TSG-42 Agenda

Research and Development in Assessment in Mathematics Education
Class: B

Session 1: 19:30-21:00 Beijing time, July 13th

1. Time: 19:30─19:40 Online Pre-recorded video

STUDENTS' DIFFICULTIES IN THE MANAGEMENT OF ALGEBRAIC EXPRESSION HIGHLIGHTED IN LARGE-SCALE ASSESSMENT

Federica Ferretti
Free University of Bolzano-Bozen, **Italy**

The learning of algebra represents a difficulty within the mathematics learning process. Precisely because of their epistemological and ontological nature, semiotics provides a good key to understanding the main difficulties that hinder the learning of algebraic objects. The answers to a large scale assessments task that requires a treatment in the sense of Duval of sizeable sample of upper secondary school student is analysed. Statistical analysis allows the nationwide data to be considered according to students' ability levels. The study confirms and quantifies the distance between personal meaning and the cultural meaning attributed to algebraic objects. The difficulties of the manipulation of algebraic expressions is deepened and characterized.

2. Time: 19:40─19:50 Online Pre-recorded video

IN-SERVICE TEACHERS MARKING STUDENTS' ANSWERS CONTAINING DERIVATION ERRORS

Alberto Arnal-Bailera[1], José M. Muñoz-Escolano[1], Antonio M. Oller-Marcén[2].
[1]Universidad de Zaragoza, **Spain**; [2]Centro Universitario de la Defensa de Zaragoza, **Spain**

The marking of exams is a usual assessment tool in Mathematics. Previous studies point out a certain lack of objectivity in this process depending on the teacher, the task and the presence of errors in the students' answers, among other factors. In this work, we analyze the behavior of 45 in-service Secondary school teachers when marking answers to Mathematics written exams with derivation errors. We have found that the marks awarded to all the answers present a high variability. Some factors, as previous experience of the teacher, do not seem to have an influence in the marks, while others do, like the presence of a certain type of argumentation in the answers.

3. Time: 19:50─20:00 Online Pre-recorded video

INVESTIGATING TEACHERS' AWARENESS OF THE REASONS FOR STUDENTS' MATH ERRORS AT PRIMARY SCHOOL LEVEL

Valentina Vaccaro Eleonora Faggiano Federica Ferretti
University of Oviedo, INVALSI - Roma University of Bari Aldo Moro University of Ferrara
Italy

This paper presents and discusses the first results of a project aimed at investigating, through the voice of teachers, the link between the standardized mathematics assessment and the teaching-learning processes of mathematics at the Primary School level. For this purpose, a questionnaire was built and administered to more than five hundred teachers. In particular, data coming from the first section of the questionnaire have been analyzed in order to investigate how teachers read and interpret students' answers to standardized mathematics assessment test. Results give evidence of the teachers' lack of awareness in interpreting the errors of the students, thus revealing the need for specific training in order to use standardized assessment as a teaching tool.

4. Time: 20:00─20:10 Online Pre-recorded video

COGNITIVE LOAD REDUCTION IN MATH ITEMS: PERFORMANCE, GENDER AND SOCIOECONOMIC STATUS

Emiliano Augusto Chagas[a] **,** Mauricio Urban Kleinke[b]

[a] IFSP – Instituto Federal de São Paulo (Federal Institute of São Paulo), **Brazil**
[b] Unicamp – Universidade Estadual de Campinas (State University of Campinas), **Brazil**

The National Secondary Education Examination (Enem) is the most important large-scale assessment in Brazil, and the contextualization permeates all the math items of this test, which makes the test as a whole quite extensive. In this paper we explore the effects of cognitive load reduction on Enem items on student performance with respect to gender and socioeconomic status (SES). A 24-item Enem test was administered to 688 high school students, 378 males and 310 females. The results indicate that the reduction of extraneous cognitive load has enhanced students' performance, especially of female students. In contrast, there is evidence that reduced cognitive load benefits more to the students whose parents have more education or higher income. Therefore, cognitive load reduction brings performance of male and female students closer, but ultimately distances socioeconomic groups.

