Continuing with practice of previous ICMEs, four Survey Teams (ST) have been set up. The organization of these teams is intended to strengthen the emphasis on new developments and progress in the area of each theme or issue since the last three or four ICMEs. Each Survey Team will work all the way till the opening of ICME-14 to survey the state-of-the-art with respect to a certain theme or issue, with particular concern in identifying and characterizing important new knowledge, recent developments, new perspectives, and emergent issues.

The survey teams will have 90 minutes to present their work at ICME-14 in a kind of sub-plenary format and will present their work in parallel.

ST1: Research on University Mathematics Education

July 18, 16:30—18:00   **Location: A**

Chair: Chris Rasmussen (USA)
Team members: Marianna Bosch (Spain), Reinhard Hochmuth (Germany), Oh Nam Kwon (Korea), Birgit Loch (Australia), Mike Thomas (New Zealand), María Trigueros (Mexico)
IPC Liaison: Anjum Halai (Pakistan)

ST

16:30   Opening Speech
Chris Rasmussen (San Diego State University, USA)
Description: In addition to providing an overall orientation to the session, the opening will summarize the survey process and resulting themes on advances and gaps in university mathematics education.

16:35   Speech 1: Instructional Practices: Advances in Research
Oh Nam Kwon (Seoul National University, South Korea)
Description: This portion of the presentation will highlight advances in the research on instructional practices. Research related to this topic regards two categories: active and inquiry-oriented learning, and undergraduate mathematics teaching and classroom practices.

16:45   Speech 2: Professional Development of University Teachers: Advances in Research
Birgit Loch (La Trobe University, Australia)
Description: Much of the research on the professional development of university teachers has closely examined lecturer practice, either in traditional presentations or more student-centred modes, and has sometimes considered the effect on student learning. This portion of the presentation will highlight advances in these domains.

16:55   Speech 3: Service Courses in University Mathematics Education: Advances in Research
Reinhard Hochmuth (University of Hannover, Germany)
Description: This portion of the presentation will highlight advances in the research on maths for non-maths students. Expanding research on the use of mathematics in empirical sciences as well as at the workplace and linking the corresponding findings with systematic research on research-based teaching and learning activities is one of the most promising developments for the future, as is knowledge about obstacles to learning and a wealth of suggestions for optimising teaching and learning.

17:05   Speech 4: Theories and Methods: Gaps in Research
Reinhard Hochmuth (University of Hannover, Germany)
Description: While there have been considerable theoretical and methodological advances, there is a distinct lack of a shared discourse on meta-level learning with the abundance of frameworks not necessarily compatible or even commensurable. Developing a shared and explicit discourse for the informal/meta-level content of collegiate mathematics education is a crucial component in any effort to improve pedagogy at this level.

17:15   Speech 5: Linking Research and Practice: Gaps in Research
María Trigueros (Instituto Tecnológico Autónomo de México, Mexico)
Description: This portion of the presentation will highlight gaps in linking research and practice. In particular three different categories will be highlighted: Classroom practices and the link between research

and practice; adopting research-based instructional strategies; and interrelation between didactical logos and praxis.

17:25   Speech 6: Professional Development of University Teachers: Gaps in Research
Chris Rasmussen (San Diego State University, USA)
Description: While there has been some progress in the research on the professional development of teachers, much more is still needed. One of the several gaps that will be highlighted in this session is the scarcity of organised, developmental research into university teachers' pedagogical knowledge and its development through formalized education.

17:35   Speech 7: Curriculum: Advances and Gaps in Research
Marianna Bosch (IQS, Universitat Ramon Llull, Spain)
Description: Curriculum is an entity present but rarely taken as a unit of analysis in research in undergraduate mathematics education. Curricular questions are obviously at the center of all study and examination regulations of mathematics degree programs. However, their treatment rarely relies on specific research. This portion of the presentation will highlight advances and gaps in the research on curriculum.

