TSG Agenda

TSG _57: ___**Diversity of theories in mathematics education**___

Class: _A___ (Class A for TSGs with odd numbers)

Marcel Klinger, Jessica Lajos and Sun Young Ban will not attend the conference.
Further, the order of the slots on Wednesday has been changed, see below.

This is the new schedule. The abstracts can be find below in the original version:

Session 2, 19:30-21:00 Beijing time, July 14th

→19:40–19:50, **VERTICAL ANALYSIS AS A STRATEGY OF THEORETICAL WORK: FROM PHILOSOPHICAL ROOTS TO INSTRUMENTAL AND EMBODIED BRANCHES, Anna Shvarts;** Arthur Bakker

→19:50–20:10, **CONFIGURATION OF THE THEORETICAL-METHODOLOGICAL CONSTRUCT «THE TEACHING MODEL» BY AFFINITY BETWEEN THEORIES, Ulises Salinas-Hernández;** Luis Moreno-Armella; Isaias Miranda

→20:10–20:20, **THE HOLISTIC INSTRUCTIONAL DESIGN MODEL OF THE UNIT KNOWLEDGE STRUCTURE OF ELEMENTARY SCHOOL MATHEMATICS BASED ON CORE COMPETENCIES, ShiQi Lu,** Wenbin Xu (China)

→20:20–20:40, **NETWORKING THEORIES AND METHODOLOGY: IDENTIFYING ARGUMENTATIVE GRAMMARS IN DESIGN RESEARCH. Arthur Bakker;** William R. Penuel

→19:30-19:40: Introduction and 20:40-21:00 discussion

Session 3, 21:30-23:00 Beijing time, July 17th

→21:40–22:00, **MATHEMATICS TEACHING AND LEARNING AS AN ETHICAL EVENT, Luis Radford**

→22:00–22:20, **HOW CAN WE CLASSIFY TEACHERS' PARADIDACTIC PRAXEOLOGIES IN DIFFERENT INSTITUTIONAL SETTINGS? Tatsuya Mizoguchi,** Yusuke Shinno, Toru Hayata

→22:20–22:30, **THEORETICAL NETWORKING IN A LARGE-SCALE DANISH AND A LARGE-SCALE NORWEGIAN INTERVENTION STUDY: TMTM AND PBG, Lena Lindenskov**

→21:30-21:40: Introduction

→22:30-23:00: Discussion about the talks and the three sessions.

Session 1

(120 min) 14:30-16:30 Beijing time, July 13th

Time: 14:30-14:40: Introduction to the TSG57

1. Time: 14:40─15:10

   Title of the Paper:

   FACING THE CHALLENGE OF THEORETICAL DIVERSITY: THE DIGITAL CASE

Author:
Michèle Artigue
Institution:
LDAR, Université Paris-Diderot (France)

Abstract:
As is stressed in the presentation of TSG 57: "Mathematics education is a scientific field with many theory cultures. This diversity can be regarded as richness but it also challenges research as well as communication and cooperation in the field". It is added that "how the scientific community can cope with this diversity with scientific integrity remains an open question". I propose to contribute to the reflection by focusing on research addressing teaching and learning processes in digital environments. I first give a brief overview of the theoretical landscape in this area of research, highlighting its diversity. I then introduce two conceptual tools having proved their effectiveness in addressing issues of theoretical diversity: the scale of networking strategies and the concept of research praxeology, before using two particular cases: the instrumental approach and the documentational approach to didactics to discuss theoretical diversity in this area.

2. Time: 15:10─15:30
Title of the Paper:
ROLE OF FEEDBACK WHEN LEARNING WITH AN ARTIFACT
Author(s):
Angelika Bikner-Ahsbahs; Estela Vallejo-Vargas; Steffen Rohde
Institution:
Bremen University, Faculty of Mathematics (Germany)

Abstract:
Activity Theory and Instrumental Genesis are theoretical approaches, combined to investigate feedback for the teaching/learning of integers with a digital artifact. The students' learning and development are explored on four layers: learning the artifact, learning with the artifact, linking the artifact and the arithmetic symbol systems, and emancipating from the artifact. Findings show that feedback and their pragmatic and epistemic function bridge these layers in a supportive way, as an inner mechanism of the interaction system of the artifact, the tutor and the students. Reflection on the way the two

theories work together reveal that both theories are combined in a layering model describing the transformations in the activity of teaching/learning negative numbers mediated by feedback.