5. Time: 20:10─20:20 Online Power Presentation

EXPRESSIONS OF MATHEMATICAL PROFICIENCY IN STUDENTS' MATHEMATICAL WORK

Priscila D. Corrêa
University of Windsor, Canada

This research paper portrays ways in which mathematical proficiency can be expressed in students' mathematical work. It is noteworthy that students' mathematical proficiency can be expressed in diverse ways and not only through procedural knowledge. The study investigates the richness of students' mathematical work, when solving mathematical modelling tasks, in terms of a model that distinguishes five strands of mathematical proficiency. This work suggests the use of this proficiency model as a possibility to ground mathematics assessment.

6. Time: 20:20─20:30 Online Power Presentation

STRUCTURAL FEATURES IN CLASSROOM LEVEL STANDARDIZED MATHEMATICS ACHIEVEMENT RESULTS

Timothy Sibbald
Nipissing University, Ontario, Canada

Individual student achievement on a standardized test was accrued to generate a histogram of classroom achievement. An analysis of the fit of the histogram to characterizing distributions implies the achievement is heteroscedastic. In particular, five general shapes of distributions have been identified and account for 66 percent of all classrooms. Of the classrooms 17 percent can be considered small samples (<15 students). The magnitude of the occurrence suggests that there are three distinct types of classrooms warranting further investigation as to whether there is a pedagogical advantage to knowing the shape of the classroom distribution.

7. Time: 20:30─20:40 Online pre-recorded video

PHILOSOPHICAL INSIGHTS INTO PISA AND MATHEMATICS EDUCATION POLICY ISSUES

IAN CANTLEY

Queen's University Belfast, **North Ireland**

The mathematical attainment of schoolchildren around the world is assessed in PISA (the Programme for International Student Assessment), which is administered on a three-yearly cycle by the Organisation for Economic Co-operation and Development (OECD). PISA is purported to provide valid and reliable comparisons of students' mathematical achievements in a range of different national education systems, and the results can have major implications for the mathematics education policies of these nations, sometimes leading to policy-borrowing from high-performing countries/regions. Aspects of Ludwig Wittgenstein's later philosophy of mind are used to problematize an over-reliance on the use of PISA to inform policy decisions in mathematics education. It is suggested that, when PISA is viewed through a later Wittgensteinian lens, a potential deficiency in the underpinning psychometric model, pertaining to the inherent indeterminism in unmeasured mathematical abilities, may weaken PISA's utility in guiding mathematics education policy decisions.

8. Time: 20:40─20:50 Online pre-recorded video

A UNIQUE ITEM FORMAT TO ASSESS ATTENTIVENESS TO STUDENTS' MATHEMATICAL IDEAS

Ya Mo, Laurie Cavey, Michele Carney, Tatia Totorica, Patrick Lowenthal

Boise State University, **Idaho**

Teacher education and professional development programs need high-quality assessments of complex constructs that are important to mathematics education. Here we present our assessment of teacher attentiveness to students' quantitative reasoning using an item format that makes use of authentic student work samples and teacher responses. Using Rasch analysis, we examine the functioning of the items and the assessment as a whole. The results indicate the individual items function well; however, they also indicate the need to increase the upper and lower range of attentiveness assessed. Proposed approaches for doing so are discussed.

9. Time: 20:50─21:00 Online Power Presentation

DEVELOPING PRESERVICE ELEMENTARY TEACHERS' CAPACITY IN THE DESIGN OF AUTHENTIC MATHEMATICS ASSESSMENT

Kim Koh, Olive Chapman, & Shimeng Liu

Werklund School of Education, University of Calgary, **Canada**

Due to limited assessment coursework, it is important to have continuing professional development and a systematic intervention model in order to develop preservice elementary teachers' capacity to design and use authentic assessment tasks in mathematics in the context of their teacher preparation programs and beyond. In this paper, we describe our research and development efforts in authentic mathematics assessment. We also report findings derived from the first two phases of our mixed-methods longitudinal intervention study that investigated an intervention model (Authentic Assessment Learning Activities) and its impact on preservice elementary teachers' knowledge (conceptions, expertise) and learning of authentic assessment in mathematics. Implications for planning and design of assessment coursework and professional development programs for prospective mathematics teachers will be discussed at the conference.