17:45   Speech 8: Interdisciplinarity: Gaps in Research
María Trigueros (Instituto Tecnológico Autónomo de México, Mexico)
Description: This portion of the presentation will highlight gaps in the intersection between mathematics and other disciplines. Gaps exist on many different levels and with regard to several perspectives. Discussion of gaps will proceed from the outside to the inside, from the more general to the more specific.

17:55   Concluding Remarks
Oh Nam Kwon (Seoul National University, South Korea)
Description: The conclusion will reflect on the findings of the survey team and point to future directions for the field.

ST2: Early Childhood Mathematics Education (Up to Age 7)
July 18, 16:30—18:00   Location: S
Chair: Elia Iliada (Cyprus)
Team members: Anna Baccaglini-Frank (Italy), Nosisi Feza (South Africa), Esther Levenson (Israel), Nanae Matsuo (Japan)
IPC Liaison: Anjum Halai (Pakistan)

16:30   Opening Speech
Panel Chair: Iliada Elia (Department of Education, University of Cyprus, Cyprus)

16:35   Lecture Part 1: Trends and advances in content-oriented themes
Speech 1: Geometry Education
Iliada Elia (Department of Education, University of Cyprus, Cyprus)
Discription: An extensive literature review about geometry education in early childhood between 2012 and 2020 has highlighted some of the major themes in which recent research on this field is concerned, including, spatial skills, shape knowledge and understandings, semiotic and embodied approaches, teaching and interventions in early geometry. This speech will focus on the main findings in each of these themes.

Speech 2: Number Sense and Whole Number Development
Nosisi Feza (Research Unit, University of Venda, South Africa)
Description: This speech is based on a qualitative analysis of published peer reviewed literature on number sense of young children from 2012 to 2020. The review revealed three types of themes: pedagogical approaches, innate numerical abilities, cognitive and non-cognitive influences. Findings and identified research gaps for these themes will be elaborated and discussed.

Speech 3: Children's Competences in Other Content Domains
Nanae Matsuo (Department of mathematics, Faculty of Education, Chiba University, Japan)
Description: This speech draws on a qualitative synthesis of the literature on young children's competences in other content domains beyond the domains of number and geometry for the past 8 years. Findings and implications are emphasized with respect to the following content domains: patterns and structure, measurement, statistical reasoning, functional thinking, spatial ability, and others.

17:05   Lecture Part 2: Trends in the use of technology

Speech 4: The Role of Technology in Mathematics Teaching and Learning

Anna Baccaglini-Frank (Department of Mathematics, University of Pisa, Italy)

Description: Recent literature includes studies on various uses of technology in early years mathematics. Based on a qualitative synthesis of this body of research between 2012 and 2020, this speech will focus on the main findings in five major themes: design features, use of technological tools in mathematics learning, pedagogical issues, mathematics taught/learned through technological tools and affective/social issues involved in learning/teaching with technology.

17:15   Lecture Part 3: Cognitive skills and special education of young children

Speech 5: Cognitive Abilities and Mathematical Performance

Anna Baccaglini-Frank (Department of Mathematics, University of Pisa, Italy)

Description: Based on an extensive literature review in mathematics education and also in the disciplines of developmental and cognitive psychology, this speech identifies the abilities that have been found to be predictive of or associated with mathematical performance, including domain general abilities, domain specific abilities and abilities related to the socio-cultural dimension and language.

Speech 6: Cognitive Abilities for Mathematics Learning: Assessment and Curriculum Design

Iliada Elia (Department of Education, University of Cyprus, Cyprus)

Description: An important strand of research on cognitive skills involved in mathematical learning focuses on the assessment of cognitive abilities for mathematics learning and curriculum design in light of sets of abilities or skills to strengthen. The major findings and relevant future directions based on a review of this body of research are elaborated and discussed in this speech.

Speech 7: Special Education

Nanae Matsuo (Department of Mathematics, Faculty of Education, Chiba University, Japan)

Description: This speech focuses on the reviewed research in special education within early childhood mathematics education, which involves two major directions: a) mathematical capabilities and their development in young children with special needs and b) ways to support and improve mathematics learning of children with special needs. For both directions, findings reveal a greater emphasis on researching low-attaining children than high-achievers.

