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Preservice Teachers Relearning Mathematics Concept within STEM Course

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Abstract: This qualitative exploratory case study research provides insight into what and how preservice teachers may learn about important mathematics knowledge needed for teaching from engaging in the newly redesigned interdisciplinary STEM Education undergraduate course from Werklund School of Education.

Preservice teachers (PTs) need meaningful opportunities to engage with mathematical content, pedagogical strategies, and instructional tools that deepen their understanding of mathematics and how students learn mathematics. Many PTs will teach mathematics in their career, therefore developing strong mathematical knowledge for teaching becomes an essential component of undergraduate teacher preparation (AMTE, 2017; Blömeke et al., 2016; Charalambous et al., 2020). This study investigates how elementary PTs build such knowledge within a required undergraduate STEM education course designed to cover the STEM disciplinary thinking processes and interdisciplinary problem solving. Additional to STEM education purpose and goals, PTs are required to *relearn* an elementary or middle-school mathematics concept with objective to strengthen foundational knowledge.

Using an exploratory case study design (Merriam & Tisdell, 2016; Simons, 2009), this research will examine how PTs engage with mathematics through multiple representations, hands-on manipulatives, pattern, and reflective narratives that document their challenges and growth. Data sources include interviews, analyses of student coursework, in-class learning activities, and instructor lesson plans. Preliminary findings are expected to illustrate how targeted learning tasks support PTs in relearning mathematical content that may provide a knowledge foundation for developing the capacity to design or select meaningful instructional resources for their future classrooms.

References

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Context

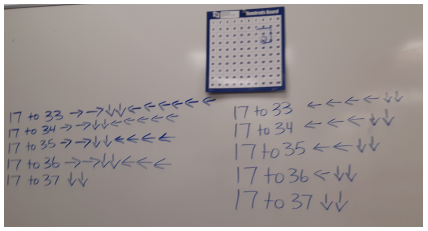
- Preservice teachers (PTs) need meaningful opportunities to engage with mathematical content, pedagogical strategies, and instructional tools that deepen their understanding of mathematics and how students learn mathematics.
- More preservice and professional teachers are expressing anxiety for teaching mathematics which then directly impacts their mathematics teaching practices.
- Research shows that providing educational opportunities to strengthen and deepen teachers' mathematics knowledge used for teaching can positively result in developing effective teaching practices (AMTE, 2017; Blömeke et al., 2016; & Charalambous et al., 2020)
- Undergraduate education is one place to support PTs knowledge development of important mathematics knowledge.

Purpose

- Purpose of this study is to explore how PTs may develop mathematics knowledge for teaching through participation in a required STEM Education undergraduate course.
- This study aims to explore the unique course context for learning this special kind of mathematics knowledge. Most existing research in this field conducts studies within undergraduate courses dedicated to this development of mathematics knowledge.
- The STEM Education course counts as a program and professional certification requirement for the PTs. As the course explores other STEM disciplines along with mathematics, the course provides a new context to investigate what and how PTs may develop mathematics knowledge for teaching.

Research Questions

- (1) How do prospective teachers in the STEM Education course demonstrate their understanding of the characteristics of specialized mathematics content knowledge within the context of this case study?
- (2) How do prospective teachers in the STEM Education course demonstrate their understanding of the characteristics of knowledge of mathematical content and students within the context of this case study?
- (3) What aspects of the STEM Education course support prospective teachers' development of specialized mathematics content knowledge and their knowledge of mathematics content and students?



Course instructor example of bridging mathematical thinking and computational thinking (R. Carson)

Methods and Findings

Exploratory Qualitative Case Study (Merriam & Tisdell, 2016; Simons, 2009)

Theoretical Framework:

- **Mathematics Knowledge for Teaching (MKT)** Ball et al., 2008
- *Specialized Content Knowledge* – knowing how and why math works and multiple representations used to understand the math
- *Knowledge of Content and Students* – knowing common student misconceptions and common challenges for learning mathematics; analogies and metaphors that help students with knowledge development
- *Horizon Content Knowledge* – knowing how the mathematical concepts transcend the grade levels, connected mathematical knowledge

Participants: First Year Education students from Werklund School of Education who have completed the STEM Education Course Fall 2025. Desired sample size = 12 participants.

Data:

- Interviews with each participant
- Documents for analysis (for triangulation purposes)
  - Participating students' course work
  - In-class activities
  - Instructor Lesson Plans
  - Course Outline

Data Analysis:

- Thematic Coding process and exploratory analysis

Preliminary Findings:

- Better understanding of how PTs develop and perceive their mathematics knowledge for teaching in association with STEM disciplinary thinking processes
- Knowledge about specific aspects of the STEM course that supports this knowledge development and how to improve the course design
- Further studies to investigate how the STEM course prepares the preservice teachers for further learning of mathematics knowledge for teaching – both in undergraduate courses specializing in this knowledge development and in field-practicum placement work.

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