3. Time: 15:30─15:50

Title of the Paper:

COSTRUCTING MATHEMATICAL KNOWLEDGE BY MEANS OF ANALOGY: CONNECTING FISCHBEIN'S THEORY ON THE ROLE OF INTUITION IN MATHEMATICS AND THE THEORY OF ABSTRACTION IN CONTEXT

Author:

Ivy Kidron

Institution:

Jerusalem College of Technology, Jerusalem (Israel)

Abstract:

The paper deals with analogical reasoning in mathematics as a powerful means for students towards construction of knowledge that is new to them. Reasoning by analogy includes intuitive mechanisms of thought that accompany students' processes of conceptual thinking. Research on analogical reasoning in mathematics relates to two main foci of research: research on the role of intuition in mathematics and research on processes of construction of mathematical knowledge. I have been involved in both foci of research but separately. In this research, I connect these two foci of research into one focus that refers to constructing knowledge by means of analogy. Two theories are used and connected: Fischbein's theory which offers a rich insight in the mechanisms of intuition and the theory of Abstraction in context. The paper offers a concrete case of networking the two theories.

In the next sections, I describe shortly the two frameworks and explain the substantial reasons of the choice of these two specific theories. Then, I describe and analyze with both theories a concrete example of constructing mathematical knowledge by means of analogical reasoning. The core of the paper relates to the insights offered by each theoretical frame to the other one.

4. Time: 15:50─16:00 (skipped)

Title of the Paper:

A THEORETICAL FRAMEWORK FOR STUDENTS' CONCEPTUAL UNDERSTANING IN THE EARLY CALCULUS CLASSROOM

Author:

Marcel Klinger

Institution:

University of Duisburg-Essen (Germany)

Abstract:

In this article, a classification model for constructing tasks requiring students' conceptual understanding in the field of functions and the early calculus classroom is proposed. The "3L-model" combines three relevant dimensions: the involved representations (in the model called layouts) of a given function, the involved mental images (called layers), and the levels of the appearing functional relationships. The latter comprises the level of simple functions, the level of transformed functions, and the level of differentiated functions. The use of the 3L-model in test construction is illustrated for a sample item. The administration of the developed test allows insights of the conceptual understanding of more than 3000 students regarding functions in the early calculus classroom.
The administration of the developed test allows insights of the conceptual understanding of more than 3000 students regarding functions in the early calculus classroom.

5. Time: 16:00─16:20

   Title of the Paper:

   SEEKING A 'THEORY' OF NETWORKING PRAXEOLOGIES IN MATHEMATICS EDUCATION: A META-THEORETICAL DISCUSSION

   Author(s):

   Yusuke Shinno; Tatsuya Mizoguchi,

   Institution(s):

   Hiroshima University (Japan),

   Tottori University (Japan)

   Abstract:

   For this study, we explored the researchers' practice of networking theories and subsequently presented our retrospective analysis. The concept of 'research praxeologies' was utilised as a meta-theoretical frame to characterise three different case studies of networking theories. The results show how theoretical concepts and languages are differently situated in diverse networking praxeologies according to different types of studies such as empirical study, design study, and theory development.

Time: 16:20-16:30: Final discussion of Session 1 (enlarged: 16:10-16:30)

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Session 2: (90 min) 19:30-21:00 Beijing time, July 14th

19:30-19:40: Introduction

6. Time: 19:40─20:00 (exchanged with the presentation of Shvarts & Bakker)

   Title of the Paper:

   NETWORKING THEORIES AND METHODOLOGY: IDENTIFYING ARGUMENTATIVE GRAMMARS IN DESIGN RESEARCH

   Author(s).

