



PME42
42nd Annual Meeting
July 3-8, 2018
Umeå, Sweden

PME42 Conference Program

42nd Annual Meeting of the
International Group for the
Psychology of Mathematics Education

July 3-8, 2018
Umeå, Sweden



UMEÅ UNIVERSITY



UMEÅ UNIVERSITY

UMERC
Umeå Mathematics Education
Research Centre

PME42 International Program Committee (IPC)

Ewa Bergqvist (co-chair), Magnus Österholm (co-chair), Carina Granberg, Lovisa Sumpter, Peter Liljedahl, Laurinda Brown, Stanislaw Schukajlow-Wasjutinski, and Hamsa Venkatakrishnan.

Local Organising Committee (LOC)

Ewa Bergqvist, Tomas Bergqvist, Carina Granberg, Johan Lithner, Olof Johansson, Mathias Norqvist, Catarina Rudälv, Lovisa Sumpter, Lotta Vingsle and Magnus Österholm. In addition, Umeå Congress is the congress bureau involved in the organising of PME42.

Support

We are grateful to the International Group for the Psychology of Mathematics Education (IGPME) for giving us the opportunity to host PME42, and to the following organisations for making it possible:

Umeå University, especially Umeå School of Education, the Department of Science and Mathematics Education, the Department of Applied Educational Science, the Department of Mathematics and Mathematics Statistics, and Umeå Mathematics Education Research Centre

Composition of Conference Program Booklet

Tomas Bergqvist and Catarina Rudälv

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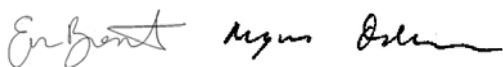
Welcome to PME42

We are delighted to welcome you all to PME42 in Umeå, Sweden. PME is one of the most important international conferences in mathematics education and draws educators, researchers, and mathematicians from all over the world. This is the first time PME is organized in Sweden and since Umeå lies 64 degrees north, this is the furthest north a PME conference has ever taken place.

The theme of the 42nd PME conference is: *Delight in Mathematics Education*. It refers to the joy, pleasure, and beauty in both mathematics and mathematics education. It includes issues on how both teaching and learning mathematics can be fun, meaningful, and inspiring, for teachers as well as for students. The theme also encompasses how mathematics and mathematics education can connect to individual students and teachers, for example, through aspects of motivation, creativity, and usefulness, and how individuals can see themselves as able in mathematics.

The organisation of PME42 is a collaborative effort. We acknowledge the support and effort of all involved in making the conference possible and thank each and every one of you. Especially, we thank each PME participant for making your journey to PME42 in Umeå and for your contributions to this conference.

We hope that you find your participation fruitful and memorable and that you experience *delight*, both through the conference and through the magical summer light in Umeå.

The image shows two handwritten signatures in black ink. The first signature on the left is 'Ewa Bergqvist' and the second signature on the right is 'Magnus Österholm'. Both are written in a cursive, flowing style.

Ewa Bergqvist and Magnus Österholm

PME42 Conference Chairs

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Conference Information

Umeå University

PME42 is hosted by Umeå University, which was founded in 1965 and is Sweden's fifth oldest university. The university has developed interaction between research, education, collaboration and innovation that challenges boundaries. With its 34 000 students and 4 000 employees the university plays a crucial role in the region's development.

Umeå Mathematics Education Research Centre (UMERC) are the organisers of the conference. The research at UMERC addresses many areas, for example, formative assessment, reasoning, communication and special education.

Conference Information

The Local Organising Committee (LOC)

The Local Organising Committee is responsible for all practical aspects of the conference. There are also a lot of helpers all around the venue. You can recognize the helpers on their red jackets. Feel free to ask for help at any time.

Umeå Congress (www.umea-congress.se) is the congress bureau that takes care of most of the practical issues during the conference. We are grateful and fortunate to have them as our allies!

If you want to get in contact with the Local Organising Committee, you can talk to the LOC members directly or send an email to elisabet@umea-congress.se. Ask any helper (in red jackets) if you want to get in touch.

The International Program Committee (IPC)

The International Program Committee is responsible for the scientific program at PME42. If you want to get in contact with the IPC, please contact Ewa or Magnus, co-chairs of the conference:

Ewa Bergqvist: ewa.bergqvist@umu.se

Magnus Österholm: magnus.osterholm@umu.se

Conference Information

Administrative Manager for PME

The administrative manager for PME, Bettina Rösken-Winter, has her own office in the MIT building on floor 2 (the entrance floor). The room is marked “PME Office” on the door and on the map. You can also reach her at: info@igpme.org.

The Conference Venue

Umeå University campus is large but compact, so all sessions will take place within a few minutes’ walk. In case of rain, all buildings at the venue can be reached via skywalks. The opening session, all plenary lectures, the plenary panel, and the AGM will take place in the large auditorium, Aula Nordica (see the map on the next page).

The Natural Science building and the MIT building are where most parallel sessions will take place (for example, the presentations of Research Reports and the Oral Communications). Larger parallel sessions, like Research Forums, will be in the auditoriums in the Lindell building.

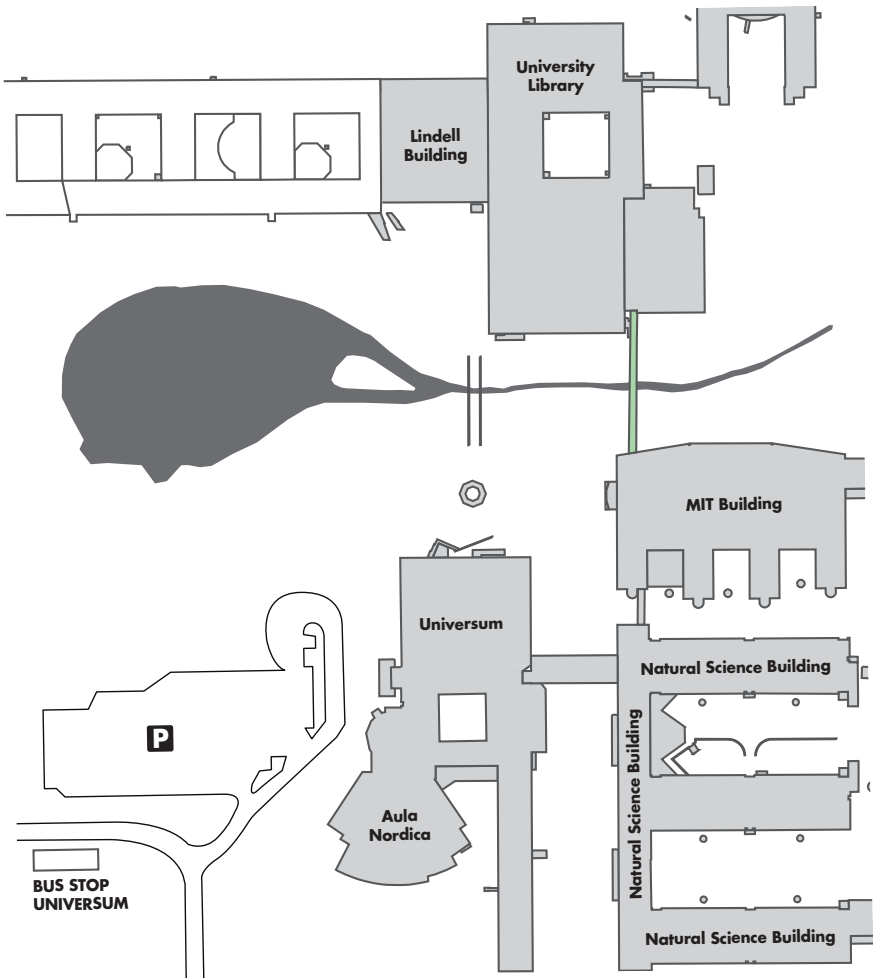
On the maps on the following pages you can find where the rooms are on each floor of the Natural Science building and the MIT building. The numbering of the rooms follows a certain system. The first letter indicates what building the room is in, N stands for the Natural Science building and M for the MIT building. The first digit shows the floor, where the entrance floor is number 2. The second and third digits show where in the building the room is. For example, on the third floor of the Natural Science building, we find N300, N320, N330 and so on.

The auditoriums in the Lindell building are called Hörsal A, Hörsal B, Hörsal C and Hörsal D.

There is one session in the Social Science building, near the Lindell Building. The Seminar is in room S305.

English name	Swedish name
Natural Science Building	Naturvetarhuset
Lindell Building	Lindellhallen
MIT Building	MIT-huset
University Library	Universitetsbiblioteket
Universum Building	Universum

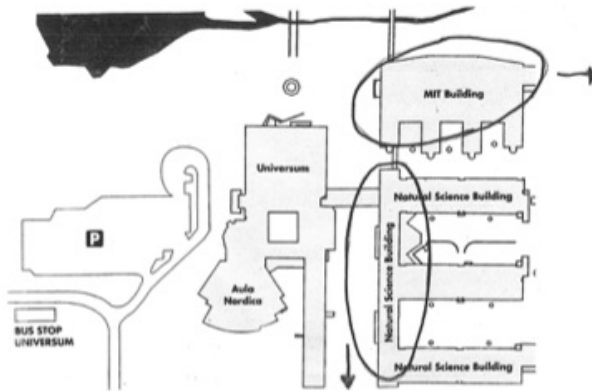
Maps



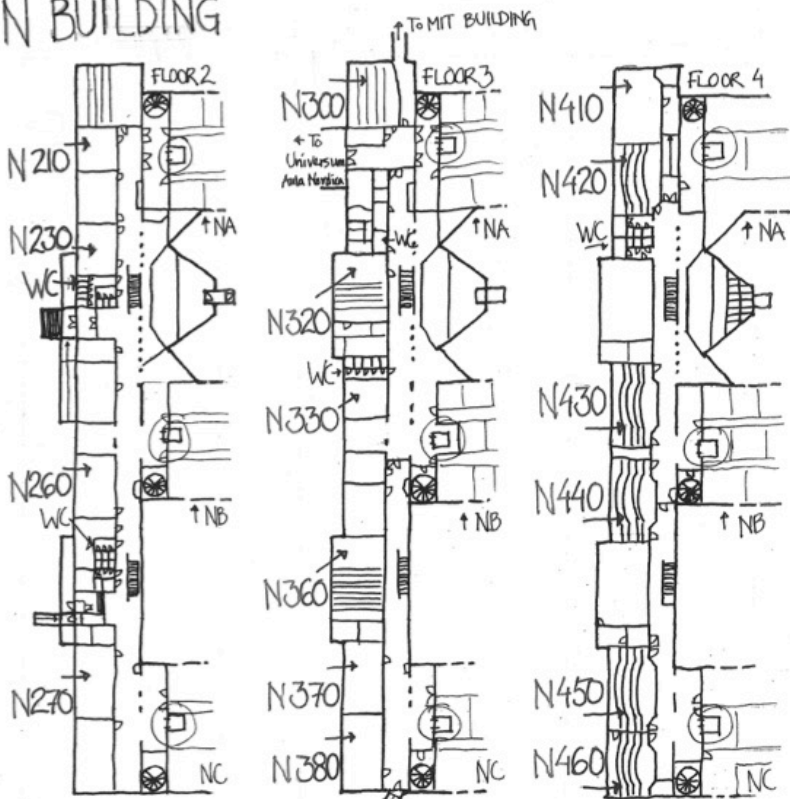
Map of the conference venue

Detailed maps of the floors in the Natural Science building (N building) and the MIT building can be found on the next two pages. Lifts (elevators) are marked with circles.

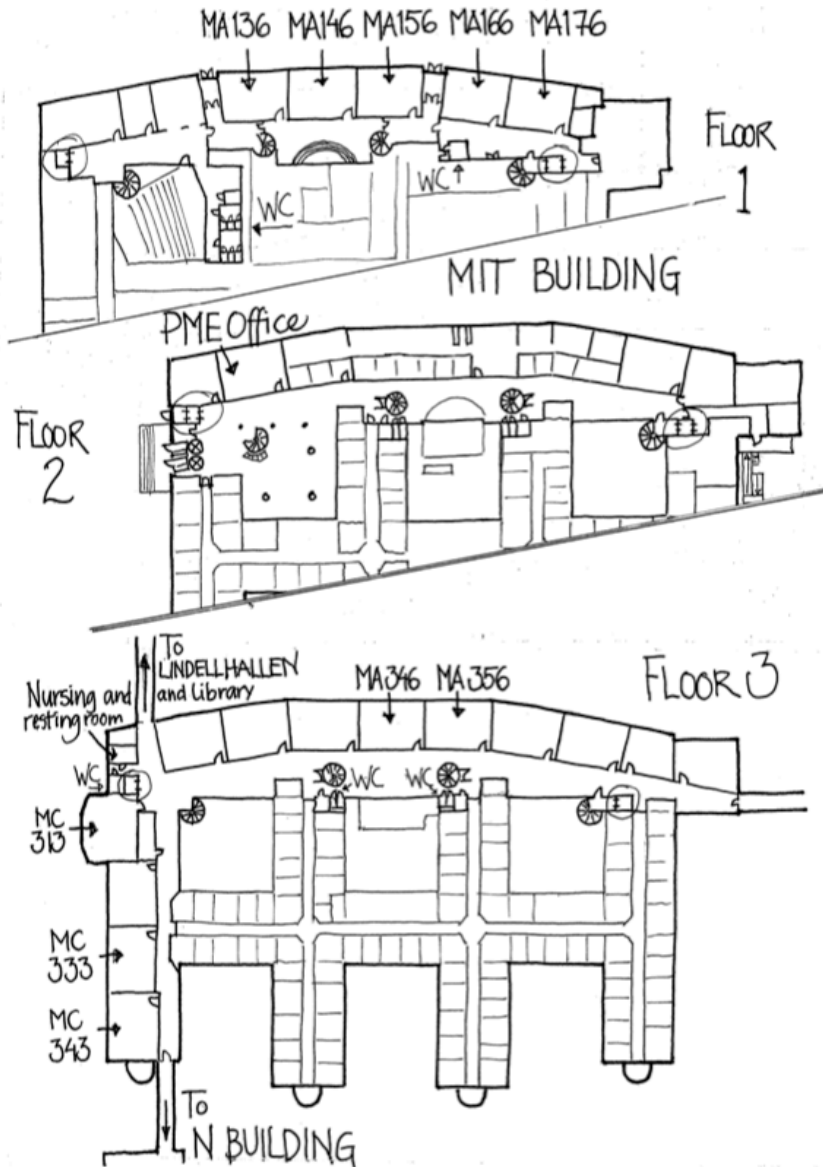
Conference Information



N BUILDING



Conference Information



Conference Information

Conference Office

Umeå Congress takes care of all practical aspects of the conference. Their office and desk are close to Aula Nordica (see map on page 7). Announcement boards with updated information and important messages can be found in the Universum building, near the Umeå Congress information desk.

Conference Badge

Participants and accompanying persons receive a name badge. Everyone is requested to wear this badge during the conference to have access to the conference activities. There are badges of three different colours:

White for participants, yellow for accompanying persons, and green for local organizers and helpers.

Lunch and Coffee

Lunch will be served in the Universum building Wednesday to Saturday, 12.30 – 13.30. We offer a choice of at least two courses every day, of which one is vegan. For those of you who have requested for special food (e.g., halal, kosher or allergies) there will be a separate station. There will also be helpers that can guide you. Your name badge gives you access to the lunches.

Coffee will always be available in the Universum building. During coffee breaks (Swedish: fika) coffee will also be served in the Natural Science building and the MIT building. Fika during the poster presentations will be served in the Lindell building.

Special coffee (e.g., espresso), soft drinks and candy can be purchased at MOCCADO, the coffee shop in the Universum building.

Conference Information

Internet Access

The easiest way to connect to the Internet is to use *eduroam*, a wireless network developed for the international research and education community, which is available at Umeå university campus.

You can also access the Internet by the wireless network *UmU wlan*. You can change language to English in the top right corner of the login page. Use the option “*Login using guest account*” and use the following username and password (remember to check the box on IT-policy):

Username: PME42

Password: umu2018! (note the exclamation mark)

Exhibitions

We are glad to welcome the exhibitions to PME42. You can find them in the Universum building.

General information

Free Bus Card

All participants and accompanying persons will get a bus card that is valid for free rides during the conference (Monday to Sunday). Read more about the system of local buses (Ultra) in the 2nd announcement that can be found on the conference website, www.pme42.se.

The University Library

Umeå University library, entrance from the Lindell Building, will be open 10.00–14.00, Monday to Friday during the conference. The library has a large collection of international research journals, including many for mathematics education. Specifically for PME42, there is an exhibition of old mathematics textbooks, from the 16th century and forward, the *Granolund Collection*.

Conference Information

No Smoking

Smoking is prohibited in public buildings in Sweden. This includes public transports, shops, restaurants, and pubs. At the conference venue, smoking is only allowed outdoors in designated areas.

Drinking Water

The tap water in Umeå is of very high quality and is drinkable for everyone. It is of such good quality that there is no need for chlorination. A good idea can be to bring a water bottle of your own which you can fill in any of the restrooms.

Currency

Sweden is on its way to becoming a cashless society. In some places, you cannot pay with cash, in particular on public transport, including buses in Umeå. The Swedish Krona is the currency of Sweden. The currency code for Kronor is SEK, and the currency symbol is kr.

Emergency Phone Numbers in Sweden

- General emergency: 112
- Police: 114 14
- Helthcare: 1177

Taxi in Umeå

There are several taxi companies in Umeå and the prices are similar for all companies. It is rather expensive to use taxis, normally a 10 km trip that takes 15 minutes costs about 300 SEK. A trip from the city centre to the university (the conference Venue) costs about 150 SEK. Here are the phone numbers to some of the taxi companies:

Eco Taxi	Tel: +46 (0)90 - 911 911
Taxi Direkt	Tel: +46 (0)90 - 100 100
Taxi Kurir Umeå	Tel: +46 (0)90 - 18 18 18
Umeå Miljötaxi	Tel: +46 (0)90 - 12 12 12
Umeå Taxi	Tel: +46 (0)90 - 77 00 00

Social activities

Opening Session and Welcoming Reception

The opening session will start at 16.00 in Aula Nordica. The conference will be declared open by Peter Liljedahl, president of IGPME. All participants will be welcomed to Umeå University and PME42 by the chairs of the conference, Ewa Bergqvist and Magnus Österholm. During the session we will listen to music by the Swedish vocal group Kraja. The opening session is followed by the first plenary lecture, given by Mogens Niss.

All participants are invited to the welcoming reception in the restaurant in Universum. We will be served a dinner buffet with many specialties from the northern part of Sweden. During the dinner there will be dancing to the Big Band Renhornen (*The Reindeer Horn Big Band*).

Excursions

There are eleven excursions in total (the beach volleyball excursion was cancelled). As a participant you will get a ticket showing what excursion you were assigned when you register. There will be limited possibilities to change excursion at the information desk outside Aula Nordica. You can also exchange tickets with other participants, if you want to.

All excursions depart from the conference venue. Exact information about departure time and where each group will meet can be found on the announcement board.

Conference Dinner

The conference dinner on Friday evening, July 6, will be an outdoor event and take place in Kassjö, a small village outside Umeå. A variety of food will be served, and there will of course be dancing!

Bus transfers will depart from the conference venue and will also stop to pick up participants in the city centre, at Vasaplan. Exact information about departure times can be found on the announcement board. More information about the dinner will be given on the buses.

Note that you will need to wear durable shoes and clothing for this event!

Scientific Program

Equipment

All lecture rooms will be equipped with projectors and whiteboards. If you need photo-copying, please contact the conference office.

Plenary Lectures and Plenary Panel.

There will be four Plenary Lectures from invited speakers. The Plenary panel will be held according to the Oxford-Style debate protocol.

Personal Presentations

There are four types of personal presentations. Research Reports (RR) are given a 40 minutes time slot. Oral Communications (OC) are given 10 minutes each for presentation and a total of 60 minutes for a group of three presentations, including 30 minutes for discussion. A Colloquium (CO) is a 90 minutes presentation of three interrelated papers (RR and/or OC). The Poster Presentations (PP) are given 60 minutes, where participants can walk around and talk to the presenters.

Group Activities

There are three group activities in the program: Research Forums (RF), Working Groups (WG), and Seminars (SE). In the Research Forums, a dialogue is created by elaborate presentations and discussions. The Working Groups give opportunities for collaboration while the goal of a Seminar is professional development in scientific PME activities. The Ad Hoc Meeting (AH) is a fourth type of group activity for discussions of a topic that has *emerged during* the conference. To organize an Ad Hoc Meeting, contact the PME administrative manager at info@igpme.org.

Other activities

In addition to the above activities there are also The National Presentation (NP), the First Timers Meeting, the Policy Meeting and the Annual General Meeting (AGM). More information can be found in the day-by-day program.

Tuesday, July 3

Overview of Tuesday July 3

14.00 – 16.00	Registration
14.30 – 15.30	First timers' meeting
16.00 – 17.00	Opening session
17.00 – 18.00	Plenary Lecture 1: Mogens Niss
18.00	Welcoming reception

Tuesday July 3, 14.00 – 16.00

Registration in the foyer to Aula Nordica

Tuesday July 3, 14.30 – 15.30

First timers' meeting in Universum.

The aim of the First Timers' Meeting is to provide new PME participants with some insights into the work of the International group for the Psychology of Mathematics Education.

Tuesday July 3, 16.00 – 17.00

Opening Session in Aula Nordica.

Tuesday July 3, 17.00 – 18.00

Plenary Lecture 1:

Mogens Niss, Professor Emeritus at Roskilde University, Denmark.

The very multi-faceted nature of mathematics education research

Abstract:

This talk is an analytic presentation of a research position. Its purpose is to identify and discuss a phenomenon that has evolved in mathematics education research journal publications during the last three decades, namely the emergence of an 'ideal-typical' research paper that represents an understanding of mathematics education research that is far too narrow and rigid because it does not reflect the multi-faceted reality of the field as it has developed since the 1960s and as represented in other kinds of publications, primarily books. The talk offers an outline and an

Tuesday, July 3

explanation of this development, and suggests that it is detrimental to a field which is far from having found a universal, agreed-upon theoretical underpinning. It further argues that we have to take strong measures to prevent our field from prematurely congealing into insufficient research paradigms.

Tuesday July 3, 18.00 – 22.00

Welcoming reception in Universum.

Notes

Wednesday, July 4

Overview of Wednesday July 4

09.00	–	10.30	Plenary Lecture 2: Natalie Sinclair
10.30	–	11.00	Fika
11.00	–	11.40	Research Reports, session 1
11.50	–	12.30	Research Reports, session 2
12.30	–	13.30	Lunch
14.00	–	15.00	Oral Communications, session 1
15.10	–	15.50	Research Reports, session 3
15.50	–	16.30	Fika
16.30	–	18.00	Working Groups, part 1

Wednesday July 4, 09.00 – 10.30

Plenary 2:

Nathalie Sinclair, Professor at Simon Fraser University, Canada

An aesthetic turn in mathematics education

Abstract:

Though often marginalised as simultaneously elitist and frivolous, the aesthetic remains a significant and understudied factor in the evolution of the discipline of mathematics, as well as in the learning and teaching of mathematics. One reason that the aesthetic often functions implicitly in school mathematics is that it conjoins two, often distinct, tendencies, between the rational and the sensible. By developing the political aspects of aesthetic practices, I propose an aesthetic approach to school mathematics that perturbs the prevailing values of order and clarity, and welcomes new values that energise students and teachers both in relation to the discipline of mathematics, but also in their experience of the world.

Reactor: Matthew Inglis

Wednesday, July 4

Wednesday, July 4, 11.00 – 11.40

Research Reports No 1.

RR # Room	Author	Title	Chair
RR 1:01 N410	<u>Miragliotta, Elisa</u> ; Baccaglini-Frank, Anna	You see (mostly) what you predict: The power of geometric prediction	Heinze, Aiso
RR 1:02 N420	<u>Izsak, Andrew</u> ; Beckmann, Sybilla	Using equations to develop a coherent approach to multiplication and measurement	Hodkowski, Nicola
RR 1:03 N430	<u>Martín-Molina, Verónica</u> ; Toscano, Rocío; González-Regaña, Alfonso J.; Fernández-León, Aurora; Gavilán-Izquierdo, José María	Analysis of the mathemati- cal discourse of university students when describing and defining geometrical figures	Hock, Natalie
RR 1:04 N440	<u>Vanluydt, Elien</u> ; Verschaffel, Lieven; Van Dooren, Wim	Emergent proportional reasoning: Searching for early traces in four- to five-year olds	Askew, Mike
RR 1:05 N450	<u>Turgut, Melih</u>	Interplay in students' thinking modes and representation types of linear algebra in a DGS	Kayali, Lina

Wednesday, July 4

RR # Room	Author	Title	Chair
RR 1:06 N460	<u>Maciejewski, Wes</u>	Changes in attitudes revealed through students' writing about mathematics	Schukajlow-Wasjutinski, Stanislaw
RR 1:07 N300	<u>Shahbari, Juhaina</u> <u>Awawdeh;</u> Salameh, Rania	Group thinking styles and their modelling process while engaging in modelling activities	Krawitz, Janina
RR 1:08 N320	<u>Fellus, Osnat</u>	From principles of vision and division to a system premised on and subject to interanimated dimensions: Some reflections on identity in mathematics education	Fidje, Anders Støle
RR 1:09 N330	Tirosh, Dina; Tsamir, Pessia; Levenson, Esther; <u>Barkai, Ruthi</u>	Kindergarten teachers' knowledge of students: The case of repeating patterns	Mesiti, Carmel
RR 1:10 N360	<u>Ding, Liping;</u> Jones, Keith	Conceptualizing an expert teacher's expertise in a lesson design study in Shanghai	Rouleau, Annette
RR 1:11 N370	<u>Schwarts, Gil;</u> Karsenty, Ronnie	A teacher's reflective process in a video-based professional development program	Cooper, Jason
RR 1:12 N380	<u>Papadopoulos, Ioannis;</u> Gunnarsson, Robert	The use of 'mental' brackets when calculating arithmetic expressions	Zindel, Carina

Wednesday, July 4

RR # Room	Author	Title	Chair
RR 1:13 N210	<u>Hamm, Jill</u> ; Hoffman, Abigail; Lambert, Kerrilyn; Heck, Daniel	Framing the social dynamics of small group work in adolescence as peer cultures of effort and achievement	Haataja, Eeva
RR 1:14 N230	<u>Tasara, Innocent</u>	Making sense of the teaching of calculus from a commognitive perspec- tive	Ayalon, Michal
RR 1:15 N260	<u>Norqvist, Mathias</u>	Cognitive abilities and mathematical reasoning in practice and test situa- tions	Hayata, Toru
RR 1:16 N270	<u>Inglis, Matthew</u> ; Alcock, Lara	Watching mathematicians read mathematics	Krummenauer, Jens Oliver
RR 1:17 MC313	<u>Sahin-Gür, Dilan</u> ; Prediger, Susanne	“Growth goes down, but of what?” A case study on language demands in qualitative calculus	Ryan, Ulrika
RR 1:18 MC333	<u>Pitsili-Chatzi,</u> <u>Dionysia</u>	“I always wished that i had a mathematical mind”: Mathematical abil- ity and other stories	Song, Shuang
RR 1:19 MC343	<u>Winkel, Kirsten</u> ; Mueller, Henning; Schunk, Daniel	Mathematics achievement and the role of working memory and attention - Evidence from a large- scale study with first grad- ers	Steiner, Aya
RR 1:20 MA346	<u>Iannone, Paola</u> ; Rizza, Davide; Thoma, Athina	Investigating secondary school students’ epistemologies through a class activity concerning infinity	Son, Ji-Won

Wednesday, July 4

Wednesday, July 4, 11.50 – 12.30

Research Reports No 2.

RR # Room	Author	Title	Chair
RR 2:01 N410	<u>Robotti, Elisabetta</u>	Geometry in kindergarten: First steps towards the definition of circumference	Miragliotta, Elisa
RR 2:02 N420	<u>Kullberg, Angelika</u> ; Björklund, Camilla; Brkovic, Irma; Runesson Kempe, Ulla	Using fingers to discern the structure of part-whole relations of numbers in preschool	Izsak, An- drew
RR 2:03 N430	<u>Kilic, Hulya</u> ; Dogan, Oguzhan; Tun, Sena Simay; Arabaci, Nil	Supporting preservice teachers' in-the-moment noticing	Martín- Molina, Ve- rónica
RR 2:04 N440	<u>Piñeiro, Juan Luis</u> ; Castro-Rodríguez, Elena; Castro, Enrique	Prospective primary teachers' conceptual understanding of mathematical problems and problem solving	Vanluydt, Elien
RR 2:05 N450	<u>Kayali, Lina</u> ; Biza, Irene	Micro-evolution of docu- mentational work in the teaching of the volume of revolution	Baccaglini- Frank, Anna E.
RR 2:06 N460	Böckmann, Matthias; <u>Schukajlow,</u> <u>Stanislaw</u>	Value of pictures in modelling problems from the students' perspective	Radišić, Jelena
RR 2:07 N300	<u>Lagrange,</u> <u>Jean-baptiste</u>	Connected working spaces: Designing and evaluating modelling-based teaching situations	Shahbari, Juhaina Awawdeh

Wednesday, July 4

RR # Room	Author	Title	Chair
RR 2:08 N320	<u>Fidje, Anders Støle</u>	Use of student-produced videos in the teaching of combinatorics	Prediger, Susanne
RR 2:09 N330	<u>Christiansen, Iben Maj;</u> Österling, Lisa	The desired teacher reflected in research articles on practicum	Barkai, Ruthi
RR 2:10 N360	<u>Chirinda, Brantina;</u> Barmby, Patrick	Peer observation as a tool to facilitate mathematics teachers' self-reflection in a professional development intervention	Ding, Liping
RR 2:11 N370	<u>Canavarro, Ana Paula;</u> Santos, Leonor	A large scale cascade model in the context of mathematics curriculum reform: Interactive factors of influence on multipliers' work	Schwartz, Gil
RR 2:12 N380	<u>Zindel, Carina</u>	Unfolding and compacting when connecting representations of functions	González-Forte, Juan Manuel
RR 2:13 N210	<u>Heck, Daniel J.;</u> Hoover, Pippa; Porter, Jessica; Hamm, Jill V.	Mathematics discourse in small groups	Hattermann, Mathias
RR 2:14 N230	<u>Emre-Akdogan, Elcin;</u> Gucler, Beste; Argun, Ziya	One student's discursive development on rotation in relation to instruction from a commognitive perspective	Tasara, Innocent
RR 2:15 N260	<u>Oslington, Gabrielle</u>	Second-graders' predictive reasoning strategies	Norqvist, Mathias

Wednesday, July 4

RR # Room	Author	Title	Chair
RR 2:16 N270	Komatsu, Kotaro; Yamazaki, Miho; Fujita, Taro; Jones, Keith; Sue, Naoki	Secondary school students' appraisal of mathematical proofs	Inglis, Matthew
RR 2:17 MC313	<u>Helliwell, Tracy</u>	Responding to teachers: Learning how to use verbal metacommunication as a mathematics teacher educator	Sahin-Gür, Dilan
RR 2:18 MC333	<u>Song, Shuang</u> ; Guo, Kan; Cao, Yiming	Effects of socioeconomic status on middle school students' mathematics achievement in China	Pitsili-Chatzi, Dionysia
RR 2:19 MC343	<u>Coles, Alf</u> ; Sinclair, Nathalie	Re-thinking 'concrete to abstract': Towards the use of symbolically structured environments	Winkel, Kirsten
RR 2:20 MA346	<u>Hotomski, Mirjana</u>	Gestures as embodiments of variables and algebraic expressions	Iannone, Paola

Wednesday, July 4

Wednesday July 4, 14.00 – 15.00

Oral Communications No 1.

OC 1:01 Room N410	Topic: Mathematics difficulties Chair: Tsur, Ron
<u>Cheung, Kwok-cheung</u> ; Ieong, Man-kai; Mak, Soi-kei; Sit, Pou-seong	Important factors classifying Macao's resilient and non-resilient students in PISA 2012 mathematical study for informed policy making
<u>Ruttenberg-Rozen, Robyn</u>	Revisiting and growing prior knowings for learners experiencing mathematics difficulties
<u>Peteers, Florence</u>	A trouble at the interface of different disciplinary fields (mathematics education, psychology and cognitive sciences): Dyscalculia

OC 1:02 Room N420	Topic: ICT and learning, Grade 7-9 Chair: Jones, Keith
<u>Gurjanow, Iwan</u> ; Ludwig, Matthias	The mathcitymap app – a gamified math trail experience
<u>Subtil, Manuela</u> ; Domingos, António	The instrumental genesis in the demonstration of the pythagorean theorem
<u>Uygan, Candas</u> ; Köse, Nilüfer Yavuzsoy	Middle school students' reasoning processes on symmetrical figures through a dynamic geometry environment

OC 1:03 Room N430	Topic: Classroom assessment Chair: Viitala, Hanna Leena
<u>Häsä, Jokke</u> ; Rämö, Johanna; Nieminen, Juuso Henrik; Leppinen, Jussi	Exam vs. Self-assessment – students' achievement goal orientations in two different assessment models
<u>Szabó, Csaba</u> ; <u>Muzsnay, Anna</u>	Efficiency of test-enhanced learning in teaching number theory
<u>Pinto, Jorge</u> ; Santos, Leonor	Assessment for learning in first school years

OC 1:04 Room N440	Topic: Geometry, space and shape Chair: Kaur, Berinderjeet
<u>Thouless, Helen Rachel</u> ; Gifford, Sue	When is a pattern not a pattern? Developing pattern awareness in young children
<u>Helf, Nader</u> ; Abu-Naja, Muhammad	Teachers' mathematical knowledge of definitions in geometry
<u>Papageorgiou, Maria</u> ; <u>Tzekaki, Marianna</u>	Students' introduction to the axiomatic foundation of mathematics through geometry

Wednesday, July 4

OC 1:05	Topic: Preservice teachers, practice experience
Room N450	Chair: Levenson, Esther
<u>Taylan, Rukiye Didem;</u> Fendi, Aysun	Investigating the nature and development of a prospective mathematics teacher's professional noticing skills during fieldwork experience
<u>Kennedy, Nadia Stoyanova</u>	Re-viewing mathematical practice
<u>Szítányi, Judit;</u> Bagota, Mónika; Pintér, Klára; Csíkos, Csaba	Pre-service kindergarten teachers' experiences about teacher-guided mathematical activities

OC 1:06	Topic: Tasks in algebra and functions
Room N460	Chair: Dahl Soendergaard, Bettina
Tanışlı, Dilek; <u>Ayber, Gözde;</u> Turgut, Melih	Development of a combined test assessing sixth and seventh graders' mathematical competence of algebra
<u>EL Mouhayar, Rabih Raif</u>	Levels of generalization and the SOLO taxonomy
<u>Sproesser, Ute;</u> Vogel, Markus; Dörfler, Tobias; Eichler, Andreas	Teachers' judgment accuracy of task difficulty related to functions

OC 1:07	Topic: Proof, argumentation and reasoning
Room N300	Chair: Stylianides, Andreas
<u>Aksoy, Esra;</u> Narlı, Serkan	Why do instructors prefer not to present proofs of some theorems?
Ali, Sikunder; Gustavsen, Trond Stølen; Hals, Sigurd; <u>Hofmann, Andrea</u>	Challenges of mathematics teachers with proof: Oscillating between different expectations
<u>Klöpping, Peter Michael;</u> Kuzle, Ana	Critical incidents shaping teachers' conceptions of argumentation in primary education

Wednesday, July 4

OC 1:08 Room N330	Topic: Representations and modeling Chair: Gorgorió, Núria
<u>Cifarelli, Victor</u>	Examining students' informal modeling strategies to solve applied mathematics problems
<u>Kızıltoprak, Ayhan;</u> <u>Köse, Nilüfer Yavuzsoy</u>	Reflection of a billiard activity upon reasoning processes in teaching quadrilaterals
<u>Rojas, Francisco;</u> <u>Montenegro, Helena</u>	Approaches to modeling by mathematics teacher educators: The perception of student teachers

OC 1:09 Room N370	Topic: Professional development programs Chair: Karsenty, Ronnie
<u>Noh, Jihwa;</u> <u>Kim, Yeon</u>	How does video analysis of teaching lead teachers to action, or to change?
<u>Steinthorsdottir, Olof Bjorg;</u> <u>Hughes, Elizabeth</u>	Teachers' growth: Proportion and the 5 practices
<u>Heyd-Metzuyanim, Einat;</u> <u>Nachlieli, Talli;</u> <u>Weingarden, Merav;</u> <u>Baor, Rinat</u>	The "teams" professional development program for enhancing explorative instruction

OC 1:10 Room N380	Topic: Probability and statistics Chair: Berger, Margot
<u>Ku, Na-Young;</u> <u>Kang, Hyun Young;</u> <u>Choi, InYong</u>	Pre-service secondary mathematics teachers' reading of curriculum materials
<u>Wang, Fang-Jiun;</u> <u>Yang, Kai-Lin;</u> <u>Liu, Xin-Yi</u>	Exploratory study on the relation between the understanding of correlation and association
<u>Yang, Kai-Lin;</u> <u>Liu, Xin-Yi</u>	Investigating the relationship between epistemology and goal-orientation in learning statistics

Wednesday, July 4

OC 1:11	Topic: Preservice teachers and teaching
Room N210	Chair: Palmér, Hanna
<u>Nyman, Rimma</u> ; Kilhamn, Cecilia; Callos Cronberg, Florenda; Knutsson, Lena; Skidras, Christina; Frisk, Susanne; Holmberg, Britt	A tool for planning and orchestrating mathematical discussions
<u>Magiera, Marta T.</u> ; <u>Zambak, Vecihi S.</u>	Noticing student generalizations and justifications: Does task context matter?
<u>Forsythe, Susan Kathleen</u> ; Baldry, Fay	How can we promote pre-service teachers' reflection on students' mathematical thinking?

