EDUCATION TEACHERS TO PROMOTE ARGUMENTATION AS AN INCLUSIVE PRACTICE

Pilar Peña; Horacio Solar; Constanza San Martín & Florencia Gómez - 744

Pontificia Universidad Católica de Chile - Universidad Diego Portales – Chile

This communication shows the preliminary results of a qualitative study with the purpose to analyze the collaboration processes between teachers dyads of special education and mathematics that favor the development of argumentation in the mathematics classroom. Using case studies methodology, we conducted interviews and classroom video recordings. From a sample including 24 pairs of 7th-grade math and special education teachers, three pairs of cases were selected because they showed high levels of argumentation and had worked collaboratively. Through analyses of interviews, we identified facilitators and obstacles of collaboration to promote argumentation. The results show that in order to promote argumentation, teacher dyads need to have common goals and shared workspaces for planning and decision making, but time devoted to shared work is still insufficient.

4. Time 20:15—20:30 (including 5' discussion)

DEVELOPING AND SUPPORTING EXEMPLARY MATHEMATICS EDUCATORS IN HIGH NEED SCHOOLS

Lillie R. Albert, Chi-Keung Cheung & Solomon Friedberg - 32

Boston College – USA

In the United States, students in high need school districts generally do not do as well in mathematics as students in other districts, and they are ultimately less likely to become part of the STEM workforce. Addressing this gap requires both the development and the retention of high-quality math teachers in high need districts. In this paper we report on a project, now in its seventh year, to do so. The project features university level math educators and mathematicians working together, allowing for foci on content knowledge, pedagogical content knowledge and expertise in pedagogy as well as the development of a professional community concerned with supporting secondary math teachers. The project has been broadly successful, and our experience provides lessons that may be helpful for other programs with similar concerns.

5. Time: 20:30–20:45 (including 5' discussion)

AN INVESTIGATION ON MATHEMATICS TEACHERS' PROFESSIONAL DEVELOPMENT IN RURAL CHINA

Limin Chen, Caroline Williams-Pierce, Min Jing & Lieven Verschaffel – 56

Shenyang Normal University, Shenyang – China; University of Maryland, College Park, Maryland – USA, Center for Instructional Psychology and Technology, KU Leuven – Belgium

In this study, a questionnaire was administered to 61 rural middle school mathematics teachers from China to investigate their professional development and their views of its influencing factors on their professional development. The questionnaire, consisting of 45 items, was designed in four dimensions: teachers' personal information; teachers' professional development (i.e., identity as rural teachers, self-development consciousness); impact of other influencing factors (i.e., rural students and their parents, school atmosphere); and their training requirements. Firstly, results revealed that rural teachers held a slightly positive beliefs in their professional development, as well as the impact of influencing factors on their professional development. Secondly, results revealed a significant positive relationship between teachers' points of view in their identities, self-development consciousness, the impact of rural students and parents, and the impact of school atmosphere.

6. Time: 20:45–21:00 (including 5' discussion)

IN-SERVICE MATHEMATICAL TEACHER EDUCATION IN MOROCCO: IMPEDIMENTS AND CHALLENGES

Nouzha El Yacoubi – 1821

Mohammed V University, Rabat – Morocco

The Mathematical Teacher Professional Development including the In-service Mathematical teacher Education, is a national priority in Morocco. Several actions, including various reforms, to improve the quality of Education in Morocco with the main objective to strengthen teachers' professional skills have been undertaken early in this new millennium. Several reports, reveal that the Moroccan Educational System, despite some registered progress, is still facing some dysfunctions, in particular the In-service mathematical Teacher education and Mathematical Teacher Professional Development, has not yet been placed, in a strategic position to respond to the teacher real needs. Nevertheless in the framework of the reform 2015-2030, a new vision is currently in stage of realization, aiming to enable teachers to complete and perfect their training, in order to be in step with the reforms in the education system. Indeed, these reforms have affected all aspects of the system, including the organization of cycles, pedagogical approaches, curricula and textbooks, pedagogical guidance, evaluation, examinations, governance and human resources management.

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Session III

- 21:30 – 23:00 Beijing time (UCT +8), Friday, July 16th

1. Time: 21:30—21:45 (including 5' discussion)

SUSTAINABILITY AND SCALING UP OF SCHOOL-BASED TEACHER PROFESSIONAL DEVELOPMENT PROGRAMME

Zhen Feng Eric Koh, Leng Low, Ngan Hoe Lee - 117

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

This paper discusses the factors that influence the sustainability and scale-up of a school-based professional development programme for mathematics teachers in the Singapore context. In particular, this study discusses factors such as shared vision and mutual accountability, influencing the scale-up and sustainability of a school-based professional development programme's impact on mathematics teachers' knowledge or practice (Zehetmeier, 2015). Data from document analyses is used to describe as well as explain this programme's impact on different levels within a case study setting. Finally, implications for such professional development programmes are discussed.