   Arthur Bakker; William R. Penuel

   Institution(s):

   Utrecht University (the Netherlands),

   University of Colorado (USA)

   Abstract:

   The original idea of networking theories has been expanded into various directions. In this paper I make a plea for including methodology in the efforts of networking theories. Starting from the methodological orientation of design research, I focus on argumentative grammars behind the various schools of design research. I contrast the types of design research that focus on knowing and product design versus those that are informed by cultural-historical activity theory, which more explicitly focus on sustainable development and transformation of practices. Turning to theories behind them, it is apparent that they differ in their purposes and values, units of analysis, explaining mechanisms, and conceptualizations of causality or constitutive processes.

7. Time: 20:00─20:20

   Title of the Paper:

   CONFIGURATION OF THE THEORETICAL-METHODOLOGICAL CONSTRUCT «THE TEACHING MODEL» BY AFFINITY BETWEEN THEORIES

   Author(s):

   Ulises Salinas-Hernández; Luis Moreno-Armella; Isaias Miranda

   Institution(s):

   ENS de Lyon-France/Cinvestav IPN-Mexico

Cinvestav IPN-Mexico; IPN-CICATA, Legaria

Abstract:
Following one of the main interests of the TSG 57 (sub-theme 4) and focusing on the analysis of teaching practice, this article presents the use of the idea of "affinity" as a complementary heuristic of network theories strategies with the aim of configuring the theoretical-methodological construct «the teaching model» through the articulation of three theories around a semiotic-mediated point of view. Thus, the construct presents elements from a conceptual framework structured on three theoretical approaches that together address the epistemological and didactic dimensions of teaching practice in our research. After identifying related elements (affinities) between the theories used and configuring the teaching model, a qualitative investigation through case study is presented, analyzing the teaching practice of two teachers of grade 11 with different experience. The analysis deepens into the different levels of the teachers' expertise from relationships carried out by each of them in their teaching model of the movement of objects.

8. Time: 20:20─20:30 (skipped)

Title of the Paper:

MATHEMATICAL INTUITION IN FORMAL PROOF CONSTRUCTION: DEVELOPING AN APPROACH TO THEORETICAL RESEARCH

Author(s):

Jessica Lajos; Sepideh Stewart

Institution:

University of Oklahoma (USA)

Abstract:
This paper is an introduction to an expansive research project in the works on mathematical intuition in proof construction. The intent of this project, in its entirety, leans more towards scientific understanding and aims to make contributions that provides additional support for investigations on learners' intuitions. The purpose of this paper is to focus on the theoretical portion of this project, state research questions, discuss the

diversity of theoretical perspectives related to mathematical intuition, and an approach that we are taking to try to connect these perspectives.

9. Time: 20:30─20:40
   Title of the poster abstract:
   THE HOLISTIC INSTRUCTIONAL DESIGN MODEL OF THE UNIT KNOWLEDGE STRUCTURE OF ELEMENTARY SCHOOL MATHEMATICS BASED ON CORE COMPETENCIES
   Author(s):
   ShiQi Lu; Wenbin Xu
   Institution:
   Nanjing Normal University (China)

   Abstract:
   The Core Competencies concept requires the development of mathematical thinking. From this background, the research constructs and applies a holistic instructional design model. The basic theory of this model is thick epistemology. The process of the model consists of five sections (unit knowledge structure, learning psychological process, teaching objectives, learning evaluation, learning activities). The study also introduces multiple design cases developed from this model and reports on its specific situation in practice.

10. Time: 20:40─20:50 (exchanged with the presentation of Shvarts & Bakker)
    Title of the Paper:
    VERTICAL ANALYSIS AS A STRATEGY OF THEORETICAL WORK: FROM PHILOSOPHICAL ROOTS TO INSTRUMENTAL AND EMBODIED BRANCHES
    Author(s):
    Anna Shvarts; Arthur Bakker
    Institution:
    Utrecht University (the Netherlands)

Abstract:
In the paper, we propose vertical analysis as necessary work in the comparing and contrasting theories that metaphorically complements horizontal work of networking. By doing historical and conceptual work, vertical analysis aims to clarify grand theories behind local approaches and their ontological and epistemological philosophical presumptions. We exemplify vertical analysis by our work on bodied processes in instrumental genesis in which we coordinate instrumental and radical embodied approaches. The theoretical comparison of notions of action scheme and sensorimotor coordination led us to distinguish enactive and mental schemes. The educational applications and values-oriented sequences of this theoretical work are discussed.