Session 2: 21:30-23:00 Beijing time, July 16th

1. Time: 21:30─21:45 Online Power Point Presentation

TITLE OF THE PAPER: EVALUATING MATHEMATICS TEACHERS' PROFESSIONAL LEARNING IN A PLN: A COMPLEX SYSTEMES PERSPECTIVE

Xiong Wang
University of Alberta, **Canada**

This study aimed to evaluate mathematics teachers' professional learning in a PLN by investigating their participation in a PLN with interpretive inquiry as a methodology and complex systems as a theoretical framework. From one targeted PLN were collected three types of triangulated data: archived documents such as logs, posts, comments, or responses; participants' reflections through their blogging; and my own reflections. And several data analysis techniques were adopted to evaluate mathematics teachers' participation in the PLN such as mathematics-for-teaching, recursive dynamics, mind maps, fractal geometry, necessary conditions for complex systems, and thematic analysis. The results presented an evaluation framework to reveal the diverse conversation structures among participants and the emergent knowing from the conversations including the knowing of mathematics-for-teaching as well as the other four types of knowing such as social relationships, blog sharing, experience sharing, and teacher's beliefs about teaching. The study offers a valuable reference for evaluating on both online and conventional professional development for teachers.

2. Time: Time: 21:45─22:00 Online Power Point Presentation

VALIDITY OF ASSESSMENTS IN MATHEMATICAL TEXTBOOKS: A STUDY OF BEGINNING OF PRIMARY SCHOOL LEVEL TEXTBOOK ASSESSMENTS

GRAPIN Nadine
Laboratoire de Didactique André Revuz, Université Paris Est Créteil, **France**

This paper proposes an analysis of how mathematical textbooks address the assessment and how formal assessment is prescribed in textbooks to teachers, using a didactical framework. The prescribed teaching material in textbooks can be considered as one step of the didactical transposition and the analysis of the mathematical content of assessments in textbooks enables us to better understand teaching practices and to better interpret students' performance. The present analysis is based on didactical criteria of validity and on a methodology for studying textbooks. A comparison of ten Grade 1 (beginning of primary school) textbooks on the mathematical domain of numbers is done. The comparison reveals significant differences between collections of assessment tasks in terms of the specified rhythm and administration of formal assessments, types and complexity

of tasks, indications for grading and interpreting students' answers, etc. However, these textbooks share one common feature: the description they provide for teachers and the content of their assessments are not adequate to ensure their validity. Therefore, teachers need to take initiatives of their own to adapt these assessments if they wish to use them effectively.

3. Time: 22:00─22:15 Online Power Point Presentation

ARE THE STAKES THE SAME? A COMPARISON OF THREE TYPES OF LARGE SCALE ASSESSMENTS IN ALBERTA, CANADA

Richelle Marynowski
University of Lethbridge, **Canada**

In Alberta, Canada, there are three different provincially developed large scale exams that are administered to students. Each of the large-scale assessments have different purposes, are administered at different grade levels, are administered at different times of the year, and have different implications for students and teachers. This paper presents descriptions and an analysis of the three different exams focusing on the numeracy and mathematics exams. The analysis centers around the stakes that these exams pose for teachers in a culture of accountability.

4. Time: 22:15─22:30 Online Pre-recorded video

FACTORS RELATED TO MATHEMATICS TEACHERS PEDAGOGIC DISCRETION, SPECIFICALLY WHEN EVALUATING PARABOLIC SKETCHES

Shai Olsher, Kawthar **Nakhash Khalaila**
University of Haifa, **Israel**

This paper examines the influencing factors on mathematics teacher's pedagogical discretion when assessing parabolic sketches in a digital environment. We provided 62 secondary mathematics teachers with 20 sketches representing student answers to a task requiring them to sketch a quadratic function that passes through a certain point. The teachers were asked whether they would accept each sketch as a correct answer to the task in different teaching settings: classwork, homework, and a test. We identified different characteristics of inaccuracies in the sketches that correlated and did not correlate with the acceptance of the sketch as correct by the teachers. In addition, we identified significant differences between the percentage of acceptance of sketches in the different settings.

