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Making sense of elementary pre-service teachers' mathematical wounds: A proposed framework for practice

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ABSTRACT

We, six elementary mathematics teacher educators (MTEs), noticed that many of our elementary pre-service teachers (EPSTs) were limited by their views of mathematics, typically as the result of their prior experiences with learning mathematics. Much of the research around such limiting views focuses primarily on negative experiences or treats such views as associated with individual factors (e.g., self-efficacy, mathematics anxiety, and views about problem solving). Using a (re)humanizing mathematics perspective, we sought to identify these limiting views of mathematics in a more holistic approach, considering the complexity of views that EPSTs hold. In this article, we introduce a framework, developed through collaborative self-study methodology, to give shared language to the types of *mathematical wounds* EPSTs may have. Utilizing this framework, MTEs can support EPSTs' mathematical healing by enacting intentional instructional practices. We provide three general approaches to frame these intentional practices as well as reflection questions to support other MTEs in reconsidering their own courses and how they may take EPSTs' mathematical wounds and healing into account.

Keywords: mathematics teacher education, mathematics methods course, mathematics content course, pre-service teachers, mathematics education

INTRODUCTION

Many elementary pre-service teachers (EPSTs) enter our university-based teacher preparation programs with negative, even debilitating, consequences of their prior experiences in school mathematics (Beswick & Callingham, 2014, Burton, 2012; Kalder & Lesik, 2011). As elementary mathematics teacher educators (MTEs), we have observed that many EPSTs carry limiting views about themselves or others as doers of mathematics, what it means to do and be "good" at mathematics, and how to teach mathematics. We refer to these limiting views, which often stem from EPSTs' K-12 schooling experiences, as *mathematical wounds* (Beswick, 2011; Beswick & Callingham, 2014; Gagnon Jr, 2006; Gerardo, 2018; Olson, 2008; Uusimaki & Nason 2004). Mathematical wounds can limit the ways EPSTs see themselves as capable in learning and teaching mathematics in-line with reform-based perspectives, or limit how they view the study of mathematics. Much like the non-mathematical wounds that all adults carry, resulting from various experiences such as traumas or relationships, mathematical wounds can also have lasting impacts that adversely impact EPSTs in their development as educators. For example, if a young student was in a classroom where answers that deviated from the "traditional" methods were subjected to public humiliation (Feldhaus, 2014), that student could potentially become an adult who struggles with mathematics anxiety. It would be reasonable for that adult to experience uncomfortable feelings in a mathematics classroom and be hesitant to share their mathematical thinking or engage in discussions.

Individual EPSTs may experience none, some, or many wounds from their lived experiences as a K-12 student (Burton, 2012; Feldhaus, 2014). While it is common for EPSTs to hold negative views of themselves as mathematicians or of mathematics broadly, there are many who are neutral or positive towards mathematics (Kalder & Lesik, 2011). We have found that even EPSTs who identify as "math people" with generally positive experiences in mathematics may carry some internalized experiences and views about the teaching and learning of mathematics that can be counter to their own learning as doers and teachers of reform-based mathematics. Thus, our framing of mathematical wounds moves beyond broadly negative or positive views of the subject and includes all limiting views. For instance, while timed multiplication tests may be associated with mathematics anxiety for some

students (Boaler, 2014), others may truly enjoy taking them (Feldhaus, 2014), or find public comparison of multiplication facts motivating. However, such tests have the potential to lead all students to see speed and memorization as defining qualities for what it means to do and be good at mathematics. Such views may limit students' ability to see themselves as capable of doing mathematics or consider differing interpretations of mathematics for their future classrooms (Beswick & Callingham, 2014; Kalder & Lesik, 2011). In this way, our work diverges from much of the work around EPSTs' mathematical histories (Bekdemir, 2010; Uusimaki & Nason, 2004), including mathematical trauma (Faradillah & Febriani, 2021; Lange & Meaney, 2011) and mathematics microaggressions (Harrison, 2020; Kohli & Solórzano, 2012; LópezLeiva & Khisty, 2014), which generally focuses on the impact of negative experiences.

