# Improving Preservice Teachers' Math Learning Experiences: A Look at One Program's Intentional Redesign

**Amy Smith**[1] and **Mercedes Tichenor**[2]
*Stetson University*

**Abstract:** A major challenge faced by elementary education programs is the vast amount of content preservice teachers must master in various subject areas. With limited time and coursework, how can teacher preparation programs scaffold meaningful experiences and provide a progression of opportunities to aid preservice teachers in mastering this content and the delivery of this content? In this article, we describe how a teacher preparation program strategically redesigned their existing elementary teacher preparatory mathematics courses to provide preservice teachers with conceptually driven, impactful mathematical knowledge for teaching. Preliminary feedback indicates that the math redesign has supported preservice teachers' mathematical content knowledge for teaching.

## Introduction

As today's public schools reignite their attention toward math teaching and learning (Klein, 2022), there is, once again, an increased consideration about what mathematical understanding teachers bring with them to the classroom (Copur-Gencturk & Li, 2023; Hodkowski, 2024). It is well recognized that teachers' mathematical content knowledge for teaching (MKT) directly impacts teacher practices and, thus, student learning opportunities (Alshehri & Youssef, 2022; Ball et al., 2008). When considering teacher practices, it seems logical to begin with teacher preparation programs. However, many preservice teachers enter these programs with mathematical anxiety and conceptual gaps from their own K-12 mathematics experiences (Fitzmaurice et al., 2021; Skultety et al., 2023). It is therefore essential that colleges, universities, and other teacher certification pathways be deliberate in their mathematical content design and implementation to best support future teachers' content knowledge and confidence in elementary mathematics instruction.

To promote content knowledge for teaching, teacher educators must address two distinct aspects of learning: mathematical content knowledge and pedagogical best practices. Since preservice teachers bring unique experiences to their teacher education programs (Lo, 2021; Lutovac, 2020) deepening math content knowledge can vary depending on the preservice teachers' past math experiences and identities. It is, therefore, essential for teacher preparation programs to consider not only the necessary mathematical content knowledge preservice teachers will need when they enter the

SRATE Journal

A peer-reviewed publication of the
Southeastern Regional Association of Teacher Educators (SRATE)
2024, Volume 33, Issue 1
SRATE.org

classroom, but also how they currently understand the math for themselves and how that might be different from how their future students understand the math (Hodkowski, 2018; Smith & Hodkowski, in press; Steffe, 1992), much like classroom teachers do for their students. To support this content learning, teacher preparation courses should focus on developing preservice teachers' conceptual mathematical reasoning to strengthen their foundational understanding of the content they will be teaching (Copur-Gencturk & Tolar, 2022; Hine, 2015) This content learning impacts not only preservice teachers' mathematical reasoning, but also their mathematical identities and view of themselves as confident mathematics teachers (McConnell III et al., 2021). And, as teachers' mathematical content knowledge improves, their mathematical pedagogy improves as well (Hill & Ball, 2004; Santagata & Lee, 2021).

In this article, we describe how a teacher preparation program housed in a small liberal arts university strategically redesigned their existing elementary teacher preparation mathematics courses to provide preservice teachers with conceptually driven, impactful mathematical knowledge for teaching. Specifically, we discuss the elementary math program prior to the redesign and the current sequence of math experiences after the redesign. Further, we share challenges we faced during the redesign process, and how we addressed those challenges to build a more content and pedagogically supportive program for preservice teachers.

## Where We Started

Our elementary education program is organized by tiers, allowing preservice teachers to progress through three scaffolded stages of coursework and field experiences. Beginning at Tier 1, our elementary education majors complete required foundation level education classes (i.e., education psychology, social foundations of education) and courses to meet other university general education requirements. Preservice teachers move into Tier 2 during the junior year of the program, which offers various methods courses in reading, math, science, social studies, and ESOL endorsement. The final tier of the program, Tier 3, provides a full-time, semester-long internship in local elementary schools and serves as the culminating experience of the program.

