

TSG Agenda

TSG 10: Teaching and learning of measurement

Class: B

Please prioritize the sessions in “core-time” (from 19:30-23:00, Beijing time, i.e. Session 2, 3 for Class A and **session 1, 2 for Class B) as they are friendly to most of the time zones in the world.

Session 1

Title of the session:

Relationships between Numbers and Units

1. Time: 19.30 – 19.40

Introduction and overview of three sessions.

2. Time: 19.40 – 20.10

Title of the Paper:

Rethinking measure

Author(s) (with the presenter name in BOLD if more than 1 name here): Petronilla Bonissoni, Marina Cazzola, Gianstefano Riva, **Ernesto Rottoli**, Sonia Sorgato

Institution(s) (to school/department/research center) and Country/Region:
Gruppo di Ricerca sull'insegnamento della matematica per la scuola primaria –
Università Milano Bicocca, Italy

Short abstract of the paper (20 lines maximum):

Reflections about teaching and learning fractions have led us to rethink the concept of measurement. Rethinking starts with classroom practices that directly concern the

comparison between two quantities without “juxtaposing” them; this leads to focusing the attention of children on the “common unit”, rather than on “unit of measurement”. Our proposal refers directly to the Pythagorean statement “The comparison is a logos”; an act of mathematization that makes the outcome of the measurement a pair of numbers. All this leads to rethinking the concept of measurement, obtaining significant indications of: didactic type, historical-philosophical type, and physical type.

3. Time: 20.10–20.30

Title of the Paper:

Can length measurement estimation activities contribute to learners’ improvement On number line estimation tasks?

Author(s) (with the presenter name in BOLD if more than 1 name here)

Pamela Vale

Institution(s) (to school/department/research center) and Country/Region

Rhodes University, South Africa

Short abstract of the paper (20 lines maximum):

In this paper I reflect on whether a connection can be made between length measurement estimation and number line estimation, and as such whether length measurement estimation activities can be a vehicle for connecting and linking to the topic of number in this way. I explore the performance of a group of Grade 3 learners in South Africa on a series of number line estimation tasks. These tasks formed part of a pretest administered before the learners participated in the Fraction as Measure instructional sequence.

Learners completed a post-test immediately after the design experiment and shifts were evident in their performance on the number line estimation tasks. The expanded provides greater depth, as well as presenting a richer sample and representation of the data than is possible within the length restrictions.

4. Time: 20.30–21.00

Title of the Paper:

Measurement units and numeration units: What reveals the introduction of a “mixed” table in decimals teaching

Author(s) (with the presenter name in BOLD if more than 1 name here)

Chambris Christine*, **Coulange Lalina****, Train Grégory**

Institution(s) (to school/department/research center) and Country/Region

*CY Cergy Paris Université, Université de Paris, Univ Paris Est Creteil, Univ. Lille, UNIROUEN, LDAR, F-95000 Cergy-Pontoise, France, **Lab-E3D – Université de Bordeaux, France

Short abstract of the paper (20 lines maximum):

This paper investigates conditions for fostering relations between 1) metric and numeration units, 2) tasks involving length measurement and numeration (for decimals). The study (grade 4, in France) is based on the analysis of an innovative practice introducing a table mixing numeration units and metric length units. It reveals issues on different kind of multiplicative relations between units.

Session 2

Title of the session:

Negotiating Measure and Its Meanings

5. Time: 21.30 – 22.00

Title of the Paper:

The role of error in measurement

Author(s) (with the presenter name in BOLD if more than 1 name here):

Ishan Santra, Jeenath Rahman

Institution(s) (to school/department/research center) and Country/Region:

Homi Bhabha Centre for Science Education, TIFR, Mumbai, India

Short abstract of the paper (20 lines maximum):

The linear scale (or measurement) is very prominently present in our everyday social practices and communication as a way of understanding the world around us. However, such ways of knowing are not made available in the school curriculum. School curriculum mostly turns linear measurement into an individual exercise and reduces the real-life human subjectivity and negotiations in measurement into an “error”. However, the same notion of “error” can be used as a resource in learning measurement from the commognitive conflict perspective of Sfard.

6. Time: 22.00 –22.20

Title of the Paper:

An investigation of teachers’ explanatory talk when introducing standard units of measuring length to standard 4 learners in Malawi

Author(s) (with the presenter name in BOLD if more than 1 name here)

Liveness Mwale

Institution(s) (to school/department/research center) and Country/Region

University of Malawi, Malawi

Short abstract of the paper (20 lines maximum):

This study investigated teachers’ explanatory talk when introducing units of measuring length, to early grade learners in Malawi. Explanatory talk was regarded as explanations that teachers offer as they elaborate Mathematics in their classrooms. The study used Mathematics Discourse in Instruction (MDI) as its theoretical framework to analyse teachers’ talk during lessons. MDI is built on four interacting components; object of learning, exemplification, explanatory talk and learner participation. Data was collected from three teachers using lesson observations and video recording. The teachers were purposively sampled to ensure that they were teaching measuring length during the time of data collection. The data were transcribed and elements of teachers’ explanatory talk were analysed. Findings of the study showed that some core mathematical knowledge that could help learners access the concept of standard units of measuring length were omitted in teachers’ explanations. These include comparison of lengths, estimation, understanding

the use of tools for measuring length, equivalence and converting from one unit to another.

