

TSG20 Learning and Cognition Agenda

TSG 20: _Learning and Cognition Class: B Times: Beijing time

Session 1 19:30-21:00, July 13th 1.5 Hours

1. Time: 19:30-20:00, July 13th

Title of the Paper:

Exploring new models for teacher professional learning: Working *with* teachers rather than *on*

Author(s):

ALISON SUPERFINE CASTRO

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

University of Illinois at Chicago

Short abstract:

New models for supporting teacher professional learning generate new conceptualizations of teacher learning, afford new designs for studying teacher learning over time, and situate teacher learning in problems of practice relevant to their own circumstances. In this paper, I describe two examples in which we engaged teachers in new models to support their professional learning, including examples of the various forms of inquiry we developed, as well as ways in which teachers engaged in the activities as part of these efforts. I then discuss a set of design principles underlying both examples. Finally, I discuss tensions that emerged from these efforts.

2. Time: 20:00-20:15, July 13th

Title of the Paper:

Introduction of stem education through collaborative action research practices

Author(s):

FATLUME BERISHA; Eda Vula

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

Faculty of Education, University of Prishtina, Kosovo

Short abstract:

Science, Technology, Engineering, and Mathematics (STEM) is the leading education reform worldwide, yet, many teachers lack the knowledge and confidence to teach integrated STEM. This study examines the initiative of teaching a STEM integrated approach through the collaboration of mathematics and science university lecturers and pre-service teachers in a Teaching and Learning subject-specific course. The study presents the pre-service teachers' knowledge development of integrating STEM and their views and attitudes towards STEM. Data were collected through pre-surveys, post-surveys, lesson plans, and presentations from 51 pre-service mathematics and science teachers. Results show that experiences of pre-service teachers with STEM learning and teaching had a positive impact on their understanding and importance of STEM and their motivation and enthusiasm to design and present STEM lesson plans in group settings while integrating mathematics and science.

3. Time: 20:15-20:30, July 13th

Title of the Paper:

Theorizing teachers' learning of students' mathematical thinking in the context of student-teacher interaction

Author(s)

BIYAO LIANG, Kevin C. Moore

Institution:

University of Georgia, USA

Short abstract:

We discuss how constructivism affords a cognitive account of social interaction between students and teachers. By combining the Piagetian scheme theory with the notions of second-order modeling, we theorize three types of mental processes involved in teachers' learning of students' mathematical thinking in the context of student-teacher interaction. We conclude by discussing the affordances and limitations of this framework and proposing a methodology compatible with our theorization.

4. Time: 20:30-20:40, July 13th

Title of the Paper:

Students' ways of thinking in a computer-based mathematics investigation projects

Author(s)

JOYCE MGOMBELO¹; Wendy Ann Forbes¹; Chantal Buteau¹; Eric Muller¹; Ana I. Sacristán²

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

¹Brock University, Canada; ²Cinvestav, Mexico

Short abstract:

This paper explores students' ways of thinking in a computer-based mathematics investigation projects. The paper draws from a preliminary analysis of data collected from first year of study that seeks to examine how post-secondary mathematics students learn to use programming as a computational thinking instrument for mathematics. Two distinct thinking styles that emerged during data analysis of two participants are discussed.

5. Time: 20:40-20:50, July 13th

Title of the Paper:

Reciprocity between teachers' and students' problem-solving actions enables teacher change

Author:

GAYE WILLIAMS

Institution:

The University of Melbourne, Australia

Short abstract:

This study of Year 5 teacher change in capacity to implement mathematical problem-solving was situated in an independent girls' school in Australia. It investigates whether pedagogical changes occurred, and what influenced the change process. Data was sourced from video of professional learning sessions, video excerpts of trials of tasks, group worksheets from lessons, and teacher and student interviews. Reciprocity between teacher and student actions was found to influence the development of problem-solving capacity (pedagogical and mathematical) for teachers and students respectively. These findings about teachers from one year-level in one girls' school, although not generalizable, provide insights that could inform other professional learning programs.