### Math in Our Previous Tier 1

Our program had a previously developed math content course to meet general education quantitative reasoning (Q) requirements, Elementary Mathematics. This course offered foundational concepts and skills supportive for the math methods course, such as review of all four operational algorithms, fraction computation, and geometric vocabulary and measurement. However, being situated as a general education course, Elementary Mathematics was not required for future preservice teachers—in fact, only about half of our majors were taking this course.

This was problematic for numerous reasons. First, some students entered our university with their quantitative reasoning Q credits already met through AP exams, thus did not take any mathematics content courses prior to the Tier 2 methods course. Tier 1

students who did complete their Q course on campus had dozens of classes in math, science, and business, among others, to choose from, and therefore did not have to take Elementary Mathematics to fulfill this requirement. This caused our Tier 2 preservice teachers to come with a spectrum of different quantitative perspectives, many not suitable nor applicable to the mathematics they would be teaching as elementary teachers. Additionally, Elementary Mathematics is a one-hundred level course, so many of our majors who were taking this course took it during their freshman year, early in their academic journey and often before any Tier 1 work had even begun. All of these led to inconsistencies in the mathematical content knowledge and comfort in elementary mathematical concepts of our Tier 2 preservice teachers.

## Math in Our Previous Tier 2

Like other traditional teacher preparation programs, our program requires numerous methods of teaching courses taken during Tier 2, preservice teachers' junior year of study (Block 1 and Block 2). However, unlike other teacher education programs around the country, we offer only one elementary math methods course that covers both content and pedagogy for teaching kindergarten through sixth grade taken during Block 1 only. The large amount of content to cover in this one course posed a challenge for faculty teaching this class as well as students taking the course. Specifically, the mathematical content learned across the seven years covered by our licensure program, and therefore the content that should be mastered by our preservice teachers, spans early number concepts from counting and place value knowledge; operating with positive and negative numbers, and variables; fractions, decimals and percents; geometric reasoning in 2 and 3D; measurement in all forms (length, area, volume, weight, unit conversions, etc.); data collection and analysis; and probability and statistics. This content does not address the best-practices for mathematical instruction taught to our preservice teachers, such as utilizing manipulatives and assessing student reasoning.

Additionally, this course includes a field experience component where preservice teachers work with elementary students in a local elementary school one day each week throughout the semester. During this time, our preservice teachers had numerous in-class assignments to plan and teach math lessons to their peers, but only a single, small-group instructional math lesson with their elementary students. With the structure of this course as it existed, we recognized an opportunity for growth to build our program out from this single course—with extensions down to Tier 1 and up to Block 2 of Tier 2 and Tier 3.

## Math in Our Previous Tier 3

Like Tier 1, our previous Tier 3 structure had no formal mathematical component. While our student interns were expected to teach math as part of their full-time student teaching experience, support was limited to what the cooperating teachers provided from the curriculum and what university supervisors observed during classroom visits. There was no coursework or additional instructional support for math content or practice during this tier. This proved to be a concern during university observations, when it was noticed that interns were relying on memorized procedures to teach upper-elementary concepts (e.g., 2- and 3-digit multiplication and fractions) and were unable to notice how their

students were making sense of the math, thus were unable to modify their instructional practices for the benefit of their students. This is not uncommon in mathematics teaching (Harrington, 2021; Hodkowski, 2018; Wei, 2022), but we wanted better for our preservice teachers and their future students.

## Where We Are Currently

When reflecting on our mathematical "scope and sequence," we recognized that our single, Block 1 Tier 2 math methods course was not adequate in preparing our preservice teachers for success in the diverse elementary school setting. We needed to design other, intentionally planned math experiences before and after this course, to create a more content and pedagogically supportive program. However, given the nature of the credit system at our university and the high number of education-credits our majors were already taking, adding additional math methods courses was not an option. We knew we needed to find creative ways to supplement and scaffold math experiences outside of this one required course and promote our preservice teachers' mathematical content knowledge and confidence. Specifically, we addressed two challenges: 1) supporting the limited number of math courses taken by elementary education majors; and 2) clarifying the type of MKT we were providing for our preservice teachers' successful practice.