5. Time: 22:30─22:45 Online Pre-recorded video

ASSESSMENT BASED ON GAMIFICATION IN HUNGARIAN SECONDARY MATHEMATICS CLASSES

Marta Barbarics

Budapest Semesters in Mathematics Education, **Hungry**

T*he paper presents the results of a six-year-long study on assessment based on gamification in public secondary education in Hungary. The study consists of three phases: the first phase explores students' experiences in connection with traditional school assessment and assessment based on gamification. The second phase presents the views, motivations, purposes, and practices of teachers already using assessment based on gamification. The third phase is an action research project incorporating the results of the first two phases of the study and also an experiment of a Hungarian guided discovery learning method in mathematics education: The Pósa Method. Results of the study show that assessment based on gamification can fulfil several aims. From the students' point of view, it can serve as an answer to their needs and criticism to traditional school assessment in Hungary. It can also act as a powerful tool for teachers to motivate their students, to deal with mixed ability groups, and to assess different skills (in addition to mathematical knowledge). Preliminary results of the action research prove that gamification based assessment can also support guided discovery learning.*

6. Time: 22:45─23:00 Online Power Point Presentation

I KNOW ALL ABOUT THIS MATHEMATICAL TOPIC, BUT I CANNOT ANSWER THIS QUESTION' MOMENT, CAN I HAVE A CLUE PLEASE?

Anne D'Arcy-Warmington
Curtin College **Australia**

Imagine the situation, you are sitting in the chair facing the 'Million Dollar' question about your favourite topic feeling somewhat confident when suddenly, all your hopes are dashed. The question is phrased differently or you don't quite understand the slant/ aspect of the question so you don't know how to answer. In that moment, the million dollars becomes just a dream again. In a real-life situation, whether it be at home or at work, you would look for help in any form, internet search, ask a colleague or phone a friend! At Curtin College, Western Australia, this issue is trying to be addressed, in an academic situation, by a system of an exchange of marks for information by means of a clue or hint to complete the question during written tests. Anxiety can affect students who consequently may be unable to write a solution befitting their level of knowledge, even with a sheet of notes under timed test conditions. This instant feedback system provides insight for the educator about areas involving misconceptions or where greater detail is required and for the student this information is received at the precise moment and specific area of need. This paper will utilize Structure of the Observed Learning Outcome Taxonomy (SOLO) to illustrate the journeys of students' learning and educators' pedagogical enrichment.

Session 3: 14:30-16:30 Beijing time, July 17th

1. Time: 14:30─14:45 Online Power Point Presentation

INVESTIGATING THE TREATMENT OF MISSING DATA IN AN OLYMPIAD-TYPE TEST – THE CASE FOR SELECTION VALIDITY

Caroline Long, Johann Engelbrecht Vanessa Scherman,
University of Johannesburg University of Pretoria University of **South Africa**

The purpose of Olympiad-type tests is to generate interest in mathematics and to identify the most talented mathematical thinkers. The focus here is on how the various scoring procedures adopted in an initial round of testing may affect the selection of learners for a subsequent round. In particular, we look at the treatment of missing data. Two approaches to the handling of missing data applying the Rasch measurement model, the first where missing data is scored zero, and the second where missing is regarded as missing, are discussed. Whether the student answers or omits a question for which they are unsure is affected by the scoring procedures, in this case negative marking. Recommendations are made for future scoring in the selection of talented students.

2. Time: 14:45─15:00 Online Power Point Presentation

MATHEMATICS ASSESSMENT PRACTICES OF PRIMARY SCHOOL TEACHERS IN FRANCE

Nathalie Sayac[1] & **Michiel Veldhuis[2]**
[1]LDAR Université Paris-Diderot, ESPE Créteil
[2]iPabo University of Applied Sciences Amsterdam & Utrecht University, **France**

We investigated French primary school teachers' assessment practice in mathematics. Using an online questionnaire on teachers' background, teaching, and grading practice, we were able to determine the assessment profiles of the 600 teachers who filled in our questionnaire. As evidenced by the teachers' scores on the latent factors Assessment purposes, Assessment practices, and Differentiation, teachers with the profile of Enthusiastic assessors' view assessment as more useful and use it more often to adapt their instruction than teachers with the profile of Unenthusiastic assessors.

