

TSG Agenda

TSG 60: Semiotics in mathematics education (Class B)

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

Embodied aspects, gestures / movement, technology

1. **Time:** 19:45–20:00

Title: Collaborative gestures among secondary students conjointly proving geometric conjectures

Authors:

- **Candace Walkington** (Southern Methodist University, USA)
- Min Wang (Southern Methodist University, USA)
- Mitchell Nathan (University of Wisconsin-Madison, USA)

Abstract:

Collaborative gestures occur when multiple learners coordinate their bodies in concert to accomplish mathematical goals. Collaborative gestures show how cognition becomes distributed across a system of dynamic agents, allowing for students to act and gesture as one. We explore ways secondary students gesture collaboratively while proving geometric conjectures in an embodied video game. We find that students use joint action to reason together and establish intersubjectivity. We also find that gestures generally, and collaborative gestures specifically, are associated with powerful forms of mathematical reasoning about geometry.

2. **Time:** 20:00–20:15

Title: Conceptualization of co-emergent curriculum in a mathematics lesson

Authors: **Kazuma Kageyama** & Masataka Koyama (Hiroshima University, Japan)

Abstract:

This research addresses a co-emergent mathematics curriculum from the social semiotic perspective. In this article, we define co-emergent curriculum as something enacted through a series of interactions between a teacher and students such that they actually design, implement, assess, and modify a possible learning path together. The aim of this article is to conceptualize this curriculum and describe a process of co-emergence in the terms of certain word usage in a secondary school mathematics lesson. A conceptual discussion and an episode analysis suggest that a mathematics textbook with some idiosyncratic texts represents a hypothetical story to learn

mathematics effectively, but this is not necessarily harmonious with real student learning activity. The participants were drawn from secondary school mathematics lessons and were interested in how to use words and sentences mathematically in spite of figural leaning. The genesis of this article is in our wager that because curriculum is a possible learning path, we would do well to unfurl the potential of a co-emergent one.

3. **Time:** 20:15—20:30

Title: Proof, conditionals and gesture

Author: Laurie D. Edwards (Saint Mary's College of California, USA)

Abstract:

This paper considers the embodied conceptual underpinnings for mathematical proof, that is, how proof is related to physical experience and everyday kinds of thinking, as expressed in the modalities of writing, speech and gesture. Data were gathered through a study of doctoral students who were interviewed about proof and then worked in pairs to find a proof for a supplied conjecture. The analysis focuses on metaphors for proof as well as the use of “if-then” statements, also known as epistemic conditionals. Evidence from gestures that accompany conditional statements is used to argue for conceptual continuity in how conditionals are expressed within mathematical and nonmathematical contexts.

4. **Time:** 20:30—20:45

Title: Can a movement notation be a mathematical notation?

Authors: Giulia Ferrari & Francesca Ferrara (Università degli Studi di Torino, Italy)

Abstract:

This paper presents a tailor-made notation as a methodological approach to the study of movement in the mathematics classroom. The notation helps us better investigate the question of whether movement can be some kind of notation for a graphical representation (similarly to the way that the graph is a semiotic notation for movement), in the context of graphing motion with a specific technology. We also offer it as a case of notation-in-use that allows us to mobilize our research practice and to take notice of new elements in our discourse. We present the notation by means of two examples, which we discuss from the methodological point of view and in terms of the implications for mathematics education research.

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

Language, meaning making, social factors

5. **Time:** 21:45–22:00

Title: Semiotic character and issues in the learning and teaching of linear functions in Japan: The influence of terminology

Authors: **Hiroaki Hamanaka**, Masayoshi Yoshikawa, Hisae Kato, & Mitsunobu Kawauchi (Hyogo University of Teacher Education, Japan)

Abstract:

Previous studies reveal that mathematics education may be influenced by the language used. For example, the literal meaning of Japanese term “ichi-ji kansu,” which means “linear function,” has no connotation that involves a straight line, and is quite different from its literal meaning in English. We will therefore consider what kind of character and issue can be observed in the teaching and learning of linear functions in Japan, which might be influenced by differences in the terminology. Also, we will discuss the observed difficulty in Japan in recognizing a relation described by a liner equation as a linear function from the view point of Duval’s theory of registers.