### Math in Our Redesigned Tier 1

To better prepare our preservice teachers for the math methods course in Tier 2, and their future math instruction, we now require the math content course (Elementary Mathematics) for all elementary education majors. This redesigned course satisfies a general education requirement, thus does not add any additional credits to our students' program and, more importantly, provides foundational learning of the developmental progression of number through hands-on, exploratory tasks. These tasks were designed in different base systems (other than base 10) to provide our preservice teachers the opportunity to (re)develop a concept of number beginning with rote counting and 1-1 correspondence and moving through additive, multiplicative, and fractional reasoning—without translating their new learning into base 10. By having to re-learn numbers, our students develop more robust reasoning about units and operations and are more cognizant of how their future students learn our standard place value base 10 system—both the developmental progression they go through and the challenges and frustrations they may face.

Initially, we allowed our preservice teachers to take Elementary Mathematics any time prior to their entrance into Tier 2; however, we found that those students who took this course the semester before the math methods course were better able to retain and integrate their content learning into their pedagogical practices during Tier 2 classwork and in the field. To maintain a more cohesive mathematics learning and teaching experience, we now plan for our preservice teachers to complete the Tier 1, Tier 2, Tier 3 math progression during consecutive semesters.

### Math in Our Redesigned Tier 2

To fulfill state requirements, we maintained much of the previous structure and expectations of our Tier 2 math methods course. Specifically, this course still addresses K-6 mathematics across the range of mathematical content (numbers and operations, algebraic reasoning, geometric reasoning and measurement, and data analysis and probability). Because this remains a daunting amount of content to cover in a short amount of time, our redesign focused on promoting more equitable pedagogical practices for our preservice teachers to engage in and integrate into their field and future classrooms.

We adopted a CRA instruction approach throughout our math methods course. The CRA (Concrete-Representational-Abstract) instructional sequence fosters scaffolded supports to promote conceptual, mathematical learning experiences (Disney et al., 2022; Flores & Hinton, 2022); beginning with concrete objects (manipulatives), moving to visual representations such as diagrams, and finally to abstract, symbolic operations. The pedagogical intention of the CRA structure is to provide meaning for the numbers (if necessary) when reasoning mathematically, beginning with recognizing the mathematical concepts as tangible attributes of the world.

To support our preservice teachers' appreciation for this sequence, and its importance for their future students, all tasks in the math methods course were aligned with the CRA approach. Additionally, we require that each preservice teacher purchase a primary grade and intermediate grade math manipulative set to use throughout the math methods course and accompanying field work. These tools become valuable supports for our preservice teachers as they work to explain their own reasoning during class time, such as explaining the exchange of units ("borrowing") when subtracting 35-18. Further, manipulatives are useful teaching tools for differentiated planning and practice as preservice teachers bring their mathematics instruction during their required field work in this (and other) Tier.

To maintain our preservice teachers' developing content knowledge and strengthen their pedagogical practices, we wanted our math redesign to provide ongoing experiences and opportunities for our preservice teachers. To do this, we supplemented the experiences from the Elementary Math (Tier 1) content learning and the pedagogical approaches from the math methods course (Block 1 of Tier 2) into the next semester of the program, Block 2 of Tier 2. Block 2 of Tier 2 is the final semester of coursework before our elementary education majors complete their culminating student teaching experience. Since there are no math courses taken by students during the second block of Tier 2 (only science, social studies, and reading), we integrated weekly Number Talks (a practice they learned during Block 1 of Tier 2) into our preservice teachers' field experience during this semester through their professional education course.