OC 1:12	Topic: Arithmetic, numbers and operations
Room N230	Chair: Askew, Mike
<u>Ekdahl, Anna-Lena</u> ; Björklund, Camilla; Runesson Kempe, Ulla	Finger patterns as means to experience numbers' part-part-whole relations
Torbeyns, Joke; <u>Verguts, Gwen</u> ; De Smedt, Bert; Verschaffel, Lieven	Efficient and flexible use of subtraction by addition in multi-digit subtraction in elementary school children
<u>Goral, Johanna</u> ; Kortenkamp, Ulrich	Prospective teachers' strategies to solve non-decimal addition problems

OC 1:13	Topic: ICT, GeoGebra in Higher education
Room N260	Chair: Drijvers, Paul
<u>Bozkurt, Gulay</u> ; Uygan, Candas; Turgut, Melih	An examination of a preservice mathematics teacher's reasoning on construction tasks in a dynamic geometry environment
<u>Hewitt, Dave</u> ; Treffert-Thomas, Stephanie; Jaworski, Barbara; Vlaseros, Nikolaos; Anastasakis, Marinos	Using imagery with geogebra to assist with matrix multiplication: A collaborative project
<u>Hernández, Alexánder</u> ; Perdomo Díaz, Josefa; Camacho Machín, Matías	Prompts, technology and problem solving

Wednesday, July 4

OC 1:14 Room N270	Topic: Proportions Chair: Valero, Paula
<u>Larsson, Kerstin</u>	Middle school students' proportional reasoning
<u>Ursekar, Chaitanya Prashant;</u> <u>Subramanian, Jayasree</u>	A framework for students' understanding of invariance in proportion problems across grades
Vysotskaya, Elena; Rekhtman, Iya; Lobanova, Anastasia; Yanishevskaya, Maria; <u>Chumachenko, Dmitry</u>	Primary school math: Proportions as a starting context?

OC 1:15 Room MC333	Topic: Affect, emotions and attitudes Chair: Schukajlow-Wasjutinski, Stanislaw
<u>Nyman, Martin</u>	Primary students emotions towards mathematics
<u>Liu, Di</u>	Relationships between trait emotional intelligence and different mathematical skills in elementary students
<u>Zhang, Qiaoping</u>	What is important in mathematics learning: Perspective from the chinese mainland students

OC 1:16 Room MC343	Topic: Affect, emotions and attitudes Chair: Wagner, David
<u>Innabi, Hanan</u>	Modifying the traditional public view of mathematics
<u>Jiang, Zheng;</u> Mok, Ida Ah Chee; Tang, Jinbo	Relationships between mathematics teacher emotions and instructional approaches
<u>Westaway, Lise</u>	The role of reflexivity in the expression of teachers' identities in teaching mathematics

OC 1:17 Room MA346	Topic: Problem solving, grade 8 Chair: Rott, Benjamin
<u>Dincer, Bahar;</u> Yilmaz, Süha	Examination the horizontal mathematization processes of secondary school students according to the realistic mathematic education: The example of probability subject
<u>Kızıltoprak, Fatma;</u> Kabael, Tangül	Investigating eight graders' ways of thinking associated with problem solving in context of mathematical literacy
<u>Lee, Shin-Yi</u>	Exploring how a reflection instructional approach influenced a student's learning of mathematical problem solving

Wednesday, July 4

Wednesday, July 4, 15.10 – 15.50

Research Reports No 3.

RR # Room	Author	Title	Chair
RR 3:01 N410	<u>Heinze, Aiso</u> ; Weiher, Dana Farina; Huang, Hsin-Mei; Ruwisch, Silke	Which estimation situations are relevant for a valid assessment of measurement estimation skills?	Robotti, Elisabetta
RR 3:02 N420	Johnson, Heather Lynn; Tzur, Ron; <u>Hodkowski,</u> <u>Nicola</u> ; Jorgensen, Cody; Wei, Bingqian; Wang, Xin; Davis, Alan	A written, large-scale assessment measuring gradations in students' multiplicative reasoning	Kullberg, Angelika
RR 3:03 N430	<u>Hock, Natalie</u> ; Borromeo Ferri, Rita	Professionalisation of prospective teachers through the promotion of cognitive diagnostic competence	Kilic, Hulya
RR 3:04 N440	<u>Askew, Mike</u> ; Venkat, Hamsa	Middle grade students' performance on arithmetic calculations presented as word problems or numeric problems	Piñeiro, Juan Luis
RR 3:05 N450	<u>Baccaglini-Frank,</u> <u>Anna E.</u> ; Di Martino, Pietro; Sinclair, Nathalie	Elementary school teachers' implementation of dynamic geometry using model lesson videos	Turgut, Melih
RR 3:06 N460	Kaarstein, Hege; <u>Radišić, Jelena</u> ; Nilsen, Trude	20 years of mathematics motivation mirrored through TIMSS: Example of Norway	Maciejewski, Wes

Wednesday, July 4

RR # Room	Author	Title	Chair
RR 3:07 N300	<u>Krawitz, Janina;</u> Schukajlow, Stanislaw	Activation and Monitoring of Prior Mathematical Knowledge in Modelling Processes	Lagrange, Jean-baptiste
RR 3:08 N320	<u>Prediger, Susanne;</u> Şahin-Gür, Dilan; Zindel, Carina	Are teachers' language views connected to their diagnostic judgments on students' explanations?	Fellus, Osnat
RR 3:09 N330	<u>Mesiti, Carmel;</u> Clarke, David	The professional, pedagogical language of mathematics teachers: A cultural artefact of significant value to the mathematics community	Christiansen, Iben Maj
RR 3:10 N360	<u>Rouleau, Annette</u>	Tensions in implementing mathematics journaling	Chirinda, Brantina
RR 3:11 N370	<u>Cooper, Jason;</u> Olsher, Shai	Boundary crossing in design based research - Lessons learned from tagging didactic metadata	Canavarro, Ana Paula
RR 3:12 N380	<u>González-Forte,</u> <u>Juan Manuel;</u> Fernández, Ceneida; Van Dooren, Wim	Gap and congruency effect in fraction comparison	Papadopoulos, Ioannis
RR 3:13 N210	<u>Haataja, Eeva;</u> Garcia Moreno- Esteva, Enrique; Toivanen, Miika; Hannula, Markku	Teacher's gaze behavior when scaffolding peer interaction and mathematical thinking during collaborative problem-solving activity	Heck, Daniel J.
RR 3:14 N230	<u>Ayalon, Michal;</u> Wilkie, Karina	Learning to assess: Explor- ing changes to pre-service teachers' criteria for a quadratics task	Emre- Akdogan, Elcin

Wednesday, July 4

RR # Room	Author	Title	Chair
RR 3:15 N260	<u>Hayata, Toru</u> ; Uegatani, Yusuke; Hakamata, Ryoto	Can students construct non-constructive reasoning? Identifying fundamental situations for proof by contradiction	Oslington, Gabrielle
RR 3:16 N270	<u>Krummenauer, Jens Oliver</u> ; Kuntze, Sebastian	Primary student's data-based argumentation – an empirical reanalysis	Komatsu, Kotaro
RR 3:17 MC313	<u>Ryan, Ulrika</u>	From “How good I am!” to “Forgive me...please trust me”- microaggressions and angles	Helliwell, Tracy
RR 3:18 MC333	<u>Anderson, Judy Anne</u> ; Kriesler, Alice	Making maths matter: Engaging students from LSES schools through social justice contexts	Valero, Paola
RR 3:19 MC343	<u>Steiner, Aya</u>	Objectifying tinga: A case of children inventing their own discourse on fractional quantities	Coles, Alf
RR 3:20 MA346	Kim, Hee-jeong; <u>Son, Ji-Won</u>	Core mathematical teaching practices in algebraic and functional relations	Hotomski, Mirjana

Wednesday, July 4

Wednesday July 4, 16.30 – 18.00

Working groups, part 1.

WG # Room	Authors	Title
WG 1 N410	<u>Judy Anne Anderson,</u> <u>Yeping Li</u>	Integrating mathematics in STEM education: An international perspective
WG 2 N260	<u>Chiara Andrà,</u> <u>Pietro Di Martino,</u> <u>Peter Liljedahl,</u> <u>Annette Rouleau</u>	Teacher tensions as a lens to understand teachers' resistance to change
WG 3 N270	<u>Paul Drijvers,</u> <u>Francesca Ferrara</u>	Instruments and the body
WG 4 MC313	<u>Vanessa Franco Neto,</u> <u>Raimundo Elicer,</u> <u>Gustavo Bruno</u>	Mathematics education research from and in Latin America
WG 5 N420	<u>Matthew Inglis,</u> <u>Stanislaw Schukajlow,</u> <u>Wim Van Dooren,</u> <u>Markku Hannula</u>	Replication in mathematics education
WG 6 N430	<u>Ronnie Karsenty,</u> <u>Alf Coles</u>	Exploring the role of facilitators in video-based professional development for mathematics teachers
WG 7 MA346	<u>Guo Kan,</u> <u>Hege Kaarstein,</u> <u>Agida Manizade,</u> <u>Chandra Orrill</u>	International perspectives: Measuring mathematics teachers' knowledge in the digital era
WG 8 N440	<u>Ricardo Nemirovsky,</u> <u>Kate O'Brien,</u> <u>Nathalie Sinclair</u>	Learning mathematics in/through/by arts practices
WG 9 MA356	<u>Guri Nortvedt,</u> <u>Leonor Santos,</u> <u>Anna Teledahl</u>	Assessment for learning in diverse classrooms
WG 10 MA136	<u>Cecile Ouvrier-Bufferet,</u> <u>Elisabetta Robotti,</u> <u>Thierry Dias,</u> <u>Marie-Line Gardes</u>	Mathematical learning disabilities: A challenge for mathematics education

Wednesday, July 4

WG # Room	Authors	Title
WG 11 MA146	<u>Annalisa Cusi,</u> <u>Francesca Morselli,</u> <u>Cristina Sabena</u>	Argumentation and formative assessment: A possible synergy?
WG 12 MA156	<u>Maike Schindler,</u> <u>Eeva Haataja,</u> <u>Achim J. Lilienthal,</u> <u>Enrique Garcia Moreno-Esteva,</u> <u>Anna Shvarts</u>	Eye-tracking in mathematics education research: A follow-up on opportunities and challenges
WG 13 MA166	<u>Kicki Skog,</u> <u>Iben Maj Christiansen,</u> <u>Lisa Österling</u>	Considering the desired teacher of mathematics teacher education
WG 14 N450	<u>Andreas J. Stylianides,</u> <u>William G. McCallum,</u> <u>Lynne McClure,</u> <u>Aisling Twohill</u>	Working group: The design of intended mathematics curricula
WG 15 MA176	<u>Helen Rachel Thouless,</u> <u>Robyn Ruttenberg-Rozen,</u> <u>Ron Tzur</u>	Maths and special education working group

Overview of Thursday July 5		
09.00	–	10.30 Plenary Lecture 3: Kim Beswick
10.30	–	11.00 Fika
11.00	–	11.40 Research Reports, session 4
11.50	–	12.30 Research Reports, session 5
12.30	–	13.30 Lunch
13.00	–	14.00 Policy Meeting
14.00	–	Excursions

Thursday July 5, 09.00 – 10.30

Plenary 3:

Kim Beswick, Professor at University of Tasmania, Australia

Systems perspectives on mathematics teachers' beliefs:

Illustrations from beliefs about students

In this talk I draw on the example of one secondary mathematics teacher, and a group of such teachers to illustrate some possible affordances of complexity science ideas along with those of belief systems for understanding and possibly influencing the belief systems of individual teachers as well as those of groups of teachers. I focus particularly on teachers' beliefs about their students, drawing attention to the ways in which these beliefs might relate to other influential beliefs that teachers hold and how they constrain the ways in which students experience mathematics and hence the opportunities that they have to learn and enjoy the discipline.

Reactor: Chiara Andrà

Thursday, July 5

Thursday, July 5, 11.00 – 11.40

Research Reports No 4.

RR # Room	Author	Title	Chair
RR 4:01 N410	<u>Eames, Cheryl</u> <u>Lynn</u>	Students' conceptions for curve length: A hypothetical learning trajectory approach	Büscher, Christian
RR 4:02 N420	<u>Obersteiner, Andreas</u> ; Alibali, Martha W.	Are adults biased in complex fraction comparison, and can benchmarks help?	Christou, Konstantinos
RR 4:03 N430	<u>Ivars, Pedro</u> ; Fernández, Ceneida; Llinares, Salvador; Choy, Ban Heng	Enhancing teacher noticing using a hypothetical learning trajectory	Bampili, Amalia
RR 4:04 N440	Andresen, Mette; <u>Dahl, Bettina</u>	Classroom dialogue as a French braid: A case study from trigonometry	Rott, Benjamin
RR 4:05 N450	<u>Kontorovich, Igor'</u>	Learning mathematics through online forums: A case of linear algebra	Widder, Mirela
RR 4:06 N460	<u>Strohmaier, Anselm R.</u> ; Reiss, Kristina M.	Mathematics in disguise: Effects of the external context of mathematical word problems	Street, Karin Elisabeth Sørlie
RR 4:07 N300	Preciado Babb, Armando Paulino; Solares Rojas, Armando; <u>Peña, Fredy</u> ; Ortiz, Andrea; Sandoval Rosas, Marisol; Soriano Velasco, Remedios; Carrión Vázquez, Vicente; Farrugía Fuentes, Mauricio	Exploring perspectives on mathematical modelling: A literature survey	Viirman, Olov

Thursday, July 5

RR # Room	Author	Title	Chair
RR 4:08 N320	<u>Awoniyi, Florence</u> <u>Christianah</u>	Motivation and caning in Ghanaian secondary school: Evidence from a survey and interviews	Levenson, Esther
RR 4:09 N330	<u>Kuntze, Sebastian</u> ; Friesen, Marita	Teachers' criterion awareness and their analysis of classroom situations	Kim, Jinho
RR 4:10 N360	<u>Losano, Leticia</u> ; Fiorentini, Dario	Mathematics teachers' identity development in the context of professional master's degrees	Crisan, Cosette
RR 4:11 N370	<u>Kim, Ok-Kyeong</u>	Teacher capacity for productive resources use	Weingarden, Merav
RR 4:12 N380	<u>Vale, Pamela</u> ; Graven, Mellony	Facilitating conceptual engagement with fractions through suspending the use of mathematical terminology	Tzur, Ron
RR 4:13 N210	<u>Smedlund, Joakim</u> ; Hemmi, Kirsti; Røj-Lindberg, Ann-Sofi	Structuring students' mathematical conversations with flowcharts and intention analysis – affordances and constraints	Hamm, Jill
RR 4:14 N230	<u>Pede, Stella</u> ; Borromeo Ferri, Rita; Lipowsky, Frank	Making mathematical learning long-termed and effective using interleaved practices	Nieminen, Juuso Henrik

Thursday, July 5

RR # Room	Author	Title	Chair
RR 4:15 N260	Lem, Stephanie; <u>Van Dooren, Wim</u>	The influence of saliency in intuitive reasoning	Horne, Marj
RR 4:16 N270	<u>Dreher, Anika</u> ; Heinze, Aiso	Mathematicians' criteria for accepting theorems and proofs – an international study	Carotenuto, Gemma
RR 4:17 MC313	<u>Neto, Vanessa Franco</u> ; Valero, Paola	The mathematics textbook for rural population in Brazil: Learning to be a modernized farmer	Barwell, Richard
RR 4:18 MC333	<u>Griese, Birgit</u>	Gender specificities in a support project for engineering students	Hawks, Michelle
RR 4:19 MC343	<u>Simon, Martin</u>	Designing for guided reinvention of mathematical concepts	Wedman, Lotta
RR 4:20 MA346	<u>Chimoni, Maria</u> ; Pitta-Pantazi, Demetra	The predictive role of different reasoning forms to students' early algebraic thinking abilities	Vlassis, Jo-elle

Thursday, July 5

Thursday, July 5, 11.50 – 12.30

Research Reports No 5.

RR # Room	Author	Title	Chair
RR 5:01 N410	<u>Büscher, Christian</u>	Clumps or chunks? - contextual relevance of students' features of the data	Eames, Cheryl Lynn
RR 5:02 N420	Ahl, Linda Marie; <u>Helenius, Ola</u>	Why is calculating the average speed difficult?	Obersteiner, Andreas
RR 5:03 N430	<u>Bampili,</u> <u>Amalia-Christina</u> ; Sakonidis, Charalampos; Zachariades, Theodossios	The transition from high school to university mathematics: Entering a new community of practice	Ivars, Pedro
RR 5:04 N440	<u>Rott, Benjamin</u> ; Liljedahl, Peter	Creativity or imagination: challenges with measuring creativity	Dahl, Soen- dergaard, Bettina
RR 5:05 N450	<u>Widder, Mirela</u> ; Berman, Abraham; Koichu, Boris	Action strategies in spatial geometry problem solving supported by dynamic geometry software	Kontorovich, Igor'
RR 5:06 N460	<u>Street, Karin</u> <u>Elisabeth Sørlie</u> ; Malmberg, Lars-Erik; Stylianides, Gabriel J.	Investigating self-efficacy expectations and mastery experiences across a sequence of lessons in mathematics	Strohmaier, Anselm R.
RR 5:07 N300	<u>Viirman, Olov</u> ; Nardi, Elena	Ritualised and exploratory graphing routines in mathematical modelling: The Digoxin task	Peña, Fredy

Thursday, July 5

RR # Room	Author	Title	Chair
RR 5:08 N320	<u>Levenson, Esther</u>	Is mathematical creativity related to mathematical excellence? Teachers' beliefs	Awoniyi, Florence Christianah
RR 5:09 N330	Seo, Eun-Min; <u>Kim, Jin-Ho</u> ; Lim, Woong	Analysis of the PCK of an elementary mathematics master teacher	Kuntze, Sebastian
RR 5:10 N360	<u>Crisan, Cosette</u> ; Rodd, Melissa	From 'frowns and groans' to 'astonishment and delight': Seeking indicators of a mathematics teachers identity	Losano, Ana Leticia
RR 5:11 N370	<u>Weingarden, Merav</u> ; Heyd-Metzuyanim, Einat	Examining explorative instruction according to the realization tree assessment tool	Kim, Ok-Kyeong
RR 5:12 N380	<u>Tzur, Ron</u> ; Wei, Bingqian; Smith, Amy; Norton, Anderson; Davis, Alan; Johnson, Heather Lynn	Same unit coordination: A conceptual screener for mixed unit coordination and base-10, place value reasoning	Vale, Pamela
RR 5:13 N210	<u>Hattermann, Mathias</u> ; Heinrich, Daniel; Salle, Alexander; Schumacher, Stefanie	Instrument to analyse dyads' communication at tertiary level	Smedlund, Joakim
RR 5:14 N230	Tuohilampi, Laura; <u>Nieminen, Juuso</u> <u>Henrik</u> ; Häsä, Jokke; Rämö, Johanna	The interplay of informative assessment criteria and continuous feedback with mathematics students' learning orientations	Pede, Stella

Thursday, July 5

RR # Room	Author	Title	Chair
RR 5:15 N260	Seah, Rebecca; <u>Horne, Mari</u>	Middle school students' reasoning about volume and surface area	Van Dooren, Wim
RR 5:16 N270	<u>Carotenuto, Gemma</u> ; Coppola, Cristina; Di Martino, Pietro	Mathematical induction at the tertiary level: Looking behind appearances	Dreher, Anika
RR 5:17 MC313	<u>Barwell, Richard</u>	Situational and distal sources of meaning in a multilingual mathematics classroom	Franco Neto, Vanessa
RR 5:18 MC333	<u>Hawks, Michelle</u>	Striving for equity: How policy shapes our understanding of race in math class	Griese, Birgit
RR 5:19 MC343	<u>Wedman, Lotta</u>	A concept analysis of the notion concept: Contributions of an analysing tool	Simon, Martin
RR 5:20 MA346	<u>Vlassis, Joelle</u> ; Demonty, Isabelle	Symbolisation and objectification through social interactions for meaningful learning of mathematics	Chimoni, Maria

Thursday, July 5, 13.00 – 14.00

Policy meeting.

The Policy Meeting gives space for an open discussion with the members of the International Committee. There will be possibilities to bring a lunch box to the meeting.

Room: N320

Thursday, July 5, 14.00 –

Excursions.

More information about where each excursion will start can be found on page 13 in this booklet, and at the announcement board near the conference office.

Friday, July 6

Overview of Friday July 6		
09.00	–	10.30 Plenary Panel
10.30	–	11.00 Fika
11.00	–	11.40 Research Reports, session 6
11.50	–	12.30 Research Reports, session 7
12.30	–	13.30 Lunch
14.00	–	15.00 Oral Communications, session 2 National Presentation
15.00	–	16.00 Poster Presentations, session A Fika
16.00	–	17.30 Research Forums, part 1 Seminar, part 1 Colloquium 1
18.00	–	Conference Dinner

Friday July 6, 09.00 – 10.30

Plenary Panel:

Márcia Pinto, Federal University of Rio de Janeiro, Brazil (chair).

Francesca Morselli, University of Genoa, Italy.

Wee Tiong Seah, The University of Melbourne, Australia.

Wim Van Dooren, KU Leuven, Belgium.

Qiaoping Zhang, The Education University of Hong Kong, Hong Kong SAR.

Chicken-egg cycles: What needs to come first, high performance or positive affective variables regarding mathematics?

Friday, July 6

Friday, July 6, 11.00 – 11.40

Research Reports No 6.

RR # Room	Author	Title	Chair
RR 6:01 N410	Mutara, Lydia; <u>Makonye, Judah Paul</u>	Students' pathways for solving probability problems	López-Martín, María del Mar
RR 6:02 N420	<u>Sievert, Henning</u> ; Van Den Ham, Ann-Kathrin; Niedermeyer, Inga; Heinze, Aiso	Textbook effects on the development of adaptive expertise	Ilany, Bat-Sheva
RR 6:03 N430	Buorn, Ángela; <u>Fernández, Ceneida</u> ; Llinares, Salvador	Decision-making in noticing students' proportional reasoning	Sanchez-Matamoros, Gloria
RR 6:04 N440	<u>Fritzlar, Torsten</u> ; Karpinski-Siebold, Nadja	Solving arithmetic-algebraic word problems by 10- to 12-year-old students	Waisman, Ilana
RR 6:05 N450	<u>Lisarelli, Giulia</u>	How dragging mediates a discourse about functions	Saenz-Ludlow, Adalira
RR 6:06 N460	Di Martino, Pietro; <u>Gregorio, Francesca</u>	The first-time phenomenon: Successful students' mathematical crisis in secondary-tertiary transition	Geisler, Sebastian
RR 6:07 N300	<u>Dyrvold, Anneli</u>	Conceptualising translations between representations	Psycharis, Giorgos

Friday, July 6

RR # Room	Author	Title	Chair
RR 6:08 N320	<u>Conner, AnnaMarie</u> ; Singletary, Laura Marie	Teacher beliefs and support for argumentation	Pyper, Jamie S
RR 6:09 N330	<u>Zoitsakos, Sotirios</u> ; Zachariades, Theodosios; Sakonidis, Charalampos	The role of horizon content knowledge in teachers' recognition and interpretation of students' mathematical misconceptions	Anabousy, Ahlam Adnan
RR 6:10 N360	<u>Segal, Ruti</u> ; Lehavi, Yaron; Merzel, Avi; Baram, Ami; Eylon, Bat-Sheva	Using self-video-based conversations in training mathematics teacher instructors	Hoffmann, Anna
RR 6:11 N370	<u>Amador, Julie</u> ; Earnest, Darrell	Preservice mathematics teachers' curriculum visualization	Vos, Pauline
RR 6:12 N380	<u>Weigand, Hans-Georg</u>	The development of the concept of limit – aspects and basic mental models	Connolly, Mary
RR 6:13 N210	<u>Høynes, Siri-Malén</u> ; Klemp, Torunn; Nilssen, Vivi	Pre-service mathematics teachers' whole-class dialogs during field practice	Shvarts, Anna
RR 6:14 N230	<u>Carney, Michele</u> ; Paulding, Katie	Response process validity evidence: A proportional reasoning example	Shabtay, Galit
RR 6:15 N260	<u>Datsogianni, Anastasia</u> ; Ufer, Stefan; Sodian, Beate	Elementary students' conditional reasoning skills in mathematical and everyday contexts	Lindmeier, Anke

Friday, July 6

RR # Room	Author	Title	Chair
RR 6:16 N270	<u>Asghari, Amir Hossein</u> ; Taghi Dastjerdi, Sharareh; Ahmadpour Mobarakeh, Fatemeh	Big blocks of proof	Thomas, Stephanie
RR 6:17 MC313	<u>Silva, Marcio</u> ; Valero, Paola	Brazilian high school textbooks: Mathematics and students' subjectivity	Haser, Çiğdem
RR 6:18 MC333	<u>Smith, Cathy Anne</u> ; Golding, Jennie	Schools' strategies for promoting girls' participation in mathematics	Schindler, Maiké
RR 6:19 MC343	<u>Van Hoof, Jo</u> ; Degrande, Tine; Ceulemans, Eva; Verschaffel, Lieven	Investigating learners' fraction understanding: A longitudinal study in upper elementary school	Steffensen, Lisa
RR 6:20 MA346	<u>Tuomela, Tatu Dimitri</u> ; Hähkionniemi, Markus	Variation of student engagement between different algebra tasks	Qiao, Xuefeng

Friday, July 6

Friday, July 6, 11.50 – 12.30

Research Reports No 7.

RR # Room	Author(s)	Title	Chair
RR 7:01 N410	Batanero, Carmen; <u>López-Martín,</u> <u>María del Mar;</u> Gea, María Magdalena; Arteaga, Pedro	Knowledge of statistical tests by prospective high school teachers	Makonye, Judah Paul
RR 7:02 N420	Hamo, Pircha; <u>Ilany, Bat-Sheva;</u> Buzaglo, Meir	Which is smaller...? Partial understandings and misconceptions about multiplication and division by fractions	Sievert, Henning
RR 7:03 N430	<u>Sanchez-</u> <u>Matamoros,</u> <u>Gloria;</u> Moreno, Mar; Valls, Julia; Callejo, M Luz	Use of a learning trajectory as a conceptual instrument to develop the competence of professional noticing	Fernandez, Ceneida
RR 7:04 N440	<u>Waisman, Ilana;</u> Leikin, Mark; Leikin, Roza	Does the cognitive demand of a problem increase when the answer is an inequality?	Fritzlar, Torsten
RR 7:05 N450	<u>Saenz-Ludlow,</u> <u>Adalira;</u> Athanasopoulou, Anna	Transformation of a geometric diagram to produce a conjecture and its proof	Lisarelli, Giulia
RR 7:06 N460	<u>Geisler, Sebastian;</u> Rolka, Katrin	Academic procrastination in the transition from school to university mathematics	Gregorio, Francesca

Friday, July 6

RR # Room	Author(s)	Title	Chair
RR 7:07 N300	Vroutsis, Nikolaos; <u>Psycharis, Giorgos</u> ; Triantafillou, Chrissavgi	Crossing the boundaries between school mathemat- ics and workplace through authentic tasks	Dyrvold, Anneli
RR 7:08 N320	<u>Pyper, Jamie S</u> ; MacGregor, Stephen	Problem solving: How preservice teachers understand it during their preservice learning	Conner, AnnaMarie
RR 7:09 N330	<u>Anabousy, Ahlam</u> <u>Adnan</u> ; Tabach, Michal	Links between teachers' pedagogical technological knowledge and their personal characteristics	Zoitsakos, Sotirios
RR 7:10 N360	<u>Hoffmann, Anna</u> ; Even, Ruhama	What do mathematicians wish to teach teachers in secondary school about mathematics?	Segal, Ruti
RR 7:11 N370	<u>Vos, Pauline</u> ; Roorda, Gerrit	Students' readiness to appropriate the derivative - Meta-knowledge as support for the ZPD	Amador, Julie
RR 7:12 N380	<u>Connolly, Mary</u> ; Nicol, Cynthia	Financial literacy: Practicing money manage- ment as your future-self	Weigand, Hans-Georg
RR 7:13 N210	<u>Shvarts, Anna</u>	A dual eye-tracking study of objectification as student-tutor joint activity appropriation	Høynes, Siri-Malén
RR 7:14 N230	<u>Shabtay, Galit</u> ; Heyd-Metzuyanim, Einat	Examining teachers' discourse on students' struggle through figured worlds	Carney, Michele
RR 7:15 N260	<u>Lindmeier, Anke</u> ; Brunner, Esther; Grüßing, Maike	Early mathematical reasoning – theoretical foundations and possible assessment	Datsogianni, Anastasia

Friday, July 6

RR # Room	Author(s)	Title	Chair
RR 7:16 N270	<u>Treffert-Thomas, Stephanie</u> ; Rogovchenko, Svitlana; Rogovchenko, Yuriy	The use of nonstandard problems in an ODE course for engineering students	Asghari, Amir Hossein
RR 7:17 MC313	<u>Haser, Cigdem</u>	Doctoral programs' contribution to becoming a mathematics education researcher	Silva, Márcio
RR 7:18 MC333	<u>Schindler, Maike</u> ; Lilienthal, Achim J.	Eye-Tracking for studying mathematical difficulties—Also in inclusive settings	Smith, Cathy Anne
RR 7:19 MC343	<u>Steffensen, Lisa</u> ; Herheim, Rune; Rangnes, Toril Eskeland	Wicked problems in school mathematics	Van Hoof, Jo
RR 7:20 MA346	<u>Qiao, Xuefeng</u>	A study of middle school students' algebraic proofs in China	Tuomela, Tatu Dimitri

Friday, July 6

Friday July 6, 14.00 – 15.00

Oral Communications No 2.

OC 2:01	Topic: Early algebra
Room N410	Chair: Koichu, Boris
<u>Partanen, Anna-Maija;</u> Tolvanen, Pieti	Uncategorizable cases in developing a frame for analyzing different meanings of the concept of the variable mediated by mathematical tasks
<u>Kaas, Thomas</u>	The landscape of early algebra teaching and learning
<u>Twohill, Aisling</u>	Shape patterning tasks: The role played by collaboration in supporting children's thinking

OC 2:02	Topic: Teacher orchestration of Interaction
Room N420	Chair: Applebaum, Mark
<u>Lahdenperä, Juulia Josefiina</u>	Supporting quality of learning in university mathematics: A comparison of two instructional designs
<u>Serrazina, Maria de Lurdes;</u> <u>Rodrigues, Margarida Maria;</u> <u>Caseiro, Ana Sofia</u>	The teacher's role in whole class discussion in developing the quantitative reasoning
<u>Ingram, Jenni;</u> Andrews, Nick; Pitt, Andrea	The multiple functions of scaffolding in supporting students' task completion

OC 2:03	Topic: Geometry, space and shape
Room N430	Chair: Fernandez, Ceneida
<u>Podkhodova, Natalia</u>	Reflexive abilities of the 9th grade students and "many-valued" geometric problems
<u>Mizzi, Angel</u>	Students' difficulties when solving spatial tasks
<u>Huang, Hsin-Mei E.;</u> Hsieh, Chia-Chun; Tu, Shu-Min	Children's performance of recognizing angles of inclination, turning, and rotation

Friday, July 6

OC 2:04 Room N440	Topic: Calculus and functions Chair: Ferrari, Giulia
<u>Akın, Ayça</u> ; Sezgin, H. Seda	Pre-calculus college students' quantitative reasoning in the context of real-world situations
<u>Özaltun Çelik, Aytuğ</u> ; Bukova Güzel, Esra	Constructing axes of symmetry and vertex for quadratic functions through quantitative reasoning
<u>Borji, Vahid</u> ; Font, Vicenç; Alamolhodaei, Hassan; Sánchez, Alicia; Pino-Fan, Luis R.	On students' understanding of implicit differentiation, based on two lenses: APOS and OSA

OC 2:05 Room N450	Topic: Problem solving and thinking skills Chair: Santos, Leonor
<u>Evans, Tanya</u> ; Klymchuk, Sergiy; Thomas, Mike	Puzzle-based learning in university mathematics: Students' perspectives
<u>Aaten, Aaltje Berendina</u> ; Roorda, Gerrit; Deprez, Johan; Goedhart, Martin	Evolution of undergraduate students' mathematical reasoning
<u>Hattori, Yuichiro</u> ; Baba, Takuya	Fostering critical thinking through mathematical problem solving based on the perspective of critical mathematics education

OC 2:06 Room N460	Topic: Proof, argumentation and reasoning Chair: Stoppel, Hannes
<u>Pala, Ozan</u> ; Narlı, Serkan; Aksoy, Esra; Ercire, Yusuf Emre; Aksoy, Mehmet Akif	Proof tripod: Proof image, enlightenment & feelings
<u>Vargas, Francisco Javier</u> ; Stenning, Keith	The world around Pythagoras: Interpretation, logic and reasoning considerations
Albano, Giovannina; Ferrari, Pier Luigi; <u>Pierrri, Anna</u>	Grice's relevance maxim for investigating undergraduates' argumentations

Friday, July 6

OC 2:07 Room N300	Topic: Preservice teacher preparation Chair: Helliwell, Tracy
<u>Essien, Anthony A.</u>	Towards a framework for understanding the choice and use of examples in teacher education multilingual mathematics classrooms
<u>Ramdhany, Viren</u>	Conflict or compromise: Pre-service mathematics teachers' experiences of school and university mentors
Jeschke, Colin; Saas, Hannes; Kuhn, Christiane; Zlatkin- Troitschanskaia, Olga; Lindmeier, Anke M.	How do pre-service teachers apply their knowledge for teaching mathematics and economics?