6. **Time:** 22:00–22:15

Title: A semiotic lens on learning math in sign languages

Authors:

- **Christina M. Krause** (University of California Berkeley, USA / University of Duisburg-Essen, Germany)
- Annika M. Wille (Universität Klagenfurt, Austria)

Abstract:

Trying to understand better the specificities of deaf students' learning of mathematics naturally suggests the consideration of their specific way of approaching mathematics in and through sign language. Semiotically, the learning processes differ in comparison to those of hearing students, but in which way and with which effect? In this paper, we present two semiotic approaches on learning mathematics to compare their potential for investigating learning mathematics in sign languages.

7. **Time:** 22:15–22:30

Title: Semiotic chaining in Linear Algebra

Author: Hamide Dogan (University of Texas at El Paso, USA)

Abstract:

This paper discusses findings from the analysis of two participants' responses to a single question. It also outlines the relevant research, and instructional activities through which participants formed their knowledge. The findings showed signified-signifier pairs facilitating semiotic spaces from which new signifiers (with new meanings) were adopted. Furthermore, we identified similarities and differences in comparing features of templates and signified-signifier pairs within and between participant responses.

8. **Time:** 22:30–22:45

Title: Interference between artifacts in semiotic chains

Authors: Andrea Maffia & **Mirko Maracci** (University of Pavia, Italy)

Abstract:

We propose a definition of semiotic interference between artifacts as enchaining of signs emerging from the context of use of one artifact that are translated in the context of a different one. We relate such definition to existing literature about chains of signification adopting a triadic view of sign. The analysis of a production by a student will serve to illustrate the phenomenon of interference and discuss about its possible relevance in the process of teaching/learning mathematics.

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

Workshop: Semiotics and Abstraction: Exploring potential relationships by means of two cases of mono printing and sign languages

Authors / organizers: Christina Krause, Ricardo Nemirovsky, Tam Dibley

(14:30-15:00: General discussion of the papers presented and transition towards the workshop)

Abstract:

Mathematics is widely considered 'abstract' – but in most cases, what is meant by 'abstraction' or in what sense mathematical ideas are concrete or 'abstract' stays implicit and vague. Semiotics as the science of signs necessarily needs to address this question in that semiotic perspectives on learning mathematics require taking a stance on the ontology of the mathematical objects in their focus – is mathematics what is behind the signs or is it in the signs itself?

The papers presented in this TSG address aspects of mathematical thinking and learning from a variety of semiotic perspectives – encompassing ideas centered around embodiment, multimodality, language, to only name a few, perhaps all conceptualizing how mathematics relates to abstraction differently. This workshop takes into account and appreciates these different semiotic approaches to learning mathematics to explore *what abstraction can be and what it can mean in learning mathematics from semiotic perspectives*. It aims at illuminating concreteness and abstraction through looking at the same data through the semiotic lenses offered by the participants of the workshop to discuss what abstraction can mean from these different viewpoints.

The first episode concerns groups of undergraduate students as they created a monoprint reflecting overall aspects of an image, obtained through Google Maps, which consisted of a layout of the area in front of the building they were working in. The selected episode emphasizes the use of materials and tools, in some cases without accompanying speech, in an effort to elucidate their role as quasi-conversants. The second episode is from a videorecording of a study exploring the complexities of Deaf students' learning of mathematics, with a focus on the influence of the use of sign language (here, German Sign Language).

We do not expect all participants in this workshop to be experienced in semiotic theories and approaches to learning but welcome interested scholars that seek to get in touch with what semiotics can offer them. The working phases will consequently be arranged in groups to allow for fruitful exchange and discussion.