Number Talks are a tool to support instruction by framing teaching and learning around students' voices and conceptions (Math Perspectives, 2023). During these engaging experiences, students are able to justify their ways of reasoning, providing opportunities to develop their mathematical identities through open discourse (Bieda & Staples, 2020). By providing preservice teachers with numerous opportunities to use Number Talks during the Tier 2 Block 2 field experience, we anticipate that they will be better equipped, and comfortable, using Number Talks with diverse populations of learners in their own, future, classrooms. During Block 2, one Number Talk (out of nine) is recorded for analysis by the preservice teacher and the professional education instructor to inform and improve

practices. Additionally, each preservice teacher completes a final reflection at the end of the semester, addressing:

- Now that you have done Number Talks for a second time, why do you think this is a practice you should integrate into your future classroom?
- What is the benefit for your students? For you, as the teacher?
- How will you work to promote the use of Number Talks in all elementary classrooms?

The integration of Number Talks into Block 2 allows preservice teachers to continue focusing on math content, giving them more positive experiences, and building their confidence for teaching math before moving into Tier 3, the final student teaching semester.

### Math in Our Redesigned Tier 3

To continue our preservice teachers' development of MKT during their senior internship (student teaching), we have introduced two new mathematics components: a grade-level Professional Development session (PD) and a math mini-unit; each component guided by the elementary math methods professor and supported through the university student teaching supervisor and the cooperating teacher.

Each intern completes their math PD prior to the start of the student teaching experience. These sessions focus on the specific mathematical content and pedagogical practices that interns may see from their grade-level students. For example, the interns working with kindergarteners review early number concepts like 1-1 correspondence and cardinality with a heavy focus on Concrete instructional strategies, while the interns in fifth grade classrooms delve into operations with fractions and decimals beyond procedures and rules. These focused sessions provide our interns with purposeful math support that can be directly implemented in their practice during Tier 3. These PDs are also a chance to introduce the newly designed math mini-unit.

During their student teaching experience, each intern is responsible for planning and teaching a five-day math mini-unit based on the district approved curriculum. This mini-unit is designed around three main instructional goals: 1) Considering students' existing understandings as the foundation for each lesson; 2) Integrating CRA approaches into each lesson (despite the grade level); and 3) Explicitly addressing how the math can be used in the students' own lives. Each of these goals is intended to address equitable teaching practices that can support the diverse learners found in any current classroom in the United States. Specifically, these goals provide the opportunity for our interns to purposefully differentiate their math instruction for students, maintaining the focus of students as mathematical thinkers and doers.

## Where We Are Headed

Over the past two years, we purposefully redesigned our education department's math sequence with the intention of improving the mathematical learning experience for our preservice teachers. Specifically, we aimed to deepen our preservice teachers' content

knowledge and strengthen their pedagogical practices for the benefit of their future students. To achieve this, we reflected on how elementary students learn math for themselves—beginning with hands-on tasks then moving to more abstract applications. From this, we realigned our existing three-tier sequence: 1) First, working to build our preservice teachers' mathematical understandings of number on a deep, conceptual level; 2) Then, delving into research-based mathematical routines and best practices, including Number Talks; and 3) Finally, utilizing our preservice teachers' developing MKT during a math mini-unit in their final student teaching block. The overarching goal of our redesign was to better equip our preservice teachers with the content knowledge and confidence to address the mathematical needs of diverse populations of elementary students.

We were intentional in weaving math experiences throughout our teacher preparation program in both formal and informal ways allowing each experience to build upon another across our three-tier structure. Based on our experience so far, we believe we are moving in the right direction in preparing our future teachers with strong math content and pedagogical knowledge who are positive mathematical role models for their students. Preliminary feedback from our preservice teachers and interns, as well as field observations have indicated that our redesign has potential for sustained success.