17:35   Lecture Part 4: Developments and trends in teacher-related issues

Speech 8: Early Childhood Teachers' Knowledge, Education and Affective Issues in Mathematics

Esther Levenson (Department of Mathematics, Science, and Technology Education, Tel Aviv University, Israel)

Description: This speech presents a synthesis of results of recent studies on early childhood teachers' knowledge, education and affective issues in mathematics. In reviewing this body of research, what comes to light is the emphasis on children. The major trends of most studies on these teacher-related issues are also revealed, while specific needs for additional research are identified.

17:45   Concluding Remarks

Iliada Elia (Department of Education, University of Cyprus, Cyprus)

17:50   Interaction Session: Questions and Discussion about the Survey

ST3: Teachers' Collective Work as a Regular School Practice for Teacher Development

July 18, 16:30—18:00   **Location: T225**

Chair: Birgit Pepin (Netherlands)

Team members: Jehad Alshwaikh (Palestine), Hiroyuki Ninomiya (Japan), Gérard Sensevy (France), Yudong Yang (China)

IPC Liaison: Anjum HALAI (Pakistan)

16:30—16:40   Opening and Introduction

Prof. Dr. Birgit Pepin (Eindhoven University of Technology, The Netherlands)

16:40—16:50   Speech 1: Mathematics Teachers' Collective Work as a Regular School Practice for Teacher Development: First Results

Prof. Dr. Birgit Pepin & Dr. Zeger-Jan Kock (Eindhoven University of Technology, The Netherlands)
Description: In this presentation, we present the first results from our international survey of the literature regarding mathematics teachers' collective work in schools. In particular, we tentatively answer the four following research questions based on our extensive literature search:

1. What is the nature of mathematics teachers' collective work as regular school practice, and how does this relate to situation, culture and context?
2. Who is engaged in such school-based collective work, what are the roles of those people involved, and how do they relate to each other in the different communities? In particular, what is the nature of the relationship between teachers and researchers?
3. What kinds of learning can be observed in school-based teacher collective work? How does teacher collective learning happen in teacher collectives at school, what is the evidence for their learning? What do teachers say? How does teacher learning relate to the collective aspect, context and goal of the work? How (and what) do researchers learn in these collectives?
4. Which methodological and theoretical perspectives are used to guide and inform school-based teacher collective work, and teacher learning in such teams?

In addition, we conducted a survey (with questionnaires) in selected countries where we asked mathematics teachers about their collaborative professional development practices at school level. Results will be compared and juxtaposed with those found in the literature.

16:50—16:55   Short Break

Birgit Loch (La Trobe University, Australia)
Description: Much of the research on the professional development of university teachers has closely examined lecturer practice, either in traditional presentations or more student-centred modes, and has sometimes considered the effect on student learning. This portion of the presentation will highlight advances in these domains.

16:55—17:10   Speech 2: Japanese Teachers' Collective Work as a Regular School Practice

Prof. Dr. Hiro Ninomiya (Saitama University, Japan)
Description: Japanese teachers have been doing their voluntary in-service training, not only at the official Lesson Study activities but also within their daily teaching practices. Lesson Study has been one of important activities for Japanese teachers' professional development for more than 100 years, and at the same time, teachers' collective work as a regular school practice has been accumulated. In this presentation, Japanese teachers' collective work as a regular school practice will be reported on and portrayed, based on articles in journals of the Japan Society of Mathematical Education. Even though all papers were written in Japanese, the existence of such cumulative work is likely to provide important information for all of mathematicseducators in the world. It is noteworthy that the Japan Society of Mathematical Education is the biggest mathematics education society in Japan, which has more than 100 years of history.