OC 2:08 Room N330	Topic: Teacher beliefs Chair: Rott, Benjamin
Pinta, Maritza; Moreno Balcázar, Juan José; Gil Cuadra, Francisco; Montoro Medina, Ana Belén	Conceptions and beliefs of the professors of numerical methods in the engineering degrees at Ecuadorian universities
<u>Reyes Santander, Pamela</u> ; vom Hofe, Rudolf	Basic ideas for addition in primary education trainees
<u>Haj Yahya, Aehsan</u> ; Daher, Wajeih; Swidan, Osama	Inservice teachers' perspectives of parallelogram definitions

OC 2:09 Room N370	Topic: Professional development, case study Chair: Conner, AnnaMarie
<u>Chen, Chang-Hua</u>	A secondary school mathematics teacher's professional development in differentiated instruction: A case study
<u>Yıldırım, Duygu</u> ; Yavuzsoy Köse, Nilüfer; Tanışlı, Dilek	Professional development of a mathematics teacher through web-based educational portal
<u>Costa, Maria Cristina</u> ; Domingos, António	Promoting mathematics' teaching through hands-on science experiments

Friday, July 6

OC 2:10	Topic: Preservice teachers, content knowledge
Room N380	Chair: Pyper, Jamie S.
<u>Bikner-Ahsbabs, Angelika;</u> Hanke, Erik; Schäfer, Ingolf	How to overcome fragmentation in pre-service teacher education in mathematics at university level
<u>Hannula, Jani</u>	Pre-service mathematics teachers' evoked concept images of number systems
<u>Hubeňáková, Veronika;</u> Semanišínová, Ingrid	Pre-service teachers as learners of pedagogical content knowledge in combinatorics

OC 2:11	Topic: Representations and modeling
Room N210	Chair: Schukajlow, Stanislaw
<u>Jung, Hyunyi;</u> Magiera, Marta	Prospective teachers' learning opportunities to pose mathematical modeling problems
<u>Leong, Swee Ling;</u> Soon, Tan Liang	The joy of learning mathematical modelling: Networked learning community as an activity system
<u>Earnest, Darrell;</u> Gonzales, Alicia	A second grader's shifting descriptions of time on an analog clock

OC 2:12	Topic: Classroom discourse
Room N230	Chair: Wagner, David
<u>Huang, Chih Hsien</u>	Teachers' use of examples and accompanying mathematical discourse: The case of derivative
<u>Ndlovu, Williams</u> <u>Chapasuka;</u> Mwakapenda, Willy	A commognitive analysis of grade 12 learners' participation in a situated mathematical activity
<u>Kristinsdóttir, Bjarnheiður;</u> <u>Hreinsdóttir, Freyja;</u> Lavicza, Zsolt	Initiating student discourses with silent video tasks in mathematics classrooms

OC 2:13	Topic: Numbers and operations, younger students
Room N260	Chair: Barmby, Patrick
<u>Nogues, Camila;</u> Dorneles, Beatriz	Number estimation, working memory and quantitative reasoning: A study with 3rd and 4th grade school children
<u>Degrande, Tine;</u> Verschaffel, Lieven	To add or to multiply? An interview study on primary school children's preference for additive or multiplicative relations
<u>Hansa, Sameera;</u> Venkatakrishnan, Hamsa; Askew, Michael	Improving grade 4 multiplicative reasoning in South Africa: Findings from an intervention study

Friday, July 6

OC 2:14	Topic: Affect, emotions and attitudes
Room N270	Chair: Csikos, Csaba
<u>Rach, Stefanie</u> ; Engelmann, Laura	Students' expectations concerning studying mathematics at university
<u>Bjorkman, Katie</u>	Peer tutors' awareness of affective factors
Johansson, Helena; Österholm, Magnus; Flodén, Liselott; Heidtmann, Pia	Teachers' and students' perceptions of the gap between secondary and tertiary mathematics

OC 2:15	Topic: ICT and learning, higher education
Room MC333	Chair: Matos, João Filipe
<u>Poudel, Amrit Bahadur</u> ; Shults, F. LeRon; Vos, Pauline	Students of religion studying social conflicts through simulation and modelling - a pilot study
<u>Mali, Angeliki T</u> ; Mesa, Vilma M	Instructor creation of lecture notes with digital textbooks
<u>Zeynivandnezhad</u> , <u>Fereshteh</u>	Developing mathematical thinking powers: The case of using a computer algebra system in differential equations

OC 2:16	Topic: Language and multilingualism
Room MC343	Chair: Levenson, Esther
<u>Culligan, Karla Marie</u>	An exploration of high school french immersion students' communication during a collaborative mathematics problem-solving task
<u>Pan, Jiahui</u>	Second-generation migrant students from Singapore: A preliminary study on their mathematics performance in Australia
<u>Riesten, Laila</u>	Challenges and opportunities: Listening to newly arrived students' mathematical stories

OC 2:17	Topic: Mathematics, curricula and textbooks
Room MA 346	Chair: Li, Yeping
<u>Chidthachack, Sousada</u>	Implementing standards-based mathematics: Toward improving conceptual understanding for middle school immigrant students
<u>Wang, Guangming</u> ; Li, Jian; Kang, Yueyuan; Zhang, Nan; Wu, Libao; Chen, Jun; Chen, Hanjun	Presentation of fractions in primary mathematics textbooks: The combination of historical order and "transcendent recursion"
<u>Ataide Pinheiro</u> , <u>Weverton</u> ; Lei, Kin Hang; Lu, Feng-Lin; Tso, Tai-Yih	Textbook approaches and PISA exam questions

Friday, July 6

Friday July 6, 14.00 – 15.00

National Presentation

Ola Helenius, Cecilia Kilhamn and Peter Nyström

The National Presentation will be presented by Ola Helenius from the Swedish National Centre for Mathematics Education, NCM. He will give an overview of the history, traditions and perspectives of Swedish mathematics education. In addition, he will relate and contrast the Swedish situation with international mathematics education research.

Room: N320.

Friday, July 6

Friday July 6, 14.50 – 16.00

Poster presentations, session A.

Room: Lindellhallen.

PP #	Authors	Title
PP 1 A	<u>Abu-Naja, Muhammad;</u> Helf, Nader	Geometric thinking levels among college of education students
PP 2 A	<u>Ali, Clement Ayarebilla;</u> Anderson, Hans Kweku	Scaffolded transference from basic musical notations to basic fractions: A study on the development of preservice teachers' pedagogical content knowledge
PP 3 A	<u>Berggren, Johannes</u>	Children's conceptions of time
PP 4 A	<u>Blanco, Teresa F.;</u> Gorgal, Alejandro; Salgado, María; Salinas, María Jesús; Sequeiros, Pablo G.; Rodríguez, Dolores; Núñez, Cristina; Diego, José Manuel	Interdisciplinary activities for an inclusive mathematics education
PP 5 A	<u>Stoppel, Hannes;</u> Rott, Benjamin	Subject matter analysis: The case of cryptography with elliptic curves
PP 6 A	<u>Cavalcante, Alexandre;</u> Savard, Annie; Turineck, Louis-Philippe; Javaherpour, Azadeh	Teaching mathematics through financial contexts: Are teachers comfortable with financial concepts?
PP 7 A	<u>Chen, Chia Huang</u>	A study on elementary school teacher treating student error examples in fraction operation
PP 8 A	Cao, Yiming; <u>Zhang, Shu</u>	Studying teachers' beliefs on teaching whole numbers with the application of nine times table
PP 9 A	<u>de Chambrier,</u> <u>Anne-Françoise</u>	Second graders with mathematical learning disabilities use more finger-counting on small problems but less on large ones

Friday, July 6

PP #	Authors	Title
PP 10 A	Vanegas, Yuly; <u>Diez-Palomar, Javier</u> ; Giménez, Joaquim	Validating a methodological instrument to foster creativity in solving open-ended tasks in mathematics textbooks
PP 11 A	<u>Domingos, António</u> ; Santiago, Ana; Costa, Conceição; Machado, Ricardo	On-line platform as an artefact for teaching and learning mathematics
PP 12 A	<u>Dreher, Anika</u> ; Holzäpfel, Lars	Can visualizations (re)activate conceptual knowledge of central mathematical concepts? - An exploratory study
PP 13 A	<u>Billion, Lara</u>	Mathematical learning processes with varying types of material conditioning
PP 14 A	<u>Gebel, Inga</u> ; Kuzle, Ana	Problem solving for all: Evaluation of a problem solving teaching concept for primary education
PP 15 A	Gebel, Inga; <u>Kuzle, Ana</u>	Can problem fields engage all students in mathematical problem solving?
PP 16 A	<u>Gomez, David</u> ; Dartnell, Pablo; Urrutia, Mabel	Strategies for fraction comparison when selecting the larger or the smaller one
PP 17 A	Cavalcanti, Érica; <u>Guimarães, Gilda Lisbôa</u>	Statistics in primary and middle school: Hypothesis formulation, data analysis and conclusions
PP 18 A	<u>Gunnarsson, Robert</u> ; Papadopoulos, Ioannis	The impact of number-pairing on students' ideas on how to evaluate numerical expressions
PP 19 A	<u>Haja-Becker, Shajahan</u>	Prospective teachers' exploration of Cinderella.2,8 with primary children
PP 20 A	<u>Hanazono, Hayato</u>	A case study on facilitating students' appreciation of aesthetic qualities of mathematical objects

PP #	Authors	Title
PP 21 A	<u>Tam, Hak Ping</u> ; Sun, Wei-Min; Hsieh, Shu-Chi	How would students decide if a line is straight?
PP 22 A	<u>Henriques, Ana</u> ; Gutiérrez-Fallas, Luis Fabián	Developing prospective mathematics teachers' TPACK in a didactics course
PP 23 A	<u>Hodge, Lynn</u> ; Cheng, Karen; King, Shande; Kim, Nick	Elementary teachers' take-aways from summer math Institutes in a three-year professional development project in Rural Appalachia
PP 24 A	<u>Hsu, Hui-Yu</u> ; Chen, Ya-Wen; Cheng, Ying-Hao; Chen, Jian-Cheng	Task design to scaffold low-achievers in learning system of linear equations with two unknowns
PP 25 A	Albano, Giovannina; <u>Dello Iacono, Umberto</u>	"Think, drag, communicate" - a scaffolding toolkit to foster argumentation and proofs
PP 26 A	Hansson, Örjan; <u>Juter, Kristina</u>	Drug calculations in nursing education: Is mathematics a problem?
PP 27 A	<u>Kawasaki, Masato</u> ; Morita, Taisuke; Hayashi, Tomoko; Sugimoto, Shin; Takenoya, Syuuta	Analyses of change in young children's capability of comparative judgment based on rectangles drawn on a tablet
PP 28 A	<u>Kuntze, Sebastian</u> ; Krummenauer, Jens	Teachers' views about characteristics of professional development activities
PP 29 A	<u>Leshota, Moneoang</u>	Visible and invisible affordances of a mathematics textbook
PP 30 A	<u>Lin, Su-Wei</u>	The investigation of reading and cognitive components of item difficulties for mathematical literacy test
PP 31 A	Caponi, Matteo; <u>Lisarelli, Giulia</u>	Realization trees: A commognitive lens

PP #	Authors	Title
PP 32 A	<u>Losano, Ana Leticia</u> ; Fiorentini, Dario	Mathematics teachers' identity work in the context of lesson study
PP 33 A	<u>Mak, Soi-kei</u> ; Cheung, Kwok-cheung; Sit, Pou-seong; Jeong, Man-kai	An examination of study motivation classifying high- and low-performing students in PISA 2012 mathematical literacy study
PP 34 A	<u>Costa, Conceição</u> ; Charneca, Eliane; Nascimento, Marisa; Matos, José Manuel	Young children's visual-spatial thinking in interpreting spatial vocabulary
PP 35 A	Healy, Lulu; <u>Nardi, Elena</u> ; Biza, Irene	Attuning to the mathematics of difference: Examples of teachers' haptic constructions of number
PP 36 A	<u>Nogues, Camila</u> ; Dorneles, Beatriz	Number estimation ability in 3rd and 4th grade school children
PP 37 A	<u>Nortvedt, Guri</u> ; Sumpter, Lovisa	Gender as a cultural construct: Methodological issues in questionnaire development
PP 38 A	<u>Orrill, Chandra</u> ; Brown, Rachael	Epistemic network analysis as a lens to understand teacher knowledge of proportions
PP 39 A	<u>Özaltun Celik, Aytuğ</u> ; Bukova Güzel, Esra	Generalizing the ideas regarding translation of a parabola by a mathematical modeling activity
PP 40 A	<u>Polotskaia, Elena</u> ; Cavalcante, Alexandre; Savard, Annie	Visual representations of multiplicative relationships by students learning mathematics
PP 41 A	Hertling, Dorothea; <u>Rathgeb-Schnierer, Elisabeth</u>	Developing understanding of numbers in different approaches to mathematics in kindergarten
PP 42 A	<u>Reitz-Koncebovski, Karen</u> ; Goral, Johanna; Kortenkamp, Ulrich	Biography, emotion and motivation in mathematics studies: Design of a course for student teachers
PP 43 A	<u>Rodrigues, Maria Paula</u> ; Serrazina, Lurdes	Six years old pupils' knowledge about rectangles

Friday, July 6

PP #	Authors	Title
PP 44 A	<u>Säfström, Anna Ida</u> ; Nagy, Caroline	Embodied fractions: Conceptual difficulties in the light of grounding metaphors
PP 45 A	Movshovitz-Hadar, Nitsa; Shriki, Atara; <u>Segal, Ruti</u>	The effect of exposing students to mathematics-news-snapshots on their image of mathematics
PP 46 A	<u>Sezgin, H. Seda</u> ; Ada, Tuba	Supporting middle-school students' spatial orientation by using orienteering activities in real-world environment
PP 47 A	<u>Héroux, Sabrina</u>	Doing mathematics playing Nine Men's Morris
PP 48 A	<u>Staats, Susan Kimberley</u>	Sensuous syntax: Coloring conjectures with sound, silence, gesture and grammar
PP 49 A	<u>Szabó, Csaba</u>	The danger of picking the wrong dress
PP 50 A	<u>Takeuchi, Ayumu</u>	Positioning of mathematics within integrated STEM education: The viewpoint of learning mathematics
PP 51 A	<u>Tsikalaki, Eleni</u> ; Misailidou, Christina	Primary school teachers' enjoyment (or not!) of mathematics and its teaching
PP 52 A	Gea, María Magdalena; Arteaga, Pedro; Molina-Portillo, Elena; <u>López-Martín,</u> <u>María del Mar</u>	Correlation and regression problems in the Spanish high school textbooks
PP 53 A	<u>Watanabe, Satoshi</u>	Activity for spatial reasoning development of elementary school children
PP 54 A	<u>Wu, Huei-min</u> ; Huang, Hui-chuan; Chu, Ting-hua	Playing a cooperative geometry board game: Who benefit? When and how?

Friday, July 6

Friday July 6, 16.00 – 17.30

Research Forums, part 1, Seminar, part 1, Colloquium No 1.

RF # Room	Authors	Title
RF 1 Hörsal A	<u>Yasmine Abtahi</u> , Jill Adler, David <u>Guillemette</u> , Rune Herheim, Steve <u>Lerman</u> , Jean-Francois Maheux, Paola Valero	Otherness in mathematics education
RF 2 Hörsal B	<u>Camilla Björklund</u> , Angelika <u>Kullberg</u> , Ulla Runesson <u>Kempe</u> , Maria Reis Douglas <u>Clements</u> , Julie <u>Sarama</u> , Esther Levenson, Ruthi <u>Barkai</u> , Dina Tirosh, Pessia Tsamir, Michael Askew, Hamsa <u>Venkat</u> , Minna Hannula-Sormunen	Learning and teaching of arithmetic skills in early years
RF 3 Hörsal D	<u>Lynn McGarvey</u> , Jennifer Thom, Joyce Mgombelo, Jerome Proulx, <u>Elaine Simmt</u> , Florence Glanfield, <u>Brent Davis</u> , Lyndon Martin, Jo Towers, Charlotte Bertin, Kevin Champagne, Rox-Anne L'Italien-Bruneau, Charlotte Mégroureche	Vital signs of collective life in the classroom

SE/CO Room	Authors	Title
SE 1 S305	David Maximiliano Gomez, Anika Dreher	Reviewing for PME - a primer for (new) reviewers
CO 1 Hörsal C	<u>Man Ching Ester Chan</u> Discussant: Markku Hannula	Parallel analyses of collaborative mathematics problem solving in a laboratory classroom setting
	<u>Man Ching Esther Chan</u> , May Ee Vivien Wan, David Clarke	P1: Entangled modes of social interaction in student collaborative problem solving in mathematics: Connecting process and product
	<u>Javier Díez-Palomar</u>	P2: Analysing patterns of students' interaction when solving open-ended tasks in small groups
	<u>Laura Tuohilampi</u>	P3: Analyzing engagement in mathematical collaboration: What can we say with confidence?

Friday, July 6

Friday July 6, 18.00 –

Conference Dinner.

See more information on page 13 and on the announcement boards.

Notes

Saturday, July 7

Overview of Saturday July 7		
09.00 – 09.40	Research Reports, session 8	
09.50 – 10.30	Research Reports, session 9	
10.30 – 11.00	Fika	
11.00 – 12.30	Working Groups, part 2	
12.30 – 13.30	Lunch	
14.00 – 15.00	Oral Communications, session 3	
15.10 – 16.10	Oral Communications, session 4	
16.10 – 16.30	Fika	
16.30 – 18.00	Annual General Meeting, AGM	

Saturday, July 7, 09.00 – 09.40

Research Reports No 8.

RR # Room	Author	Title	Chair
RR 8:01 N410	Bernabeu, Melania; <u>Moreno, Mar</u> ; Llinares, Salvador	Primary school children's (9 year olds') understanding of quadrilaterals	Kuzle, Ana
RR 8:02	<u>Bempeni, Maria</u>	Individual differences in fractions' conceptual and procedural knowledge: What about older students?	Anderson, Judy Anne
RR 8:03 N430	<u>Dilberoglu, Merve</u> ; Haser, Cigdem	Role of using an alternative concept definition in conducting mathematical tasks of teaching: The case of explaining why an algorithm works	Rotem, Sigal
RR 8:04 N440	<u>Höveler, Karina</u>	Solving combinatorial counting problems: Primary children's recursive strategies	Joklitschke, Julia
RR 8:05 N450	<u>Bakos, Sandy</u> ; Thibault, Mathieu	Affordances and tensions in teaching both computational thinking and mathematics	Swidan, Osama

Saturday, July 7

RR # Room	Author	Title	Chair
RR 8:06 N460	<u>Ryoo, Byeongguk;</u> Choi-Koh, Sang Sook	Some changes of math anxiety groups based on two measurements, MASS & EEG	Meehan, Maria
RR 8:07 N300	<u>Triantafillou, Chrissavgi;</u> Psycharis, Giorgos; Bakogianni, Dionysia; Potari, Despina	Enactment of inquiry-based mathematics teaching and learning: The case of statistical estimation	Ferrari, Giulia
RR 8:08 N320	Cooper, Jason; <u>Pinto, Alon</u>	Jourdain and Dienes effects revisited - playing Tic Tac Toe or learning non-Euclidean geometry?	Appova, Aina
RR 8:09 N330	<u>Österling, Lisa;</u> Christiansen, Iben Maj	Productive ways of organising practicum – what do we know? A systematic review	Friesen, Marita Eva
RR 8:10 N360	<u>Brown, Julian Tom</u>	A comparison of approaches to stimulated recall interviews with mathematics teachers in order to identify shifts in attention	Andrews, Nick
RR 8:11 N370	<u>Ribeiro, Miguel;</u> Jakobsen, Arne; Mellone, Maria	Secondary prospective teachers' interpretative knowledge on a measurement situation	Morselli, Francesca
RR 8:12 N380	<u>Marmur, Ofer;</u> Koichu, Boris	Which key memorable events are experienced by students during calculus tutorials?	Bresock, Krista Kay
RR 8:13 N210	<u>Kageyama, Kazuya</u>	Criteria for knowing a geometrical object: The enactivist perspective	Duranczyk, Irene

Saturday, July 7

RR # Room	Author	Title	Chair
RR 8:14 N230	Moutsios-Rentzos, Andreas; <u>Micha, Ioanna</u>	Proof and proving in high school geometry: A teaching experiment based on Toulmin's scheme	von Hering, Robert
RR 8:15 NN260	McMullen, Jake; Resnick, Lauren B.	Linking informal and formal mathematical reasoning: Two directions across the same bridge?	Dreyøe, Jonas
RR 8:16 N270	Zandieh, Michelle; Williams-Pierce, Caro; Plaxco, David; Amresh, Ashish	Using three fields of education research to frame the development of digital games	Alderton, Julie
RR 8:17 MC313	<u>Edwards, Antony</u> ; Carroll, David	Predictors of demand for mathematics support	Chorney, Sean
RR 8:18 MC333	<u>Hilton, Caroline</u>	The role of finger gnosis in the development of early number skills	Vennberg, Helena
RR 8:19 MC343	<u>Krzywacki, Heidi</u> ; Hemmi, Kirsti; Remillard, Janine; van Steenbrugge, Hendrik	Finnish primary teachers' interaction with curriculum materials – digitalisation as an augmenting element	Baya'a, Nimer Fayeze
RR 8:20 MA346	<u>Heil, Cathleen</u>	The relation of children's performances in spatial tasks at two different scales of space	Medrano, Ana

Saturday, July 7

Saturday, July 7, 09.50 – 10.30

Research Reports No 9.

RR # Room	Author	Title	Chair
RR 9:01 N410	<u>Kuzle, Ana</u> ; Glasnović Gracin, Dubravka; Klunter, Martina	Primary grade students' fundamental ideas of geometry revealed via drawings	Moreno, Mar
RR 9:02 N420	<u>Christou, Konstantinos</u>	The natural number bias in arithmetic operations: The case of the representational form of the numbers	Helenius, Ola
RR 9:03 N430	<u>Rotem, Sigal</u> ; Ayalon, Michal	Using critical events in pre-service training: Examining the coherence level between interpretations of students' mathematical thinking and interpretations of teacher's responses	Dilberoglu, Merve
RR 9:04 N440	<u>Joklitschke, Julia</u> ; Rott, Benjamin; Schindler, Maike	Theories about mathematical creativity in contemporary research: A literature review	Höveler, Karina
RR 9:05 N450	<u>Swidan, Osama</u>	Task design to prompt making sense of pre-calculus concepts using dynamic technological tools	Bakos, Sandy
RR 9:06 N460	<u>Meehan, Maria</u> ; Howard, Emma; Ni Shuilleabhain, Aoibhinn	Students' sense of belonging to mathematics in the secondary-tertiary transition	Ryoo, Byeongguk
RR 9:07 N300	Ferrara, Francesca; <u>Ferrari, Giulia</u>	Thinking in movement and mathematics: A case study	Triantafillou, Chrissavgi

Saturday, July 7

RR # Room	Author	Title	Chair
RR 9:08 N320	<u>Appova, Aina</u>	Developing prospective teachers' mathematics orientations in the content courses	Pinto, Alon
RR 9:09 N330	<u>Friesen, Marita</u> ; Mesiti, Carmel; Kuntze, Sebastian	What vocabulary do teachers use when analysing the use of representations in classroom situations?	Österling, Lisa
RR 9:10 N360	<u>Andrews, Nick</u> ; Ingram, Jenni; Pitt, Andrea	Using self-video analysis to promote teacher growth	Brown, Julian Tom
RR 9:11 N370	Cusi, Annalisa; <u>Morselli, Francesca</u>	Linking theory and practice: Prospective teachers creating fictional classroom discussions	Ribeiro, Miguel
RR 9:12 N380	<u>Bresock, Krista Kay</u> ; Sealey, Vicki Lynn	Calculus students' use of visualizations when solving volume problems	Marmur, Ofer
RR 9:13 N210	Cawley, Anne; <u>Duranczyk, Irene</u> ; Mali, Angeliki; Mesa, Vilma; Strom, April; Watkins, Laura; Kimai, Patrick; Lim, Dexter	An innovative qualitative video analysis instrument to assess the quality of post-secondary algebra instruction	Kageyama, Kazuya
RR 9:14 N230	<u>von Hering, Robert</u> ; Rietenberg, Anja; Heinze, Aiso; Lindmeier, Anke	The applied knowledge of trainees as industrial clerks solving problems with vocational and non-vocational context	Micha, Ioanna
RR 9:15 N260	<u>Dreyøe, Jonas</u> ; Larsen, Dorte Moeskær; Misfeldt, Morten	From everyday problem to a mathematical solution — understanding student reasoning by identifying their chain of reference	McMullen, Jake

Saturday, July 7

RR # Room	Author	Title	Chair
RR 9:16 N270	<u>Alderton, Julie;</u> Pratt, Nick	Accountability and assessment: Gaps and grids	Zandieh, Michelle
RR 9:17 MC313	<u>Chorney, Sean</u>	A social expression of number using TouchCounts	Edwards, Ant
RR 9:18 MC333	<u>Vennberg, Helena;</u> Norqvist, Mathias	Counting on – long term effects of an early intervention programme	Hilton, Caroline Ann
RR 9:19 MC343	<u>Baya'a, Nimer</u> <u>Favez;</u> Daher, Wajeeh Mahmood; Abo-Mokh, Dania Jamal; Anabousy, Ahlam Adnan	The effectiveness of integrating geogebra HOTS activities on the development of creative mathematical thinking	Krzywacki, Heidi
RR 9:20 MA346	Xolocotzin, Ulises; Inglis, Matthew; <u>Medrano, Ana</u>	Elementary and secondary students' functional thinking with tables and diagrams	Heil, Cath- leen

Saturday, July 7

Saturday July 7, 11.00 – 12.30

Working groups, part 2.

WG # Room	Authors	Title
WG 1 N410	<u>Judy Anne Anderson,</u> <u>Yeping Li</u>	Integrating mathematics in STEM education: An international perspective
WG 2 N260	<u>Chiara Andrà,</u> <u>Pietro Di Martino,</u> <u>Peter Liljedahl,</u> <u>Annette Rouleau</u>	Teacher tensions as a lens to understand teachers' resistance to change
WG 3 N270	<u>Paul Drijvers,</u> <u>Francesca Ferrara</u>	Instruments and the body
WG 4 MC313	<u>Vanessa Franco Neto,</u> <u>Raimundo Elicer,</u> <u>Gustavo Bruno</u>	Mathematics education research from and in Latin America
WG 5 N420	<u>Matthew Inglis,</u> <u>Stanislaw Schukajlow,</u> <u>Wim Van Dooren,</u> <u>Markku Hannula</u>	Replication in mathematics education
WG 6 N430	<u>Ronnie Karsenty,</u> <u>Alf Coles</u>	Exploring the role of facilitators in video-based professional development for mathematics teachers
WG 7 MA346	<u>Guo Kan,</u> <u>Hege Kaarstein,</u> <u>Agida Manizade,</u> <u>Chandra Orrill</u>	International perspectives: Measuring mathematics teachers' knowledge in the digital era
WG 8 N440	<u>Ricardo Nemirovsky,</u> <u>Kate O'Brien,</u> <u>Nathalie Sinclair</u>	Learning mathematics in/through/by arts practices
WG 9 MA356	<u>Guri Nortvedt,</u> <u>Leonor Santos,</u> <u>Anna Teledahl</u>	Assessment for learning in diverse classrooms
WG 10 MA136	<u>Cecile Ouvrier-Bufferet,</u> <u>Elisabetta Robotti,</u> <u>Thierry Dias,</u> <u>Marie-Line Gardes</u>	Mathematical learning disabilities: A challenge for mathematics education

Saturday, July 7

WG # Room	Authors	Title
WG 11 MA146	<u>Annalisa Cusi,</u> <u>Francesca Morselli,</u> <u>Cristina Sabena</u>	Argumentation and formative assessment: A possible synergy?
WG 12 MA156	<u>Maike Schindler,</u> <u>Eeva Haataja,</u> <u>Achim J. Lilienthal,</u> <u>Enrique Garcia Moreno-Esteva,</u> <u>Anna Shvarts</u>	Eye-tracking in mathematics education research: A follow-up on opportunities and challenges
WG 13 MA166	<u>Kicki Skog,</u> <u>Iben Maj Christiansen,</u> <u>Lisa Österling</u>	Considering the desired teacher of mathematics teacher education
WG 14 N450	<u>Andreas J. Stylianides,</u> <u>William G. McCallum,</u> <u>Lynne McClure,</u> <u>Aisling Twohill</u>	Working group: The design of intended mathematics curricula
WG 15 MA176	<u>Helen Rachel Thouless,</u> <u>Robyn Ruttenberg-Rozen,</u> <u>Ron Tzur</u>	Maths and special education working group

Saturday, July 7

Saturday July 7, 14.00 – 15.00

Oral Communications No 3.

OC 3:01	Topic: Gender
Room N410	Chair: Brown, Laurinda
<u>Sumpter, Lovisa</u> ; Nortvedt, Guri	Gender as a cultural construct: Theoretical issues
<u>Staats, Susan Kimberley</u> ; Laster, Lori Ann; Whipple, Kyle	Storytelling and legitimation in social justice mathematics
<u>Applebaum, Mark</u> ; Freiman, Viktor	Gender issues in the Kangaroo contest

OC 3:02	Topic: Teacher professional development
Room N420	Chair: Lindmeier, Anke
<u>Roorda, Gerrit</u> ; de Vries, Siebrich	Teacher learning in the context of lesson study: One team, five mathematics teachers
<u>Wang, Ting-Ying</u> ; Yang, Kai-Lin; Wu, Lan-Ting; Lin, Fou-Lai	Design and evaluation of a workshop to develop teachers' competence in designing mathematical grounding activities
<u>Cheng, Ying-Hao</u> ; Hsu, Hui-Yu; Chen, Jian-Cheng	How to help an experienced teacher to take the first step successfully in changing their mathematics teaching

OC 3:03	Topic: Probability and statistics
Room N430	Chair: Van Den Heuvel-Panhuizen, Marja
<u>Supply, Anne-Sophie</u> ; Van Dooren, Wim; Onghena, Patrick	Mapping the development of probabilistic reasoning in children
<u>Malaspina, Uldarico</u> ; Malaspina, Martín	Stimulus of probabilistic thinking by engaging children and primary teachers in game invention
<u>Borba, Rute Elizabete</u> ; Batista, Rita; Lima, Ewellen	Children and adults understanding randomness, sample space and comparison of probabilities

Saturday, July 7

OC 3:04 Room N440	Topic: Calculus and functions Chair: Antonini, Samuele
<u>Thoma, Athina;</u> Nardi, Elena	Conflating discourses: University students' exam responses on injective and surjective functions
Garcia, Mark Lester; <u>Aberin, Maria Alva</u>	Error analysis and metacognition of college students
<u>Mamona-Downs,</u> <u>Joanna;</u> Kourouniotis, Christos	The ε - δ definition for one variable real function revisited

OC 3:05 Room N450	Topic: Problem posing and problem solving Chair: Pyper, Jamie S.
<u>Kozaklı Ülger, Tuğçe;</u> Yazgan, Yeliz	Non-routine problem posing skills of prospective mathematics teachers
<u>Torres Ninahuanca,</u> Carlos; Malaspina Jurado, Uldarico Victor	Improving in-service teachers' problem posing skill by means of didactic reflection
<u>Lee, Kyungwon;</u> Kwon, Oh Nam	Students' consolidation through problem posing and solving activities

OC 3:06 Room N460	Topic: Proof, argumentation and reasoning Chair: Pratt, Nick
<u>Neuhaus, Silke;</u> Rach, Stefanie	Proof comprehension of undergraduate students
Larson, Niclas; <u>Pettersson, Kerstin</u>	Proof by induction – a comparative study
<u>Sommerhoff, Daniel;</u> Ufer, Stefan	Students' and mathematicians' acceptance criteria for mathematical proofs

OC 3:07 Room N300	Topic: Teacher beliefs Chair: Kuzle, Ana
<u>Pandit, Ekaraj</u>	Prospective mathematics teachers' self-efficacy beliefs on using history in mathematics teaching
Perdomo Díaz, Josefa; Ulloa, Rodrigo; <u>Martínez Videla, María</u> <u>Victoria;</u> Rojas, Francisco	Integrating instruments to capture preservice teachers' beliefs about mathematics and its teaching
<u>Safrudiannur,</u> <u>Safrudiannur;</u> Rott, Benjamin	Validating a questionnaire: Capturing the way in which beliefs about math and students' abilities influence teachers' actions in problem solving

Saturday, July 7

OC 3:08	Topic: Teaching numbers and operations
Room N330	Chair: Schindler, Maike
<u>Ladel, Silke;</u> Kortenkamp, Ulrich; Goral, Johanna; Thanheiser, Eva	German prospective teachers' understanding of place value
<u>Ercire, Yusuf Emre;</u> Narli, Serkan	How do prospective mathematics teachers define the basic concepts in numbers and operations content area?
Bofferding, Laura; <u>Wessman-Enzinger, Nicole</u>	Prospective teachers' explanations for integer word problems

OC 3:09	Topic: Teacher knowledge and students' learning
Room N370	Chair: Ribeiro, Miguel
<u>Kaur, Berinderjeet;</u> Toh, Tin-Lam; Toh, Wei-Yeng Karen	Opportunity to learn mathematics afforded by two competent teachers in their lessons
<u>Arai, Mitsue</u>	Mathematics teacher's problems in the process of pedagogical reasoning from the perspective of curriculum maker; The case of an elementary school teacher in the Philippines
<u>Mudrikah, Achmad</u>	The influence of mathematics teachers' competencies, attitude and interest on their professional behavior

OC 3:10	Topic: Preservice teachers, subject knowledge
Room N380	Chair: Haser, Çiğdem
<u>Ndlovu, Zanele</u> <u>Annatoria</u>	Exploring pre-service mathematics teachers' subject matter knowledge of school mathematics concepts
<u>Wickstrom, Megan H.</u>	Self-reflection as a pedagogical tool for pre-service elementary teachers' growth in reasoning about measurement
<u>Alapala, Burcu;</u> Isler-Baykal, Isil	Elementary pre-service mathematics teachers' conceptions of algebra

Saturday, July 7

OC 3:11	Topic: Preservice teacher preparation
Room N210	Chair: Leikin, Roza
<u>Berger, Margot</u>	Reading styles: Goals, prior knowledge and text
<u>Weston, Tracy L.;</u> <u>Amador, Julie M.</u>	Teacher questioning: Comparing multi-media platforms in initial teacher education
<u>Sánchez, Alicia;</u> Font, Vicenç; Borji, Vahid	Considerations of creativity by pre-service teachers of mathematics in their master's degree final projects

OC 3:12	Topic: Classroom interaction, younger students
Room N230	Chair: Abtahi, Yasmine
<u>Huitzilopochtli, Salvador;</u> <u>Moschkovich, Judit</u>	Appropriating inscriptions and manipulatives
<u>Lundström, Marita</u>	Communicating birthdays' in preschool a way for children to understand time
<u>Foxworthy, Julianne</u> <u>Elsie;</u> Moschkovich, Judit N	Characterizing teacher follow-up moves

Saturday, July 7

OC 3:14 Room N260	Topic: Conceptual change Chair: Maciejewski, Wes
<u>Moon, Sung-Jae;</u> Lee, Kyeong-Hwa	The conversion of perspectives on angles through the operation of signs and attention
<u>Hohensee, Charles;</u> Willoughby, Laura; Gartland, Sara	Backward transfer effects when learning about quadratic functions
<u>Johnson, Heather Lynn;</u> McClintock, Evan; Gardner, Amber	Promoting secondary students' shifts to covariational reasoning: Theory networking and task design

OC 3:15 Room MC333	Topic: Affect, emotions and attitudes Chair: Chorney, Sean
<u>Räsänen, Jenni;</u> Oikkonen, Juha; Aksela, Maija	Supporting upper secondary school students' interest in playful learning and peer tutoring in a new learning environment
<u>Shi, Jie;</u> Sun, Sijie; <u>Zhu, Yan;</u> Lu, Xiaoli	Is mathematics me? Chinese high school students' identity in mathematics
<u>Skilling, Karen</u>	Investigating student STEM beliefs within a transdisciplinary robot building project

OC 3:16 Room MC343	Topic: Language and multilingualism Chair: Chiara, Andrà
<u>Edmonds-Wathen, Cris</u>	Learning complex spatial verbs in a bilingual mathematics class
<u>Wagner, David;</u> Culligan, Karla; Dicks, Joseph; Kristmanson, Paula	Language choice and meaning in prediction
<u>Røj-Lindberg, Ann-Sofi;</u> Hemmi, Kirsti	Investigating the student perspective on school mathematics in the process of change

OC 3:17 Room MA346	Topic: Algebra, grade 4-6 Chair: Ntow, Foster
<u>Avala-Altamirano, Cristina;</u> Molina, Marta	Representation of indeterminate quantities in functional contexts by third grade students
<u>Ureña, Jason;</u> Molina, Marta; Ramírez, Rafael	4th graders' working on a functional context: Generalization levels and influence of stimuli
Arbona, Eva; <u>Gutierrez, Angel;</u> Beltrán-Meneu, María José	Strategies of solution of geometric pattern problems as traits of mathematical giftedness

Saturday, July 7

Saturday July 7, 15.10 – 16.10

Oral Communications No 4.