We asked our preservice teachers who have completed the redesigned math sequence about their experiences; the following narratives provide a glimpse into some of their experiences.

> *Emily [pseudonym; Current Tier 2 Block 2 Preservice Teacher]: I had MATH110Q [Elementary Mathematics] the semester directly before [Tier 2] Block 1, therefore everything was fresh in my head. This helped me succeed and go that extra mile. The other students in my Block 1 class, who had not taken MATH110Q directly beforehand, had the same capabilities and intelligence as I did, however I believe concepts clicked a lot quicker for me due to my previous knowledge on the content. I found this to give me a great advantage to being successful not only in my Block 1 class, but also teaching my math lessons in the field [like with] Number Talks. Number Talks are about 5 minutes and can benefit the students and the teacher hugely! It is so helpful for students to understand what it is they are doing in their head. Being able to say step by step the process in their brain is an incredible tool for students learning at any age. Asking students why? These words can change a student's math level greatly. Even us college students benefited from these Number Talks. My field experience [also] proved to me how important [CRA] is. I had a 5th grade ELL student who spoke very little English. She had very low scores in math. One of my differentiation tools for her was providing concrete manipulatives for her to use as she worked through her math assignments. CRA is not only important in those primary younger grades. It is crucial through all grades. Eventually my ELL student was able to work with drawing out models instead of using concrete manipulatives. This is an awesome way for teachers to see how much improvement their students are making.*

> *Laura [pseudonym; Current Tier 3 Intern]: Going into this major, my absolute biggest concern was math. I worried about my ability—as someone who struggled with my math throughout her whole school career—how I might be able to teach these students without messing them up. As I grew to know my cohort even more, I noticed how a lot of us shared these same fears. It took me awhile to realize that math was not this big scary beast I needed to conquer. In fact, I learned more by messing up. In MATH110Q [Elementary Mathematics], I learned quite frankly to not only question every little aspect of "why," but I learned that I learn best through messing up. That class was eye opening to me simply because I could feel myself coming to terms with "hey, math is actually kinda really cool." Then, I was introduced to Number Talks, and that was a game changer. Being able to get inside other people's heads and view how they see these concepts was so much fun, and a majority of the time it showed me different, unique ways to solve these problems. Because of these skills I was learning, not only was I becoming more confident in my own personal math skills, but I was becoming more confident in how I could help students. Diving into CRA gave me the opportunity to help show these students how to break down math and make it less scary. I am in a fifth-grade class for my senior internship and a lot of what I am seeing in terms of math is simply the abstract and a lot of these students are simply not there yet. If I had not been taught these concepts, I would not know what I could do to help these students who are struggling. If these skills were not taught to me, I honestly would be very lost on what to do to support these students and would keep moving forward which is why they keep falling behind. Math is not cut and dry like many people believe, there are so many underlying currents that tend to get overlooked, and if we go in as teachers not understanding that, we are doing a disservice to our future students. Understanding the "why" and learning to think outside the box is one of my biggest take-aways from this program, and honestly I believe I would still be in the "math sucks" mindset if it wasn't for these experiences.*

Hearing these responses was affirming—we know we are headed in the right direction. We have evidence of the power of deep content knowledge as a springboard into purposeful pedagogical learning, a practice well documented in research (Bates et al., 2013; Hill & Ball, 2004; Wei, 2022). We have also found the implementation of CRA and Number Talks to be highly impactful, not only for our methods course and our preservice teachers, but also for our Cooperating Teachers who learn more about these practices from our interns in the field. We are aware, however, that we have only begun the important work of supporting math education and the future of this study.