20:50-21:00: Final discussion of Session 2 (enlarged to 20:40-21:00)

Session 3: (90 min) 21:30-23:00 Beijing time, July 17th

21:30-21:40: Introduction

11. Time: 21:40─22:00

Title of the Paper:

MATHEMATICS TEACHING AND LEARNING AS AN ETHICAL EVENT

Author:

Luis Radford

Institution:

Laurentian University, Ontario (Canada)

Abstract:

In this paper I contend that mathematics teaching and learning is unavoidably an ethical event. My contention is based on the fact that teaching and learning rests on (1) relations between individuals (e.g., relations of power, relations of solidarity) and (2) the legitimation of particular forms of knowledge and knowing. From an educational viewpoint, the question that arises in this context is the kind of ethics that our pedagogies could strive to nurture. The answer depends on the educational theory or theories to which we resort to understand teaching and learning. I sketch here a communitarian oriented relational ethics as articulated in the theory of objectification—a communitarian ethics whose practice features responsibility, commitment, and care.

12. Time: 22:00─22:20 (enlarged)

Title of the Paper:

HOW CAN WE CLASSIFY TEACHERS' PARADIDACTIC PRAXEOLOGIES IN DIFFERENT INSTITUTIONAL SETTINGS?

Author(s):

Tatsuya Mizoguchi; Yusuke Shinno; Toru Hayata

Institution(s):

Tottori University (Japan)

Hiroshima University (Japan)

Naruto University of Education (Japan)

Abstract:

In this paper, we examine what is being done on classification in mathematics education research. For this, we describe and examine two of our own research cases. Both are based on paradidactic praxeology in ATD as an analytical means, but we reflect on different approaches in interpreting the results. The interpretation, using intra-theory application, explains the research results in both cases; an interpretation using different theories (inter-theories or networking theories) remains as a task.

13. Time: 22:10─22:20 (skipped)

Title of the poster abstract:

THE EFFECT OF PEDAGOGICAL KNOWLEDGE ON MATHEMATICS ANXIETY IN DEVELOPMENTAL MATHEMATICS COURSE

Author:

Sun Young Ban

Institution:

Merritt College (USA)

Abstract:

This study investigated how teachers' pedagogical knowledge of active teaching strategies influence on mathematics anxiety (MA) in developmental math courses at an urban community college. The participating students (n=185) were recruited for this study: half of whom were in a lecture classrooms model (LCM), and another half of whom were in an inquiry-based learning classroom model (IBL) to measure their MA level over the 15 academic weeks. The overall findings were that there was a significant difference between the two different classroom models in measuring students' MA who took the same development math course over the academic semester.

14. Time: 22:20─22:30

Title of the Paper:

THEORETICAL NETWORKING IN A LARGE-SCALE DANISH AND A LARGE-SCALE NORWEGIAN INTERVENTION STUDY: TMTM AND PBG

Author:

Lena Lindenskov

Institution:

Danish School of Education, Aarhus University (Denmark)

Abstract:
The paper focuses on theoretical foundations and developments in two concrete research cases. The two cases are two large-scale intervention studies. They are both aiming for learning improvements by marginally performing students. Both use networking of theories. Both use and develop theories on several levels, from the individual learner and teacher to the national system, from trajectories for single mathematical concepts to philosophy of mathematics. This paper only concentrates on the instruction level theoretical foundations. We present use and development of theories about mathematics instruction by one teacher teaching one child, one small group or one class. The paper discuss and compare the networking of theories. It is discussed how theories, goals and organizations may be culture-specific. Especially culture-specific contradictions and similarities between researchers and teachers' view of how theories are meaningful. Concluding remarks concerns some experienced benefits from engaging in letting theories network. First, the paper presents the two studies' goals and organization.

22:30-23:00: Final discussion

Ethical issues in the use of theories in mathematics education, in design research and the diversity of theories relating to technology.

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Note:

Class A:

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