OC 4:01	Topic: ICT and learning, grade 5-6
Room N410	Chair: Hewitt, Dave
<u>Naalsund, Margrethe</u>	The role of interactive whiteboards to support a growth mindset in algebra learning
<u>Kim, Doyen;</u> <u>Kwon, Oh Nam</u>	How dense are rational numbers?: A new materialist approach to the number line
<u>Hoch, Stefan;</u> Reinhold, Frank; Werner, Bernhard; Richter-Gebert, Jürgen; Reiss, Kristina	How do students visualize fractions?

OC 4:02	Topic: Teacher knowledge, younger students
Room N420	Chair: Mellone, Maria
<u>Williams, Gaye</u>	Personal characteristics of teachers that increase their inclination to enact pedagogical problem-solving activity
<u>Ilany, Bat-Sheva;</u> <u>Hassidov, Dina</u>	The comprehension of relational concepts (<, >, =) by pre-service and preschool teachers – perspective of “quantity”
<u>Venenciano, Linda C.;</u> <u>Yagi, Seanyelle L.</u>	Teachers’ perspectives toward curriculum

OC 4:03	Topic: Calculus and functions
Room N430	Chair: Ufer, Stefan
<u>Håkansson, Per;</u> Gunnarsson, Robert	What is critical in order to learn the average rate of change?
Rhoads, Kathryn; Jorgensen, Theresa A.;; <u>Alvarez,</u> <u>James A. Mendoza</u>	Resolving cognitive conflicts about functions: Preservice secondary mathematics teachers’ interactions with tasks

Saturday, July 7

OC 4:04 Room N440	Topic: Teaching and visualization Chair: Nortvedt, Guri
<u>Ng, Oi-Lam</u>	In-service mathematics teachers' video-based noticing of 3D printing pens 'in action'
<u>Kawazoe, Mitsuru</u>	Students' conception of spanned space and its relation to conception of linear independence
<u>Biton, Yaniv</u> ; Fellus, Osnat	Professional online learning communities in mathematics: A case study of the Israeli VHS

OC 4:05 Room N450	Topic: Problem solving Chair: Papadopoulos, Ioannis
<u>Ouvrier-Bufferet, Cecile</u>	Research situations in elementary school
<u>Assmus, Daniela</u> ; Fritzlar, Torsten; Förster, Frank	Similarities between mathematical problems from the perspective of primary students
Ambrus, Gabriella; Herendiné Kónya, Eszter; Kovács, Zoltán; Sztányi, Judit; Varga, Eszter; <u>Csikós, Csaba</u>	Cross-sectional analysis of students' answers to a realistic word problem from grade 2 to 10

OC 4:06 Room N460	Topic: Proof, argumentation and reasoning Chair: Edmonds-Wathen, Cris
<u>Shinno, Yusuke</u> ; Mizoguchi, Tatsuya; Hamanaka, Hiroaki; Miyakawa, Takeshi; Kunimune, Susumu	How ordinary language influences the formulation of statements with quantifications
<u>Gomez, David M.</u> ; Dartnell, Pablo; Urrutia, Mabel	Gap thinking does not fully explain some fraction comparison difficulties
<u>Bronkhorst, Hugo</u> ; Roorda, Gerrit; Suhre, Cor; Goedhart, Martin	Secondary students' logical reasoning abilities

OC 4:07 Room N300	Topic: Teacher beliefs Chair: Stoppel, Hannes
<u>Lau, Wing Fat</u>	The effects of a pedagogy course on pre-service mathematics teachers' beliefs and confidence about teaching algebra
<u>Holm, Jennifer</u> ; Kajander, Ann	Interactions of knowledge and beliefs in mathematics professional development
<u>Makramalla, Mariam</u> ; Stylianides, Andreas	Problem solving in the eyes of Egyptian teachers: A case study at a national curriculum school

Saturday, July 7

OC 4:08	Topic: Teacher knowledge, grade 5-8
Room N330	Chair: Horne, Marj
<u>Kilhamn, Cecilia;</u> Røj-Lindberg, Ann-Sofi	Teachers' queries about algebra teaching
<u>Vermeulen, Cornelis;</u> Meyer, Bronwin	Teachers' knowledge and their students' misconceptions about the equal sign
<u>Orrill, Chandra;</u> Weiland, Travis; Brown, Rachael	Teachers' abilities to identify proportional situations

OC 4:09	Topic: Teaching and understanding fractions
Room N370	Chair: Teppo, Anne
<u>Baldry, Fay</u>	The complexities of enacting multiple representations when teaching fractions
<u>Peng, Aihui;</u> Ezeife, Anthony N.; Yu, Bo; Shang, Yueqiang	Using manipulatives to teach fractions in Canadian and Chinese elementary schools

OC 4:10	Topic: Teacher professional development
Room N380	Chair: Koichu, Boris
<u>Cedro, Wellington Lima</u>	Research in mathematics education seen as an activity: Teacher professional development in focus
<u>Olteanu, Constanta;</u> Olteanu, Lucian	Difference and repetition – instructional examples

OC 4:11	Topic: Classroom assessment, younger students
Room N210	Chair: Sabena, Cristina
<u>Rausch, Attila;</u> Pásztor, Attila	Technology based assessment of early numeracy and later mathematics achievement
<u>Viitala, Hanna</u>	Using formative assessment to support student development in lower secondary mathematics

Saturday, July 7

OC 4:12	Topic: Classroom interaction, grade 7-8
Room N230	Chair: Ingram, Jenni
<u>Hähkiöniemi, Markus;</u> Hiltunen, Jenna; Jokiranta, Kaisa; Nieminen, Pasi; Lehesvuori, Sami; Francisco, John; Viiri, Jouni	Changes in whole class dialogic argumentation during five mathematics lessons
<u>Dong, Lianchun</u>	Using self-learning guide to support student talk in a large-size class
<u>Ramirez, Paola</u>	Shifts in mathematics interactions between grade 8 students from an enactivist perspective

OC 4:13	Topic: Mathematics tasks
Room N260	Chair: Yang, Kai-Lin
Yang, Kai-Lin; <u>Lo, Ya-Wen</u>	Exploring a mathematics teacher's designing of activities integrating modeling and reading task
<u>Benedicto, Clara;</u> Gutiérrez, Ángel; Jaime, Adela	Analysis of mathematically gifted students' answers to cognitively demanding school tasks
<u>Lehner, Matthias C.;</u> Reiss, Kristina	Well-defined and ill-defined initial state and goal state of tasks and their effect on task difficulty

OC 4:14	Topic: Early number competence
Room N270	Chair: Christou, Konstantinos
Poncelet, Débora; Tazouti, Youssef; Baye, Ariane; Giauque, Nadine; Kerger, Sylvie; Jans, Véronique; Tièche Christinat, Chantal; Tinnes-Vigne, Mélanie	Parents' attitudes towards mathematics, home math-related activities and their effects on preschoolers' skills in early numeracy
<u>de Chambrier, Anne-Françoise;</u> Tinnes-Vignes, Mélanie; Dierendonck, Christophe; Giauque, Nadine; Fagnant, Annick; Auquière, Amélie; Luxembourger, Christophe; Vlassis, Joëlle	A test to measure early number skills progress among 4 to 6 years old children
<u>Tinnes-Vigne, Mélanie;</u> Poncelet, Débora; de Chambrier, Anne-Françoise; Dierendonck, Christophe; Tazouti, Youssef; Fagnant, Annick; Vlassis, Joëlle	Developing early number competencies through games played in school and at home

Saturday, July 7

OC 4:15 Room MC333 <u>Ntow, Forster</u>	Topic: Affect, emotions and attitudes Chair: Dahl Soendergaard, Bettina Influence of an out-of-school mathematics mentoring and tutoring programme on participants' identity formation
<u>Suriakumaran, Neruja;</u> <u>Vollstedt, Maike;</u> <u>Hannula, Markku S.</u>	Investigation of Finnish and German 9th grade students' personal meaning to mathematics
<u>Lake, Elizabeth</u>	Storytelling as a means to communicate mathematics and to engage students emotionally

OC 4:16 Room MC343 <u>Asami-Johansson,</u> <u>Yukiko</u>	Topic: Culture and differences Chair: Applying Japanese didactic practices in a Swedish classroom
<u>Hsieh, Feng-Jui;</u> <u>Wang, Ting-Ying;</u> <u>Chen, Qian</u>	Development of a scale for ideal mathematics teaching behavior and a comparison between Taiwan and mainland China
<u>Kim, Hee-jeong;</u> <u>Cho, Hyungmi</u>	The international classroom lexicon project: Identifying and documenting Korean middle school mathematics classroom practices

OC 4:17 Room MA346 <u>Krause, Christina M.</u>	Topic: Special needs education Chair: Barwell, Richard Establishing representational meaning of gestures – learning from the deaf classroom
<u>Stylianidou, Angeliki;</u> <u>Nardi, Elena</u>	“Inclusion” and “disability” in the mathematics classroom: The case of visually impaired pupils

Saturday, July 7, 16.30 – 18.00

AGM - The Annual General Meeting

Room: Aula Nordica

Sunday, July 8

Overview of Sunday July 8		
09.00	– 10.30	Research Forums, part 2 Seminar, part 2 Colloquium 2
10.30	– 11.30	Poster Presentations, session B Fika
11.30	– 12.30	Plenary Lecture 4: Markku Hannula
12.30	– 13.00	Closing session

Sunday July 8, 09.00 – 10.30

Research Forums, part 2, Seminar, part 2, Colloquium No 2.

RF # Room	Authors	Title
RF 1 Hörsal A	<u>Yasmine Abtahi</u> , Jill Adler, <u>David Guillemette</u> , Rune Herheim, <u>Steve Lerman</u> , Jean-Francois Maheux, <u>Paola Valero</u>	Otherness in mathematics education
RF 2 Hörsal B	<u>Camilla Björklund</u> , <u>Angelika Kullberg</u> , <u>Ulla Runesson Kempe</u> , Maria Reis Douglas Clements, <u>Julie Sarama</u> , <u>Esther Levenson</u> , <u>Ruthi Barkai</u> , Dina Tirosh, Pessia Tsamir, <u>Michael Askew</u> , <u>Hamsa Venkat</u> , <u>Minna Hannula-Sormunen</u>	Learning and teaching of arithmetic skills in early years
RF 3 Hörsal D	<u>Lynn McGarvey</u> , Jennifer Thom, <u>Joyce Mgombelo</u> , <u>Jerome Proulx</u> , <u>Elaine Simmt</u> , Florence Glanfield, <u>Brent Davis</u> , Lyndon Martin, Jo Towers, Charlotte Bertin, Kevin Champagne, Rox-Anne L'Italien-Bruneau, Charlotte Mégroureche	Vital signs of collective life in the classroom

Sunday, July 8

SE/CO Room	Authors	Title
SE 1 S305	David Maximiliano Gomez, Anika Dreher	Reviewing for pme - a primer for (new) reviewers
CO 2 Hörsal C	<u>Elena Polotskaia</u> Discussant: Cristina Sabena <u>Maria Mellone</u> , Gemma Carotenuto, Rosa Di Bernardo, Colomba Punzo <u>Helena Eriksson</u> <u>Elena Polotskaia</u> , Annie Savard, Marie-Sophie Gélinas, Osnat Fellus	Foregrounding Davyvod's curriculum: Relational approach and algebraic thinking in early grades P1: Algebraic thinking among graphical representations and algebraic symbols P2: Identifying algebraic reasoning about fractions P3: Multiplicative structures in elementary school mathematics: Relational approach

Sunday, July 8

Sunday July 8, 10.30 – 11.30

Poster presentations, session B.

PP #	Authors	Title
PP 1 B	<u>Akahane, Kosuke</u>	The relationship between cognitive and metacognitive strategy for construction of geometry proof
PP 2 B	<u>Beckmann, Sybilla;</u> Andrew, Izsak	Two senses of unit words and implications for topics related to multiplication
PP 3 B	<u>Eraikhuemen, Lucy;</u> Oteze, Kate Ikponmwosa	An analysis of teachers' appraisal of the use of exit cards in mathematics teaching
PP 4 B	<u>Bofferding, Laura;</u> Aqazade, Mahtob; Farmer, Sherri	Elementary students' integer comparisons
PP 5 B	<u>Carney, Michele;</u> Totorica, Tatia; Cavey, Laurie; Lowenthal, Patrick	Mapping attentiveness to student thinking
PP 6 B	<u>Cavka, Sara</u>	Do mathematics teachers experience a professional development program in formative assessment any differently than other teachers?
PP 7 B	<u>Chen, Ching-Shu</u>	Young children can distinguish fair situations from unfair ones in probability context
PP 8 B	<u>Crowder, Anita Louise</u>	Mathematics learning and aphasia
PP 9 B	<u>Jiang, Chunlian;</u> Wang, Chuang; Kim, Do-Hong	Validity of national higher education entrance examination mathematics test scores in China
PP 10 B	<u>Dilberoglu, Merve;</u> Haser, Cigdem; Cakiroglu, Erdinc	Prospective teachers' conceptions of mathematical definitions: Are definitions arbitrary?
PP 11 B	<u>Dong, Lianchun</u>	Comparing teacher questioning sequences in China and Australia

Sunday, July 8

PP #	Authors	Title
PP 12 B	<u>Earnest, Darrell</u>	The mathematics of time and time management
PP 13 B	<u>Erath, Kirstin</u>	Students' unexpected ways of enlarging figures
PP 14 B	<u>Godfrey, Alison Mary</u>	Overlapping circles - using participant generated influence maps as an interview tool
PP 15 B	<u>Gorgorió, Núria;</u> <u>Albarracín, Lluís;</u> <u>Laine, Anu;</u> <u>Llinares, Salvador</u>	Alicante - Barcelona - Helsinki: Students' mathematical background and requirements to enter a primary teaching degree
PP 16 B	<u>Kalaycı, Ozlem;</u> <u>Gun, Ozge</u>	An investigation of cognitive and meta-cognitive mathematical modelling competencies of 7th grade students
PP 17 B	<u>Günther,</u> <u>Claudia-Susanne</u>	Paper cutting the world: Fostering object recognition in geometry teaching through dissection and rearrangement of shapes
PP 18 B	<u>Hamanaka, Hiroaki;</u> <u>Otaki, Koji</u>	Fundamental task to generate the idea of reductio ad absurdum
PP 19 B	<u>Hansson, Lena;</u> <u>Hansson, Örjan;</u> <u>Juter, Kristina;</u> <u>Redfors, Andreas</u>	The notion of projectile motion – a case study
PP 20 B	<u>Chen, Donglin</u>	Mathematics identity among Chinese students
PP 21 B	<u>Sjöblom, Marie</u>	Teachers promoting active student dialogue through listening and questioning activities
PP 22 B	<u>Holm, Jennifer</u>	Prospective teachers' conceptions of mathematics
PP 23 B	<u>Huang, Hui-chuan;</u> <u>Wu, Huei-Min;</u> <u>Chu, Ting-hua</u>	How do students classify the common properties of two geometric shapes: An analysis of children's written responses
PP 24 B	<u>Ribera, Juan Miguel;</u> <u>Jaime, Adela;</u> <u>Ramirez, Rafael</u>	Problem solving to differentiate grades of mathematical talent

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PP #	Authors	Title
PP 25 B	<u>Zhao, Wenjun</u> ; Mok, Ida Ah Chee	Teachers' perceptions and enactment of the mathematical curriculum reform in China
PP 26 B	<u>Kang, Soonja</u> ; Rim, Haekyung; Shin, Bomi; Kim, Jiwon	Coding in mathematics education: The application of coding on mathematics exploration
PP 27 B	<u>Kilhamn, Cecilia</u>	Lost in translation: Implementing international research in Swedish mathematics education
PP 28 B	<u>Lee, Arthur Man Sang</u> ; Wong, Ka Lok; Pang, Ming Fai; Ki, Wing Wah	Comparing critical aspects in lessons of experienced teachers with variation pedagogy
PP 29 B	<u>Lee, Shin-Yi</u>	Learning mathematical problem solving by doing
PP 30 B	<u>Lin, Pi-Jen</u> ; Cheng, Chun-Yung; Tsai, Bao-Quei	The construction of the measure of mathematical argumentation
PP 31 B	<u>Wallin, Anna</u> ; Norén, Eva; Valero, Paola	Mathematics in the Swedish fritidshem curriculum: A policy enactment perspective
PP 32 B	Tso, Tai-Yih; <u>Lu, Feng-Lin</u>	Grounding the big idea of factoring quadratic trinomials within a learning activity
PP 33 B	<u>Matos, João Filipe</u> ; Pedro, Neuza; Pedro, Ana	Mathematics teachers' education within a technology enhanced learning environment in project FTE-lab
PP 34 B	<u>Murata, Shogo</u>	A comparative analysis of mathematics curriculum between Japan and the United States

PP #	Authors	Title
PP 35 B	<u>Ndlovu, Williams C;</u> Mwakapenda, Willy	What it means to be introduced to mathematics: An exposition of secondary school students from an intervention study
PP 36 B	Van Steenbrugge, Hendrik; <u>Norqvist, Mathias</u>	Students' reasoning in the classroom: An approach for analysis
PP 37 B	<u>O'Brien, Kate</u>	Artisans, machines and informal learning: The case of fibre mathematics
PP 38 B	<u>Ovadiya, Tikva;</u> Segal, Ruti	Graduate students' conceptual understanding of shifting between representations
PP 39 B	<u>Pai, Yun Hsia</u>	The effect of communicative multi-media materials of mathematics word problem
PP 40 B	<u>Qiao, Xuefeng;</u> Cao, Yiming	The social process of students' collaborative problem solving in China
PP 41 B	Downton, Ann; Livy, Sharyn; <u>Reinhold, Simone;</u> Wöller, Susanne	Grade 3/4 students' misconceptions of cubes: A landscape of sources of errors
PP 42 B	Colipan, Ximena; <u>Reyes Santander,</u> <u>Pamela;</u> Montoya Delgadillo, Elizabeth; Vivier, Laurent	The analytical working space used by students of pedagogy in mathematics when solving a modelling task
PP 43 B	<u>Rojas, Francisco;</u> Martínez, María Victoria; Chandia, Eugenio; Ortiz, Andrés; Perdomo-Díaz, Josefa; Reyes, Cristian; Ulloa, Rodrigo	Diagnosis of beliefs and knowledge that pre-service primary teachers have about school mathematics, its learning and teaching

Sunday, July 8

PP #	Authors	Title
PP 44 B	<u>Savard, Annie;</u> Cavalcante, Alexandre; Polotskaia, Elena	Changing paradigms in problem solving: An example of a professional development with elementary school teachers
PP 45 B	Lima, Izauriana Borges; <u>Selva, Ana Coelho Vieira</u>	Interpretation and construction of bar charts in the adult education
PP 46 B	<u>Sit, Pou Seong;</u> Mak, Soi-kei; Cheung, Kwok-cheung; Ieong, Man-kai	Self-responsibility in mathematics learning of Macao students in PISA 2012 mathematics study
PP 47 B	<u>Sommerhoff, Daniel</u>	Can validating proofs help to construct proofs?
PP 48 B	<u>Campbell, Anita</u>	A learning theory framework to guide 'growth mindset' interventions
PP 49 B	Szabó, Csaba; <u>Szeibert, Janka</u>	Efficiency of test-enhanced learning in teaching elementary geometry
PP 50 B	<u>Hendrikse, Petra</u>	Quality of 1st year preservice teachers' selection of tasks, intended as a base for interaction
PP 51 B	<u>Twohill, Aisling;</u> NicMhuirí, Siún; Harbison, Lorraine	Investigating the mathematics teaching efficacy beliefs of student teachers
PP 52 B	<u>Wang, Sasha;</u> Yang, Dazhi; Swanson, Steve; Ching, Yu-hui; Baek, Younghyun; Chittoori, Bharskar	Cultivating mathematics practice in a computational thinking infused robotic activity
PP 53 B	<u>Weiher, Dana Farina</u>	Development of a measurement estimation test for length, area, and volume
PP 54 B	<u>Zeynivandnezhad,</u> <u>Fereshteh;</u> Asgharzadeh, Nasrin; Kazemi, Maryam	The effect of expertise level in geogebra on technological and pedagogical and content knowledge among Iranian secondary mathematics teachers
PP 55 B	<u>Jojo, Zingswa Mybert</u>	Ubuntu infused in the conceptual understanding of Geometric concepts

Sunday, July 8

Sunday July 8, 11.30 – 12.30

Plenary 4:

Markku Hannula, Professor at University of Helsinki, Finland

From anxiety to engagement: History and future of research on mathematics-related affect

Anxiety is an important concept in mathematics education. It has roots in psychoanalytic theory, behaviourism, and social psychology. In mathematics education, other early areas of research were emotions in problem solving, beliefs, and attitudes. Research on mathematics-related affect has struggled to find a shared theoretical framework. Another problem with this research is too strong focus on individual trait type affect, and more research on group level dynamic processes is needed. Some examples of research on collaborative engagement are presented, including first results of a mobile gaze tracking study.

Sunday July 8, 12.30 – 13.00

Closing session.

Research Forum Abstracts

RF 1 Otherness in mathematics education

Yasmine Abtahi, David Guillemette, Rune Herheim, Steve Lerman, Jean-Francois Maheux, Paola Valero

Reflecting on the inseparability of the I from the other, this research forum (RF) proposes to highlight how the connection between them can be discussed in mathematics education. Building on and extending the existing research, we aim at clarifying and re-flec-ting on the role and the place of Otherness in teaching and learning mathematics. Looking at mathematical, social, and cultural tools, historical texts and problems solving as well as broader socio-political and epistemological considerations, our discussions will provide a base to highlight the richness and the nuances in relation to the issues of Otherness in mathematics education.

RF 2 Learning and teaching of arithmetic skills in early years

Camilla Björklund, Angelika Kullberg, Ulla Runesson Kempe, Maria Reis, Douglas Clements, Julie Sarama, Esther Levenson, Ruthi Barkai, Michael Askew, Hamsa Venkat, Minna Hannula-Sormunen

This Research Forum aims to consolidate the current research on early arithmetic learning and teaching. Five research groups will participate in discussions focusing both on theoretical approaches and innovative research methods that have been developed and practiced during the recent years. The RF will contribute an overview of earlier and on-going research to highlight contemporary academic debates and perspectives within this field and present advances in research. Furthermore, we direct our attention to the future and need for knowledge and methodological development.

RF 3 Vital signs of collective life in the classroom

Lynn McGarvey, Jennifer Thom, Joyce Mgombelo, Jérôme Proulx, Elaine Simmt, Florence Glanfield, Brent Davis, Lyndon Martin, Jo Towers, Charlotte Bertin, Kevin Champagne, Rox-Anne L'Italien-Bruneau, Charlotte Mégrourèche

For almost two decades, the researchers in this Research Forum have been developing strategies to represent and model collective dynamics at the classroom level. However, efforts to do so with singular visual, auditory, or textual representations have not been particularly fecund. A possible reason for limited success is the sheer complexity of collective human phenomena. In this forum, we share our current work as a researching collective, explore past methodological perspectives, and present new possibilities afforded by the metaphor “vital signs,” as applied to classroom episodes.

Colloquium Abstracts

- CO 1** Parallel analyses of collaborative mathematics problem solving in a laboratory classroom setting

Chair: Man Ching Esther Chan

Discussant: Markku Hannula

- P 1** Entangled modes of social interaction in student collaborative problem solving in mathematics: Connecting process and product

Man Ching Esther Chan, May Ee Vivien Wan, David Clarke

The Social Unit of Learning project examines individual, dyadic, small group problem solving in mathematics in order to investigate the social nature of learning. Utilising a laboratory classroom equipped with 10 built-in video cameras and more than 15 audio inputs, multiple forms of data were collected, including student written products and high definition video and audio recording of every student and the teacher in the classroom. This paper reports the analysis of a class of Year 7 students' social interactions during pair collaborative problem solving of a mathematical task. The possible connections between the proportion of time spent on different negotiative foci and students' written product is discussed.

- P2** Analysing patterns of students' interaction when solving open-ended tasks in small groups

Javier Diez-Palomar

- P3** Analyzing engagement in mathematical collaboration: What can we say with confidence?

Laura Tuohilampi

Affective aspects of collaborative learning situations in mathematics can be thought of as a multidimensional and complex system. In this article, Goldin's analytical tool of motivating desires, which is aimed to cover multiple aspects of affect and includes social and contextual elements is examined in detail. An episode of students' mathematical collaboration is analyzed using Goldin's tool. The analysis showed that the interpretations of students' participation and identification are dependent on the choice of analytical unit. Different information is available in different excerpts that precede the analyzed episode. Confidence in the interpretive coding of a given excerpt can be heightened or perturbed by the consideration of preceding episodes.

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CO 2 Foregrounding Davydov's curriculum: Relational approach and algebraic thinking in early grades

Chair: Elena Polotskaia

Discussant: Christina Sabena

P1 Algebraic thinking among Graphical representations and algebraic symbols

Maria Mellone, Gemma Carotenuto, Rosa Di Bernardo, Colomba Punzo

Based on evidence showing the presence of Algebraic skills in very young children, we will discuss some theoretical aspects connected to Algebraic thinking and its expression by means of graphical representation. In doing this, we also refer to an ancient example of manipulations of surfaces of rectangles in the resolution of second-degree problems of the Babylonian period. Subsequently, we will present an episode that occurred during an experimental path inspired by Davydov's Curriculum developed in a first-grade class. In this class, we have actually observed that the activities rooted in the observations and work on real quantities give rise to pupils' Algebraic thinking, expressed through the coordination of verbal language, actions, graphical representations and Algebraic symbols.

P2 Identifying algebraic reasoning about fractions

Helena Eriksson

The issue for this paper is to identify algebraic reasoning through students' sense-making actions, during a lesson, where students and a teacher develop learning models for mixed numbers. The analysis focuses the students' work, trying to make sense of the unknown fractional part of the number. This unknown part was elaborated when the students suggested to "add a little bit more" to construct equality. The unknown part developed to a fractional part with help of an emerging learning model containing algebraic symbols: $B=W+p/a$. In this activity, I identified potentialities in the students' algebraic reasoning; an additive relationship between the integer and the fractional part of the number, and a multiplicative relationship between the numerator and the denominator in this fractional part.

P3 Multiplicative structures in elementary school mathematics: Relational approach

Elena Polotskaia, Annie Savard, Marie-Sophie Gélinas, Osnat Fellus

In this theoretical essay, we critically analyze some multiplicative structures identified by researchers and practitioners in the field of teaching elementary school mathematics (grades 3-5). Drawing upon Davydov's theory of developmental

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instruction, we use the relational perspective and propose another classification and graphical representations of multiplicative structures. We suggest that the new approach may better support student understanding of multiplicative relationships and at the same time contribute to the foundation of their algebraic thinking.

Research Report Abstracts

RR 1:01 You see (mostly) what you predict: The power of geometric prediction

Miragliotta, Elisa; Baccaglini-Frank, Anna

We consider geometric prediction (GP), as a mental process through which a figure is manipulated, and its change imagined, while certain properties are maintained invariant. In this report on a recent study, we concentrate: 1) on capturing processes of GP before explorations are carried out in a dynamic geometry environment (DGE), to gain insight into possible characteristics of such processes; 2) on possible implications it can have in a subsequent process of dynamic exploration of a DGE figure, in particular in the solver's interpretation of feedback from the DGE.

RR 1:02 Using equations to develop a coherent approach to multiplication and measurement

Izsak, Andrew Gyula; Beckmann, Sybilla

We explicate connections between multiplication and measurement that hold promise for developing a more coherent approach to core topics in the K-12 mathematics curriculum. Within research on multiplication, there has been an ongoing conversation about the extent to which topics in the multiplicative conceptual field (Vergnaud, 1983, 1988) should or should not be unified under a single meaning for multiplication. Within research on measurement, specific types of quantities (e.g., length, area, volume, and angle measure) have often been treated as separate topics (e.g., Smith & Barrett, 2017). We start with notion of equal-sized units that are the basis for both multiplication and measurement and develop an approach for integrating these two core strands of school mathematics into a more coherent whole.

RR 1:03 Analysis of the Mathematical Discourse of University Students when Describing and Defining Geometrical Figures

Martín-Molina, Verónica; Toscano, Rocío; González-Regaña, Alfonso J.; Fernández-León, Aurora; Gavilán-Izquierdo, José María

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This is part of a bigger and ongoing empirical research study that uses the commognitive framework in order to characterize how university students (that are also pre-service teachers) define 3D geometrical figures. We consider that the process of defining plays an important role in the generation of a mathematic knowledge specific for teaching, which future teachers must acquire. With the purpose of understanding this process, we designed a task with open questions and used as data sources audio recordings of one-hour sessions (and their transcripts) and written answers of four groups of students when they solved the task. We have identified different routines that appear during the process of defining as indicators of students' knowledge.

RR 1:04 Emergent proportional reasoning: Searching for early traces in four- to five-year olds

Vanluydt, Elien; Verschaffel, Lieven; Van Dooren, Wim

More and more research suggests that proportional reasoning emerges already at a very early age in childhood. The present study aimed to investigate these abilities in four- to five-year-old children. A five-item proportional reasoning task involving discrete quantities was administered in 389 children. On average children could solve about one item correctly. An error analysis allowed to identify five answer profiles, showing that four- to five-year olds already systematically and meaningfully attempt to make sense of one-to-many and many-to-many correspondences. Our findings advocate for the presence of precursors of the one-to-many correspondence notion in most four- to five-year-old children.

RR 1:05 Interplay in students' thinking modes and representation types of linear algebra in a DGS

Turgut, Melih

This paper reports the interplay of students' thinking modes and representation types of linear algebra when they interact with a dynamic geometry system (DGS). The participants of the case study are two undergraduate linear algebra students and the data obtained from task-based interviews in the context of linear combination, linear independency-dependency, and basis and dimension has been analysed according to a theoretical lens of students' thinking modes and representation types of linear algebra. According to the findings, students often switch between thinking modes in a DGS, and the most common thinking modes and representation types are synthetic-geometric mode and geometric representation, while the least common are analytic-structural thinking modes and abstract representation.

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RR 1:06 Changes in attitudes revealed through students' writing about mathematics

Maciejewski, Wes

This paper proposes a conceptualization of an expert teacher's expertise by coordinating a subject-based behaviour/cognitive analysis and a social-culturally situated analysis. Data from our Lesson Design Study in Shanghai, China, included lesson plans, transcripts of the video-recorded lessons, and transcripts of commentary on the lessons by the expert teacher was analysed. This showed the attunements of the expert teacher to the affordances and constraints of the activity system. This conceptualization of the 'dual nature' of the expert teacher's expertise contributes to a deep analysis of the unique and significant functions of the expert teacher in China.

RR 1:07 Group thinking styles and their modelling process while engaging in modelling activities

Shahbari, Juhaina Awawdeh; Salameh, Rania

The current study investigated the relationship between students' thinking style and their modelling process and routes. Thirty-five eighth-grade students were examined. For the first stage, the students solved a word problem, and according to their solutions, they were assigned to one of two groups: a visual thinking style group and an analytic thinking style group. The two groups engaged in three modelling activities. Findings indicating differences in the groups' modelling processes in performing the three activities. The primary differences in the modelling processes were manifested in simplifying, mathematizing, and eliciting a mathematical model. In addition, the analytic thinking group skipped the real-model phase in the three activities, while the visual group built a real model for each activity.

RR 1:08 From principles of vision and division to a system premised on and subject to interanimated dimensions: Some reflections on identity in mathematics education

Fellus, Osnat

The concept of identity in mathematics education has gained much attention in scholarly work in the last two decades. However, in spite of growing momentum in seeing learners' identity as part and parcel of students' level of engagement and success in school mathematics, the concept remains under-specified and under-theorized. This paper presents a critical overview of the concept of identity and draws on Ricoeur's (1992) differentiation between idem identity and ipse identity, on Brubaker and Cooper's (2000) distinction between identity as a category of practice and identity as a category of analysis, and on Ivanič's (1998) four-

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dimensional model to foreground a shift in mathematics education from seeing identity as principles of vision and division to seeing it as an inter-animated, multi-dimensional system.

RR 1:09 Kindergarten teachers' knowledge of students: The case of repeating patterns

Tiresh, Dina; Tsamir, Pessia; Levenson, Esther; Barkai, Ruthi

Knowledge of students' conceptions and competencies is an important element of teachers' knowledge for teaching mathematics. This study reports on kindergarten teachers' knowledge of children's abilities to complete two repeating pattern tasks: extending repeating patterns and comparing two repeating patterns. These tasks had previously been implemented with children. Results indicated that on the extension task, teachers tended to underestimate children's ability to complete the task, but on the comparison task, they tended to overestimate children's abilities.

RR 1:10 Conceptualizing an expert teacher's expertise in a lesson design study in Shanghai

Ding, Liping; Jones, Keith

This paper proposes a conceptualization of an expert teacher's expertise by coordinating a subject-based behaviour/cognitive analysis and a social-culturally situated analysis. Data from our Lesson Design Study in Shanghai, China, included lesson plans, transcripts of the video-recorded lessons, and transcripts of commentary on the lessons by the expert teacher was analysed. This showed the attunements of the expert teacher to the affordances and constraints of the activity system. This conceptualization of the 'dual nature' of the expert teacher's expertise contributes to a deep analysis of the unique and significant functions of the expert teacher in China.

RR 1:11 A teacher's reflective process in a video-based professional development program

Schwartz, Gil; Karsenty, Ronnie

The purpose of the study reported herein was to closely observe the reflective process of one teacher who participated in a video-based professional development course for secondary school mathematics teachers. This process was initiated in a session where a group of teachers watched and analysed a Japanese TIMSS lesson, and continued with the teacher's decision to teach this lesson in her class. We analyse the teacher's reflective process in terms of Ricks' (2011) "process reflection" framework, and explore the factors that affected it. The results demonstrate

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the impact that facilitated peer discussion around a videotaped foreign lesson may have on teachers' reflection..

RR 1:12 The use of 'mental' brackets when calculating arithmetic expressions

Papadopoulos, Ioannis; Gunnarsson, Robert

In this paper, the influence of the written format of an arithmetical expression on the way the students evaluate this expression, as well as a possible connection between this way of evaluation and an understanding of structure, are examined. Students from two countries evaluated a small number of rational expressions. The findings show that the rational form guided the students in their evaluation, temporarily leaving aside the rules for the order of operation. Instead, they used 'mental' brackets that mask a possible, or actual, structure sense.

RR 1:13 Framing the social dynamics of small group work in adolescence as peer cultures of effort and achievement

Hamm, Jill; Hoffman, Abigail; Lambert, Kerrilyn; Heck, Daniel

This study applies the concept of peer cultures, which involve the values and concerns, habits and routines, and roles that students develop through sustained interaction with one another, to characterize the social dynamics of mathematics small group work. Each dimension was coded in time sample intervals in 30 small group audio- recordings from 27 American 6th-9th grade classrooms. The major dimensions of peer cultures could be reliably coded in mathematics small groups, and variations in frequency and quality of each dimension were evident. Coding of 23 more groups will occur; analyses will continue to document the frequency and quality of these dimensions, as well as co-occurrences of the dimensions within small groups. Results inform understanding of and supports for productive small groups for adolescents.

RR 1:14 Making sense of the teaching of calculus from a commognitive perspective

Tasara, Innocent

Examining the discourse through the lens of commognition theory allowed an investigation of how teachers of mathematics teach elementary calculus. Analysing the teachers' word use and narratives provided insights into the specialisation of the mathematical language used in the discourse. Analysing the visual mediators, routines and meta-rules used in the classroom discourse, but more importantly, how and when they were used, explained the modes of mediation used in teaching elementary calculus.