From our redesign, we have begun a grass-roots effort, of sorts, to reestablish Number Talks as a critical practice for all teachers. Number Talks are not new (see the work of Kathy Richardson and Ruth Parker in the 1990s), but like many educational practices, they have veered out of use in some areas. We see Number Talks as a high-impact teaching tool that should be part of every math classroom PK-12 and beyond. As both of our

preservice teachers previously mentioned, Number Talks were invaluable in redefining their view of math and what it means to be mathematical. Integrating Number Talks into university-level courses (Smith, 2022; Smith, in press) and (re)introducing them to current practicing teachers is a high priority for our department. Additionally, we hope to instill the importance of hands-on, relevant math experiences for our preservice teachers as well as their cooperating teachers through the expansion of CRA approaches—particularly in the upper grades, as noted by Emily and Laura. Our department mission is for our students to be agents of change when they graduate from our program and begin their professional teaching careers. Fostering the importance of manipulatives and visual representations for students of all ages (not just primary grade) to become mathematical thinkers, instead of just procedural problem-solvers, is essential to re-defining what math is and why it matters for life outside the classroom.

Moving forward, we continue to strive to address preservice teachers' prior experiences, both positive and negative, and existing understandings about math teaching and learning so they are effectively prepared to work with diverse elementary students of their own. We encourage other teacher education programs to tackle the challenging issue of preparing strong, passionate elementary math teachers by reflecting on their current practices and designing math experiences that allow preservice to hone their craft of teaching elementary school math and support their attitudes and enjoyment of math instruction. Although this can be a daunting task to begin, we are excited to see how our redesign is beginning to impact our preservice teachers' mathematical knowledge and confidence, and eventually, will impact elementary grade students' understanding and love of math.

## References

Alshehri, K. A., & Youssef, N. H. (2022). The influence of mathematical knowledge for teaching towards elementary teachers' mathematical self-efficacy. Eurasia Journal of Mathematics, Science & Technology Education, 18(6), 1-15. https://doi.org/10.29333/ejmste/12086

Ball, D., Thames, M., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? Journal of Teacher Education. 59(5), 389-407. https://doi.org/10.1177/0022487108324554

Bates, A. B., Latham, N. I., & Kim, J. A. (2013). Do I have to teach math? Early childhood pre-service teachers' fears of teaching mathematics. Issues in the Undergraduate Mathematics Preparation of School Teachers. 5.

Bieda, K.N., & Staples, M. (2020). Justification as an equity practice. Mathematics Teacher: Learning and Teaching PK–12, 113(2), 102-108. https://doi.org/10.5951/MTLT.2019.0148

Copur-Gencturk, Y., & Li, J. (2023). Teaching matters: A longitudinal study of mathematics teachers' knowledge growth. Teaching and Teacher Education, 121. https://doi.org/10.1016/j.tate.2022.103949

Copur-Gencturk, Y. & Tolar, T. (2022). Mathematics teaching expertise: A study of the dimensionality of content knowledge, pedagogical content knowledge, and

content-specific noticing skills. Teaching and Teacher Education. 114. https://doi.org/10.1016/j.tate.2022.103696

Disney, A., Eisenreich, H., Fisher, K., Lorden, A., Willis, T., & High, S. J. (2022). I can't remember which fraction to keep or flip: Building understanding of fraction division with the CRA instructional model. GCTM Reflections, 14(3). https://gctm.org/page-1709595

Fitzmaurice, O., Walsh, R., & Burke, K. (2021). The mathematics problem and preservice post primary mathematics teachers–analysing 17 years of diagnostic test data. International Journal of Mathematical Education in Science and Technology, 52(2), 259-281. https://doi.org/10.1080/0020739X.2019.1682700

Flores, M. M., & Hinton, V. M. (2022). Use of the Concrete–Representational–Abstract Instructional Sequence to Improve Mathematical Outcomes for Elementary Students With EBD. Beyond Behavior, 31(1), 16-28. https://doi.org/10.1177/10742956211072421

Harrington, C. (2021). Progressions in mathematical reasoning: A case study of two teachers' levels of units coordination. [Doctoral dissertation, University of Colorado Denver]. ProQuest Dissertations & Theses. 28416231