3. Time: 15:00─15:10 Online Power Point Presentation

THE ROLE OF FORMATIVE ASSESSMENT EXPERIENCES IN THE TEACHING AND LEARNING OF MATHEMATICS

Adri van der Nest Caroline Long, Johann Engelbrecht

University of South Africa University of Johannesburg University of Pretoria

Poor mathematics performance levels reported in external comparative assessments raise concerns about the quality of mathematics education in South Africa. One constraining factor of systemic type testing is the reliance on sources of external monitoring, inevitably leading to 'teaching to the test'. Literature on formative assessment reveals great potential for significant improvements in the teaching and learning of mathematics. However, little is known about mathematics teachers' understanding, implementation and experiences of formative assessment. This qualitative study reports on an Assessment Enhanced Teaching and Learning (AETL) project, involving Grade nine teachers as they participated in the implementation of curriculum-aligned formative assessment tasks. Findings from this study indicate that exposure to activities designed for formative assessment can be used productively as a tool for enhancing the teaching and learning of mathematics in a range of contexts.

4. Time: 15:10─15:20 Online Pre-recorded video

ASSESSING MATH IN TEACHER TRAINING; WHAT TO LEARN FROM OUR STUDENTS RESEARCH

Willem van der Vegt

Windesheim University of Applied Sciences, Zwolle, The **Netherlands**

In the final stage of their teacher education students do research within the school in which they work as a teacher-in-education. A couple of the research papers of the students concerning assessment is analyzed to investigate which themes are important for the students and their schools. We compare these themes with the current curriculum of the math teachers training program and we formulate some conditions for adjusting the curriculum, in order to meet with the concerns of our students and their schools.

5. Time: 15:20─15:30 Online Power Point Presentation

TRANSFORMATIVE ASSESSMENT SYSTEM IN MATHEMATICS EDUCATION: ENGAGING MIND, BODY AND SOUL

Basanta Raj Lamichhane

Saptagandaki Multiple Campus, Bharatpur, Chitwan, **Nepal**

In this paper, I will attempt to explore visions of TAS in mathematics education that is more integrative, empowered, and contextual, opposing narrowly conceived post/positivist perspective embedded in mathematics education practices. The main essence of TAS is to develop a creative, critical, imaginative and reflective thinking among the learners by giving them an opportunity for demonstrating and preforming their mathematical knowledge, skills, concepts, theorems and techniques through deep engagement in the assessing process. In this process, learners are not assessed, but they are involved in assessing process for exploring corrosive forces that incarcerate the world in a mesh of present crisis (terrorism, famine, violence, environmental degradation, global warming, etc.) and they would be able to envisage a better future of the world. This evocative and illuminating view possibly brings the perspectival changes in mathematics education and assessment practices that makes mathematics more meaningful, viable and interesting.

6. Time: 15:30─15:40 Online Pre-recorded video

ANALYSING STUDENTS' ERRORS IN SOLVING CONTEXT-BASED PROBLEMS IN MARWA ASSESSMENT

Ummy Salmah, Uki Rahmawati and Bungkus Dias Prasetyo

SEAMEO Regional Centre for QITEP in Mathematics, **Indonesia**

Analyzing students' errors in solving mathematics problems is essential. This study aims to investigate students' errors in solving context-based problems in Mathematics Regional Wide Assessment (MaRWA). MaRWA provides items including context-based problems that students have to solve. Students' answers were analyzed using six error types that represent different aspects. Students' answers were chosen from five context-based problems in MaRWA that were presented in short answer questions. Students' answers were analyzed qualitatively and quantitatively based on six error types that have been developed from other related research. The result shows that most of the students in this study did errors related to their mathematical understanding. Moreover, students also made error that related to their understanding of context showed in each problem.