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RR 1:15 Cognitive abilities and mathematical reasoning in practice and test situations

Norqvist, Mathias

Research studies have shown that to develop conceptual understanding of mathematics, practice needs to focus on this skill. In this study, the aim is to examine how different practice tasks, which promote either imitative or creative mathematical reasoning, can influence which variables (i.e., cognitive abilities, mathematics grade, and gender) that are important for task completion. Two earlier studies show that cognitive abilities are more important in the test situation when students have practiced with imitative tasks. The result from this study indicates that although cognitive abilities are important when practicing with creative tasks, the influence of cognition is only implicit during the test. Since students often practice imitatively with given solution methods, this study suggests that a substantial part of what we test in school could be cognitive abilities rather than mathematics.

RR 1:16 Watching mathematicians read mathematics

Inglis, Matthew; Alcock, Lara

This report contributes to the debate about whether expert mathematicians skim-read mathematical proofs before engaging in detailed line-by-line reading. It reviews the conflicting introspective and behavioural evidence, then reports a new study of expert mathematicians' eye movements as they read both entire research-level mathematics papers and individual proofs within those papers. Our analysis reveals no evidence of skimming, and we discuss the implications of this for research and pedagogy.

RR 1:17 “Growth goes down, but of what?” A case study on language demands in qualitative calculus

Sahin-Gür, Dilan; Prediger, Susanne

The instructional approach of qualitative calculus aims at developing conceptual understanding for the relationship between amount and change, e.g., by connecting multiple representations of complex context phenomena. This article presents a design experiment with two Grade 11 students' pathways towards the mathematical concepts of amount, change, and change of change. Qualitative analysis is used to show how deeply concept and language development are intertwined and to unpack the language demands occurring on the students' conceptual pathways.

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RR 1:18 “I always wished that I had a mathematical mind”: Mathematical ability and other stories

Pitsili-Chatzi, Dionysia

Research on mathematics and gender suggests that mathematics, far from being a neutral discipline, is actually a masculine field. This perspective has significant implications in understanding girls' relationships with mathematics. In this report, I use a Foucauldian discourse analysis methodology to examine the mathematical identities constructed by two female high school students in relation to the discourse about mathematical ability. Although the discourses around mathematics, ability and gender prevent the students from identifying as “good at maths”, the students actively negotiate their identities by challenging the discourses within which they act.

RR 1:19 Mathematics achievement and the role of working memory and attention - Evidence from a large-scale study with first graders

Winkel, Kirsten; Mueller, Henning; Schunk, Daniel

Besides pure intelligence and subject-specific skills, there are other determinants which substantially affect learning outcomes in mathematics. Working memory capacity is one of the key determinants and as recent studies show that it can be trained, it's highly relevant for improving mathematical learning processes. In this study, we investigate the relationship between mathematics achievement, and three dimensions of working memory as well as attention and inhibition control. We used data from highly standardized computer-based tests from more than 500 first grade students. As a second perspective we also considered teacher ratings for the same students. Our findings confirm a strong and highly significant correlation between math achievement and different working memory and attention subtests.

RR 1:20 Investigating secondary school students' epistemologies through a class activity concerning infinity

Iannone, Paola; Rizza, Davide; Thoma, Athina

In this paper, we report findings from a pilot study investigating school students' epistemologies of mathematics by using novel mathematics definitions. Students aged 17 and 18-year-old in Italy and the UK were asked to complete a worksheet that used a numerical approach to determine the sizes of infinite sets and were, then, invited to attend focus group interviews about their experience with the material. Thematic analysis of the interviews reveals that this approach is useful to distinguish between naïve and advanced epistemologies and using unseen mathematical definitions can help enrich our understanding of epistemologies held by students of school age.

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RR 2:01 Geometry in kindergarten: First steps towards the definition of circumference

Robotti, Elisabetta

This paper deal with a teaching experiment concerning geometry in kindergarten for children aged 4-5. Through a classroom-based intervention, designed according to the Semiotic Mediation theoretical framework and developed on a multimodal approach, children produce a “pseudo-definition of circumference”, which still refers to perceptual elements linked to the shape, but where it is possible identifying the dynamic nature of the curve as a trace generated by the movement of a point. The analysis of the teaching experiment highlights the specific roles of the teacher and of artifacts in supporting the process of semiotic mediation through which the children and teacher transform the signs linked to artifacts into mathematical signs.

RR 2:02 Using fingers to discern the structure of part-whole relations of numbers in preschool

Kullberg, Angelika; Björklund, Camilla; Brkovic, Irma; Runesson Kempe, Ulla

In this paper we report on results from an eight-month intervention with preschool teachers aiming to enhance five-year-olds’ learning of basic arithmetic skills. The purpose of this study is to investigate how the children’s learning developed through participation in the theoretically driven intervention, which was based on the idea of experiencing numbers and their part-whole relationships. We report on an analysis of task-based interviews with 103 children before and after the intervention. Our findings show that the learning outcomes of the intervention group were significantly higher compared to those of the control group after the intervention, and that differences between the groups remained a year after the intervention.

RR 2:03 Supporting preservice teachers’ in-the-moment noticing

Kilic, Hulya; Dogan, Oguzhan; Tun, Sena Simay; Arabaci, Nil

The purpose of this paper is to discuss the factors influencing preservice teachers’ in-the-moment noticing that emerged from a research on noticing skills. We set up an environment where preservice teachers worked with a group of students on mathematical tasks for 24 weeks. We focused on the mathematical opportunities occurred during task implementations and how preservice teachers respond to those opportunities as an indicator of their noticing skills. We analysed their interactions with students and coded their responding actions according to our coding scheme. We recognized that not only preservice teachers’ knowledge or noticing skills but other factors such as research setting, students’ prior knowledge and tasks were likely to influence how they responded to students’ mathematics.

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RR 2:04 Prospective primary teachers' conceptual understanding of mathematical problems and problem solving

Piñeiro, Juan Luis; Castro-Rodríguez, Elena; Castro, Enrique

Prospective primary teachers' understanding of problem solving and the concept of what constitutes a mathematical problem were analysed. The exercise involved defining three fundamentals: characterisation of what a problem is, the problem-solving process and the willingness to undertake problem solution. That served as the basis for formulating a questionnaire responded to by 51 future teachers near the end of their pre-service training. The findings were uneven, for whereas participants exhibited knowledge in accordance with the literature on problem solving, contradictions were detected. For instance, while attaching importance to solvers' consideration, that notion was not taken into attention in practical examples.

RR 2:05 Micro-evolution of documentational work in the teaching of the volume of revolution

Kayali, Lina; Biza, Irene

In this paper, we draw on the documentational approach to analyse the evolution of one experienced secondary teacher's work towards the teaching of the topic of "volume of revolution". He used a range of paper and computer based resources including the software Autograph. Data were collected in observations of three lessons on this topic taught to two different groups of 16-18 years old students and a follow up interview with the teacher where he was asked to reflect on his choices in these lessons. The findings illustrate teacher's documentational work with the used resources, and his schemes of use – aims, rules of actions, operational invariants and inferences – and identify the micro-evolution, namely the small changes and the rationale behind these changes, of these schemes across the lessons.

RR 2:06 Value of pictures in modelling problems from the students' perspective

Böckmann, Matthias; Schukajlow, Stanislaw

Pictures are an important part of human life, and they often accompany modelling problems. In the present study, we investigated whether the extent to which students believe pictures are valuable for understanding modelling problems differs for decorative, representational, and essential pictures. 217 ninth and tenth graders from nine German middle-track classes were randomly assigned to three groups. One group reported the picture-specific utility value of decorative pictures, whereas two other groups reported the utility value of representational pictures and essential pictures, respectively. Students' picture-specific utility value ratings were higher for essential pictures and representational pictures than for

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decorative pictures, and their utility value ratings were higher for essential pictures than for representational pictures.

RR 2:07 Connected working spaces: Designing and evaluating modelling-based teaching situations

Lagrange, Jean-baptiste

This contribution focuses on modelling at upper secondary level. Modelling is considered as a work on various models of a reality, belonging to different scientific fields, with varied mathematizations. The framework of Connected Working Spaces is chosen in order to describe the work on each model, and the connections made along the modelling process. The hypothesis is that these choices allow designing and evaluating situations that help students to understand comprehensively concepts taught at upper secondary level and enable them to appreciate how diverse fields contribute to a scientific perception of the sensible world. This hypothesis is tested by way of an experiment in realistic school settings.

RR 2:08 Use of student-produced videos in the teaching of combinatorics

Fidje, Anders Støle

This study aims to identify and characterise different orchestrations used by a teacher in a mathematical discussion with regards to student-produced videos. Brown's (2009) degrees of artifact appropriation and the documental approach (Gueudet & Trouche, 2009) was used to identify key aspects of these orchestrations. The findings show that the teacher used the videos and their presentations in distictly different ways, capitalising on the affordances and working around the constraints of the resource.

RR 2:09 The desired teacher reflected in research articles on practicum

Christiansen, Iben Maj; Österling, Lisa

Starting from questions about what is privileged in mathematics teacher education, we conducted a systematic review of research on practicum. One element was to interrogate the notion of the desired mathematics (student) teacher reflected in existing research. Selecting peer reviewed, empirically based articles for 2001-2017 resulted in the inclusion of 51 articles. Our findings suggest the desired teacher implied in papers to have content knowledge, MKT/PCK, positive beliefs and attitudes, and the ability to reflect on teaching. Teachers who can exercise reasoned judgement were more frequently valued than teachers who can implement specific practices.

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RR 2:10 Peer observation as a tool to facilitate mathematics teachers' self-reflection in a professional development intervention

Chirinda, Brantina; Barmby, Patrick

The paper reports on how peer observation of teaching (POOT) was used as a tool to assist grade 9 South African mathematics teachers' self-reflection in a classroom-based design research project. Two grade 9 mathematics teachers at a public secondary school in Gauteng, South Africa acted as observer and observed with reciprocation of roles after each observation. Findings indicated that the observer developed increased awareness of how mathematical problem-solving was being taught and learned. The observed valued feedback from the observer and became aware of their mathematical problem-solving pedagogy and revised their own teaching strategies. The authors advocate that there are clear benefits when POOT is used as a professional development strategy to support mathematics teachers' self-reflection.

RR 2:11 A large scale cascade model in the context of mathematics curriculum reform: Interactive factors of influence on multipliers' work

Canavarro, Ana Paula; Santos, Leonor

This study aims to know the influences identified by the multipliers on their work with schools, in order to understand the development of the cascade model implemented in the context of a Portuguese national large-scale programme for support mathematics teachers in mathematics curriculum change. 80 multipliers were surveyed with an open-ended questionnaire and the data were analysed with an inductive approach. Multipliers revealed they were affected by interrelated factors from different contexts: their colleagues, the scientific commission, the mathematics teachers and their schools and the Minister of Education. This suggests that the cascade model do not develop in a top down way, neither it is bottom up defined. Instead, it accommodates contrasting influences and its dynamics evolves as conditions change.

RR 2:12 Unfolding and compacting when connecting representations of functions

Zindel, Carina

Connecting representations of functions is both, means for developing a deeper understanding of functions and an activity students need to learn. Hence, it is necessary to specify in a more detailed way what learners need to do for adequately connecting representations of functions. This paper empirically identifies two important sub-processes of connecting representations: unfolding and compacting of comprehension elements of functions.

Abstracts

RR 2:13 Mathematics discourse in small groups

Heck, Daniel J.; Hoover, Pippa; Porter, Jessica; Hamm, Jill V.

This study of secondary classrooms examined students' mathematics discourse in small group learning environments. Audio-recorded conversations from naturalistic observations of classrooms provided data for investigating the learning environments students created and experienced in their small groups. The discourse framework and related coding scheme we utilized revealed key differences in the frequency and quality of students' explaining and questioning.

RR 2:14 One student's discursive development on rotation in relation to instruction from a commognitive perspective

Emre-Akdogan, Elcin; Gucler, Beste; Argun, Ziya

The aim of this study is to explore one Turkish high school student's discursive development on rotation in relation to his teacher's discourse through a commognitive framework. The data sources for examining the teacher's and student's discourses included classroom observations and task-based interviews. The data was analyzed in terms of participants' word use, visual mediators, routines, and narratives from a commognitive perspective. The results indicated that teacher's discourse was based on an algebraic-formal approach during his instruction. The student imitated the teacher's algebraic approach but he also adjusted the teacher's discourse with his own previously existing discourse, possibly due to a lack of clarity about the reason and logic behind the teacher's discourse.

RR 2:15 Second-graders' predictive reasoning strategies

Oslington, Gabrielle Ruth

This paper reports predictive reasoning strategies used by ten second-graders in a classroom design study. A modelling activity based upon real data required students to predict maximum monthly temperatures for the current year using the natural variation provided by readings from the previous six years. The development of reasoning strategies was documented throughout the lesson sequence by analysis of responses to written prompts, videos of interviews and student drawn graphs. Student predictions reflected an emerging understanding variability, clusters and mean. Reasoning strategies became increasingly sophisticated using TinkerPlots, and with repeated opportunities for students to observe, represent, reflect upon trends in data.

Abstracts

RR 2:16 Secondary school students' appraisal of mathematical proofs

Komatsu, Kotaro; Yamazaki, Miho; Fujita, Taro; Jones, Keith; Sue, Naoki

Research on the reading of proofs is an important area of proof research in mathematics education. As one aspect of the reading of proofs, we focus on 'proof appraisal' by students (that is, students' judgements about given proofs) and explore how students appraise different proofs of an identical statement. Using a simple proof and a generalisable proof of a statement, we analysed the results of a questionnaire completed by 39 Grade 8 secondary school students (13–14 years old). We show aspects of each proof that were appraised by the students, such as simplicity, and the relativity of their proof appraisals. An implication is a possible 'gap' between the 'mathematical value' appreciated by students and that by researchers and teachers.

RR 2:17 Responding to teachers: Learning how to use verbal metacommunication as a mathematics teacher educator

Helliwell, Tracy Jane

In this paper, I present the process of developing a framework for analysing verbal metacommunications, in the context of a new mathematics teacher educator working with in-service teachers of mathematics. The interest in analysing verbal metacommunication arises from reflecting on the process of becoming a mathematics teacher educator, as I am learning how to respond in-the-moment to teachers of mathematics as they talk about teaching. Responding to teachers with verbal metacommunication appears to be significant in terms of supporting teachers in their own learning. There is currently no existing framework, within the mathematics education literature, for making systematic distinctions between types of verbal metacommunications in supporting group discussion.

RR 2:18 Effects of socioeconomic status on middle school students' mathematics achievement in China

Song, Shuang; Guo, Kan; Cao, Yiming

Socioeconomic status (SES) plays an important role in influencing students' academic achievement. This paper presents a large-scale quantitative study to explore the diverse effects of SES on Chinese middle school students' mathematics achievement. According to the data analyses on over 25,000 middle school students in one province, it showed that parents' educational level, occupation and household resources significantly influence students' mathematics achievement. The results of interaction analysis suggested that the impact patterns of SES depend on region and gender. Compared with girls, boys' mathematics achievements were more heavily influenced by their SES.

Abstracts

RR 2:19 Re-thinking ‘concrete to abstract’: Towards the use of symbolically structured environments

Coles, Alf; Sinclair, Nathalie

In this theoretical report, we question the prevalent assumption that teaching and learning mathematics should entail a movement from the concrete to the abstract. Such a view leads to reported difficulties in students moving from manipulatives and models to more symbolic work – moves that many students never make, with all the implications this entails for life chances. We propose working in “symbolically structured environments” as an alternative way of conceptualising students’ direct engagement with the abstract and we exemplify one such environment, that involves early number learning.

RR 2:20 Gestures as embodiments of variables and algebraic expressions

Hotomski, Mirjana

Researchers have investigated how students may represent indeterminate quantities (variables or unknowns) through expressions in natural language, non-numerical symbols, and external representations, implicitly treating indeterminate quantities much as if they were known quantities (Radford, 2011). Here I will focus on the following research question: How do sixth graders’ gestures reflect their work with indeterminate quantities and the ways in which they operate on those quantities? Specifically, the present study provides evidence that: 1) sixth graders used gestures as visual representations of indeterminate quantities; and 2) students combined gestures into embodied forms of algebraic expressions.

RR 3:01 Which estimation situations are relevant for a valid assessment of measurement estimation skills?

Heinze, Aiso; Weiher, Dana Farina; Huang, Hsin-Mei; Ruwisch, Silke

Measurement estimation skills are of significant importance for everyday life. In the last decades a lot of research results were generated describing students’ estimation skills and strategies. Surprisingly, little attention has been paid to the basic question which types of situations are relevant for a valid conceptualization and operationalization of measurement estimation skills. Some studies refer to the basic structure of estimation conditions described by Bright (1976) whereas others ignore this question, though it is central to ensure validity of the empirical data. Following validity criteria and based on existing empirical findings on estimation strategies, we developed a comprehensive model of measurement estimation situations. This model provides a basis for the development of valid tests on

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measurement estimation skills as well as for the development of learning environments.

RR 3:02 A written, large-scale assessment measuring gradations in students' multiplicative reasoning

Johnson, Heather Lynn; Tzur, Ron; Hodkowski, Nicola M; Jorgensen, Cody; Wei, Bingqian; Wang, Xin; Davis, Alan

We examine a written, large-scale assessment that assessors can use to infer and measure gradations in students' scheme for whole number multiplicative reasoning. To design such an instrument we drew on Tzur's notion of fine grain assessment, which is used to distinguish two stages in the construction of a scheme: participatory and anticipatory. We briefly present the assessment items, the validation process, and reliability statistics—Cronbach's alpha, Rasch modeling, and student response patterns from students (N=492) in grades 3 and 4 (~ages 8-10), including distinctions in item difficulty levels. We discuss implications for large-scale assessment design and implementation.

RR 3:03 Professionalisation of prospective teachers through the promotion of cognitive diagnostic competence

Hock, Natalie; Borromeo Ferri, Rita

Teacher's knowledge about student's cognition is important in order to recognize the deficits of the students, to analyse them and to give appropriate support (Kunter et al. 2013). Thus the presented DiMaS-net project focus on the professionalisation of prospective teachers regarding their diagnostic competence. A specific seminar for becoming secondary teachers was developed and with a pre-post Design the increase of teachers' diagnostic competence was investigated. In this paper we will describe the teacher training and present first results concerning the improvement of the perceived self-efficacy.

RR 3:04 Middle grade students' performance on arithmetic calculations presented as word problems or numeric problems

Askew, Mike; Venkat, Hamsa

This paper examines South African middle grade students' performance on problems set either within a word problem format or a purely numeric format. Students across Grades 4, 5 and 6 in suburban and township schools answered, as part of a written assessment, four word problems – two involving additive relations and two multiplicative – and also four matched numeric calculations. Analysis of differences in performance on items and formats indicate that, for these students, there was little evidence to support the claim that students find it more difficult to solve problems when presented in word problem format. The findings

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show that while both formats presented challenges, students displayed a preference for one or other of the formats.

RR 3:05 Elementary school teachers' implementation of dynamic geometry using model lesson videos

Baccaglini-Frank, Anna E.; Di Martino, Pietro; Sinclair, Nathalie

In this study, a set of activities on line symmetry in a Web Sketchpad environment, published on the website of a Canadian university, were adapted by two Italian researchers for 1st and 2nd grades with an Interactive White Board in the classroom. The activities were proposed to a 2nd grade during two video-recorded lessons conducted by one of the researchers. The videos were viewed by three teachers who then proposed the same activities in their 1st and 2nd grade classes. The study was carried out over a 6-month period. One of its aims, the main focus of this paper, was the following: to study teachers' implementation of the activities and to identify aspects of the study's teacher instructional improvement cycle that were most influential in their implementations of the technology-based activities.

RR 3:06 20 years of mathematics motivation mirrored through TIMSS: Example of Norway

Kaarstein, Hege; Radišić, Jelena; Nilsen, Trude

Student motivation is important for recruitment to further STEM education and carrier. Over the last decades, Norway has allocated many resources for recruitment to STEM, especially for girls, making it important to explore how students' motivation has changed across time. Using data from TIMSS, this paper explores the changes in Norwegian students' motivation in mathematics across time (N= 43 366), including differences across grades (4 and 8) and gender over the past 20 years. Measurement invariance analysis and multi-group CFA was conducted in Mplus. Findings indicate an increase in motivation (self-concept, intrinsic and extrinsic) across time for both grades, and higher motivation in favour of boys. These findings have implications for policy making and teaching practices in mathematics classrooms in Norway.

RR 3:07 Activation and monitoring of prior mathematical knowledge in modelling processes

Krawitz, Janina; Schukajlow, Stanislaw

In a qualitative study with eighth to tenth graders (N=18), we investigated whether the activation of prior mathematical knowledge would promote or interfere with solution processes as students solved modelling problems. In addition, we analyzed the role of metacognitive monitoring of knowledge activation. Participants with different prior mathematical knowledge solved modelling problems

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in which multiple solution approaches were possible. We found that the activation of inappropriate prior mathematical knowledge negatively impacted modelling. Negative effects of prior knowledge also occurred if a second solution for a problem was required because learners stuck to the prior knowledge of their first approach. Monitoring of knowledge activation was rarely found, even when it would have been helpful.

RR 3:08 Are teachers' language views connected to their diagnostic judgments on students' explanations?

Prediger, Susanne; Şahin-Gür, Dilan; Zindel, Carina

When teachers analyze students' explanations in a language-responsive mathematics classroom, they explicitly and implicitly activate various categories and hold different views on language and mathematics learning. This study investigates how typical views on language in mathematics classrooms are related to what teachers consider relevant in their diagnostic judgments, in this case on students' explanations of the slope formula for linear functions. Seventy-eight teachers' personal constructs were elicited using a diagnostic activity and related to their self-reported views on language and mathematics learning. The group of language reducers can be shown to focus significantly more on the surface level of language whereas the language pushers group focuses more on the discourse level. In contrast, worries about language responsiveness being time consuming do not seem to influence diagnostic judgments.

RR 3:09 The professional, pedagogical language of mathematics teachers: A cultural artefact of significant value to the mathematics community

Mesiti, Carmel; Clarke, David

This paper draws on a project involving nine mathematics communities internationally that set out to identify the familiar, professional, pedagogical vocabulary in use by middle school mathematics teachers. The national research teams comprise both academic researchers and experienced teachers and each lexicon identified the actual terms that teachers use when describing the phenomenon of the middle school mathematics classroom. Each such lexicon can be thought of as a cultural artefact of the mathematics teaching community in which its practitioners name the valued, pedagogical practices in their respective world. The documentation of these lexicons has significant practical value to each participating community and can also be used for the study and promotion of reflective practice of teachers.

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RR 3:10 Tensions in implementing mathematics journaling

Rouleau, Annette

Research suggests there is a strong connection between mathematical writing and mathematical learning. As a result, many educators are implementing journaling in their mathematics classroom, which can be a challenging process. This paper identifies the tensions faced by an individual teacher implementing journal writing for the first time and interprets those tensions through the lens of activity theory. The results suggest that pinpointing the areas of tension within an activity system may provide a means of mitigating the challenges.

RR 3:11 Boundary crossing in design based research - Lessons learned from tagging didactic metadata

Cooper, Jason; Olsher, Shai

Teachers are coming to take a crucial role in designing the curriculum they teach, relying to varying extents on learning-resources that they gather. The internet, though rich in resources, does not support didactically-sensitive searching. To address this, we are developing a pair of tools, one for tagging didactic aspects of learning resources, and one for searching based on tagged metadata. Employing a design-based-research approach, we search for a set of metadata categories that will support changes in teachers' practices, yet will be comprehensible to teachers and useful in their current practices. We describe the "boundary" that this research has exposed between the communities of teachers and researchers, and the mutual learning that took place through boundary-crossing.

RR 3:12 Gap and congruency effect in fraction comparison

González-Forte, Juan Manuel; Fernández, Ceneida; Van Dooren, Wim

Natural number bias in fraction comparison has been studied examining the role of congruency effect. However, the congruency effect has been observed in opposite directions, suggesting that an explanation may lie in the strategies used by students. One of the strategies that may be used by students is gap thinking. We have carried out a cross-sectional study from 5th to 10th grade with 438 participants examining the effect of congruency and gap thinking in students' responses and reasoning. Results show that gap thinking has influenced students' responses and support the claim that gap effects could explain differences between congruent and incongruent items, extending this result from primary to secondary school. However, it seems that this effect disappears (in Spanish students) at the end of Secondary Education.

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RR 3:13 Teacher's gaze behavior when scaffolding peer interaction and mathematical thinking during collaborative problem-solving activity

Haataja, Eeva; Garcia Moreno-Esteva, Enrique; Toivanen, Miika; Hannula, Markku S.

Scaffolding is an important teaching action that can target either at student cognitive or socio-emotional processes. The details of these scaffolding events can be examined through teacher visual attention, which interacts with his pedagogical decisions. In this study we use mobile gaze tracking device to investigate the different types of teacher's gaze behavior while he is scaffolding collaborative problem solving on mathematics lesson. Teacher's attentional focus during scaffolding events was found to relate to the purpose of the scaffolding event and thus to reflect teacher's objectives for the interaction with students. This situational nature of teacher gaze implicates the need of contextual use of gaze tracking analysis in the field of education.

RR 3:14 Learning to assess: Exploring changes to pre-service teachers' criteria for a quadratics task

Ayalon, Michal; Wilkie, Karina

This study sought insights into the process of pre-service teachers (PSTs) learning to assess student learning through designing and then refining assessment criteria for a quadratics task using student example responses. Sixty PSTs attempted the task individually, then worked in pairs to develop initial assessment criteria, analyse a selection of student responses, and revise their criteria. The data analysis examined variations in the pre-service teachers' own use of and attention to quadratic features and mathematical language as assessment criteria for this task throughout the activity. This paper discusses evidence suggesting that collaborative analysis of example student task responses can make certain, but not all, assessment criteria salient to PSTs.

RR 3:15 Can students construct non-constructive reasoning? Identifying fundamental situations for proof by contradiction

Hayata, Toru; Uegatani, Yusuke; Hakamata, Ryoto

The purpose of this study is to identify and empirically corroborate a fundamental situation (Brousseau, 1997) for constructing "proof by contradiction." We identified the four elements of a fundamental situation: i) obtaining strong conviction; ii) negating the given proposition naturally without being aware of the assumption; iii) finding a contradiction easily; and iv) noticing the origin of the contradiction. Based on this study, a new research question arises: How can students construct "proof by contradiction" using teacher support.

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RR 3:16 Primary student's data-based argumentation – an empirical reanalysis

Krummenauer, Jens Oliver; Kuntze, Sebastian

Despite its importance for informed citizenship, empirical research into student's abilities in developing data-based argumentations is relatively scarce and needs to be broadened, in particular as far as primary students are concerned. In a reanalysis of data from more than 380 primary students, this research need is addressed. The study describes key elements of data-based argumentation in the intersection domain of statistical thinking and critical thinking, drawing on a framework focused on scientific reasoning. A corresponding coding affords insight into primary student's approach to data-based argumentation, both into their strengths and difficulties.

RR 3:17 From “how good I am!” to “forgive me...please trust me”- microaggressions and angles

Ryan, Ulrika

The endeavour of this report is to provide findings on how the normative appreciation of preciseness in mathematical concepts evoke micro-aggressions when students in a linguistically and socially diverse classroom reason about angles in a group activity. Results show that Samir, an emergent Swedish speaker, becomes deprived of reliability and hence loses his chances to make claims of knowledge partly due to the rigidity of (Western) mathematics. The analysed interaction begins with Samir confidently saying “How good I am” when solving a task with his peer Darko. However, it ends with Samir's talk about himself ways of talking about himself being completely changed from confidence to insecurity and subordination, begging Darko to rely on his mathematical knowledge saying “Forgive me...please trust me.”.

RR 3:18 Making maths matter: Engaging students from LSES schools through social justice contexts

Anderson, Judy Anne; Kriesler, Alice

Junior secondary students typically believe mathematics is challenging and has little connection to the real world. Consequently, Australian students are less engaged and fewer are choosing to study mathematics beyond grade 10, particularly in low socio-economic. Contextualising mathematics using tasks with a social justice perspective was investigated to ascertain the levels of behavioural, emotional and cognitive engagement of students in three grade 7 classrooms. Student surveys and teacher interviews indicated students were more engaged when the mathematics was perceived as relevant with connections to real world issues, enabled longer and deeper conversations about social justice perspectives, and was challenging with appropriate scaffolding when necessary.

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RR 3:19 Objectifying tinga: A case of children inventing their own discourse on fractional quantities

Steiner, Aya

Much has been written about differences between ontogenetic and the historical development of mathematics. In this paper, I present a case of learning that may inform our vision of what have happened when people began thinking in terms of fractional quantities for the first time. The case is taken from a large research project, in which I follow the development of the discourse of rational numbers. The study provided insights into both historical and ontogenetic development of that discourse.

RR 3:20 Core mathematical teaching practices in algebraic and functional relations

Kim, Hee-jeong; Son, Ji-Won

Teaching and learning algebra in school mathematics is challenging. The purpose of this study is to explore the core classroom practices that support students' development of algebraic thinking. By analysing 5 video-taped lessons among three middle grade teachers who are in different career stages in Korea, we identify the core classroom practices that create rich learning opportunities for algebraic thinking and support students' access to those learning opportunities. Findings illustrate characteristics of classroom practices that support essential opportunities to learn for development of algebraic thinking.

RR 4:01 Students' conceptions for curve length: A hypothetical learning trajectory approach

Eames, Cheryl Lynn

The purpose of this paper is to report on a larger program of research, aimed at extending and evaluating a hypothetical learning trajectory for length measurement. Prior research focused on young children's conceptions related to unit for straight or rectilinear path tasks. The present study increased the scope of this research by including middle and secondary level students conceptions related to unit for curved paths. Two individual task-based interviews were conducted with 16 participants. Codes related to students' strategies related to unit were generated through a constant comparative method and the frequency of each code was tracked to explore developmental patterns and inform extensions to the hypothetical learning trajectory.

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RR 4:02 Are adults biased in complex fraction comparison, and can benchmarks help?

Obersteiner, Andreas; Alibali, Martha W.

When people compare simple fractions, the natural number components can interfere with processing of fraction magnitudes (“natural number bias”). There is conflicting evidence about whether this also occurs for complex fraction comparisons. We asked 107 university students to solve complex fraction comparison problems. Fractions varied in their relative positions to benchmarks (i.e., reference numbers such as 0, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, or 1), which may help people activate fraction magnitudes. We found a “smaller components—larger fraction” bias in participants with lower mathematical experience and a reduced bias in participants with more experience. The benchmarks 0 and 1 facilitated performance and reduced the bias; effects of other benchmarks were small. The study highlights the variability of the natural number bias.

RR 4:03 Enhancing teacher noticing using a hypothetical learning trajectory

Ivars, Pedro; Fernández, Ceneida; Llinares, Salvador; Choy, Ban Heng

Since noticing has been identified as a critical component of teaching expertise, researchers have tried to identify contexts to its development. These studies assume that growth in teachers’ noticing expertise can be inferred from their professional discourse. Prior research has also shown that teachers’ noticing development in teacher education programs is challenging if no framework or guide to support pre-service teachers in their noticing is provided. In our study, 29 pre-service teachers used a hypothetical learning trajectory as a guide to interpret students’ fractional thinking. Results show that the use of a hypothetical learning trajectory improves pre-service teachers’ professional discourse on students’ mathematical thinking and then, enhances noticing.

RR 4:04 Classroom dialogue as a French braid: A case study from trigonometry

Andresen, Mette; Dahl, Bettina

Studies have shown that dialogues in teaching that follow the model of IRE (initiation, response, evaluation) are widely used in teaching despite it having some deficiencies. Based on the theories of collective learning and the social nature of thought, knowledge creation and learning, we argue in this paper that a ‘captivating’ dialogue which at a first glance seemed to follow the model of IRE can be understood as part of a process that initiates the students into the practices of school mathematics including learning to speak mathematically. We illustrate this point with an example from an upper secondary Norwegian class in trigonometry. Here the teacher combined asking open-ended problems to the students with IRE questions during a joint review of problem-solving using the principles of Polya.

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RR 4:05 Learning mathematics through online forums: A case of linear algebra
Kontorovich, Igor'

The aim of the study reported in this paper was to explore online interactions of twenty five high-school students in an asynchronous forum that accompanied a face-to-face course in linear algebra. The forum generated a considerable number of mathematical post-exchanges, the vast majority of which came from a small group of six students. The data analysis revealed a positive correlation between thread-initiation and achievements of students in the course. Students' activity in their self-initiated threads correlated with their activity in the threads initiated by their peers, which attests to the collaborative nature of the forum. In about half of the threads students sought verifications for their solutions to the assigned problems. The paper ends with a discussion on what one's online activity might indicate in terms of her course learning.

RR 4:06 Mathematics in disguise: Effects of the external context of mathematical word problems

Strohmaier, Anselm R.; Reiss, Kristina M.

Both the content and the context of a mathematical word problem (WP) influence its solution process. We focus on the external context beyond the problem text, e.g. the classroom and the cover sheet of the WP. The few studies analysing influences of the external context commonly focus on the mathematical solution. In contrast, we report two experiments analysing processes beyond solutions. First, we found that a mathematical external context increases physiological arousal indicated by electrodermal activity, but not self-reported state anxiety. In contrast, eye movements during WP reading did not differ between a mathematical and a problem-solving external context. This indicates that the external context can initiate a variety of processes and emphasizes its relevance for mathematical WP.

RR 4:07 Exploring perspectives on mathematical modelling: a literature survey

Preciado Babb, Armando Paulino; Solares Rojas, Armando; Peña, Fredy; Ortiz, Andrea; Sandoval Rosas, Marisol; Soriano Velasco, Remedios; Carrión Vázquez, Vicente; Farrugía Fuentes, Mauricio

Mathematical modelling has a long tradition in mathematics education and has been gaining international attention, not only in research and practice, but also in official perspectives reflected explicitly in programs of studies around the world. Despite extensive publications on diverse aspects of mathematical modelling, systematic literature surveys on this topic are scarce. We highlight some qualitative results from a systematic survey of 452 publications related to different perspectives on mathematical modelling, extending and complementing previous reviews of the state of the art. In particular, we elaborate on the notion of 'authenticity'

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and the purposes of mathematical modelling in education. Finally, we identify two trends in Latin American countries.

RR 4:08 Motivation and caning in Ghanaian secondary school: Evidence from a survey and interviews

Awoniyi, Florence Christianah

A total of 3,342 eleventh graders from ten public Senior High Schools were engaged in an investigation of motivation for the learning of mathematics. Likert survey revealed both intrinsic and extrinsic motivation, while in the interview students mainly provided extrinsic motivation explanations. The interviewed students mentioned fear for corporal punishment as the most important demotivating issue. Interviewees' responses, observation of the lessons and the verification of the students' exercises by the researcher confirmed that some teachers either do not provide constructive feedback or provided quite a bit of harsh feedback and high stake national examination remains the impetus for the learning of mathematics in Ghana.

RR 4:09 Teachers' criterion awareness and their analysis of classroom situations

Kuntze, Sebastian; Friesen, Marita

Mathematics teachers' noticing and their analysis of classroom situations is considered as a key component of teacher expertise in a growing body of empirical research. However, research into what dispositions may direct teachers' noticing and their criteria-based analysis is still scarce. In this study, we use the notion of teachers' criterion awareness for exploring interdependencies between teachers' analysis of classroom situations and their awareness. Building on our prior research, the study concentrates on awareness criteria related to dealing with representations in the mathematics classroom. The findings suggest interdependencies of the teachers' reported awareness with the teachers' analysis scores, and encourage the development of further indicators.