2. Time: 21:45—22:00 (including 5' discussion)

EFFECTIVE DESIGN OF MASSIVE OPEN ONLINE COURSES TO SUPPORT MATHEMATICS TEACHERS' PROFESSIONAL LEARNING

Karen Hollebrands & Hollylynn S. Lee - 454

North Carolina State University – USA

Three MOOCs for Educators were designed for mathematics and statistics teachers based on principles of effective online professional development. In this paper, we illustrate how design of these MOOC-Eds were guided by design principles and describe characteristics and engagement of 5,767 registrants with these designed features. We also share findings about how design principles provided opportunities for educators to develop their pedagogical skills.

3. Time: 22:00–22:15 (including 5' discussion)

USING VIDEOS TO FOSTER FACILITATORS' NOTICING IN THE FIELD OF LANGUAGE-RESPONSIVE MATHEMATICS TEACHING

Christoph Look, Christin Laschke, Bettina Roesken-Winter & Rebekka Stahnke - 1533

Humboldt-Universität zu Berlin – Germany

Students showing low language proficiency struggle with learning mathematics, especially with conceptually comprehending. Many teachers are challenged with the language-responsive mathematics teaching needed, and thus engage in Professional Development (PD). Accordingly, PD facilitators who provide such PD, are requested to support teachers' learning. To prepare facilitators for their challenging role, and to foster their noticing of teacher learning we opted for using videos, taken from PD. Our design research approach was twofold: By an expert rating, involving five experienced facilitators we confirmed that the videos address PD-PCK aspects, and yielded noticing prompts to be added to the videos. In our implementing study with fourteen (prospective) facilitators we could show that 60 % of the discussion was related to PD-PCK, the remaining 40 % on general PK. When facilitators reflected on content-specific aspects, 31 % of the time was dedicated to describing, 44 % on interpreting the situation, and 25 % on making suggestions for alternative actions. For the re-design we will concentrate to further push discussions towards PD-PCK.

4. Time: 22:15–22:30 (including 5' discussion)

INVESTIGATION ON THE IDENTIFICATION AND GROUP DIFFERENCES OF PROFESSIONAL DEVELOPMENT APPROACHES OF MATHEMATICS TEACHERS

Luyishou Ma – 491, physical

Shanghai Normal University – China

The fit of approaches plays a key role in the effectiveness of mathematics teachers' professional development, and it is the important basis for the selection of the methods of mathematics teacher education. This study conducted a qualitative survey on 110 primary and secondary mathematics teachers' independent development, teaching and research activities, routine training practices, induction culture and exceptional professional development approaches.

5. Time: 22:30—22:45 (including 5' discussion)

DEVELOPING AN E-MENTORING PROFESSIONAL DEVELOPMENT PROGRAM IN SUPPORTING PEDAGOGICAL CONTENT KNOWLEDGE OF NOVICE MATHEMATICS TEACHERS: A DESIGN-BASED STUDY

Derya ÇELİK^a, Mustafa GÜLER^a, Rukiye Didem TAYLAN^b, Müjgan BAKİ^a, Esra Bukova GÜZEL^c, Fatma Aslan TUTAK^d, Damla KUTLU^a, Aytuğ Özaltun ÇELİK^e - 1789

^aTrabzon University, Fatih Faculty of Education, Department of Mathematics Education,

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^dBoğaziçi University, Faculty of Education, Department of Mathematics Education,

^ePamukkale University, Faculty of Education, Department of Mathematics Education – all Turkey

Although many studies have determined the professional needs of novice teachers, there are limited articles that have introduced interventions to address these needs. As part of a large-scale project, this paper presents two cycles of a design-based study aimed to develop the pedagogical content knowledge (PCK) of novice mathematics teachers. The study was conducted with the participation of 12 novice mathematics teachers in total and the change between two cycles is described descriptively. The analyses of the data show that teachers in the cycle which was enriched with additional video content presenting student thinking made better progress in knowledge of students, particularly related to misconceptions and learning difficulties compared to other teachers. Overall both cycles appeared to support novice teachers' PCK. Finally, some suggestions are made for further research and practices for teacher learning.

6. Time: 22:45—23:00

CHANGES IN MATHEMATICS TEACHERS' TECHNOLOGY ACCEPTANCE AFTER THE IMPLEMENTATION OF BYOD SCHEME

Ming-Yan Tsui & Ida A. C. Mok - 1642

The University of Hong Kong – China

The purpose of this study was to investigate the change in the teachers' technology acceptance level during a school year after the implementation of Bring Your Own Device (BYOD) Scheme. The study was carried out with 10 mathematics teachers from a secondary school in the year 2018 -2019. School-based professional development was arranged for participating teachers. Before and after the school year, teachers completed questionnaires which aimed at scrutinizing their Perceived usefulness, Perceived ease of use and Intention to use. The questionnaire adopted the Technology Acceptance Model (TAM) as a lens to see the change of teachers' technology acceptance after a school year. The results showed that the technology acceptance and intention applied and used by mathematics teachers improved after the BYOD scheme.