Building on decades of knowledge generated from research on EPSTs' beliefs and mindsets (Austin, 2015; Boaler, 2015; Novikasari, 2017; Philipp, 2007; Twohill et al., 2023), our mathematical wounds framework provides a lens for MTEs to holistically consider the experiences and resulting perceptions around mathematics that EPSTs likely bring into teacher preparation programs. This is not to say that EPSTs enter teacher education programs broken, or in need of saving. EPSTs bring innumerable strengths with them, no matter their previous experiences with mathematics. By enrolling in such teacher preparation programs, even those with the most severe of wounds have chosen to pursue a career that requires publicly doing and teaching mathematics. As MTEs, we see it as part of our responsibility to support such EPSTs in working through their prior experiences so that they may be confident and capable in their future classrooms.

MTEs are uniquely positioned to address mathematical wounds as a means to support EPSTs in learning to teach reform-based mathematics. Our approach aligns with the recommendations that MTEs ought to consider EPSTs' school mathematics experiences as well as acknowledge their discomfort and anxiety toward mathematics (Beswick & Callingham, 2014; Burton, 2012; Kalder & Lisik, 2011) and to provide positive mathematical experiences (Feldhaus, 2014; Uusumaki & Nason, 2004). From a (re)humanizing mathematics perspective, our approach assumes one integral role of MTEs is to promote a classroom culture, assignments, and activities that support EPSTs on their professional journey and facilitate healing of their mathematical wounds. In this way, we actively work to remove psychological roadblocks so that EPSTs are more likely to become mathematics educators who can create positive, mathematically rich, and student-centered classrooms that do not perpetuate or ignore the same wounds. We believe that one way in which MTEs can effectively prepare EPSTs in learning, and learning to teach mathematics is by enacting intentional practices targeted at healing these wounds. Without recognizing and addressing these wounds, EPSTs are more likely to inflict the same types of wounds on their future students.

In the next section, we describe our perspective and analytic process for identifying mathematical wounds through a collaborative self-study. We follow this by discussing the three types of mathematical wounds identified from our collaborative self-study and conclude by describing three approaches we leverage to attempt to address these wounds.

OUR PERSPECTIVE: (RE)HUMANIZING MATHEMATICS

We are concerned that many EPSTs are wounded because of their experiences in K-12 school mathematics. Based on our experiences as MTEs, we hypothesized that these wounds are key factors, which hinder EPSTs' professional development as mathematics learners and teachers. To help frame this phenomenon, we employed the (re)humanizing mathematics perspective (Gutiérrez, 2018). This perspective outlines how mathematics teaching has dehumanized both teachers and students and argues for mathematics teacher education research to move towards rehumanizing mathematics teaching and learning.

Gutiérrez (2018) conceptualized four ways that students and teachers can feel dehumanized in mathematics education: measuring and categorizing bodies instead of participation and positioning, evaluation of students instead of mathematics as living practice, rule following instead of rule creation, and lastly, speed instead of reflection and ownership. Measuring and categorizing bodies refers to the phenomenon of sorting students into high or low "ability" groups in mathematics classrooms as well as tracking students toward advanced mathematics courses or regular courses. In contrast, participation and positioning refers to rejecting the hierarchy of the classroom where teachers are the experts and students the novices and engaging all students as knowers and doers of mathematics in heterogeneous groups. Closely related is evaluation or the prevalence of high stakes testing of mathematics, which results in categorizing students. Instead, mathematics could be taught as a living practice where students explore, discuss, and debate mathematical ideas. Rule following refers to situations like students copying notes and memorizing steps. Whereas rule creating or breaking refers to students developing algorithms, noticing patterns, and making generalizations while engaged in worthwhile mathematical tasks. And last, speed over reflection refers to privileging speed and fidelity to a pacing plan over student understanding. In juxtaposition, reflection refers to privileging sense-making and conceptual understanding of mathematical ideas. And closely related, ownership refers to students' desire to do mathematics and grapple with mathematical problems beyond the classroom. Rehumanizing mathematics counters the negative experiences to offer more positive and holistic mathematical experiences in the classroom.