RR 4:10 Mathematics teachers' identity development in the context of professional master's degrees

Losano, Leticia; Fiorentini, Dario

Considering that participation in teacher education initiatives usually involves negotiating new ways of being and projecting into the teaching profession, this article develops an interpretative case study focused on a mathematics teacher's identity development from his participation in a professional master's degree. Conceptualizing identity as a shifting entity that involves constructing and reconstructing meaning over multiple and conflicting discourses, the article analyzes

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how the mathematics teacher orchestrates voices and discourses coming from the professional master's degree and from his teaching practice to create self-understandings as a mathematics teacher.

RR 4:11 Teacher capacity for productive resources use

Kim, Ok-Kyeong

By compiling the analyses of the data from elementary teachers using a range of mathematics curriculum programs in the United States, this paper elaborates teacher capacity needed for productive resource use. The capacity elaborated in this paper includes (1) articulating mathematical points of the lesson and steering instruction toward the mathematical points, (2) recognizing affordances and constraints of the resource, (3) using the affordances of the resources, and (4) filling in the holes and gaps in the resources. Each of these aspects is explained along with examples from the data and related literature. This paper also discusses the need of nurturing proper operational invariants in teacher education (teacher preparation and professional development) and the role of resources in increasing teacher capacity.

RR 4:12 Facilitating conceptual engagement with fractions through suspending the use of mathematical terminology

Vale, Pamela; Graven, Mellony

In this study we sought to establish whether an instructional sequence focused on fractions as measures was effective in supporting a group of South African Grade 3 students' understanding of fractions. The sequence is centred on a story that utilises 'nonsense' words to describe fractions. The students in this study had already been introduced to fraction terminology and symbols, but struggled in the initial lessons of this sequence and in the pre-test to use these with understanding. This paper focuses on how this sequence's suspension of the use of the mathematical terminology in favour of these 'nonsense' words helped to facilitate students' deep engagement with the concept of fractions during these lessons.

RR 4:13 Structuring students' mathematical conversations with flowcharts and intention analysis – affordances and constraints

Smedlund, Joakim Vilhelm; Hemmi, Kirsti; Røj-Lindberg, Ann-Sofi

This paper is based on a study that compares how student groups from three different cultural contexts solve the same mathematical problem. In this paper, the focus is on the methodology. More specifically, we describe the use of flowcharts and intention analysis to reveal important qualities in student discussions. The aim is to show how these tools may support the analyses of students' mathematical discussion. We also emphasise the shortcomings of the tools in the light of our

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experiences from the study. We show that in order to better understand why certain interaction happens, it is important to extend the analysis to contextual factors.

RR 4:14 Making mathematical learning long-termed and effective using interleaved practices

Pede, Stella; Borromeo Ferri, Rita; Lipowsky, Frank

While most educational approaches focus on improving learning through making things easier, the approach of desirable difficulties is to make the learning process more difficult, but long-termed. Within cognitive psychology several of those desirable difficulties could be identified, for example the interleaved practices. In the presented empirical classroom study the focus lies on the investigation of effects of interleaving practices in contrast to blocked learning with seventh Graders. Most students learn mathematics in the blocked way: they deal first with one topic and after it is completed, they start to learn the next one. Learning in this way is easier than learning several topics at the same time, which is called interleaved practice. The study and some of its results will be presented in this report.

RR 4:15 The influence of saliency in intuitive reasoning

Lem, Stephanie; Van Dooren, Wim

Intuitions play an important role in mathematical reasoning. Stavy and Tirosh proposed the intuitive rules theory and showed how various tasks are incorrectly solved on the basis of intuitive rules triggered by salient task characteristics. In this study we wanted to replicate and extend the results of Stavy and Tirosh. Furthermore, we wanted to test two different ways of making intuitive reasoning more likely (textual and graphical saliency). We found that all tasks tested in this study showed similar patterns of accuracy rates and reaction times as in the studies of Stavy and colleagues. However, we were not able to replicate the result that more salient task elements lead to more intuitive reasoning. We propose explanations for these different results and discuss implications for further research and educational practice.

RR 4:16 Mathematicians' criteria for accepting theorems and proofs – an international study

Dreher, Anika; Heinze, Aiso

Argumentation and proof are crucial for the mathematics discipline and should thus permeate mathematics education. In particular proof validation lately became a focus of attention in mathematics education research. Since expert practice is seen as an important frame of reference for instructional goals regarding proof validation, it was emphasized that empirical research on mathematicians'

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criteria for accepting proofs is needed. However, such empirical research based on reliable quantitative data is still scarce. Consequently, this study analyzes criteria for accepting proofs in their daily work held by $N = 243$ highly respected mathematicians from all over the world. The results indicate three types of mathematicians who rely on certain criteria to various degrees as well as differences between status groups.

RR 4:17 The mathematics textbook for rural population in Brazil: Learning to be a modernized farmer

Neto, Vanessa Franco; Valero, Paola

The Brazilian National Textbook Program has evaluated and distributed textbooks for rural population in mathematics. From a Foucaultian perspective, textbooks are conceived as a technology that governs. Through a discourse analysis, statements about the modernization of peasants' practices with and through mathematics are identified. The results show that textbooks use images and texts of good traditional rural lifestyle to contextualize mathematical activities. But at the same time, the idea that mathematics is necessary for the modernization of rural work to become effective and industrialized is constructed. School mathematics, as articulated in the textbooks, plays an important role in peasant subjectivation processes, being a powerful validation for the need to adopt modern and economically effective production.

RR 4:18 Gender specificities in a support project for engineering students

Griese, Birgit

Supporting students in mathematics requires concepts that match the target group, which can be classified, among others, according to gender. Our study explores data from almost 1,500 engineering first-years in order to identify gender-specific learning behavior and its impact on academic success, thus investigating if classification by gender does provide insights into criteria for project re-design. Results show that in spite of stereotyped learning strategies, non-gender-specific factors are better suited to explain different examination outcomes.

RR 4:19 Designing for guided reinvention of mathematical concepts

Simon, Martin

In this theoretical paper, I discuss two ways of promoting guided reinvention for mathematical concepts. I begin by discussing our elaboration of the rationale for Freudenthal's construct of guided reinvention. I then use two constructivist constructs, generalizing assimilation and reflective abstraction, to distinguish two types of conceptual development. Finally, I explain and exemplify our approaches for designing instruction to promote guided reinvention through generalizing

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assimilation and through reflective abstraction. These approaches are potentially complementary to approaches grounded in problem solving.

RR 4:20 The predictive role of different reasoning forms to students' early algebraic thinking abilities

Chimoni, Maria; Pitta-Pantazi, Demetra

The development of early algebraic thinking has become a goal for many curricula, yet important questions remain regarding the nature of students' early algebraic thinking. This study aims to clarify the relationship between early algebraic thinking and different reasoning forms. To this end, 9, 10, 11, and 12-year-old students were tested in three tests: (i) an algebraic thinking test which involved a range of early algebraic tasks, (ii) the Naglieri Non-Verbal Ability Test (NNAT) which allows the examination of analogical reasoning, inductive reasoning, and spatial reasoning, and (iii) a deductive reasoning test. The quantitative analysis of the data yielded insights into the predictive role of different reasoning forms on students' early algebraic thinking abilities in the age groups under investigation.

RR 5:01 Clumps or chunks? - contextual relevance of students' features of the data

Büscher, Christian

For reasoning on data, learners make use of features of the data in an intuitive and informal way. More insights however are needed into learners' processes of reasoning on data to identify conditions and reasons for learners to focus on particular features of the data. This study reports on results of a design research project on German 7th grade students' reasoning on data. The analysis shows how students' focus on features of the data follows their perceived contextual relevance induced by the context of a teaching-learning arrangement.

RR 5:02 Why is calculating the average speed difficult?

Ahl, Linda Marie; Helenius, Ola

Speed may seem like a simple concept, but similar to other rate-based concepts, tasks involving speed can be significantly challenging for students. We examine adult and 16-year-old students' work with a task involving the average speed over two equal distances. Solutions are analyzed by applying scheme theory and the distinction between the predicative and operative forms of knowledge. We show that a major obstacle in achieving successful solutions of the problem is related to the linguistic properties in the problem formulation, inducing students to calculate the arithmetic average instead of the average speed. Students who solve the

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task successfully use predicative forms of knowledge related to speed, or they reason directly with the rate concept.

RR 5:03 The transition from high school to university mathematics: Entering a new community of practice

Bampili, Amalia-Christina; Sakonidis, Charalampos; Zachariades, Theodossios

The transition from secondary to tertiary mathematics encompasses a complex interaction of social, institutional and mathematical context changes, including a vast array of emotions, beliefs and issues. The present paper reports on a study of the challenges faced by two first year mathematics undergraduate students during their transition from secondary to tertiary education through the lenses offered by the Communities of Practice framework. Data were gathered over the students' first two semesters of attendance predominately through interviews. The results indicate a powerful interaction between social and institutional issues shaping their initiation into a new practice of mathematics.

RR 5:04 Creativity or imagination: Challenges with measuring creativity

Rott, Benjamin; Liljedahl, Peter

In this article, we look closely at the relationship between creativity and imagination. Using a combination of theoretical and empirical analysis, we call into question the validity of measuring creativity by examining products and coding them for flexibility. The framework of imagination proves to be a useful lens for analysing the data.

RR 5:05 Action strategies in spatial geometry problem solving supported by dynamic geometry software

Widder, Mirela; Berman, Abraham; Koichu, Boris

This study is aimed at characterization of action strategies in spatial geometry problem solving supported by Dynamic Geometry Software (DGS), by means of a measure allowing dynamic monitoring of visual difficulty during problem-solving moves. Twenty-one high-school students were engaged in DGS-supported solving of spatial geometry cube-related problems, in individual work-sessions. Data analysis consisted of identification of changes in the visual difficulty of the sketches undertaken by the students on the computer screen and characterization of their problem-solving moves. The results suggest that the students used DGS to reduce visual difficulty in a nonlinear process, influenced by their spatial abilities, the initial visual difficulty of the problems and the solution-stage at which the DGS is employed.

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RR 5:06 Investigating self-efficacy expectations and mastery experiences across a sequence of lessons in mathematics

Street, Karin Elisabeth Sørli; Malmberg, Lars-Erik; Stylianides, Gabriel J.

While a few longitudinal studies have provided empirical data on the relationship between students' mathematics self-efficacy expectations (SEE) and mastery experiences (ME) at the macro-level (across months or years), there is little empirical evidence for the theoretically proposed process of SEE change at the micro-level (across lessons or learning events). We aimed to address this research gap using a micro-analytic design with repeated measures across mathematics lessons involving grade 6 ($n=81$) and grade 10 ($n=100$) students. Path models with cross-lagged effects illuminated the relationship between SEE and ME: the dominant direction was from SEE to ME, but the effects from ME to SEE were also substantial. Implications for both theory and practice are discussed.

RR 5:07 Ritualised and exploratory graphing routines in mathematical modelling: The Digoxin task

Viirman, Olov; Nardi, Elena

The project we report from in this paper explores whether and how, biology students' competence and confidence in – as well as appreciation for – mathematics in their discipline can be improved through greater integration of mathematics and biology in their study programme. Here, we examine biology students' mathematical discourse as they engage with a biology-related Mathematical Modelling (MM) activity, the Digoxin task. We report commognitive analyses of data collected during sessions in which biology-related MM activities were introduced to undergraduate biology students (four sessions with 12 first-semester students). We focus on the interplay between students' ritualised and exploratory engagement with the activity, particularly concerning graphing routines, and consider pedagogical implications.

RR 5:08 Is mathematical creativity related to mathematical excellence? Teachers' beliefs

Levenson, Esther

This study investigates mathematics teachers' beliefs regarding the relationship between mathematical creativity and mathematical excellence. Written responses to an open question regarding this relationship led to six types of relationships. Findings indicated that most teachers believed that mathematical creativity can lead to excellence, with a few believing no relationship exists. Teachers' implicit beliefs regarding creativity were also analysed. It was found that the same implicit beliefs about creativity may be held by teachers with different beliefs regarding the relationship between mathematical creativity and excellence.

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RR 5:09 Analysis of the PCK of an elementary mathematics master teacher

Seo, Eun-Min; Kim, Jin-Ho; Lim, Woong

We present a case study investigating the Pedagogical Content Knowledge (PCK) of an elementary mathematics master teacher who implements a learner-centered approach to teaching fractions. Our data include two semi-structured interviews, various artifacts, and six videotaped lessons. In this study we identify ten elements of the participant's PCK and illustrate how these elements are enacted in the classroom through select lesson transcripts.

RR 5:10 From 'frowns and groans' to 'astonishment and delight': Seeking indicators of a mathematics teachers identity

Crisan, Cosette; Rodd, Melissa

This paper reports on a research project based on designing and teaching in-service courses for Non-Specialist Teachers of Mathematics (NSTM). An NSTM is a school teacher who qualified to teach in a subject other than mathematics, yet teaches mathematics in secondary school (11-16 year old students). While the overall aim of our research was to describe what constitutes a trajectory towards a mathematics teacher identity for a NSTM, in this paper we explain how we sought indicators of a mathematics teacher identity. We do so by first describing how we adapted Wenger's notion of identity, then advanced our 'Modes of Belonging' Mathematics Teacher Identity framework. After that we exemplify how we used our framework to locate indicators of mathematics teacher identity in the data from a narrative of NSTMs working on a particular piece of mathematics.

RR 5:11 Examining explorative instruction according to the realization tree assessment tool

Weingarden, Merav; Heyd-Metzuyanim, Einat

In this paper we present a comparison of 10 lessons based on the same task – the Hexagon task. We used the RTA (Realization Tree Assessment) tool in order to compare the implementation of this task by 10 middle school teachers undergoing professional development intended to enhance explorative instruction. We focused on three aspects in our comparison: the number of realizations, the links between the realizations, and the narratives of 'saming' algebraic expressions. Results show a wide variance between lessons in number of realizations and in the extent to which links were made between them. The quantification of these aspects enabled us to rank the lessons according to RTA "robustness" to provide a measure of explorative instruction and link it with grade level and track.

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RR 5:12 Same unit coordination: A conceptual screener for mixed unit coordination and base-10, place value reasoning

Tzur, Ron; Wei, Bingqian; Smith, Amy; Norton, Anderson; Davis, Alan; Johnson, Heather Lynn

This quantitative study¹ corroborates a conceptual linkage implied by Tzur et al.'s (2013) model of progression in schemes for multiplicative reasoning. We demonstrate that the Same Unit Coordination (SUC) scheme serves as a conceptual screener for the Mixed Unit Coordination (MUC) scheme—and hence for base-10, place value (PV-B10) reasoning. Solutions to written word problems designed to indicate each scheme, given to 200 fourth and 351 fifth graders, largely supported our hypothesis that the SUC scheme is a necessary but insufficient requisite—for the MUC scheme. We discuss implications of these findings for teaching and learning PV-B10.

RR 5:13 Instrument to analyse dyads' communication at tertiary-level

Hattermann, Mathias; Heinrich, Daniel; Salle, Alexander; Schumacher, Stefanie

In this paper, we focus on the development of a theoretical instrument based on the interactive-cooperative-active-passive-framework to analyse dyads' communication processes in collaborative face-to-face learning scenarios. We can show that the adaption of this framework to the analysis of time-sampled video recordings is successful and that a dependency between dyads' communicational behaviours and their learning outcome may be present.

RR 5:14 The interplay of informative assessment criteria and continuous feedback with mathematics students' learning orientations

Tuohilampi, Laura; Nieminen, Juuso Henrik; Häsä, Jokke; Rämö, Johanna

Many researches have suggested that making assessment criteria visible supports learning. On the other hand, others have claimed that too much clarity in assessment criteria and feedback could lead to instrumentalism: superficial observance of criteria without deeper thinking. Due to this ambiguous body of knowledge, we wanted to investigate what type of mathematics learning occurs during a course which provides clear assessment criteria and continuous feedback, combined with a technology enhanced learning environment based on self-assessment and reflection of learning.

RR 5:15 Middle school students' reasoning about volume and surface area

Seah, Rebecca; Horne, Marj

This study investigates students' reasoning skills in practical application of mathematics. Students were asked to explain the volume and surface area of a shoe box

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after enlargement. The data from two groups of students were collected and analysed. The first administration of the tasks was given to 253 Year 4-10 students to validate the usability of the items and marking rubric. The second administration involved 273 Year 8-10 students of a different cohort. The results show that students use a combination of linguistic, symbolic, and diagrammatic tools demonstrating different level of reasoning.

RR 5:16 Mathematical induction at the tertiary level: Looking behind appearances

Carotenuto, Gemma; Coppola, Cristina; Di Martino, Pietro

The relevance of inductive proofs in Mathematics is beyond question and the research in Mathematics Education has widely documented the students' difficulties in understanding and applying mathematical induction, both at secondary school level and at university level. In this paper, we present a qualitative study involving third year Mathematics degree students aimed at investigating the solidity/fragility of mathematical induction comprehension. The results highlight that mathematical induction is a very hard topic also in this context, in which are involved mathematical competent students. We argue the need to design non-standard activities able to get the misconceptions emerge, in order to support a deep understanding of the topic.

RR 5:17 Situational and distal sources of meaning in a multilingual mathematics classroom

Barwell, Richard

In research on mathematics learning in contexts of language diversity, much work has focused on students' meaning-making, using the notion of language as a resource. In this report, I use an alternative though related perspective that sees language in terms of sources of meaning. This perspective is based on a dialogic, Bakhtinian theory of language. Sources of meaning are examined in terms of discourses, voices and languages. I present preliminary analysis of the sources of meaning used in one multilingual Canadian mathematics classroom. I show how the sources of meaning drawn on by students and the teacher in mathematical meaning-making can be usefully distinguished as situational or distal in nature (or both). Distal and situational sources of meaning are implicated in the stratification of mathematics classroom interaction.

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RR 5:18 Striving for equity: How policy shapes our understanding of race in math class

Hawks, Michelle Christine

The purpose of this research is to present initial findings related to how federal education legislation in the United States frames racialized students in mathematics. By relying on Critical Race Theory and governmentality, I am able to highlight how race is considered in both extant mathematics education literature and current legislation. This allows for a discussion regarding how the use of race in policy actually impacts the types of research completed and how teachers perceive their students in class. To conclude, I join the calls of other mathematics educators who suggest that in order to attain equity, teachers and researchers must first actively work to counteract deficit narratives about racialized students.

RR 5:19 A concept analysis of the notion concept: Contributions of an analysing tool

Wedman, Lotta

The word ‘concept’ is used with several meanings in mathematics education. In order to obtain a coherent theoretical framework, a concept analysis of the notion concept is performed for some current frameworks in the field. The taken approach includes creating a tool for analysing views on concept, based on a literature review in philosophy. This tool uses three distinctions of views on concept: mental versus abstract, subjective versus intersubjective, and molecular versus holistic. Examples from texts in mathematics education are given, where the three distinctions are present. Further, the taken approach offers a perspective on concept that simplifies comparisons between frameworks.

RR 5:20 Symbolisation and objectification through social interactions for meaningful learning of mathematics

Vlassis, Joelle; Demonty, Isabelle

From the very beginning of their history, mathematical objects have been developed in close relationship with the symbols they use. Starting from an epistemicohistorical analysis of the development of algebraic notation, this article proposes a theoretical reflection on the interdependence between objectification and symbolisation that is specific to the mathematical thinking. Based on recent Radford’s recent definitions of learning and mathematical objects, it aims to develop the importance of symbolisation activities organised into chains of significations and of social interactions in mathematics learning conceived as a social process of objectification. It finally proposes an example of a classroom activity illustrating the theoretical principles.

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RR 6:01 Students' pathways for solving probability problems

Mutara, Lydia; Makonye, Judah Paul

To produce mathematics knowledge for teaching probability, this study explored students' representations and associated errors as they solved probability tasks. Sfard (2007)'s argument of mathematics as discourse and; Chaput, Girard and Henry (2011)'s three probability learning modelling processes guide the study. Data from sixteen grade 10 students aged between 15 and 17 years showed that students regarded representations as thoroughfares that mediate task solution, but most students could not construct correct representations. Further, interviews showed that some students had little faith in their constructed representations and suggested better task solutions independent of their representations. Probing of students' visual representations in interviews helped them to get better insight for solving the probability problems.

RR 6:02 Textbook effects on the development of adaptive expertise

Sievert, Henning; Van Den Ham, Ann-Kathrin; Niedermeyer, Inga; Heinze, Aiso

During the last two decades research on the development of adaptive expertise has gained growing research interest. While a number of studies investigated the effects of different instructional approaches, the state of knowledge regarding the impact of learning resources in this field is quite limited. This study provides new insights into the relations of textbook quality and students' adaptive use of strategies in multi-digit addition and subtraction. By reanalysing longitudinal data of 1404 students from grade 1–3, we found quality discrepancies in the textbooks' opportunities to learn as well as substantial effects of these on the students' actual strategy use. Thus, mathematics textbooks can be regarded as meaningful classroom factor predicting the development of students' adaptive expertise.

RR 6:03 Decision-making in noticing students' proportional reasoning

Bufor, Àngela; Fernández, Ceneida; Llinares, Salvador

Research has shown that pre-service teachers and teachers have difficulties in proposing instructional decisions to foster students' understanding. In this research, we analyse the relationship between how pre-service primary school teachers identify the mathematical elements involved in the problem, how they recognise characteristics of students' understanding and the decisions they make according to students' understanding, in the specific domain of proportional reasoning. Results indicate that pre-service teachers who had identified the mathematical elements involved in a problem were more able to provide activities based on students' understanding.

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RR 6:04 Solving arithmetic-algebraic word problems by 10- to 12-year-old students

Fritzlar, Torsten; Karpinski-Siebold, Nadja

Arithmetic-algebraic problems are mathematically challenging problems which can be algebraically solved using variables and equations, but also with approaches traditionally described as arithmetic. Therefore, they are particularly suitable for investigating and, simultaneously, encouraging the emergence of algebraic thinking. In the presented study we investigate how 10- to 12-year-old students work on such problems. Analyses are focussed on the dealing with unknowns which is considered as a key element of algebraic thinking.

RR 6:05 How dragging mediates a discourse about functions

Lisarelli, Giulia

Assuming that the dynamic features of dynamic algebra and geometry environments may provide a basic representation of both covariation and functional dependency and taking a commognitive perspective, a teaching experiment has been designed for introducing students to functions. This paper points to the crucial role that the Dragging tool can play as communicational mediator for discourse on functions. In particular, the episodes we are presenting here show that three different phases of dragging mediated discourse can occur when students are asked to work on activities involving both a dynamic and the traditional static environment.

RR 6:06 The first-time phenomenon: Successful students' mathematical crisis in secondary-tertiary transition

Di Martino, Pietro; Gregorio, Francesca

The huge difficulties related to the transition from secondary to tertiary mathematics are documented by several official data. The analysis of these difficulties is a main issue in educational research at undergraduate level. It is of particular interest the case of the students who choose mathematics as a major. In fact, for the most part, they are students considered excellent in mathematics during secondary school, they seem to have the cognitive resources to succeed, but, in many cases, they encounter several difficulties during their university experience. Therefore, it appears particularly interesting to study also the affective sources and consequences of these difficulties. With this aim, we developed a qualitative and narrative study focused on students' reflections about their mathematical difficulties in the university experience.

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RR 6:07 Conceptualising translations between representations

Dyrvold, Anneli

Representations and translations between them are central in mathematics education. For example in the NCTM standards it is emphasized students need to be able to “select, apply, and translate among mathematical representations to solve problems” (NCTM 2000, p.67). A variety of research studies have contributed to the knowledge about translations the last decades. This variety is both an asset and an obstacle when this research is used to implement new strategies in the school practice or as a base to plan new research studies. To enable an accumulation of the emerging knowledge there is a need to categorize studies that focus on similar questions and that conceptualizes translation similarly. The current paper suggests some classifications that such a categorization can be based on in an emerging framework.

RR 6:08 Teacher beliefs and support for argumentation

Conner, AnnaMarie; Singletary, Laura Marie

Two teachers’ beliefs were inferred from four interviews over the course of two years. Their support for argumentation in high school mathematics classes was recorded and analysed, resulting in differences in support. While the two teachers had similar beliefs about mathematics and proof, they differed in their beliefs about teaching mathematics. In particular, their belief about who was responsible for explanations in a mathematics class was most visible in their support for argumentation.

RR 6:09 The role of horizon content knowledge in teachers’ recognition and interpretation of students’ mathematical misconceptions

Zoitsakos, Sotirios; Zachariades, Theodosios; Sakonidis, Charalampos

Mathematics Knowledge for Teaching (MKT) remains a research challenge as far as its content, structure and role in teaching the subject matter are concerned. The paper examines the recognition and interpretations of 106 secondary mathematics teachers of hypothetical students’ misconceptions related to the dual decimal representation of a rational number. The analysis of these interpretations aims to provide an insight into the role of Horizon Content Knowledge, one of the components of the MKT which has attracted less the interest of the researchers so far.

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RR 6:10 Using self-video-based conversations in training mathematics teacher instructors

Segal, Ruti; Lehavi, Yaron; Merzel, Avi; Baram, Ami; Eylon, Bat-Sheva

Videotaping is widely accepted as a useful tool for the professional development (PD) of teachers because it enhances their ability to perform an in-depth reflection on classroom events. Thus, a video-based discourse has the potential to increase teachers' awareness of their own teaching processes. The present study was conducted as part of a program that emphasizes a specially designed Video-Based Didactics (VBD) discourse. The study focuses on the professional development of two mathematics teachers who also serve as district instructors of mathematics teachers. We will describe how the VBD discourse contributes to the development of the two instructors in terms of the turning points between their different levels of awareness with regard to their classroom teaching and their teachers' instruction.

RR 6:11 Preservice mathematics teachers' curriculum visualization

Amador, Julie; Earnest, Darrell

The purpose was to investigate how preservice teachers draw upon curriculum materials to design an elementary mathematics lesson. We engaged preservice elementary licensure students in a four-part process of analyzing mathematics curriculum, planning a lesson based on the materials, demonstrating their visualization of enactment through an animation, and reflecting on the process. We present a case study of one focal pair to analyze their decision making with respect to curricular adaptations, and specifically the introductory launch portion of the lesson. Findings indicate that the pair modified the curricular materials to model mathematical aspects of fractions and introduced materials not mentioned in the curriculum with which they believed children would be familiar.

RR 6:12 The development of the concept of limit – aspects and basic mental models

Weigand, Hans-Georg

The concept of limit is one of, if not the basic concept of analysis. During the 20th century, various alternatives for teaching this concept, initially in a collegiate environment, were developed which considerably influenced analysis teaching at schools. Currently, it is dominated by the so-called propaedeutic or intuitive concept of limit, in which analysis teaching immediately dives into working with real functions; a formal definition of the limit is waived in favour of an intuitive approach. In the context of teaching based on understanding, this approach needs carefully developed basic mental models, if the understanding of the concept is to surpass the intuitive level and is to be advanced into a mathematically accurate

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understanding. In order to achieve this – and this is the central hypothesis of this article – the concept of sequences is an essential resource to develop the concepts of limit and infinity.

RR 6:13 Pre-service mathematics teachers’ whole-class dialogs during field practice

Høyne, Siri-Malén; Klemp, Torunn; Nilssen, Vivi

This paper is based upon an intervention study where pre-service teachers plan whole-class mathematical dialogs together with their mentor and lecturer. Learning to conduct dialogs is increasingly in focus in teacher education, and in this paper, we examine one whole-class dialog to learn more about its nature. We show that the pre-service teacher fails to involve several pupils in the dialog at the same time, leading to a series of shorter dialogs with one pupil at a time. In the dialog, the communication often ends up being teacher-dominated.

RR 6:14 Response process validity evidence: A proportional reasoning example

Carney, Michele; Paulding, Katie

Providing validity evidence to support the interpretation of scores from diagnostic assessments is a critical component of validation (Ercikan & Pellegrino, 2017). This study provides an example of examining response process validity through analysis of cognitive interviews with middle school students on a proportional reasoning item type embedded in the Diagnostic Assessment of Proportional Reasoning. Our findings indicate students’ reasoning when solving the contextual equation item type differed in important ways from what we had assumed and highlight the critical need for assessment developers to provide, and assessment users to expect, the provision of response process validity evidence as the norm within the mathematics education research community.

RR 6:15 Elementary students’ conditional reasoning skills in mathematical and everyday contexts

Datsogianni, Anastasia; Ufer, Stefan; Sodian, Beate

Reasoning about conditional “if..then” statements is a central component of logical reasoning. Given the early start of the development of everyday conditional reasoning skills and complaints about secondary students’ failure to correctly interpret mathematical conditionals, it is a desiderate to describe the conditional reasoning in mathematics already at younger ages. We report on a study that explored if it is feasible to survey conditional reasoning skills in everyday contexts and mathematics with primary school students. Questionnaire data from 55 Cypriot primary school students show that the applied instrument is accessible to students, and reflect central predictions of Mental Model Theories of conditional

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reasoning for differences between the two contexts. We discuss first implications for research and instruction.

RR 6:16 Big blocks of proof

Asghari, Amir Hossein; Taghi Dastjerdi, Sharareh; Ahmadpour Mobarakeh, Fatemeh

In the present study, 193 groups of three students in grades 4 to 6 were assigned a proof-based problem in the field of number theory. The written responses were analyzed. Not surprisingly, the analysis showed that the majority of them relied on examples to ‘prove’ the given statements. However, there was some variation in the ways that examples had been used. Considering the observed variation, 18 students whose proofs were somehow different from each other were invited and interviewed individually for finding more details about their performances. None of them were able to produce accurate formal proofs. However, their performances had an important similarity to mathematicians’.

RR 6:17 Brazilian high school textbooks: Mathematics and students’ subjectivity

Silva, Marcio; Valero, Paola

We analyze the nationally approved high school mathematics textbooks in Brazil from a perspective of governmentality and subjectivity, important notions in recent socio-cultural-political studies of mathematics education. A Foucauldian discourse analysis on how financial mathematics and interdisciplinarity are displayed in the books was carried out. We show how the mathematics is entangled with ideas of the utility of mathematics and moral directions of behavior on how to become a good capitalist, consuming and caring citizen. This points to how the mathematics teaching and learning suggested in the textbooks go beyond the mathematical contents, but simultaneously normalize the students’ conducts and form their subjectivity.

RR 6:18 Schools’ strategies for promoting girls’ participation in mathematics

Smith, Cathy Anne; Golding, Jennie

Fewer girls than boys in England participate in post-compulsory mathematics. Previous studies have shown the significance to girls of their mathematics lessons and teachers, of cultural constructions of gender and mathematics, of career perceptions and family ‘science capital’. A multiple case-study project investigated institutions with unusually high participation by girls in mathematics. Focus groups and lesson observations were used to explore school pedagogy and culture. Common factors were: early preparation for demanding mathematics, a departmental ethos which encouraged student-teacher interactions in and out of

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lessons, teachers who explicitly and repeatedly confirmed that girls would succeed at mathematics A-level, appreciation of mathematics as opening doors to many careers.

RR 6:19 Investigating learners' fraction understanding: A longitudinal study in upper elementary school

Van Hoof, Jo; Degrande, Tine; Ceulemans, Eva; Verschaffel, Lieven

We longitudinally followed 201 upper elementary school learners in the crucial years of acquiring rational number understanding. Using latent transition analysis we investigated their conceptual change from an initial natural number based concept of a rational number towards a mathematically more correct one by characterizing the various intermediate states learners go through. Results showed that learners first develop an understanding of decimal numbers before they have an increased understanding of fractions. We also found that a first step in learners' rational number understanding is an increased understanding of the numerical size of rational numbers.

RR 6:20 Variation of student engagement between different algebra tasks

Tuomela, Tatu Dimitri; Hähkiöniemi, Markus

In this study, we analyse how 7th grade students' engagement during small group work differed in two consecutive algebra lessons: in the first lesson students solved equations and in the second lesson they created equations for other small groups to solve. Data was collected by videorecording the work of two groups in both lessons. Through directed content analysis, categories indicating student engagement were formed based on previous research and refined during analysis. The analysis revealed a change from individual engagement to collaborative engagement between lessons and an increase in many passive students' engagement. Task characteristics which may affect the type and amount of engagement are discussed.

RR 7:01 Knowledge of statistical tests by prospective high school teachers

Batanero, Carmen; López-Martín, María del Mar; Gea, María Magdalena; Arteaga, Pedro

This research was aimed to evaluate prospective high school teachers' common knowledge of hypothesis tests. The responses given by 73 Spanish prospective teachers to an open problem similar to those included in the previous years at the entrance to university tests are analysed. Although the majority of participants set correct hypotheses and select a test consistent with the same, only part of them correctly complete the procedure, make the correct decision and contextualize the

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results. The implication is the need for a better preparation of teachers in this topic.

RR 7:02 Which is smaller...? Partial understandings and misconceptions about multiplication and division by fractions

Hamo, Pircha; Ilany, Bat-Sheva; Buzaglo, Meir

This study addresses difficulties students in grades 6 and 8 have in extending the meaning of multiplication and division from whole numbers to fractions. A research questionnaire and student interviews revealed various partial understandings of multiplication and division by fractions. Using matched pairs of modelling tasks, we compared how students interpret and apply different models of multiplication and division in tasks involving fractions. This enabled us to evaluate the sophistication of their conceptions and uncover their misconceptions. In particular, we uncovered a misconception that seems unique to rational numbers expressed as fractions: students conflated multiplication and division when modeling “part of”.

RR 7:03 Use of a learning trajectory as a conceptual instrument to develop the competence of professional noticing

Sanchez-Matamoros, Gloria; Moreno, Mar; Valls, Julia; Callejo, M Luz

The objective of this study was to characterize how a learning trajectory, relating to length magnitude and its measurement, could be used by pre-service kindergarten teachers to develop their professional competence of noticing the mathematical thinking of children. That is, how a learning trajectory could be used as a conceptual instrument, by means of two instrumented action schemes: by using the trajectory’s learning progression model and tasks to interpret children’s responses, and by suggesting new tasks that supported progress in comprehension. A total of 47 pre-service kindergarten teachers took part in the study. Results showed that the learning trajectory helped pre-service teachers to interpret children’s mathematical thinking, and to make appropriate decisions in support of their students’ progress.

RR 7:04 Does the cognitive demand of a problem increase when the answer is an inequality?

Waisman, Ilana; Leikin, Mark; Leikin, Roza

This study is inspired by the observation that in school mathematics inequalities rarely appear as a problem-solving outcome. We call such problems inequality-tasks, while problems in which an answer is attained in the form of an equality we call equality-tasks. We hypothesised that inequality-tasks require higher cognitive demand as compared to equality-tasks. We examined this hypothesis using short

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geometry verification problems with students who differed in their levels of general giftedness and expertise in school mathematics. We employed Event Related Potential methodology to confirm the hypothesis. Analysis of neuro-cognitive measure led to new research questions and hypothesis about insight-related moment of answer verification and activation of working memory associated with high cognitive demand.

RR 7:05 Transformation of a geometric diagram to produce a conjecture and its proof

Saenz-Ludlow, Adalira; Athanasopoulou, Anna

Given a set of geometric conditions student-teachers were asked to construct a geometric diagram, explore it, observe it, make a conjecture, and prove the conjecture. The focus of this paper is to analyze one of two proofs, for the same task, offered by a student-teacher to validate his conjecture. This student participated in a constructivist classroom teaching-experiment on the teaching-learning of geometry using the Geometer's Sketch Pad (GSP). The analysis uses Stjernfelt's model for diagrammatic reasoning, rooted in the semiotics of Charles Sanders Peirce, which considers the transformation of diagrams to unveil valid relations among their parts. In the case of geometry, such relations enable the construction of geometric arguments to prove geometric propositions.

RR 7:06 Academic procrastination in the transition from school to university mathematics

Geisler, Sebastian; Rolka, Katrin

The transition from school to university is a challenging process for many students, especially in mathematics. This is illustrated by high dropout rates during the first year. In this contribution we discuss the connection between mathematic-related affective variables (different facets of interest in mathematics, self-concept and beliefs concerning the nature of mathematics) and academic procrastination. Moreover, the effect of procrastination on students' dropout intention and their satisfaction with their studies of mathematics during the first semester is analysed. Procrastinating students show less interest in university mathematics. While the beliefs concerning the nature of mathematics turn out to be a predictor of students' procrastination, procrastination itself predicts students' satisfaction with their studies of mathematics.