7. Time: 15:40─15:50 On site Power Point Presentation

RAW SCORES OR RASCH MEASURES? LESSONS FROM RASCH ANALYSIS OF SECONDARY ONE MATHEMATICS TEST

Hairon Salleh
National Institute of Education

Foo Kum Fong
Academy of Singapore Teachers, Ministry of Education

Koh Wei Xun
National Institute of Education

Singapore

This paper aims to share the utility of Rasch analysis in measuring Secondary 1 students' mathematical problem-solving ability through the validation of test items and insights gained from the distribution of student ability and item difficulty through the use of a Wright Map. The results show that mathematical difficulty varies with the number and type of sources of item difficulty. The differences in item difficulty highlights the different levels of cognitive loading required for different mathematical problems, which also espouses the need for differentiated instruction in increasingly diverse mixed ability classrooms.

8. Time: 15:50─16:00 Online Pre-recorded video

RESEARCH ON THE LEVEL DIVISION OF MATHEMATICAL LOGICAL REASONING LITERACY BASED ON SOLO TAXONOMY THEORY

Hua Wu **Junhan Liu** Fengqi Zhai
LiaoNing Normal University, **China**

China's new curriculum reform puts forward to cultivate students' core quality of mathematics, that is, students should have correct values, character and ability l after completing the mathematics study in senior high school. According to the diversified reference at home and abroad about the SOLO taxonomy theory, core literacy and mathematical logical reasoning, the author sets the standard of classifying students' literacy level division standard logic reasoning in the view if SOLO theory, with the combination of compulsory education and ordinary high school mathematics curriculum standard. Also, the teaching practice has been carried on during two samples. The author draws the conclusion: the division standard will help the teachers and students to accomplish each task in a targeted way.

9. Time: 16:00─16:10 Online Power Point Presentation

QUALITY OF MATHEMATICAL REASONING IN A PHILIPPINE SENIOR HIGH SCHOOL'S PRE-CALCULUS EXAMINATIONS ON CONIC SECTIONS

Vitus Paul L. de Jesus
La Salle Green Hills / Ateneo de Manila University, **Philippines**

Angela Fatima H. Guzon
Ateneo de Manila University, **Philippines**

The study assessed the quality of mathematical reasoning required for the tasks in the Pre-calculus examinations on conic sections that were administered in a Philippine senior high school. It also examined the relationships that seem to surface between the cognitive domain categories of the revised Bloom's Taxonomy and the kinds of mathematical reasoning of Lithner's framework. Findings show that about 97% of the examination tasks can be solved by simply employing memorized and algorithmic superficial methods. 298 textbook and handout tasks guided the categorization of these tasks. Furthermore, the results seem to suggest that Pre-calculus teachers would tend to produce and give tasks needing memorized and algorithmic reasoning that would fall only within the cognitive domains of Understanding, Applying and Analyzing.

10. Time: 16:10─16:20 Online Pre-Recorded Presentation

THE RESULTS OF LARGE-SCALE ASSESSMENT AS TOOLS FOR MATHEMATICS ACTIVITY DESIGN

Alessandro Gambini, **Roberto Capone**
Sapienza University of **Rome**, University of Salerno

The use of mathematics standardized assessment in an educational point of you is performed. Through the use of a research tool, the database Gestinv, it is possible to consider the results of standardized assessments in a formative way; the combined analysis of the texts and statistical analysis allow to investigate widespread difficulties of the students based on their skill level in mathematics. This allows the design of mathematical activities built ad hoc for students participating in a national project.

11. Time: 16:20─16:30 On site Power Point Presentation

RESEARCH ON THE ASSESSMENT SYSTEM COMBINING STANDARDIZATION AND NON-STANDARDIZATION IN THE MATHEMATICS EDUCATION OF TOP TALENTS

Niu Jian-ren, Lai Li, Chen Chao-dong, He Zhi-rong, Yang Liang
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The non-standardized test is introduced into the teaching activities of cultivating top talents' mathematical ability and innovation ability. It is aim to form a new assessment system combining standardization and non-standardization for top talents. Through the comparative study, it is found that the assessment system is conducive to improving the learning ability, application ability and innovation ability of top talents, as well as promoting the improvement of teaching methods.