7. Time: 22.20–22.30

Title of the Paper:

Insight into pupils' errors in solving problems involving calendar dates through analysis of knowledge states

Author(s) (with the presenter name in BOLD if more than 1 name here)

***Phei Ling TAN**, **Liew Kee KOR

Institution(s) (to school/department/research center) and Country/Region

*Methodist Girls' School, Penang, Malaysia, **Universiti Teknologi MARA (UiTM), Kedah, Malaysia

Short abstract of the paper (20 lines maximum):

This paper employed Cognitive Diagnostic Assessment [CDA] to identify pupils' common error based on their knowledge state (KS). Knowledge state is a state of knowledge, specifying the level of mastery for the tested domain. In this study, 18 items which measure the concept of "finding the date after a specific period with a given starting date" were developed based on seven attributes, hierarchically arranged in a cognitive diagnostic model. Using Artificial Neural Network, the test score of 269 primary pupils were analyzed and the common KS is "000000". Four major errors were identified in this KS, namely a) Performing incorrect operation; b) Regrouping incorrect number of days into a month; c) Including the starting date as one day in the duration; and d) Not expressing the final answer in date format. Based on the pupils' written response and the literature, we deduced further all possible causes of these errors. In return, teachers could carry out remedial activities in instructional planning to help pupils with specific needs in learning the topic.

8. Time: 22.30–23.00

Title of the Paper:

Measuring the teacher's arm span: Interpreting a data modeling sequence through an aesthetic lens

Author(s) (with the presenter name in BOLD if more than 1 name here)

Russell Tytler, Peta White, Joseph Ferguson

Institution(s) (to school/department/research center) and Country/Region

Deakin University, Melbourne, Australia

Short abstract of the paper (20 lines maximum):

There is a growing recognition of the importance of affect and aesthetic aspects of engaging students in learning mathematics and science. This paper reports on a Grade 4 learning sequence focused on foundational constructs of measurement and data modeling. The sequence involved students generating and representing measures of their teacher's arm-span, with a focus on the invention and refinement of data representations. We made use of video of classroom and group discussions, and samples of student work, to explore students' meaning-making practices. Through this analysis we came to understand aesthetics as a fundamental aspect of students' growing understanding, and of teacher's pedagogic practices. We draw on the pragmatist perspectives of Dewey and Peirce to show how students' object of interest shifted from an everyday interest in the arm span and their role in measuring this to an interest in the potentialities of the data set as an exploratory field. We argue that an aesthetic perspective, in which feeling and meaning are intertwined, provides a more powerful way to understand the role of affect in learning than perspectives that separate the emotional from the cognitive.

Session 3

Title of the session: Interplay Between Conceptions of Space and Measure/ Fostering Development of Measure through Interdisciplinary Practice

9. Time: 14.30 – 14.50

Title of the Paper:

The use of geometric construction problems to solve measurement problems at middle school

Author(s) (with the presenter name in BOLD if more than 1 name here)

Gbaguidi Ahonankpon Florent

Institution(s) (to school/department/research center) and Country/Region

Institut de Mathématiques et de Sciences Physiques, Benin

Short abstract of the paper (20 lines maximum):

Solving a geometry problem often involves writing a demonstration based on a drawing that is nothing more than a representation of a figure. Faced with the many difficulties that students have in doing mathematics and more particularly geometry problems, we believe that the regular practice of geometric constructions would help to solve geometry problems requiring the representation of a drawing. Furthermore, middle school curricula recommends, among other things, that the pupil be introduced to reasoning as early as possible, that he or she be trained in the formulation of demonstrations, and that geometric activities be an opportunity for him or her to manipulate instruments, draw freehand lines and justify a construction. Quantities and measurements, in their tool dimension, are means on the one hand to solve problems of daily life and on the other hand to link other mathematical subjects such as numbers, operations, algebra, geometry and others. It is for this reason that we have chosen to study the exploitation of geometric construction problems to solve measurement problems in middle school.

10. Time: 14.50 — 15.00

Title of the Paper:

Conceiving volume as a multiplication of three quantities: the cases of Stan and Sloane

Author(s) (with the presenter name in BOLD if more than 1 name here)

Samet Okumus

Institution(s) (to school/department/research center) and Country/Region

Recep Tayyip Erdoğan University, Turkey

Short abstract of the paper (20 lines maximum):

In this study, two middle school students who were engaged in finding the volume of prisms and cylinders described a rule for finding the volume of objects. The results indicated that students recalled some volume and area formulas, and stated the formulas when they were asked to compute the volume of objects. They tried to find three numbers to multiply to find the volume of objects referring to the length * width * height formula, which demonstrated they had difficulty understanding the volume of a rectangular prism conceptually. As a result, they conceived the volume formula of three-dimensional objects as a multiplication of three quantities.