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RR 7:07 Crossing the boundaries between school mathematics and workplace through authentic tasks

Vroutsis, Nikolaos; Psycharis, Giorgos; Triantafyllou, Chrissavgi

This paper reports a case study research aiming to connect the teaching and learning of mathematics in upper secondary education with the workplace. Four 10th grade students engaged in authentic tasks from the merchant navy context concerning the navigation of a ship through the use of original tools (e.g., the nautical map). We use the notions of activity system and boundary crossing to study students' construction of meanings for geometrical concepts. Results indicate that the students took a new look at the school taught geometry, by adopting the workplace perspective (perspective taking) and addressing authentic workplace problems through the lens of school mathematics (perspective making).

RR 7:08 Problem solving: How preservice teachers understand it during their preservice learning

Pyper, Jamie S; MacGregor, Stephen

Teaching mathematics requires writing, finding, and modifying mathematics problems relevant and appropriate for the students in the course. The preservice program sets the stage for teachers' conceptualizations, appreciations, and understandings of what teaching and learning mathematics means. This mixed methods study explores 44 secondary school preservice mathematics teachers' beliefs about problem solving as they progress through a preservice mathematics education course. Ontologically, problem solving begins closely bound to textbook examples and irrelevant 'real-world' contexts and then shifts to socially relevant experiences. Epistemologically, a gradual release of responsibility reduces structural rigidity in teaching and increases purposeful critical thinking.

RR 7:09 Links between teachers' pedagogical technological knowledge and their personal characteristics

Anabousy, Ahlam Adnan; Tabach, Michal

The present study examines the relationship between the different components of pedagogical technological knowledge (PTK), as well as the effect of seniority, employment status, educational status and technological-integration level on PTK scores. We used the PTK questionnaire introduced by Thomas and Palmer. Forty-two middle school mathematics teachers participated in the study. The statistical analysis showed strong correlations between the different components of PTK and PTK itself with the exception of content knowledge component. Results showed also the significant effect of seniority and technology-integration level on PTK, the confidence and the technology instrumental genesis scores. Education status affected positively one of the PTK components: confidence.

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RR 7:10 What do mathematicians wish to teach teachers in secondary school about mathematics?

Hoffmann, Anna; Even, Ruhama

This study investigates what mathematicians wish to teach teachers about what mathematics is. Data source included interviews with five research mathematicians who taught advanced mathematics courses to practicing secondary school teachers. Analysis revealed that expanding teachers' knowledge about what mathematics is was one of the main objectives of the interviewees. They referred to three aspects: (1) the essence of mathematics, (2) doing mathematics, and (3) the worth of mathematics. This paper characterizes and illustrates each aspect.

RR 7:11 Students' readiness to appropriate the derivative - Meta-knowledge as support for the ZPD

Vos, Pauline; Roorda, Gerrit

To what extent are students ready to appropriate a mathematical concept when this is introduced? We studied the Zone of Proximal Development (ZPD) of ten students in grade 10 before being taught the derivative. We used task-based interviews to study their pre-derivative knowing (e.g. functions, slope), and how they handled problem situations that required the derivative. Most were able to apply numerical or graphical approximations. Some students saw commonalities among the tasks, and felt a need for a more precise tool. By describing goals of a new tool, they showed to have meta-knowledge without knowing the concept itself. This meta-knowledge assisted them to appropriate the derivative as a tool they could use flexibly and confidently in non-routine situations. Other students' appropriation took more than a year.

RR 7:12 Financial literacy: Practicing money management as your future-self

Connolly, Mary; Nicol, Cynthia

This paper explores middle school students' experiences of financial literacy, specifically money management. Thirty-seven students aged 13-14 from a range of socioeconomic backgrounds participated in individual audio-recorded interviews on a budget-making task for a 25-year-old future self. Transcribed interviews were analyzed for students' perspectives on the budgeting activity and mathematical challenges they encountered. Results indicate that although familiar with the term 'budget' only 15% were initially able to describe a budgeting process. Nonetheless, all students developed a budget and almost all reported the activity deepened personal understandings of money management. The study provides insights to the developing literature on youth conceptions and experiences of financial literacy.

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RR 7:13 A dual eye-tracking study of objectification as student–tutor joint activity appropriation

Shvarts, Anna

The study develops late-Vygotsky's approach of the learning process as a progressive appropriation of an irreducibly collaborative student-tutor joint activity. Combining videography with dual eye-tracking data, we demonstrate how objectification begins with recurrent dialogue between a student and a tutor and continues with the student's egocentric speech that maintains the structure of the collective behavior, allowing the student to regulate her emerging mathematical ideas. The multimodal flow of conversation is conjoined and structured within the student-tutor dyad's joint visual attention that later transforms into mental joint attention, ready to be restored back to visual joint attention in case of difficulty or misunderstanding.

RR 7:14 Examining teachers' discourse on students' struggle through figured worlds

Shabtay, Galit; Heyd-Metzuyanim, Einat

We apply the lens of figured worlds on teachers' pedagogic discourse to understand their identity and practice in relation to offering students opportunities to struggle. The study involved 12 elementary mathematics teachers who were interviewed based on teaching vignettes - short stories exemplifying teaching that is high/low in students' opportunities for struggle. Two distinct figured worlds were identified: the world of "acquisition" and the world of "exploration". Teachers belonging to each of these worlds differed in their interpretations of identical vignettes depicting students' struggle, and their identities as teachers cohered with these interpretations. Implications of these results on attempts to reform teachers' practice towards explorative instruction are discussed.

RR 7:15 Early mathematical reasoning – theoretical foundations and possible assessment

Lindmeier, Anke; Brunner, Esther; Grüßing, Maike

Mathematical reasoning is a complex skill and as such requires coherent cumulative learning experiences. Although there is a strong research base on mathematical reasoning at the secondary level, it is hardly investigated in early mathematics education so far. There is a lack of theoretical conceptions of early mathematical reasoning as well as of empirical findings concerning prerequisites and forms of mathematical reasoning of young children. In this contribution we first discuss the nature of early mathematical reasoning and characterize it along the dimensions knowledge, representations and formulation from a theoretical perspective. This results in a description of facets of early mathematical reasoning processes.

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Second, we sketch the development of task to assess early mathematical reasoning and provide first empirical findings. The contribution hence provides an approach to further research on early mathematical reasoning with the aim of better understanding an allegedly important root of advanced mathematical thinking.

RR 7:16 The use of nonstandard problems in an ODe course for engineering students

Treffert-Thomas, Stephanie; Rogovchenko, Svitlana; Rogovchenko, Yuriy

We report on the design and use of ‘nonstandard’ problems in an ordinary differential equations (ODEs) course for engineering students. The focus of the paper is on the analysis of the development of students’ mathematical discourse and conceptual understanding of Existence and Uniqueness Theorems (EUTs) from a commognitive theory perspective. Our analysis so far shows how students use familiar mathematical routines in new situations furthering their knowledge and understanding. Nonstandard problems have been a useful tool to gain insights into students’ learning of mathematics.

RR 7:17 Doctoral programs’ contribution to becoming a mathematics education researcher

Haser, Çiğdem

The knowledge and skills that a mathematics education (MathEd) researcher should have and to what extent doctoral programs (DPs) contribute to this researcher were explored through the written responses of 37 doctoral students studying in the field of MathEd in Turkish, European and North American DPs to an open-ended survey. Findings addressed that doctoral students prioritized research and MathEd related knowledge and skills the most. Generic skills, career skills, critical research skills and habits of mind were stated the least. Participants evaluated their knowledge and skills and DPs’ contribution to them as mostly sufficient. However, more courses and experiences were needed. Scholarly climate and human resources were the strongest aspects of DPs. Research opportunities for doctoral students needed improvement.

RR 7:18 Eye-Tracking for studying mathematical difficulties—Also in inclusive settings

Schindler, Maike; Lilienthal, Achim J.

Eye-Tracking (ET) is a promising tool for mathematics education research. Interest is fueled by recent theoretical and technical developments, and the potential to identify strategies students use in mathematical tasks. This makes ET interesting for studying students with mathematical difficulties (MD), also with a view on inclusive settings. We present a systematic analysis of the opportunities ET may

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hold for understanding strategies of students with MD. Based on an empirical study with 20 fifth graders (10 with MD), we illustrate that and why ET offers opportunities especially for students with MD and describe main advantages. We also identify limitations of think aloud protocols, using ET as validation method, and present characteristics of students' strategies in tasks on quantity recognition in structured whole number representations.

RR 7:19 Wicked problems in school mathematics

Steffensen, Lisa; Herheim, Rune; Rangnes, Toril Eskeland

The paper concerns climate change controversies and teachers' facilitation of pupils' critical mathematics perspectives through wicked problems. The data was collected in a research partnership with three teachers and their tenth grade pupils. A particular focus is directed towards how controversies can influence teachers to make different versions of a quiz, and this is discussed in relation to the teachers' value perspectives. The teachers' choices of questions, numbers, and graphs are connected to their facilitation of action or critical thinking. In the dialogues, the teachers challenged each other's choices, and the controversies and value aspects were made explicit.

RR 7:20 A study of middle school students' algebraic proofs in China

Qiao, Xuefeng

This study examined how middle school students in China constructed written proofs for six elementary number theory (ENT) statements. The participants were 80 junior middle school students (year 9). It finds that students seemed not to have a good awareness of what mode of justification was needed to verify or refute a particular statement. The common problems in students' algebraic proofs include the lack of necessary steps of reasoning and incorrect explanations.

RR 8:01 Primary school children's (9 year olds') understanding of quadrilaterals

Bernabeu, Melania; Moreno, Mar; Llinares, Salvador

Our goal was to identify what factors trigger or inhibit the capacity to recognize different properties of quadrilaterals and how these properties were related to classify quadrilaterals. A total of 29 primary school children (9 years old) participated in a teaching experiment focused on representing and distinguishing quadrilaterals to emphasize the transition from description to analytical perspective. Findings suggest that the identification and use of different attributes to represent and classify quadrilaterals is gradual and depends on the attributes used. This result supports the idea that the coordination between the discursive registers and the differentiation of the relevant attributes are key factors in the transition from

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the perceptual to the analytical perspective in quadrilaterals' conceptual understanding.

RR 8:02 Individual differences in fractions' conceptual and procedural knowledge: What about older students?

Bempeni, Maria

We constructed and calibrated an instrument targeting conceptual and procedural fraction knowledge. We used this instrument in a quantitative study with 126 secondary students (7th and 9th graders), testing the hypothesis that there are individual differences in the way students combine the two types of knowledge. Cluster analysis revealed four distinct student profiles: Students who were either stronger or weaker than expected with respect to both types of knowledge; students who were stronger with respect to conceptual knowledge; and students who were stronger with respect to procedural knowledge. These findings support the individual differences hypothesis.

RR 8:03 Role of using an alternative concept definition in conducting mathematical tasks of teaching: The case of explaining why an algorithm works

Dilberoglu, Merve; Haser, Cigdem

This study illustrates the importance of attending to central concept definitions while conducting a particular mathematical task of teaching-explaining why an algorithm works. Individual task-based interviews were conducted with 14 preservice teachers, in which participants were asked twice to explain why the standard algorithm for obtaining the least common multiple (lcm) of two positive integers works: First by depending on their personal definitions of the concept lcm, and then by considering an alternative definition of the concept presented to them. Upon working on the alternative definition together with the first author, half of the participants improved their explanations. Findings suggest that study of alternative definitions might enhance preservice teachers' understanding of why mathematical algorithms work.

RR 8:04 Solving combinatorial counting problems: Primary children's recursive strategies

Höveler, Karina

The idea of recurrence is of fundamental importance in different areas of mathematics. One of these is the field of combinatorics, which provides many problems to introduce the idea of recurrence at an early stage of students' mathematical thinking. So far, there is still insufficient knowledge regarding the use of recursive strategies for combinatorial counting problems in primary schools. This paper

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therefore presents the results of a qualitative study with primary children of the third grade who solved analogous combinatorial problems by recursive strategies.

RR 8:05 Affordances and tensions in teaching both computational thinking and mathematics

Bakos, Sandy; Thibault, Mathieu

This study reports on a dynamic geometry approach to the teaching of looping in a grades 2/3 classroom. The study is part of a large initiative to integrate computational thinking in the primary mathematics classroom. Descriptive analysis of interview data suggests that the majority of young learners were capable of interpreting and creating multiple action loops. However, we identify certain difficulties that some students experienced and report on the affordances and tensions involved in trying to combine computer science and mathematical concepts in a mathematics classroom.

RR 8:06 Some changes of math anxiety groups based on two measurements, MASS & EEG

Ryoo, Byeongguk; Choi-Koh, Sang Sook

This article investigated how mathematics anxiety (MA) of Korean middle school students could be reduced by comparing analytically their cognitive neuroscience and questionnaire results. We developed a three-hour Complex Treatment Program (CTP) on quadratic functions for the study. In the summer of 2016, we collected data of the pre and post MA questionnaires by Mathematics Anxiety Scale for Students (MASS), the percent of correct answers (PCA) & reaction time (RT) by E-prime program, and also brain-imaging data of the event related potentials (ERP) by Electroencephalograph (EEG) using computer-based functional F-G model. The result indicated the CTP to be effective with the group with higher math anxiety and the group with higher achievement respectively. The MASS result was verified with the better performance of PCA on type G, which was measured by E-prime program. Some interesting patterns were revealed on brain-imaging data by EEG, indicating more mental activities with the MA groups.

RR 8:07 Enactment of inquiry-based mathematics teaching and learning: The case of statistical estimation

Triantafillou, Chrissavgi; Psycharis, Giorgos; Bakogianni, Dionysia; Potari, Despina

This paper investigates the enactment of inquiry-based mathematics teaching (IBMT) and inquiry-based mathematics learning (IBML). The focus is on how two teachers enacted the same task into their classrooms and on how this enactment framed students' mathematical activity concerning the notion of statistical

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estimation. Through the use of the sociodidactical tetrachedron, our study shows that IBMT and IBML are framed by different factors such as the selection and use of artefacts, the newly established and existing classroom norms and the meanings that teachers and students attribute to statistical estimation and to inquiry-based teaching and learning.

RR 8:08 Jourdain and Dienes effects revisited - playing Tic Tac Toe or learning non-Euclidean geometry?

Cooper, Jason; Pinto, Alon

Research mathematicians often play a central role in determining educational policies, yet the relevance of their mathematical expertise may be (and indeed often is) questioned. A mathematician who developed a game based on non-Euclidean geometry, and a high school teacher, participated in a group discussion on the game, and were interviewed separately to elicit their perspectives on enriching advanced-track students through inquiry. Though their perspectives appeared in many ways incompatible or incommensurable, we suggest ways in which many of their conflicting concerns can be reconciled. In this we are proposing a model of cooperation among communities, where mathematicians' and teachers' contribution to mathematics education is mediated by mathematics education researchers.

RR 8:09 Productive ways of organising practicum – what do we know? A systematic review

Österling, Lisa; Christiansen, Iben Maj

The starting point for this review are questions on the empirical base for the organization of practicum. Selecting peer reviewed, empirically based articles for 2001-2017, with a focus on mathematics teacher education and the practicum, resulted in the inclusion of 51 articles for review. Exploring the outcomes and student teachers' experiences of practicum suggested that responsibility for teaching together with support from mentors, university lecturers, university coursework, peers or prompts to use a theoretical framework improves learning outcomes in practicum, and the length of time in a school context does not do so on its own.

RR 8:10 A comparison of approaches to stimulated recall interviews with mathematics teachers in order to identify shifts in attention

Brown, Julian Tom

In the course of pilot studies for researching mathematics teacher pedagogy and classroom awareness, I have conducted interviews using different approaches to stimulated recall. In this methodological discussion, which draws on empirical data in order to illustrate methodological findings, I consider how the temporal

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constraints and activity-related context of the interviews interacts with the qualities of response from the participants in two such interviews. Reflections on two case studies suggest that where a stimulated recall interview follows on directly from the originating event, particular care must be taken to establish a descriptive frame for participant responses.

RR 8:11 Secondary prospective teachers' interpretative knowledge on a measurement situation

Ribeiro, Miguel; Jakobsen, Arne; Mellone, Maria

With a focus on teachers' perception about the area formula for a rectangle, we discuss components of the knowledge mobilized by prospective secondary teachers' when answering a particular task aimed at accessing and developing their interpretative knowledge. In particular, we investigate the relationships between the focus of the prospective teachers' content knowledge and their ability to expand their own space of solutions. Our findings reveal that the prospective secondary teachers seem to understand area as a surface measurement, but struggle to give meaning to the area formula of a rectangle when the reasoning involved differs from their own.

RR 8:12 Which key memorable events are experienced by students during calculus tutorials?

Marmur, Ofer; Koichu, Boris

The paper focuses on student learning experiences during large-group undergraduate Calculus tutorials. We identify eight types of Key Memorable Events – emotionally loaded events that are meaningful for the learning process in class from a student perspective. The findings are predominantly based on stimulated-recall interviews with 36 students, corresponding to 7 filmed lessons. Implications are drawn in relation to both the learning and teaching in the undergraduate mathematics classroom.

RR 8:13 Criteria for knowing a geometrical object: The enactivist perspective

Kageyama, Kazuya

This article proposes several criteria for students to know a geometrical object and identifies the trigger for evolving interactions between the teacher, the students, and the learning environment from an enactivist perspective. This article focuses on the identification of the key concept of bringing forth a world to interpret students' geometrical behaviors. Based on a qualitative research methodology, a theory for generating geometrical objects was suggested and exemplified through the analysis of third-grade mathematics lesson, from which three criteria; (I) theoretical, (II) possible, and (III) actual; were identified. It was observed that an

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important trigger for the evolving interactions was that the students were able to engage physically and theoretically in an open situation.

RR 8:14 Proof and proving in high school geometry: A teaching experiment based on Toulmin's scheme

Moutsios-Rentzos, Andreas; Micha, Ioanna

In this paper, we discuss a teaching intervention utilising a two-faceted didactical tool that draws upon Toulmin's scheme in order to introduce high school students to mathematical proof. An experimental research design was implemented. The results of the conducted analyses suggest that the proposed tool helped the students in discerning and differentiating data from claims in a geometry proving problem, whilst they obtained appropriate overview of the structure of a valid proof, including their developing a need for including only necessary arguments in a proof.

RR 8:15 Linking informal and formal mathematical reasoning: Two directions across the same bridge?

McMullen, Jake; Resnick, Lauren B.

What do students need to do in order to use their formal mathematical knowledge in everyday informal situations? How can informal everyday mathematical reasoning be used as a foundation for developing new mathematical knowledge? Are these two directions on the same bridge – that which lies between informal and formal mathematical reasoning? Herein we argue that connections between the informal mathematics of everyday life and formal mathematical instruction must be encouraged and supported throughout the mathematical curriculum, including also in late primary and lower secondary school. We argue that there are crucial mental processes that underlie both and that these processes may be keys to developing all students abilities to connect their informal and formal mathematical reasoning.

RR 8:16 Using three fields of education research to frame the development of digital games

Zandieh, Michelle; Williams-Pierce, Caro; Plaxco, David; Amresh, Ashish

In this article, we explore three theoretical perspectives that inform the development of high-quality, research-based, digital instructional materials. In our team's efforts to develop a game-based learning applet for an existing inquiry-oriented curriculum, we have sought to theoretically frame our approach so that we can draw on the corpus of researcher knowledge from multiple disciplines. Accordingly, we will discuss three bodies of literature – realistic mathematics education's approach to curriculum development, inquiry-oriented instruction and

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inquiry-based learning, and game-based learning – and draw on parallels across the three in order to form a coherent approach to developing digital games that draws on expertise in each field.

RR 8:17 Predictors of demand for mathematics support

Edwards, Antony; Carroll, David

This report analyses usage data for a well-established undergraduate mathematics support centre, exploring the relationship between time of visit, duration of visit and various demographic groupings such as age, gender, residency status, first language and a constructed variable for "at risk of failing". We found, and measured, surges in demand for mathematics support as summative assessments approached. Visits further in advance of assessments tended to be of a shorter duration, and were more likely to be made by female and older students. Our results are important for those involved in mathematics support, especially in its administration and evaluation, but they are also of interest for anyone wishing to explore or predict times where their own students may require additional support.

RR 8:18 The role of finger gnosis in the development of early number skills

Hilton, Caroline Ann

The role of fingers in the development of early number skills has often been the focus of discussion in mathematics education, psychology and neuroscience. This study describes the findings of a longitudinal exploration of the mathematical development of children with Apert syndrome. Children with Apert syndrome are born with their fingers fused and even after surgery to separate them, do not often use their fingers spontaneously in activities involving number. Through observations over a 2 year period, the role of fingers in supporting learning and activities in numerical aspects of mathematics was seen to be complex and requiring good finger awareness and finger mobility. The findings suggest a possible explanation for the observation that some children who are low-attaining in mathematics are over-dependent on finger-use.

RR 8:19 Finnish primary teachers' interaction with curriculum materials – digitalisation as an augmenting element

Krzywacki, Heidi; Hemmi, Kirsti; Remillard, Janine; van Steenbrugge, Hendrik

This paper investigates how Finnish primary teachers talk about their interaction with curriculum materials, especially the additional facilities that digitalisation and technology provide to mathematics education. Digital curriculum materials are seen as part of available resources for teaching and learning mathematics. The data of this qualitative study consists of semi-structured interviews with seven primary teachers. Six thematic categories emerge in the data illustrating the

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elements that teachers consider crucial in evaluating and using the curriculum resources. The Finnish teachers prove to be critical and strategic consumers who understand the potential of the digital curriculum materials but make decisions about the use primarily in terms of enhancing student learning.

RR 8:20 The relation of children's performances in spatial tasks at two different scales of space

Heil, Cathleen

This study investigates the relation between performances of fourth-graders in spatial tasks with depictive material in the classroom and orientation tasks in real space. The children completed a paper and pencil test and a map-based orientation test on campus. A correlational analysis revealed that the children's performances in small-scale spatial tasks are related to their performances in large-scale spatial tasks. Moreover, classes of small-scale tasks that require mental transformations concerning the self and concerning objects are related to large-scale tasks that involve the update of the self-to-landmark relations in real space and the map-environment relation, respectively. Both classes contributed to the prediction of performances in map-based orientation tasks that require a constant update of map-self-landmark relations.

RR 9:01 Primary grade students' fundamental ideas of geometry revealed via drawings

Kuzle, Ana; Glasnović Gracin, Dubravka; Klunter, Martina

Despite the importance of geometry in mathematics curriculum, the trend in reduction of geometry in school mathematics is ongoing. This raises the question concerning geometry competencies students acquire in school mathematics. The goal of this exploratory study was to analyze grade 3-6 students' understanding of geometry by using drawings, and through it to gain insight into school geometry nowadays. The results show that students have a rather narrow understanding of geometry. While fundamental idea of elementary geometric forms and their construction dominated in the students' drawings, fundamental ideas of geometric patterns, coordinates, and geometrization were minimally present. Based on the data, the results are discussed with regard to their theoretical and practical implications.

RR 9:02 The natural number bias in arithmetic operations: The case of the representational form of the numbers

Christou, Konstantinos

In this study, it is tested the effect of the natural number bias (i.e. the tendency to ascribe characteristics of natural numbers to non-natural ones), to students'

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intuitions about the size and the representational form of the outcome of multiplication and division. A paper-and-pencil test was administered to 91 7th and 8th grade Greek students. The test included equalities between given and missing numbers (e.g., $4 \div _ = 7.6$) to be validated. The results showed a strong natural number bias effect both on students' anticipations about the size of the outcome of each operation (i.e., that multiplication always makes bigger and division makes smaller), and about the representational form of the outcome (i.e., that natural makes natural, and decimals make decimals). Educational implications are discussed.

RR 9:03 Using critical events in pre-service training: Examining the coherence level between interpretations of students' mathematical thinking and interpretations of teacher's responses

Rotem, Sigal; Ayalon, Michal

The participants of this study were asked to report on critical events that hold the opportunity for teachers' decision-making to build on students' mathematical thinking. The goal of this study is to analyze the coherence between pre-service mathematics teachers' interpretations of students' contributions and their interpretation of teachers' responses in these critical events. An analysis of 37 reports indicates that while PTs show the ability to identify critical events and to interpret students' thinking within the event, there is low coherence between their interpretations and their analyses of the teacher's responses. One possible implication is that teacher educators and expert teachers who train pre-service teachers should be more explicit when discussing the reasoning behind teachers' responses to students' mathematical thinking.

RR 9:04 Theories about mathematical creativity in contemporary research: A literature review

Joklitschke, Julia; Rott, Benjamin; Schindler, Maïke

The article presents a systematic analysis of theoretical backgrounds in articles about mathematical creativity for the last ten years. Due to the multifaceted concept of creativity, various keywords were used for the literature study. These search words were identified in a search in relevant literature and ten years of PME proceedings. The coding of the articles as well as the inductively created category system is presented. As a result, we see that most authors refer to a multitude of descriptions to approach creativity. With this approach we were able to shed light to the characteristics of conceptualizations of creativity which are discussed.

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RR 9:05 Task design to prompt making sense of pre-calculus concepts using dynamic technological tools

Swidan, Osama

This study aims at exploring how learning tasks designed according to the Method of Varied Inquiry approach may enable students to discern between mathematical objects inherent in simulation of a real-world phenomenon and to become aware of the mathematical concepts within the tasks. The Method of Varied Inquiry approach is a combination of two theoretical perspectives: the logic of inquiry and the variation theory. A learning experiment was conducted with 15-year-old students in a high school in Turin, Italy. Findings shows that the tasks enable the students to discern between critical aspects of a real-world phenomenon and the mathematical relationships inherent to it. Insights for improving task design and role of the teachers were made.

RR 9:06 Students' sense of belonging to mathematics in the secondary-tertiary transition

Meehan, Maria; Howard, Emma; Ni Shuilleabhain, Aoibhinn

A “sense of belonging to math” (SBM) scale has been shown to predict undergraduate mathematics students' intent to study mathematics in the future. In this study, we use the scale to examine the impact of the transition from secondary school to university on 33 first year undergraduate students' SBM. Using a cluster analysis, we identify three clusters: students in both Cluster 1 ($n=21$) and Cluster 2 ($n=9$) display a strong SBM at secondary school. Following the transition, those in Cluster 1 exhibit a decrease in SBM, while those in Cluster 2 show only a marginal decrease. Students in Cluster 3 ($n=3$) show a strong increase in their SBM, but they started with the lowest SBM initially. From an analysis of interviews with seven of the students, factors that might impact students' SBM during the transition are discussed.

RR 9:07 Thinking in movement and mathematics: A case study

Ferrara, Francesca; Ferrari, Giulia

This paper discusses recent theories in mathematics education that, while studying the role of the body in mathematics, reveal growing interest in the dynamic nature, or flow, of mathematical activity, rather than in what the activity allows to achieve and how. Pursuing the lines of flight offered by these studies on the visceral role of movement, we draw on the idea of “thinking in movement” by Sheets-Johnstone (2009, 2011) to elucidate the interconnection between moving and thinking. We use this perspective to analyse an interview in which a grade 4 student is engaged with spatio-temporal relationships, as a way to better study his encounter with graphical configurations.

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RR 9:08 Developing prospective teachers' mathematics orientations in the content courses

Appova, Aina

We examine the work of expert mathematics teacher educators (MTEs) in mathematics “content” courses, specifically MTEs’ reflections and insights (from interviews) on the mathematics-related “orientations” that they promote and develop with K-8 prospective teachers (PTs). We found that expert MTEs, during content courses, offer PTs opportunities to develop “conceptual” orientations towards teaching mathematics (Thompson et al. 1994) and “problem-solving” orientations towards mathematics as a discipline (Ernest 1991). Implications from this work offer recommendations for teacher education, research, and practice.

RR 9:09 What vocabulary do teachers use when analysing the use of representations in classroom situations?

Friesen, Marita; Mesiti, Carmel; Kuntze, Sebastian

The International Classroom Lexicon Project has drawn attention to research into the professional vocabulary teachers use when describing classroom phenomena. It is assumed that what teachers identify and interpret when observing classroom situations is not only channelled by their knowledge but also by what they can name. The documentation of professional vocabulary might therefore be of special interest when teachers’ analysing of classroom situations is investigated. Building on our prior research, we documented the professional vocabulary used by teachers when analysing classroom situations regarding the use of representations. Although the teachers used specific vocabulary in their analysing results, the documented terms reveal a lack of key aspects regarding theory on dealing with multiple representations.

RR 9:10 Using self-video analysis to promote teacher growth

Andrews, Nick; Ingram, Jenni; Pitt, Andrea

In this paper we examine one teacher’s professional growth as she participates in a self-video based professional development project. Using the Interconnected Model of Professional Growth we explore how one teacher identified areas of her teaching she wanted to change and the nature and extent of the change for one of these areas over the two years of the project. We particularly address the question of the nature of teacher professional growth in video studies with goals that are responsive to the emerging concerns of the teachers involved.

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RR 9:11 Linking theory and practice: Prospective teachers creating fictional classroom discussions

Cusi, Annalisa; Morselli, Francesca

In this contribution we discuss a course for prospective primary school teachers aimed at providing them with theoretical tools that could support their future work. Specifically, the course is based on a theory-informed design of tasks for pupils and subsequent creation of fictional classroom discussions focused on the same tasks. Our research questions concern prospective teachers' reflections on the activities in which they are involved and on the ways in which these activities could promote their professional development. By means of a qualitative analysis, we highlight categories of prospective teachers' reflections and interpret these results in terms of levels of awareness.

RR 9:12 Calculus students' use of visualizations when solving volume problems

Bresock, Krista Kay; Sealey, Vicki Lynn

Calculus volume problems are unique in that they involve two areas important in calculus: integration and visualization. This research aims to investigate student understanding of integration when solving volume problems and how students use their drawings to aid in the problem-solving process. Participants were recruited from a large, public research university and interviews consisted of students working through routine and novel volume problems while discussing their thought processes aloud. All students in this study used pictures in the process of solving the volume problems, but the extent to which students could use their sketches meaningfully varied greatly. We recommend greater emphasis on non-traditional, non-revolution volume problems in Calculus 2 classrooms.

RR 9:13 An innovative qualitative video analysis instrument to assess the quality of post-secondary algebra instruction

Cawley, Anne; Duranczyk, Irene; Mali, Angeliki; Mesa, Vilma; Strom, April; Watkins, Laura; Kimai, Patrick; Lim, Dexter

Evaluating the Quality of Instruction in Post-secondary Mathematics (EQIPM) is a video analysis instrument designed to capture the interactions between instructors, students, and content in post-secondary (tertiary-type B) algebra courses. The instrument evolved from two existing instruments that assess the quality of instruction in K-12 settings—the Mathematical Quality of Instruction (MQI) (Hill, 2014) and the Quality of Instructional Practices in Algebra (QIPA) (Litke, 2015). This paper describes codes from the EQIPM instrument that address three aspects of instruction and presents findings from a pilot study involving 15 class sessions taught by six mathematics instructors. We highlight the potential of the

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instrument for capturing instances high-quality instruction that leads to meaningful student learning.

RR 9:14 The applied knowledge of trainees as industrial clerks solving problems with vocational and non-vocational context

von Hering, Robert; Rietenberg, Anja; Heinze, Aiso; Lindmeier, Anke

Following literacy frameworks, one aim of educational policy is to prepare students for their professional lives. Vocational training for industrial clerks, which relies on mathematical competence, is of high interest for mathematics education. One specific question is which role school-acquired mathematical competence plays in vocational training. It is suggested that mathematical competences connected to vocation-related mathematics may be a link between demands of general and vocational education. We designed problems that mirror these different demands and conducted an interview study with trainees as industrial clerks. The results show that the trainees' knowledge application differed for the different types of demands so that the approach enabled us to reveal qualitative differences between general and vocation-related mathematics.

RR 9:15 From everyday problem to a mathematical solution — understanding student reasoning by identifying their chain of reference

Dreyøe, Jonas; Larsen, Dorte Moeskær; Misfeldt, Morten

This paper investigates a group of students' reasoning in an inquiry-oriented and open mathematical investigation developed as a part of a large-scale intervention. We focus on the role of manipulatives, articulations, and representations in collaborative mathematical reasoning among grade 5 students. In this analysis, we apply the idea of the chain of reference from the studies of Bruno Latour (1999) to the exploration, generation, and formalization of scientific knowledge. This framework allows us to combine knowledge from mathematics education about language and representations, manipulatives, and reasoning in a way that allows us to follow the material traces of students' mathematical reasoning and hence discuss the possibilities, limitations, and pedagogical consequences of the application of Latour's (1999) framework.

RR 9:16 Accountability and assessment: Gaps and grids

Alderton, Julie; Pratt, Nick

A recent major policy change in England dismantled the use of National Curriculum levels for assessing pupil outcomes and progress. Our study analyses how primary teachers responded to these reforms, reorganising their practices in a manner constrained by a well-established accountability culture. We draw on Foucault's conceptualisations of power, truth, discourse and governmentality to

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understand our research focus: how technologies create particular language forms which teachers then used in reconstructing mathematics teaching and assessment. Through interview analysis we focus especially on the frequent use of the term ‘gap’. Analysis shows how pedagogical language can originate in the use of technology, affect the way teachers reconstruct practice/policy and potentially alter pupils’ mathematical experiences.

RR 9:17 A social expression of number using TouchCounts

Chorney, Sean

This research reports on an episode involving Kindergarten and grade one students using the iPad application TouchCounts. This episode highlights a moment when the children’s improvised and shared gestures become a material resource to make sense of number. These social gestures are generative for further mathematical exchanges giving rise to both personal and social meaning-making.

RR 9:18 Counting on – long term effects of an early intervention programme

Vennberg, Helena; Norqvist, Mathias

This paper reports the long-term results of an intervention study with 134 six-year-old students from seven preschool-classes in northern Sweden to evaluate whether the Think, Reason and Count in Preschool-class programme (TRC) could prevent at-risk students from becoming low-performing students in mathematics. Whereas the pre-test score revealed that the intervention and the control group preformed equally, scores on the delayed follow-up-test in Grade 3 showed that the intervention group performed better than the control group and that at-risk students had closed the performance gap between themselves and their not-at-risk peers.

RR 9:19 The effectiveness of integrating Geogebra hots activities on the development of creative mathematical thinking

Baya'a, Nimer Fayez; Daher, Wajeeh Mahmood; Abo-Mokh, Dania Jamal; Anabousy, Ahlam Adnan

Educating programs are suggested for encouraging creativity among school students. We examined the influence of a mathematics teaching unit based on higher order thinking skills activities on students’ creativity. The participants were 64 grade 9 high achievers who were divided randomly into two groups: 31 students in the experimental group, and 33 students in the control group. The research results indicated that, using different pre and post tests involving multiple solution tasks, the educating program affected positively and significantly the fluency and flexibility of the students in the experimental group, but not their originality. In addition, using pre and post tests with same types of multiple solution tasks,

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the educating program affected positively and significantly the experimental group's flexibility and originality, but not its fluency.

RR 9:20 Elementary and secondary students' functional thinking with tables and diagrams

Xolocotzin, Ulises; Inglis, Matthew; Medrano, Ana

Tables are widely used for supporting functional thinking in the early grades. This research explored whether diagrams might also be adequate for this endeavour. 322 students in late elementary and early secondary grades resolved a multiple-choice test that required the identification of unknown instances of a dependent variable. Items of varying difficulty were presented in tabular and diagrammatic formats. Diagrams facilitated better performances in easy and difficult items amongst students in elementary grades and in the lowest secondary grade – who had little or no formal algebraic instruction – but not in the highest secondary grade. Responses denoting non-functional thinking were in general selected at chance-levels. The potential of diagrams for supporting the early development of functional thinking is discussed.