Hill, H. & Ball, D. (2004). Learning mathematics for teaching: Results from California's mathematics professional development institutes. Journal for Research in Mathematics Education, 35(5), 330-351. https://doi.org/10.2307/30034819

Hine, G. S. (2015). Strengthening pre-service teachers' mathematical content knowledge. Journal of University Teaching & Learning Practice, 12(4). https://doi.org/10.53761/1.12.4.5

Hodkowski, N. M. (2018). Manifestations of elementary mathematics teachers' shift towards second-order models. [Doctoral dissertation, University of Colorado Denver]. https://doi.org/10.13140/RG.2.2.11204.68482

Hodkowski, N. (2024, June 5). When teaching students math, concepts matter more than process. EdSurge. https://www.edsurge.com/news/2024-06-05-when-teaching-students-math-concepts-matter-more-than-process

Klein, A. (2022, October 19). Why the Gates Foundation is investing $1.1 billion in math education. Education Week. https://www.edweek.org/teaching-learning/why-the-gates-foundation-is-investing-1-1-billion-in-math-education/2022/10

Lo, W. Y. (2021). Pre-service teachers' prior learning experiences of mathematics and the influences on their beliefs about mathematics teaching. International Journal of Instruction, 14(1). 795-812. https://doi.org/10.29333/iji.2021.14148a

Lutovac, S. (2020). How failure shapes teacher identities: Pre-service elementary school and mathematics teachers' narrated possible selves. Teaching and Teacher Education, 94. https://doi.org/10.1016/j.tate.2020.103120

Math Perspectives Teacher Development Center. (2023). Number Talks. http://mathperspectives.com/number-talks/

McConnell III, J. R., Teske, A. H., Attwood, A. I., & Barron, L. L. (2021). Preservice teachers' performance and confidence in their readiness to teach: An exploratory study. SRATE Journal, 30(1).

Santagata, R., & Lee, J. (2021). Mathematical knowledge for teaching and the mathematical quality of instruction: A study of novice elementary school teachers. Journal of Mathematics Teacher Education, 24(1), 33-60.

Skultety, L., Saclarides, E. S., Bajwa, N. P., Brown, K., Poetzel, A., & Gerardo, J. M. (2023). Making sense of elementary pre-service teachers' mathematical wounds: A proposed framework for practice. International Electronic Journal of Mathematics Education, 18(2). https://doi.org/10.29333/iejme/13170

Smith, A. (in press). Number talks: Instructional tools for approximations of practice. In C. W. Lee, L. Bondurant, B. Sapkots, & H. Howell (Eds.), Promoting equity in approximations of practice for preservice mathematics teachers. IGI Global. DOI: 10.4018/979-8-3693-1164-6

Smith, A. (2022, February 21). Number talks as a pedagogical tool for pre-service teachers. Faculty Focus. https://www.facultyfocus.com/articles/effective-teaching-strategies/number-talks-as-a-pedagogical-tool-for-pre-service-teachers/

Smith, A. & Hodkowski, N. M. (in press). The power of why: How a future teacher elicited their students' reasoning as a critical aspect of their instruction. In D. Polly, E. Garin, & C. Martine (Eds.), Clinically based teacher education in action: Cases from professional development schools Charlotte, NC: Information Age Publishing.

Steffe, L. P. (1992). Schemes of action and operation involving composite units. Learning and Individual Differences, 4(3), 259-309. https://doi.org/10.1016/1041-6080(92)90005-Y

Wei, B. (2022). Relating elementary teachers' MKT with their task selection for teaching multiplicative reasoning: A constructive viewpoint. [Doctoral dissertation, University of Colorado Denver]. ProQuest Dissertations & Theses. 29062817

## About the Author

**Amy Smith** is an Assistant Professor in the Department of Education at Stetson University specializing in elementary mathematics education.

**Mercedes Tichenor** is a professor of education in the Department of Teacher Education at Stetson University.