11. Time: 15.00 — 15.10

Title of the Paper:

Articulations between mathematics and physics education: the concept(s) of unit of measurement, from geometry to formulas

Author(s) (with the presenter name in BOLD if more than 1 name here)

Charlotte de Varent

Institution(s) (to school/department/research center) and Country/Region

LDAR, SPHERE, Université de Paris, France

Short abstract of the paper (20 lines maximum):

Based on an analysis of fifth grade textbooks, we examine how the area unit of measurement is represented in each register involved. The session we focused on aims at learning the area of the rectangle formula. We wonder about the compatibility of the different conceptions which are associated with the unit of measurement, in linking the geometrical register (paving the rectangle) with the arithmetical and algebraical registers (formulas and their applications). Is the measurement unit associated with a numerical quantity value of measure? Is the standard linked to a surface and an actual idea of measuring by postponing it? An algebraic symbol? An operand inside a multiplication? We specify how some textbooks have taken concrete charge of some of these epistemological difficulties. On the strength of these analyzes, we propose in opening to

seek collectively for coherence in the representations of the units of measurement, between registers, linking physics and mathematics education research on several school levels.

12. Time: 15.10 – 15.30

Title of the Paper:

Dynamic measurement for area and volume

Author(s) (with the presenter name in BOLD if more than 1 name here)

Nicole Panorkou

Institution(s) (to school/department/research center) and Country/Region

Montclair State University, U.S.A.

Short abstract of the paper (20 lines maximum):

This paper describes the forms of reasoning that students developed as they engaged with tasks presenting area and volume dynamically. The analysis of a series of design experiments with twelve fourth-grade students showed that they reasoned about dynamic measurement in terms of a) the quantities involved in the generation of the space to be measured, b) the dimensional transformation of those quantities, and c) their continuous change.

13. Time: 15.30–15.50

Title of the Paper:

Teaching with clocks: Instrumental dynamics' effects on time learning

Author(s) (with the presenter name in BOLD if more than 1 name here)

Chaereen Han and Oh Nam Kwon

Institution(s) (to school/department/research center) and Country/Region

Graduate School of Seoul National University and Seoul National University, Korea

Short abstract of the paper (20 lines maximum):

This paper investigates opportunities to manipulate clocks provided by teachers and the effects of these opportunities on students' performance in positioning clock hands. We consider how elementary teachers enacted two analog clocks that differed regarding the connectivity of the two hands. We observed 18 lessons on time taught by six teachers and administered a test of time understanding before and after the lessons to student participants (n=109) who belong to the classes of the participating teachers. Qualitative analysis of the six teachers' instruction revealed that the enacted tools differentially mediated their teaching, which resulted in students being provided with different opportunities to learn covariational reasoning. Quantitative analysis of the students' performance on clock-hand-positioning tasks by the teacher group and assigned tool showed that the assigned tool differentially mediated students' thinking as they positioned clock hands. The findings suggest that pedagogical attention to the enactment of clocks with a focus on clock properties is needed to promote students' conceptual understandings of time.

14. Time: 15.50 – 16.20

Title of the Paper:

Young students learning the mathematics of measurement through an interdisciplinary approach

Author(s) (with the presenter name in BOLD if more than 1 name here)

***Peta White**, *Russell Tytler, **Joanne Mulligan, *Melinda Kirk

Institution(s) (to school/department/research center) and Country/Region

*Deakin University, **Macquarie University, Australia

Short abstract of the paper (20 lines maximum):

There is increasing criticism of STEM activities as often trivialising mathematics as merely a computational tool. This chapter describes the situating of mathematics in an interdisciplinary setting where practices of measure (area and height), sampling, variation and data modeling are interwoven with science concepts in ways that mutually reinforce learning. We demonstrate the effect of consecutive learning sequences in ecology (Grade 1), then fast plant growth (Grade 2), through a pedagogy that involves students' invention,

comparison/evaluation, and refinement of mathematical representations, with strong teacher guidance. The sequences were followed by several classes and their teachers, across two schools, with video capture, lesson observations, and tracking students' representations in pre- and post-tests and student work samples. Teachers and case study students, across two schools, were interviewed at the end of each sequence. These sequences, and the findings, have much to say about productive inquiry-based mathematics pedagogy, and about the circumstances under which interdisciplinary practice can lead to robust mathematical learning of measure.

15. Time: 16.20 – 16.30

Concluding remarks

Commented [CC1]: A long discussion was planned, introduced by R. Lehrer (team member). It has been removed.

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Note:

Class B:

- Session 1: 19:30-21:00 Beijing time, July 13th
- Session 2: 21:30-23:00 Beijing time, July 16th
- Session 3: 14:30-16:30 Beijing time, July 17th