6. Discussion: 20:50-21:00

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Session 2 21:30-23:00, July 16th 1.5 Hour

1. Time: 21:30-22:00, July 16th

Title of the Paper:

Interactive patterns that lead to children's discursive changes in lessons comparing fractions

Author(s):

KEIKO HINO; Yuka Funahashi

Institution(s), Country/Region:

Utsunomiya University; Nara University of Education; Japan

Short abstract:

The analysis presented in this paper examined the changes in the way children explained equivalent fractions and explored the teacher's key interactions that enabled such changes. Data from nine consecutive fifth-grade lessons in Japan taught by an experienced teacher were examined using a guided focusing pattern framework (Funahashi & Hino, 2014), from which it was found that the changes in the explanations were mostly in the focusing phase. The teacher's key interactive actions were classified into three categories: proposing focus, modifying focus, and narrowing focus. In particular, it was found that the teacher consistently attempted to change the children's focus from procedure to quantity and quantitative relationships using intervening language and by evoking discursive rules.

2. Time: 22:00-22:15, July 16th

Title of the Paper:

Assessing mental abstraction activities using eye-tracking techniques

Author(s):

EIVIND KASPERSEN; Trygve Solstad

Institution(s) and Country/Region:

Norwegian University of Science and Technology, Norway

Short abstract:

When do we know students have abstracted and what student behavior attests to this? To approach this question, we recorded eye movements of people who learned new concepts in two synthetic learning environments: one in which respondents were prompted to abstract; another in which respondents were prompted to apply alternative mental activities. Findings indicated a substantial difference between the scanpaths of those who abstracted and those who used alternative mental activities.

3. Time: 22:15-22:30, July 16th

Title of the Paper:

Mathematics itself: reflections about an often neglected, but pivotal dimension

Author:

MICHAEL NEUBRAND

Institution(s) and Country/Region:

Carl von Ossietzky University Oldenburg, Germany

Short abstract:

Mathematics teaching and learning depend on many aspects. The central one – shouldn't it be self-evident? – is mathematics itself. Teaching and learning are truly influenced by the character of the mathematical practices imposed on the issues going to be studied and performed. Indeed, in whatever is taught and learned mathematical practices can emphasize either of the two sides of the coin: On the one hand, mathematics can appear as a collection of rules, procedures, and methods to be performed, or as a discipline which calls for coherence, connections, and structure, on the other hand. This paper discusses how these two views of mathematics shape the potentials a certain topic opens for learning—just by focusing the consideration on the one or the other side.

4. Time: 22:30-22:40, July 16th

Title of the Paper:

On the epistemological significance of contextualizing in mathematical cognition

Author(s):

MARCIA M. F. PINTO¹; Thorsten Scheiner²

Institution(s), Country/Region:

¹Federal University of Rio de Janeiro, Brazil; ²Institute for Learning Sciences & Teacher Education, Australia

Short abstract:

Recent research on mathematical cognition acknowledges that individuals ascribe meaning to the objects of their thinking. However, some of the dynamic and interactive processes involved in ascribing meaning have been underspecified. This paper directs attention to contextualizing, a process for the particularization of a sense of a representation that comes into being in the context the object is used. The purposes of the paper are to make some theoretical extensions and enrichments to existing perspectives on contextualizing and to highlight its epistemological significance. For fostering the epistemological value of a representation; the issue then becomes how a sense of a representation can come alive and how one can grasp such a sense in the immediate context, instead of how one can dissociate the sense from the represented object.

5. Time: 22:40-22:50, July 16th

Title of the Paper:

Learning strategies used by high achieving and low achieving students in mathematics

Author:

BISHNU KHANAL

Institution(s) and Country/Region:

Tribhuvan University, Kathmandu, Nepal

Short abstract:

This paper highlights the learning strategies used by high achieving and low achieving students in mathematics. The study was conducted through purposive sampling procedure in 178 grade IX students of Kathmandu district of Nepal with 43 high achieving and 44 low achieving students. The author adopted a mix method sequential explanatory design using questionnaire, observations, and interviews. The result shows that high achieving and low achieving students have statistically no significant difference in their preferred learning strategies. High achieving students are more conscious learners and use content-specific learning strategies; they are interested, interactive, perceptive, humorous and pleasing. However, low achieving students are less interactive, embarrassed, feeling frustrated and performance avoiding.