17:10—17:25   Speech 3: Chinese Lesson Study and Its Features: A Historical Institutionalism Perspective

Prof. Dr. Yudong Yang (Shanghai Academy of Educational Sciences, China)
Description: In this presentation the main features of Chinese Lesson Study will be described andportrayed from a historical institutional perspective and from an insider's perspective. Interms of the history of institutions, Chinese Lesson Study could be explained as 'lessonenhancement' based on activities in the Teaching Research Group, an established school based practice in China. At micro-level, 'lesson enhancement' is a fundamental practice of Chinese Lesson Study. At meso-level, the Teaching Research Group is an institutional condition for Chinese Lesson Study.

17:25—17:50   Discussion

Chair: Prof. Dr. Jehad Alshwaikh (Birzeit University, West Bank, Palestine)

17:50—18:00   Plenary & Closing

Prof. Dr. Birgit Pepin (Eindhoven University of Technology, Netherlands)

ST4: On the Teaching and Learning of Mathematical Modelling and Interdisciplinary Mathematics Educations

July 18, 16:30—18:00   **Location: T219**

Chair: Gloria Stillman (Australia)
Team members: Jussara de Loiola Araújo (Brazil), Angeles Dominguez (Mexico), Toshikazu Ikeda (Japan), Stanislaw Schukajlow (Germany)
IPC Liaison: Gabriele Kaiser (Germany)

16:30   **Opening Welcome**
Panel Chair: Associate Prof. Gloria Stillman (Faculty of Education and Arts, Australian Catholic University (Ballarat campus), Australia)

16:35   **Speech 1: Nature of the Survey**
Associate Prof. Gloria Stillman (Faculty of Education and Arts, Australian Catholic University (Ballarat campus), Australia)
Description: Our survey team has reviewed the current state-of-the-art on the teaching and learning of mathematical modelling under specific consideration of interdisciplinary aspects. In particular, the importance of a well understood relation between mathematics and the real world has been in focus. Our methodology and our main findings and the relevance of these in the context of STEM will be highlighted.

16:50   **Speech 2: The Importance of a Well Understood Relation between Mathematics and the Real World**

ST

Prof. Toshikazu Ikeda (College of Education, Yokohama National University, Japan)
Description: A well understood relation between mathematics and the real world underpins interdisciplinary work in mathematics education. Mathematical modelling produces an outcome, a model, that is the structure connecting the elements useful to describe a real world situation. This is basically interdisciplinary work to produce useful artifacts in the non-mathematical world as well as to foster modelling competencies or construct mathematical knowledge.

17:05   **Speech 3: Interdisciplinary Teams in Mathematics Education Research and Practice related to the Real World**
Prof. Dr Stanislaw Schukajlow (Department of Mathematics, University of Münster, Germany)
Description: Working in interdisciplinary teams is one of the characteristic features of research in mathematical modelling. Members of the teams can represent very different disciplines (e.g., mathematics, science, pedagogy, psychology or statistics), cultural backgrounds (East or West) or methodological approaches which contribute to the overall success of the joint work.

17:20   **Speech 4: Modelling, Interdisciplinary and the Real World in Mathematics Education**
Prof. Jussara de Loiola Araújo (Department of Mathematics, Federal University of Minas Gerais, Brazil)
Description: In modelling activities, students search for solutions to real world problems through mathematics. Thus, modelling can establish dialogues between mathematics and the real world and mobilize other disciplines such as physics, biology, economics, etcetera, leading to an interdisciplinary approach. Theoretical relationships among modelling, mathematics, the real world and interdisciplinarity will be discussed and exemplified.

17:35   **Speech 5: Mathematical Modelling as a High-leverage Topic Critical for Mathematical Depth in STEM Integration**
Associate Prof. Jonas Ärlebäck (Department of Mathematics, Linköping University, Sweden)
Description: The success of productively exploring opportunities and tackling challenges of STEM integration rest on strong, broad and deep mathematical knowledge that can be applied and drawn upon when engaged in mathematical modelling. In this context, we discuss mathematical modelling as the substrate of STEM that facilitates the integration of the disciplines as well as motivates and supports learning within each other discipline.

17:50   **Interaction Session: Interaction Topic – Future Directions**