Participants

Participants

Name	Presenter	Chair
Aaten, Aaltje Berendina	OC 2:05	
Aberin, Maria Alva	OC 3:04	
Abtahi, Yasmine	RF 1	OC 3:12
Abu-Naja, Muhammad	PP 1A	
Ahl, Linda Marie		
Akahane, Kosuke	PP 1B	
Akin, Ayça	OC 2:04	
Aksoy, Esra	OC 1:07	
Alanazi, Majed		
Alapala, Burcu	OC 3:10	
Albano, Giovannina		
Albarracín, Lluís		
Alberto, Rosa Annalucia		
Alderton, Julie	RR 9:16	RR 8:16
Ali, Clement Ayarebilla	PP 2A	
Ali, Sikunder		
Alvarez, James A. Mendoza	OC 4:03	
Amador, Julie	RR 6:11	RR 7:11
Anabousy, Ahlam Adnan	RR 7:09	RR 6:09
Anderson, Judy Anne	RR 3:18, WG 01	RR 8:02, Plenary 3
Andrà, Chiara	WG 02	OC 3:16
Andresen, Mette Susanne		
Andrews, Nick	RR 9:10	RR 8:10
Antonini, Samuele		OC 3:04
Applebaum, Mark	OC 3:01	OC 2:02
Appova, Aina	RR 9:08	RR 8:08
Arai, Mitsue	OC 3:09	
Archibald, Vivian J		
Asami-Johansson, Yukiko	OC 4:16	
Asghari, Amir Hossein	RR 6:16	RR 7:16
Askew, Mike	RR 3:04, RF 2	RR 1:04, OC 1:12
Assmus, Daniela	OC 4:05	
Ataide Pinheiro, Weverton	OC 2:17	
Awoniyi, Florence Christianah	RR 4:08	RR 5:08
Ayala-Altamirano, Cristina	OC 3:17	
Ayalon, Michal	RR 3:14	RR 1:14
Ayber, Gözde	OC 1:06	
Babarinsa-Ochiedike, Grace		
Baccaglini-Frank, Anna E.	RR 3:05	RR 2:05
Bakos, Sandy	RR 8:05	RR 9:05
Baldry, Fay	OC 4:09	
Bampili, Amalia	RR 5:03	RR 4:03
Barkai, Ruthi	RR 1:09, RF 2	RR 2:09
Barmby, Patrick		OC 2:13
Barwell, Richard	RR 5:17	RR 4:17, OC 4:17
Baya'a, Nimer Fayez	RR 9:19	RR 8:19

Participants

Name	Presenter	Chair
Beckmann, Sybilla	PP 2B	
Beltrán Meneu, María José		
Bempeni, Maria	RR 8:02	
Ben-Chaim, David		
Bender, Roland		
Benedicto, Clara	OC 4:13	
Berger, Margot	OC 3:11	OC 1:10
Berggren, Johannes	PP 3A	
Bergquist, Karli		
Bernabeu Martínez, Melania		
Beswick, Kim	Plenary 3	
Bikner-Ahsbahs, Angelika	OC 2:10	
Billion, Lara	PP 13A	
Biton, Yaniv	OC 4:04	
Bittar, Marilena		
Biza, Irene		
Björklund, Camilla	RF 2	
Bjorkman, Kaitlin Marie	OC 2:14	
Blanco, Teresa F.	PP 4A	
Bofferding, Laura	PP 4B	
Boonsena, Nisakorn		
Borba, Rute Elizabete	OC 3:03	
Borji, Vahid	OC 2:04	
Bozkurt, Gulay	OC 1:13	
Brandt-Bosman, Ria		
Bresock, Krista Kay	RR 9:12	RR 8:12
Bronkhorst, Hugo	OC 4:06	
Brown, Julian Tom	RR 8:10	RR 9:10
Brown, Laurinda		OC 3:01
Bruin-Muurling, Geeke		
Brunner, Esther		
Bruno, Gustavo Nicolás	WG 04	
Büchter, Andreas		
Bunlang, Sunti		
Büscher, Christian	RR 5:01	RR 4:01
Byalsky, Michael		
Campbell, Anita	PP 48B	
Canavarro, Ana Paula	RR 2:11	RR 3:11
Cao, Yiming		
Carney, Michele	RR 6:14, PP 5B	RR 7:14
Carotenuto, Gemma	RR 5:16	RR 4:16
Cavalcante, Alexandre Soares	PP 6A	
Cavka, Sara	PP 6B	
Cawley, Anne		
Cedro, Wellington Lima	OC 4:10	
Chan, Man Ching Esther	CO 1	CO 1
Changsri, Narumon		
Chen, Chang-Hua	OC 2:09	
Chen, Chia Huang	PP 7A	
Chen, Ching-Shu	PP 7B	

Participants

Name	Presenter	Chair
Chen, Donglin	PP 20B	
Chen, Hanjun		
Chen, Jian-Cheng		
Chen, Jun		
Cheng, Jing		
Cheng, Ying-Hao	OC 3:02	
Cheung, Kwok Cheung	OC 1:01	
Chidhachack, Sousada	OC 2:17	
Chimoni, Maria	RR 4:20	RR 5:20
Chin, Erh-Tsung		
Chirinda, Brantina	RR 2:10	RR 3:10
Chorney, Sean	RR 9:17	RR 8:17, OC 3:15
Christiansen, Iben Maj	RR 2:09, WG 13	RR 3:09
Christou, Konstantinos	RR 9:02	RR 4:02, OC 4:14
Chumachenko, Dmitry	OC 1:14	
Cifarelli, Victor	OC 1:08	
Clements, Douglas	RF 2	
Coetzee, Petrus Francois		
Coles, Alf	RR 2:19, WG 06	Plenary 2, RR 3:19
Conner, AnnaMarie	RR 6:08	RR 7:08, OC 2:09
Connolly, Mary	RR 7:12	RR 6:12
Cooper, Jason	RR 3:11	RR 1:11
Coppol, Cristina		
Cordero, Minerva		
Costa, Maria Cristina	OC 2:09	
Crisan, Cosette	RR 5:10	RR 4:10
Crowder, Anita Louise	PP 8B	
Csikos, Csaba	OC 4:05	OC 2:14
Culligan, Karla Marie	OC 2:16	
Cumino, Caterina		
Cusi, Annalisa	WG 11	
Daher, Wajeeh M.		
Dallas, Markos		
Datsogianni, Anastasia	RR 6:15	RR 7:15
David, Hamutal		
Davis, Brent Andrew	RF 3	
De Chambrier, Anne-Françoise	OC 4:14, PP 9A	
Dedieu, Lauren Aletha		
Degrande, Tine	OC 2:13	
Dello Iacono, Umberto	PP 25A	
Den Braber, Nelleke		
Deruaz, Michel		
Di Martino, Pietro	WG 02	
Dias, Thierry	WG 10	
Dibbs, Rebecca		
Díez-Palomar, Javier	CO 1, PP 10A	
Dilberoglu, Merve	RR 8:03, PP 10B	RR 9:03
Dinçer, Bahar	OC 1:17	
Ding, Liping	RR 1:10	RR 2:10
Domingos, António Manuel Dias	PP 11A	

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Name	Presenter	Chair
Dong, Lianchun	OC 4:12, PP 11B	
Dorneles, Beatriz Vargas		
Dreher, Anika	RR 4:16, PP 12A, SE 1	RR 5:16
Dreyøe, Jonas	RR 9:15	RR 8:15
Drijvers, Paul	WG 03	OC 1:13
Duranczyk, Irene	RR 9:13	RR 8:13
Dyrvold, Anneli	RR 6:07	RR 7:07
Eames, Cheryl Lynn	RR 4:01	RR 5:01
Earnest, Darrell	OC 2:11, PP 12B	
Edmonds-Wathen, Cris	OC 3:16	OC 4:06
Edwards, Antony	RR 8:17	RR 9:17
Ekdahl, Anna-Lena	OC 1:12	
El Mouhayar, Rabih Raif	OC 1:06	
Elicer, Raimundo José	WG 04	
Emre-Akdogan, Elcin	RR 2:14	RR 3:14
Engelbrecht, Johann		
Eraikhuemen, Lucy	PP 3B	
Erath, Kirstin	PP 13B	
Ercire, Yusuf Emre	OC 3:08	
Eriksson, Anna Helena	CO 2	
Essien, Anthony Anietie	OC 2:07	
Etzold, Heiko		
Evans, Tanya	OC 2:05	
Fan, Zhongxiong		
Fellus, Osnat	RR 1:08	RR 3:08
Fernandez, Ceneida	RR 6:03	RR 7:03, OC 2:03
Ferrara, Francesca	WG 03	
Ferrari, Giulia	RR 9:07	OC 2:04, RR 8:07
Fidje, Anders Støle	RR 2:08	RR 1:08
Finnane, Maureen Kathryn		
Foo, Kum Fong		
Forsythe, Susan Kathleen	OC 1:11	
Foxworthy, Julianne Elsie	OC 3:12	
Franco Neto, Vanessa	RR 4:17, WG 04	RR 5:17
Friesen, Marita Eva	RR 9:09	RR 8:09
Fritzlar, Torsten	RR 6:04	RR 7:04
Garcia Moreno-Esteva, Enrique	WG 12	
Gardes, Marie-Line	WG 10	
Gartland, Sara		
Gebel, Inga	PP 14A	
Geisler, Sebastian	RR 7:06	RR 6:06
Gifford, Sue		
Godfrey, Alison Mary	PP 14B	
Gomez, David Maximiliano	OC 4:06, PP 16A, SE 01	
González-Forte, Juan Manuel	RR 3:12	RR 2:12
Goral, Johanna	OC 1:12	
Gorgorió, Núria	PP 15B	OC 1:08
Gould, Tabitha		

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Name	Presenter	Chair
Gregorio, Francesca	RR 6:06	RR 7:06
Griese, Birgit	RR 4:18	RR 5:18
Guillemette, David	RF 1	
Guimarães, Gilda Lisboa	PP 17A	
Gun, Ozge	PP 16B	
Gunnarsson, Robert	PP 18A	
Günther, Claudia-Susanne	PP 17B	
Guo, Kan	WG 07	
Gurjanow, Iwan	OC 1:02	
Gustavsen, Trond Stølen		
Gutierrez, Angel	OC 3:17	
Haataja, Eeva	RR 3:13, WG 12	RR 1:13
Häikiöniemi, Markus	OC 4:12	
Haj Yahya, Aehsan	OC 2:08	
Haja-Becker, Shajahan	PP 19A	
Håkansson, Per	OC 4:03	
Hals, Sigurd Johannes		
Hamanaka, Hiroaki	PP 18B	
Hamm, Jill	RR 1:13	RR 4:13
Hamukwaya, Shemunyenge Taleiko		
Hanazono, Hayato	PP 20A	
Hannula, Jani	OC 2:10	
Hannula, Markku	Plenary 4, WG 05	CO 1
Hannula-Sormunen, Minna Marjaana	RF 2	
Hansa, Sameera	OC 2:13	
Hansson, Örjan	PP 19B	
Häsä, Jokke	OC 1:03	
Haser, Çiğdem	RR 7:17	RR 6:17, OC 3:10
Hassidov, Dina	OC 4:02	
Hattermann, Mathias	RR 5:13	RR 2:13
Hattori, Yuichiro	OC 2:05	
Hawks, Michelle Christine	RR 5:18	RR 4:18
Hayashi, Tomoko		
Hayata, Toru	RR 3:15	RR 1:15
Heck, Daniel J.	RR 2:13	RR 3:13
Heidtmann, Pia		
Heil, Cathleen	RR 8:20	RR 9:20
Heinrich, Daniel		
Heinze, Aiso	RR 3:01	RR 1:01, OC 4:16
Helenius, Ola	RR 5:02	RR 9:02
Helliwell, Tracy Jane	RR 2:17	RR 3:17, OC 2:07
Hemmi, Kirsti Helena Löfwall		
Hendrikse, Petra	PP 50B	
Henriques, Ana Cláudia Correia Batalha	PP 22A	
Herheim, Rune	RF 1	
Hernández Hernández, Alexánder	OC 1:13	
Héroux, Sabrina	PP 47A	
Hewitt, Dave	OC 1:13	OC 4:01
Heyd-Metzuyanin, Einat	OC 1:09	
Hilf, Nader Khali	OC 1:04	

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Name	Presenter	Chair
Hilton, Caroline Ann	RR 8:18	RR 9:18
Hjelte, Alexandra Linnéa		
Hoch, Stefan	OC 4:01	
Hock, Natalie	RR 3:03	RR 1:03
Hodge, Lynn	PP 23A	
Hodkowski, Nicola	RR 3:02	RR 1:02
Hoffmann, Anna	RR 7:10	RR 6:10
Hofmann, Andrea	OC 1:07	
Hohensee, Charles	OC 3:14	
Holm, Jennifer	OC 4:07, PP 22B	
Horne, Marj	RR 5:15	RR 4:15, OC 4:08
Horsman, Rachael		
Hotomski, Mirjana	RR 2:20	RR 3:20
Höveler, Karina	RR 8:04	RR 9:04
Hoyles, Celia		
Høynes, Siri-Malén	RR 6:13	RR 7:13
Hsieh, Feng-Jui	OC 4:16	
Hsieh, Shu-Chi		
Hsu, Hui-Yu	PP 24A	
Huang, Chih Hsien	OC 2:12	
Huang, Hsin-Mei E.	OC 2:03	
Huang, Hui-Chuan	PP 23B	
Hubeňáková, Veronika	OC 2:10	
Hughes, Elizabeth		
Huh, Nan		
Huitzilopochtli, Salvador	OC 3:12	
Iannone, Paola	RR 1:20	RR 2:20
Ilany, Bat-Sheva	RR 7:02	RR 6:02
Inglis, Matthew	RR 1:16, WG 05	RR 2:16
Ingram, Jenni	OC 2:02	OC 4:12
Innabi, Hanan	OC 1:16	
Inprasitha, Maitree		
Ishibashi, Ippo		
Ishii, Tsutomu		
Ivars, Pedro	RR 4:03	RR 5:03
Izsak, Andrew Gyula	RR 1:02	RR 2:02
Jaikla, Jitlada		
Jaime, Adela	PP 24B	
Jameson, Ellen Maureen		
Jeschke, Colin	OC 2:07	
Jiang, Chunlian	PP 9B	
Jiang, Zheng	OC 1:16	
Johansson, Helena	OC 2:14	
Johnson, Heather Lynn	OC 3:14	
Jojo, Zingswa Mybert	PP 55B	
Joklitschke, Julia	RR 9:04	RR 8:04
Jones, Keith		OC 1:02
Jorgensen, Cody Jane		
Jung, Hyunyi	OC 2:11	
Juter, Kristina	PP 26A	

Participants

Name	Presenter	Chair
Kaarstein, Hege	WG 07	
Kaas, Thomas	OC 2:01	
Kageyama, Kazuya	RR 8:13	RR 9:13
Kang, Hyun Young	OC 1:10	
Kang, Soonja	PP 26B	
Kang, Yueyuan		
Karsenty, Ronnie	WG 06	OC 1:09
Kaur, Berinderjeet	OC 3:09	OC 1:04
Kawasaki, Masato	PP 27A	
Kawazoe, Mitsuru	OC 4:04	
Kayali, Lina	RR 2:05	RR 1:05
Kennedy, Nadia Stoyanova	OC 1:05	
Kilhamn, Cecilia	OC 4:08, PP 27B	
Kilic, Hulya	RR 2:03	RR 3:03
Kim, Doyen	OC 4:01	
Kim, Hee-Jeong	OC 4:16	
Kim, Jinho	RR 5:09	RR 4:09
Kim, Ok-Kyeong	RR 4:11	RR 5:11
Kimani, Patrick		
King, Nicholas Chin Shan-Drew		
Kishimoto, Tadayuki		
Kiziltoprak, Ayhan	OC 1:08	
Kiziltoprak, Fatma	OC 1:17	
Klassen, Diana Helen		
Klöpping, Peter Michael	OC 1:07	
Ko (or Choi-Koh), Sangsook		
Koellner, Karen		
Koichu, Boris		OC 2:01, OC 4:10
Komatsu, Kotaro	RR 2:16	RR 3:16
Kontorovich, Igor'	RR 4:05	RR 5:05
Köse, Nilüfer Yavuzsoy		
Kourouniotis, Christos		
Kozaklı Ülger, Tuğçe	RR 3:05	
Krause, Christina	OC 4:17	
Krawitz, Janina	RR 3:07	RR 1:07
Kristinsdóttir, Bjarnheiður (Bea)	OC 2:12	
Krummenauer, Jens Oliver	RR 3:16	RR 1:16
Krzywacki, Heidi	RR 8:19	RR 9:19
Küchle, Valentin		
Kullberg, Angelika	RF 2, RR 2:02	RR 3:02
Kuntze, Sebastian	RR 4:09, PP 28A	RR 5:09
Kuzle, Ana	RR 9:01, PP 15A	RR 8:01, OC 3:07
Kwok Kei, Chang		
Kwon, Na Young		
Kwon, Oh Nam		
Kwon, Seokil		
Ladel, Silke	OC 3:08	
Lagrange, Jean-baptiste	RR 2:07	RR 3:07
Lahdenperä, Juulia Josefiina	OC 2:02	
Lake, Elizabeth	OC 4:15	

Participants

Name	Presenter	Chair
Larson, Niclas		
Larsson, Kerstin	OC 1:14	
Lau, Wing Fat	OC 4:07	
Lee, Arthur Man Sang	PP 28B	
Lee, Kyungwon	OC 3:05	
Lee, Shin-Yi	OC 1:17, PP 29B	
Lehner, Matthias C.	OC 4:13	
Leikin, Roza		OC 3:11
Leong, Swee Ling	OC 2:11	
Lerman, Stephen	RF 1	
Leshota, Moneoang	PP 29A	
Levenson, Esther	RR 5:08, RF 2	RR 4:08, OC 1:05, OC 2:16
Li, Yeping	WG 01	OC 2:17
Lilienthal, Achim J.	WG 12	
Liljedahl, Peter	WG 02	
Lin, Pi-Jen	PP 30B	
Lin, Su-Wei	PP 30A	
Lindmeier, Anke Maria	RR 7:15	RR 6:15, OC 3:02
Lisarelli, Giulia	RR 6:05, PP 31A	RR 7:05
Liu, Di	OC 1:15	
Liu, Xin-Yi	OC 1:10	
Lo, Ya-Wen	OC 4:13	
Lobanova, Anastasia		
López-Martín, María Del Mar	RR 7:01, PP 52A	RR 6:01
Losano, Ana Leticia	RR 4:10, PP 32A	RR 5:10
Lu, Feng-Lin	PP 32B	
Lu, Xiaoli		
Lundström, Marita	OC 3:12	
Maciejewski, Wes	RR 1:06	RR 3:06, OC 3:14
Magiera, Marta T.	OC 1:11	
Maheux, Jean-Francois	RF 1	
Mak, Soi Kei	PP 33A	
Makonye, Judah Paul	RR 6:01	RR 7:01
Makramalla, Mariam Magdi Maurice	OC 4:07	
Malaspina, Uldarico	OC 3:03	
Mali, Angeliki T	OC 2:15	
Mamona-Downs, Joanna	OC 3:04	
Manizade, Agida	WG 07	
Manuel, Kate (Cathryn) Ashmore		
Marmur, Ofer	RR 8:12	RR 9:12
Martín-Molina, Verónica	RR 1:03	RR 2:03
Martínez Videla, María Victoria	OC 3:07	
Matos, João Filipe	PP 33B	OC 2:15
McCallum, William	WG 14	
McClintock, Evan D.		
McClure, Lynne	WG 14	
McGarvey, Lynn	RF 3	
McMullen, Jake	RR 8:15	RR 9:15
Medrano, Ana	RR 9:20	RR 8:20

Participants

Name	Presenter	Chair
Meehan, Maria	RR 9:06	RR 8:06
Mellone, Maria	CO 2	OC 4:02
Mesiti, Carmel	RR 3:09	RR 1:09
Mgombelo, Joyce	RF 3	
Micha, Ioanna	RR 8:14	RR 9:14
Miragliotta, Elisa	RR 1:01	RR 2:01
Misailidou, Christina		
Mizoguchi, Tatsuya		
Mizzi, Angel	OC 2:03	
Möllerström, Veselinka		
Monquil, Adrianus		
Monteiro, Maria Cecília		
Monteiro Da Costa, Maria Da Conceição	PP 34A	
Montoro Medina, Ana Belén	OC 2:08	
Moon, Sung-Jae	OC 3:14	
Moreno, Mar	RR 8:01	RR 9:01
Morita, Taisuke		
Morselli, Francesca	RR 9:11, WG 11	RR 8:11
Moschkovich, Judit Nora		
Mudrikah, Achmad	OC 3:09	
Mukai, Keiko		
Murata, Shogo	PP 34B	
Muzsnay, Anna	OC 1:03	
Naalsund, Margrethe	OC 4:01	
Nagy, Caroline		
Nardi, Elena	OC 4:17, PP 35A	
Narli, Serkan		
Nasinsroy, Jatuporn		
Ndlovu, Williams Chapasuka	OC 2:12, PP 35B	
Ndlovu, Zanele Annatoria	OC 3:10	
Nemirovsky, Ricardo	WG 08	
Neubrand, Michael		
Neuhaus, Silke	OC 3:06	
Ng, Oi-Lam	OC 4:04	
Nieminen, Juuso Henrik	RR 5:14	RR 4:14
Niss, Mogens	Plenary 1	
Nogues, Camila	OC 2:13, PP 36A	
Noh, Jihwa	OC 1:09	
Norqvist, Mathias	RR 1:15, PP 36B	RR 2:15
Norton, Anderson Hassell		
Nortvedt, Guri	WG 09, PP 37A	OC 4:04
Noss, Richard		
Ntow, Forster	OC 4:15	OC 3:17
Nyman, Martin	OC 1:15	
Nyman, Rimma	OC 1:11	
O'brien, Katherine Claire	WG 08, PP 37B	
O'sullivan, Brendan		
Obersteiner, Andreas	RR 4:02	RR 5:02
Okazaki, Masakazu		
Olteanu, Constanta	OC 4:10	

Participants

Name	Presenter	Chair
Orrill, Chandra	WG 07, OC 4:08, PP 38A	
Oslington, Gabrielle Ruth	RR 2:15	RR 3:15
Östergren, Erik		
Österling, Lisa	RR 8:09, WG 13	RR 9:09
Otaki, Koji		
Ouvrier-Buffer, Cecile	WG 10, OC 4:05	
Ovadiya, Tikva	PP 38B	
Özaltun Çelik, Ayтуğ	OC 2:04, PP 39A	
Pai, Yun Hsia	PP 39B	
Pala, Ozan	OC 2:06	
Palmér, Hanna		OC 1:11
Pan, Jiahui	OC 2:16	
Pandit, Ekaraj	OC 3:07	
Papadopoulos, Ioannis	RR 1:12	RR 3:12, OC 4:05
Partanen, Anna-Maija	OC 2:01	
Peatfield, Nicholas John		
Pede, Stella	RR 4:14	RR 5:14
Peña, Fredy	RR 4:07	RR 5:07
Peng, Aihui	OC 4:09	
Persson, Mimmi		
Peteers, Florence	OC 1:01	
Pettersson, Kerstin	OC 3:06	
Pierri, Anna	OC 2:06	
Piñeiro, Juan Luis	RR 2:04	RR 3:04
Pinto, Alon	RR 8:08	RR 9:08
Pinto, Jorge	OC 1:03	
Pinto, Marcia		
Pitsili-Chatzi, Dionysia	RR 1:18	RR 2:18
Podkhodova, Natalia	OC 2:03	
Polotskaia, Elena	CO 2, PP 40A	CO 2
Poncelet, Débora	OC 4:14	
Potari, Despina		
Poudel, Amrit Bahadur	OC 2:15	
Pournara, Craig Gavin		
Pratt, Nick		OC 3:06
Prediger, Susanne	RR 3:08	RR 2:08
Proulx, Jerome	RF 3	
Psycharis, Giorgos	RR 7:07	RR 6:07
Pyper, Jamie S	RR 7:08	RR 6:08, OC 2:10, OC 3:05
Qiao, Xuefeng	RR 7:20, PP 40B	RR 6:20
Rach, Stefanie	OC 2:14	
Radišić, Jelena	RR 3:06	RR 2:06
Ramdhany, Viren	OC 2:07	
Ramirez, Paola	OC 4:12	
Rämö, Johanna Maria		
Räsänen, Jenni Johanna	OC 3:15	
Rathgeb-Schnierer, Elisabeth	PP 41A	
Rausch, Attila	OC 4:11	

Participants

Name	Presenter	Chair
Reddy, Alison		
Reid, David A		
Reinhold, Simone	PP 41B	
Reis, Maria	RF 2	
Reitz-Koncebovski, Karen	PP 42A	
Reyes Santander, Pamela	OC 2:08, PP 42B	
Ribeiro, Miguel	RR 8:11	RR 9:11, OC 3:09
Ridderlind, Inger Birgitta		
Riesten, Laila	OC 2:16	
Robotti, Elisabetta	WG 10, RR 2:01	RR 3:01
Rodrigues, Margarida Maria		
Rodrigues, Maria Paula Pereira	PP 43A	
Roesken-Winter, Bettina		
Rogovchenko, Svitlana		
Røj-Lindberg, Ann-Sofi Linnea	OC 3:16	
Rojas, Francisco	OC 1:08, PP 43B	
Roorda, Gerrit	OC 3:02	
Rotem, Sigal	RR 9:03	RR 8:03
Rott, Benjamin	RR 5:04	RR 4:04, OC 1:17, OC 2:08
Rouleau, Annette	WG 02, RR 3:10	RR 1:10
Runesson Kempe, Ulla	RF 2	
Ruttenberg-Rozen, Robyn	OC 1:01, WG 15	
Ryan, Ulrika	RR 3:17	RR 1:17
Rycroft-Smith, Lucy		
Ryoo, Byeongguk	RR 8:06	RR 9:06
Sabena, Cristina	WG 11	OC 4:11, CO 2
Saenz-Ludlow, Adalira	RR 7:05	RR 6:05
Safrudiannur, Safrudiannur	OC 3:07	
Säfström, Anna Ida	PP 44A	
Sahin-Gür, Dilan	RR 1:17	RR 2:17
Sakonidis, Haralambos		
Sánchez, Alicia	OC 3:11	
Sanchez-Matamoros, Gloria	RR 7:03	RR 6:03
Santos, Leonor	WG 09	OC 2:05
Sarama, Julie	RF 2	
Sato, Shigetaro		
Savard, Annie	PP 44B	
Schindler, Maike	WG 12, RR 7:18	RR 6:18, OC 3:08
Schmidt, Victor Egidius		
Schukajlow-Wasjutinski, Stanislaw	WG 05, RR 2:06	RR 1:06, OC 1:15, OC 2:11
Swartz, Gil	RR 1:11	RR 2:11
Seah, Wee Tiong		
Segal, Ruti	RR 6:10, PP 45A	RR 7:10
Seidouvy, Abdel		
Selva, Ana Coelho Vieira	PP 45B	
Semanišínová, Ingrid		
Serrazina, Maria De Lurdes	OC 2:02	
Sezgin, H. Seda	PP 46A	

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Name	Presenter	Chair
Shabtay, Galit	RR 7:14	RR 6:14
Shahbari, Juhaina Awawdeh	RR 1:07	RR 2:07
Sharma, Anu Radha		
Shi, Jie	OC 3:15	
Shimizu, Kunihiro		
Shin, Bomi		
Shinno, Yusuke	OC 4:06	
Shvarts, Anna	WG 12, RR 7:13	RR 6:13
Sievert, Henning	RR 6:02	RR 7:02
Silva, Márcio	RR 6:17	RR 7:17
Simmt, Elaine	RF 3	
Simon, Martin	RR 4:19	RR 5:19
Sinclair, Nathalie	Plenary 2, WG 08	
Sit, Pou Seong	PP 46B	
Sjöblom, Marie	PP 21B	
Skilling, Karen Gai	OC 3:15	
Skog, Kicki	WG 13	
Smedlund, Joakim	RR 4:13	RR 5:13
Smith, Amy Leigh		
Smith, Cathy Anne	RR 6:18	RR 7:18
Soendergaard, Bettina Dahl	RR 4:04	RR 5:04, OC 1:06, OC 4:15
Sommerhoff, Daniel	OC 3:06, PP 47B	
Son, Ji-Won	RR 3:20	RR 1:20
Song, Shuang	RR 2:18	RR 1:18
Soto-Andrade, Jorge		
Soury-Lavergne, Sophie		
Sproesser, Ute	OC 1:06	
Staats, Susan Kimberley	OC 3:01, PP 48A	
Steffensen, Lisa	RR 7:19	RR 6:19
Steiner, Aya	RR 3:19	RR 1:19
Steinhorsdottir, Olof Bjorg	OC 1:09	
Stoppel, Hannes	PP 5A	OC 2:06, OC 4:07
Street, Karin Elisabeth Sørle	RR 5:06	RR 4:06
Strohmaier, Anselm R.	RR 4:06	RR 5:06
Strom, April Dawn		
Stupp, Jonathan		
Stylianides, Andreas	WG 14	OC 1:07
Subtil, Manuela	OC 1:02	
Sugimoto, Shin		
Sumpter, Lovisa	OC 3:01	Plenary 4
Sun, Sijie		
Supply, Anne-Sophie	OC 3:03	
Suriakumaran, Neruja	OC 4:15	
Swidan, Osama	RR 9:05	RR 8:05
Szabó, Csaba	PP 49A	
Szeibert, Janka	PP 49B	
Szitényi, Judit	OC 1:05	
Takeuchi, Ayumu	PP 50A	
Tam, Hak Ping	PP 21A	

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Name	Presenter	Chair
Tanisli, Dilek		
Tasara, Innocent	RR 1:14	RR 2:14
Taylan, Rukiye Didem	OC 1:05	
Teledahl, Anna	WG 09	
Teppo, Anne		OC 4:09
Thoma, Athina	OC 3:04	
Thomas, Stephanie	RR 7:16	RR 6:16
Thouless, Helen Rachel	OC 1:04, WG 15	
Tinnes-Vigne, Mélanie	OC 4:14	
Tolvanen, Pieti		
Torres, Carlos	OC 3:05	
Tortora, Roberto		
Triantafillou, Chrissavgi	RR 8:07	RR 9:07
Tsikalaki, Eleni	PP 51A	
Tuohilampi, Laura	CO 1	
Tuomela, Tatu Dimitri	RR 6:20	RR 7:20
Turgut, Melih	RR 1:05	RR 3:05
Twohill, Aisling	OC 2:01, WG 14, PP 51B	
Tzekaki, Marianna	OC 1:04	
Tzur, Ron	RR 5:12, WG 15	RR 4:12, OC 1:01
Ufer, Stefan		OC 4:03
Ullsten Granlund, Nina		
Ureña Alpízar, Jason	OC 3:17	
Ursekar, Chaitanya Prashant	OC 1:14	
Uygan, Candaş	OC 1:02	
Vale, Pamela	RR 4:12	RR 5:12
Valero, Paola	RF 1	RR 3:18, OC 1:14
Vamvakoussi, Xenia		
Van De Hulst, Wim		
Van Den Heuvel-Panhuizen, Marja		OC 3:03
Van Dooren, Wim	RR 4:15, WG 05	RR 5:15
Van Hoof, Jo	RR 6:19	RR 7:19
Van Stiphout, Irene		
Vanluydt, Elien	RR 1:04	RR 2:04
Vargas, Francisco Javier	OC 2:06	
Venenciano, Linda	OC 4:02	
Venkatakrishnan, Hamsa	RF 2	
Vennberg, Helena	RR 9:18	RR 8:18
Verguts, Gwen	OC 1:12	
Vermeulen, Cornelis	OC 4:08	
Viirman, Olov	RR 5:07	RR 4:07
Viitala, Hanna Leena	OC 4:11	OC 1:03
Vlassis, Joelle	RR 5:20	RR 4:20
Vogel, Rose F.		
von Hering, Robert	RR 9:14	RR 8:14
Vos, Pauline	RR 7:11	RR 6:11
Vysotskaya, Elena		
Wagner, David	OC 3:16	OC 1:16, OC 2:12
Waisman, Ilana	RR 7:04	RR 6:04

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Name	Presenter	Chair
Wallin, Anna	PP 31B	
Wang, Fang-Jiun	OC 1:10	
Wang, Guangming	OC 2:17	
Wang, Sasha	PP 52B	
Wang, Ting-Ying	OC 3:02	
Watanabe, Satoshi	PP 53A	
Watkins, Laura Lee		
Wedman, Lotta	RR 5:19	RR 4:19
Wei, Bingqian		
Weigand, Hans-Georg	RR 6:12	RR 7:12
Weiher, Dana Farina	PP 53B	
Weingarden, Merav	RR 5:11	RR 4:11
Wessman-Enzinger, Nicole	OC 3:08	
Westaway, Lise	OC 1:16	
Weston, Tracy L.	OC 3:11	
Wickstrom, Megan H.	OC 3:10	
Widder, Mirela	RR 5:05	RR 4:05
Wilkie, Karina Joyce		
Willard, Eleanor Frances		
Williams, Gaye	OC 4:02	
Willoughby, Laura		
Winkel, Kirsten	RR 1:19	RR 2:19
Wu, Huei-Min	PP 54A	
Wu, Libao		
Yang, Kai-Lin		OC 4:13
Yazgan, Yeliz		
Yeung, Wai Ling Winnie		
Yıldırım, Duygu	OC 2:09	
Zachariades, Theodossios		
Zámbó, Csilla Gyöngyvér		
Zandieh, Michelle	RR 8:16	RR 9:16
Zeynivandnezhad, Fereshteh	OC 2:15, PP 54B	
Zhang, Nan		
Zhang, Qiaoping	OC 1:15	
Zhang, Shu	PP 8A	
Zhao, Wenjun	PP 25B	
Zhou, Chang Jun		
Zindel, Carina	RR 2:12	RR 1:12
Zoitsakos, Sotirios	RR 6:09	RR 7:09

Time Schedule

	Tuesday 3 July 2018	Wednesday 4 July 2018	Thursday 5 July 2018	Friday 6 July 2018	Saturday 7 July 2018	Sunday 8 July 2018	
09.00	Early Researchers' Day: Monday 2 July 13.30 - 18.15 Tuesday 3 July 9.00 - 13.00	Plenary 2 9.00 - 10.30 Nathalie Sinclair	Plenary 3 9.00 - 10.30 Kim Beswick	Plenary Panel 9.00 - 10.30	RR 8 9.00 - 9.40	RF/SE part 2 + CO 2 9.00 - 10.30	
10.00					RR 9 9.50 - 10.30		
11.00		Fika 10.30 - 11.00	Fika 10.30 - 11.00	Fika 10.30 - 11.00	Fika 10.30 - 11.00	Fika + PP B 10.30 - 11.30	
12.00		RR 1 11.00 - 11.40	RR 4 11.00 - 11.40	RR 6 11.00 - 11.40	WG part 2 11.00 - 12.30		Plenary 4 11.30 - 12.30 Markku Hannula
13.00		RR 2 11.50 - 12.30	RR 5 11.50 - 12.30	RR 7 11.50 - 12.30		Lunch 12.30 - 14.00	Closing 12.30-13.00
14.00		Lunch 12.30 - 14.00	Lunch 12.30 - 14.00 Policy meeting 13.00 - 14.00	Lunch 12.30 - 14.00			
15.00		Registration 14.00 - 16.00 First Timers' Meeting 14.30 - 15.30	OC 1 14.00 - 15.00	Excursion 14.00	OC 2 + National Presentation 14.00 - 15.00	OC 3 14.00 - 15.00	
16.00			RR 3 15.10 - 15.50		Fika + PP A 15.00 - 16.00	OC 4 15.10 - 16.10	
17.00		Opening 16.00 - 17.00	Fika 15.50 - 16.30		RF/SE part 1 + CO 1 16.00 - 17.30	Fika	
18.00		Plenary 1 17.00 - 18.00 Mogens Niss	WG part 1 16.30 - 18.00			Annual General Meeting 16.30 - 18.00	
Evening	Reception				Dinner		

CO - Colloquium; Fika - Coffee Break; OC - Oral Communication; PP - Poster Presentation;
RF - Research Forum; RR - Research Report; SE - Seminar; WG - Working Group