6. Discussion 22:50-23:00

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Session 3 Time: 14:30-16:30, July 17th 2 Hours

1. Time: 14:30-15:00

Title of the Paper:

The amazingly frequent, efficient, and flexible use of the subtraction-by-addition strategy in elementary school children's mental multi-digit arithmetic: a challenge for cognitive psychology and mathematics education

Author(s):

LIEVEN VERSCHAFFEL; Joke Torbeyns; Gwen Verguts; Bert De Smedt

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

KU Leuven, Belgium

Short abstract:

In two related studies - a first study with 6th grade elementary school children and a second study with children from 4th until 6th grade of elementary school - , we investigated the use of the subtraction-by-addition strategy in children with different levels of mathematics achievement. In doing so, we relied on Siegler's cognitive psychological model of strategy change (Lemaire & Siegler, 1995), which defines strategy competencies in terms of four parameters - strategy repertoire, distribution, efficiency and selection - and the choice/no-choice method (Siegler & Lemaire, 1997), which is essentially characterized by offering items in two types of conditions - choice and no-choice conditions. In both studies, children of different mathematics achievement levels solved multi-digit subtraction problems in the number domain up to 1,000 in one choice condition (wherein they could choose between direct subtraction or subtraction by addition on each item) and two no-choice conditions (wherein they had to use either direct subtraction or subtraction by addition on all items). Distinction was made between two types of subtraction problems: problems with a small versus large difference between minuend and subtrahend. Although mathematics instruction only focused on applying direct subtraction, most children reported using subtraction by addition in the choice condition. Subtraction by addition was also applied surprisingly frequently and efficiently, particularly on small-difference problems, and children flexibly fitted their strategy choices to both numerical item characteristics and individual strategy speed characteristics. Interestingly, these results were obtained for children of all grades and all mathematical achievement levels. These remarkable findings - both from a cognitive psychological and a mathematics educational perspective - add to our theoretical understanding of children's strategy acquisition and challenge current mathematics instruction practices that pay exclusive attention to direct subtraction.

2. Time: 15:00-15:15, July 17th

Title of the Paper:

Numerical processing profiles in children with varying degrees of arithmetical achievement

Author(s)

¹NANCY ESTÉVEZ; ²Danilka Castro; ³Eduardo Martínez; ⁴Vivian Reigosa

Institution(s) Country/Region:

¹Neurodevelopmental Laboratory, Cuban Centre for Neurosciences, Cuba

²Centre for Advanced Research in Education, Universidad de Chile, Chile. School of Psychology. Universidad Mayor, Chile.

³Neuroinformatics Department. Cuban Centre for Neurosciences, Cuba

⁴National Institute for Educational Assessment, Uruguay

Short abstract:

Recent studies show basic cognitive abilities such as the rapid and precise apprehension of small numerosities in object sets, verbal counting and numerical comparison significantly influence the acquisition of arithmetic and more advanced stages of mathematical cognition. The different cognitive profiles of children with varying degrees of numerical and arithmetic processing deficits have not been sufficiently characterized, despite its potential relevance to the stimulation of numerical cognition and the design of appropriate intervention strategies. Here, the cognitive profiles of groups of typically developing children, children with low arithmetical achievement and DD, exhibiting typical and atypical subitizing ability were contrasted. The results suggest that relatively independent neurocognitive mechanisms may

produce distinct profiles at the behavioral level and suggest children with low arithmetic performance exhibiting atypical subitizing abilities are not only significantly slower, but rely on compensatory mechanisms and strategies compared to typical subitizers. The role of subitizing as a correlate of arithmetic fluency is revised in the light of the present findings

