

## **COMPLEX CONNECTIONS: REIMAGINING UNITS CONSTRUCTION AND COORDINATION**

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*Students' construction, coordination, and abstraction of units underlie success across multiple mathematics domains. This working group aims to facilitate collaboration between researchers and educators with the particular aim of extending research on units coordination and construction across age groups, learning differences, and mathematical contexts.*

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### **Theoretical Background, Purpose, and History**

Units coordination and construction refers to the number of levels and type of units children can construct and bring into a situation (Steffe & Olive, 2010). Children at young ages begin counting when first constructing *pre-numerical units* (relying on perceptual material and/or physical actions) with which to use as material for future activity (Steffe & Cobb, 1988). These units are first constructed through children's external activity before becoming *internalized* (imagined actions) and then *interiorized* (able to anticipate relationships between levels of units). In Steffe's 2017 plenary for PME-NA, he substantiated particular needs for investigating how children develop operations when constructing and coordinating units. The working group began at PME- NA 2018, with the aim of facilitating collaboration amongst researchers and educators sharing Steffe's concerns about (a) the need for supporting units construction and coordination for all learners and (b) the need for accompanying learning trajectories (curricula) appropriate for students' current level of units across grade levels.

### **Working Group Goals and Strategies, Past and Present**

In the first year of the working group, goals included generation of related research topics of interest to PME-NA attendees, including the role of units coordination in early childhood education, special education, and secondary and post-secondary education (including teacher-education). Products included the creation of a website for organizing and collecting tasks used for assessing students' units coordination links to research papers addressing particular topics relating to units coordination: <https://unitscoordination.wordpress.com/> At the second working group meeting at the 41st PME-NA (2019), novice and experienced researchers described inferences of students' units activity and shared perspectives of the affordances and constraints of assessing units coordination using particular tasks and settings. Our goals for the 2020 working group are to (1) continue to build on the productive discussions from the 2019 and 2018 working group meetings relating to issues of assessments of units coordination in different settings (within classrooms, via written instruments, via clinical interviews, and via individual or paired-student teaching experiments) as well as (2) to continue to bridge efforts to emerging research connecting units coordination across mathematical domains.

### **Session 1: Shared Understanding of Units Coordination and Construction**

**GOAL:** Participants (new and returning) will come to shared understandings of the main ideas of units construction and coordination as well understandings of differences in theoretical and conceptual perspectives. **ENGAGEMENT:** Prior to the working group, we will administer an entry survey of participants to determine interests and goals for collaboration. In the first day's meeting, participants will reflect on their own actions to solve tasks used to assess and support units construction and coordination and discuss in small groups how tasks from the literature afford students' units construction and coordination and associated mental operations. Subgroups will come together and discuss their understandings of relationships between student actions and task features when assessing and supporting students' units construction/coordination.

### **Session 2: Emerging Connections between Units Coordination and Subitizing, Units Coordination and Reasoning about Rates**

**GOAL:** Explore and bring to focus the role of emerging research investigating connections between units construction and coordination across age groups and mathematical contexts (e.g., STEM fields, cognitive science fields). **ENGAGEMENT:** Participants will form three groups, one focused on units construction and coordination with young children (and their subitizing activity), one focused on units coordination with adult learners (and their reasoning about rate of change), and one focused on units coordination of elementary students with identified with learning (i.e., working memory) differences. Building on the discussions from the first session, participants will explore video-recordings of clinical interviews and teaching experiments and discuss theoretical and pragmatic connections between these constructs and describe their inferences and wonderings in these contexts by sharing their analyses in a shared google doc.

### **Session 3: Reflection and Taking Action**

**GOAL:** Reflect on connections and embark on planning collaborations of interest to participants. **ENGAGEMENT:** During the first 30 minutes, we will discuss the results from the previous session as a whole group. Then, form small groups for each of these goals: (1) collaborations within participants' research projects (2) creation of content for the webpage and (3) identification of target journals and outlets or grants and funding sources. Administer exit survey of participants' interests and goals for collaboration.

### **References**

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