Session III extra (voluntary for presenters who could not provide their input; internal meeting of the team members)

- 18:15-19:15 Beijing time (UCT +8), Saturday, July 17th

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Session IV

- 21:30-23:00 Beijing time (UCT +8), Saturday, July 17th

1. Time: 21:30—21:45 (including 5' discussion)

ENHANCING STUDENTS' MATHEMATICAL REASONING THROUGH A PROFESSIONAL DEVELOPMENT EXPERIMENT

Joana Mata-Pereira & João Pedro da Ponte - 1118

Instituto de Educação, Universidade de Lisboa – Portugal

To provide environments that allow students to develop their mathematical reasoning is a challenging teaching feature. While trying to tackle this challenge, this study scales up students opportunities to develop their mathematical reasoning by aiming to identify the main characteristics of a professional development experiment (PDE) centered on developing secondary teachers' mathematical and didactical knowledge to enhance students' mathematical reasoning. This design-based research is one of the strands of project REASON and concerns a PDE with secondary teachers that begins in October 2019. One of the main features of this PDE is the close link between research-based knowledge about enhancing

students' mathematical reasoning and participant teachers' practice, thus providing innovative PD strategies and materials to enact such link.

2. Time: 21:45-22:00 (including 5' discussion)

EXPLORING ONLINE LEARNING ENVIRONMENTS IN PROFESSIONAL DEVELOPMENT FOR SCALING-UP EDUCATIONAL INNOVATIONS

Robert Weinhandl & Stefanie Schallert - 52

Johannes Kepler University, Linz – Austria

Educational innovations often do not make it beyond pilot phases or academic discussions. To scale up educational innovations, we combined professional mathematics teacher development and online learning environments (OLE) in our educational study. By applying a grounded theory approach and design-based research, we have investigated how OLE should be designed to support scaling-up. Analysing written and oral research data indicated that (a) teachers make their own decisions concerning online learning, (b) OLE highlights benefits and practical relevance of an approach/technologies, (c) OLE does not lead to additional work, and (d) security and privacy of OLE could be crucial for teachers.

3. Time: 22:00–22:15 (including 5' discussion)

PROFESSIONAL DEVELOPMENT FACILITATORS AND THEIR LEARNING GOALS TOWARDS A PD COURSE ON TEACHING PROBABILITY AND INFERENCE STATISTICS

Ralf Nieszporek, Birgit Griese, Rolf Biehler, - 1140

Paderborn University – Germany

A newly arisen need for professional development (PD) courses on teaching probability and inferential statistics in Germany has created an increased demand for qualified facilitators. Although facilitators and their competencies play an important role for the success of PD courses, there is only little research on their orientation towards central learning goals. This case study casts a light on facilitators' decision-making, using an expertise model for the PD level (Prediger & Pöhler, 2019). Preliminary results on the choice of learning goals by facilitator Mike and his justifications enable a better understanding of his practices and thinking.

4. Time: 22:15–22:30 (including 5' discussion)

OUT-OF-FIELD TEACHERS' ACQUISITION OF SCHOOL-RELATED CONTENT KNOWLEDGE DURING A PROFESSIONAL DEVELOPMENT COURSE

Steffen Lünne & Rolf Biehler - 1351

Paderborn University – Germany

Due to the shortage of mathematics teachers in secondary schools, many German federal states have established professional development courses in mathematics for teachers who already teach or want to teach mathematics out-of-field, which means teaching mathematics without official qualification. Since 2014 the German Centre for Mathematics Teacher Education and the regional government in Detmold (North Rhine-Westphalia) have conducted three of these professional development courses for out-of-field teachers in mathematics (secondary schools), with the research aim to improve the knowledge about the group of the participating teachers and about aspects of success in the design of the courses as well as with the goal to develop curriculum material for such courses, which can be put to broader use all over Germany. During the second and the third course we investigated participants' development of school-level content knowledge in elementary algebra. Our results show that participants with little prior knowledge can build up content knowledge in the PDC, while participants with a high level of prior knowledge are probably under-challenged by the test.

5. Time: 22:30–22:45 (including 5' discussion)

WINDOWS ON THE BACKSTAGE OF THE CLASSROOM: USING VIDEO TO SUPPORT MATHEMATICS TEACHERS CONCEPTUAL CHANGE ABOUT INSTRUCTION

Ilana Horn - 890

Vanderbilt University, Nashville – USA

Around the world, teacher educators use video to support mathematics teachers' learning. But not all activities are equally valuable to teacher learning, raising the need to specify the relationship between activity design and teacher learning. In this study, I use discourse analysis to present an example of an experienced mathematics teacher's conceptual change arising from a form of video-based coaching called video formative feedback (VFF). I describe the VFF process and how it helped the focal teacher re-conceptualize her work with students during groupwork by opening up the backstage of the classroom. This expanded view of her classroom offered new insights on students' learning, shifting her understanding of their behavior from intractable to actionable, a form of conceptual change.

6. Time 22:45–23:00

SUMMARY AND CLOSING