3. Time: 15:15-15:25, July 17th
Title of the Paper:
General and specific cognitive precursors on the early mathematical performance
Author(s):
Estivaliz Aragon, Gamal Cerda, Manuel Aguilar, Carlos Mera, **JOSE I. NAVARRO**
Institution(s) and Country/Region:
University of Cadiz (Spain) University of Concepcion (Chile)
Short abstract:
This study analyzed the contribution of predictors of both domain-specific (estimation and magnitude comparison) to informal mathematical performance (numbering, comparison, calculation and understanding of concepts) and domain-general (working memory, processing speed and receptive vocabulary) in pre-schoolers, using structural equations. A total of 145 pre-school students' ages ranging from 52 to 64 participated in this study. Students were assessed with informal mathematical thinking test, numerical estimation, symbolic and non-symbolic comparison task, coding task, receptive vocabulary test, and backward digit task. Results show a structural equation model for multiple indicators and multiple causes to explaining informal mathematical thinking. The model reduced the specific-domain factors effect, such as magnitude comparison. The effect of working memory was below the straight impact of the general-domain predictors considered in the study.
4. Time: 15:25-15:35, July 17th
Title of the Paper:
A cognitive model of learning applied to data analysis of mathematics learning
Author(s):
JAIRO ALFREDO NAVARRETE
Institution(s) and Country/Region: Universidad de O'Higgins, Chile
Short abstract:
In pretest-posttest designs, literature often recommends performing an ANCOVA on posttest-scores by using pretest-scores as a covariate. However, this approach does not provide an estimator of the amount of learning that has occurred. Estimating the learning that occurs during a period of instruction is challenging. This work proposes an alternative model of learning useful to analyze educational data and aims to perform a comparison against the traditional ANCOVA analysis. To this aim, I analyzed learning data obtained during a school intervention (to promote the learning of fractions) using three approaches. The results suggest that one of them might have advantages in comparison to the traditional ANCOVA analysis. The discussion focus on implications for analyzing pretest-posttest data regarding the learning of mathematics.
5. Time: 15:35-15:45, July 17th
Title of the Paper:
Exploring basic numerical capacities in children with varying degrees of arithmetical achievement
Author(s):
¹Danilka Castro Cañizares; ²**PABLO DARTNELL**, ³Nancy Estévez Pérez
Institution(s), Country/Region:
¹Center for Advanced Research in Education. Universidad de Chile, Chile. School of Psychology. Universidad Mayor, Chile; ²Center for Advanced Research in Education and Center for Mathematical Modeling. Universidad de Chile, Chile; ³Educational Neurosciences Department. Cuban Centre for Neurosciences, Cuba.

Short abstract:

Current cognitive theories suggest mathematical learning disabilities may be caused by a dysfunction in the ability to represent non-symbolic numerosity (non-symbolic skills), by impairments in the ability to associate numbers with the underlying magnitude representation (symbolic and numerical mapping skills) or by a combination of both deficits. The aim of this study was to compare the performance of children with very low achievement in arithmetic (VLA), children with low arithmetical achieving (LA) and typically achieving (TA) peers, in non-symbolic, symbolic and numerical mapping tasks, controlling for intelligence and working memory. The results showed that children with VLA have deficits in both non-symbolic numerosity processing and number-magnitude mapping skills, while children with LA exhibited deficits only in numerical mapping tasks. These findings support the hypothesis of impaired non-symbolic numerical representation as the cognitive origin of severe arithmetical difficulties. Low arithmetical achievement, in contrast, seems to be better explained by defective numerical mapping skills, which fits the access deficit hypothesis nicely.

6. **Discussion for Session 3:** 15:45-15:55

7. **Overview Discussion:** 15:55-16:30

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Note:

The time allocated includes the discussion time.

Invited. 30 Min: 25 Min Presentation 5 Min Discussion. Speaker can adjust to more discussion time e.g., 20/10 if they want to.

Long. 15 Mins: 12 Mins Presentation 3 Mins Discussion. Speaker can adjust to more discussion time e.g., 10/5 if they want to.

Short. 10 Mins: 8 Mins Presentation 2 Mins Discussion. Speaker can adjust to more discussion time e.g., 6/4 if they want to.

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