In our work as MTEs, we have witnessed the impact of dehumanized mathematics experiences on EPSTs. By the time that EPSTs are in university-based teacher preparation programs, many have been exposed to dehumanizing mathematics for over a decade. The (re)humanizing framework's holistic framing guides us to move beyond individual components of mathematical beliefs (e.g., self-efficacy, confidence, mindset, views of what it means to do mathematics, and others) and challenges us to consider each EPST as a collection of all of these complex views and beliefs. Additionally, this perspective is useful to explore how EPSTs' ability to engage in rigorous mathematics may be hindered and what practices and experiences in rehumanized mathematics may bring some healing.

METHODS

In this collaborative self-study, we sought to answer:

(1) *What limiting views do EPSTs have because of their experiences in mathematics?* and

(2) *How do we, as MTEs, seek to rehumanize our mathematics methods and content courses so that EPSTs can take up the work of rehumanizing mathematics in their own practice?*

We begin by discussing collaborative self-study as the methodological approach used for data collection and analysis. We then describe our pertinent, shared, and unique contexts to further situate the study. We conclude by detailing our analytic process.

Collaborative Self-Study

The work presented in this article stems from a collaborative self-study (Bodone et al., 2004/2007; LaBoskey, 1998) in which we–a group of six elementary MTEs at five different universities–collaboratively explored our own practices and experiences as mathematics teachers and mathematics students. Through collaborative self-reflection, we shared stories and resources, we made sense of our pedagogical decisions and how they served EPSTs and their connections to our own experiences. Our partnership is best categorized as a learning community (Bodone et al., 2004/2007) enacted as a blend of concept-based collaborative self-study (Nicol, 2011) and critical collaborative self-study (Leaman & Flanagan, 2013). As a concept-based self-study, we wanted to evaluate and improve our pedagogy for rehumanizing mathematics for EPSTs. Based on our experience as math teachers, coaches and MTEs, we asked ourselves, "What unique assignments, pedagogies or general goals do we use to address EPSTs' insecurities regarding mathematics?" Using a dialectic approach to engage in cyclic reasoning, we began a dialogue collaboratively with our past self through stories and course materials. Bodone et al. (2004/2007) define the dialectic approach, as follows:

> The reciprocal, recursive, and symbiotic relationships of research and practice, analysis and action, inquiry and experience, theorizing and doing and being researchers and practitioners as well as the dialectic of generating local knowledge of practice while making that knowledge accessible and usable in other contexts and thus helping to transform it into public knowledge.

This process began as a collective sense making, making our "private/personal knowledge" a part of community discourse (Bodone et al., 2004/2007). The sense-making was collected in meeting notes we made for explaining our thinking. Using dialogue, that is the dialogue with our past selves, we collectively made sense of how we had been and were addressing EPSTs' mathematics wounds.

Our Context

We all taught the same two mathematics methods courses for EPSTs during our shared time as doctoral students and instructors at a large, public, research university in the Midwest United States. EPSTs at this institution were required to take three mathematics content courses as prerequisites to these mathematics methods courses. Since then, each MTE has been teaching elementary content and/or methods courses at their respective institutions. To be clear, EPSTs were not involved in this collaborative self-study, nor did we collect their responses as part of our dialogue. Additional information about each MTE can be found in **Table 1**.

Table 1. Our current contexts

Mathematics teacher educator	Current institution	Type of courses taught	Total semesters of higher education teaching experience
Lisa Skultety	University of Central Arkansas	Methods & content	14
Evthokia Stephanie Saclarides	University of Cincinnati	Methods	16
Neet Priya Bajwa	Illinois State University	Methods & content	18
Karie Brown	Georgia State University	Methods & content	21
Adam Poetzel	University of Illinois at Urbana-Champaign	Methods	32
Juan Manuel Gerardo	University of Cincinnati	Methods	21

Analytic Process of Identifying Mathematical Wounds

As part of our collaborative self-study, we met weekly or bi-monthly starting the fall of 2020 to discuss shared problems of practice (LaBoskey, 2004/2007) such as how to foster authentic collaboration among EPSTs in our content and methods courses; support our EPSTs as they transition to becoming teachers of mathematics; and encourage our EPSTs to learn to adapt to new contexts, situations, and circumstances. However, the most pressing problem of practice that was identified through these discussions was how many of our EPSTs had limiting views around mathematics, and this negatively impacted their engagement in our courses[1].

Using the dialectic process, we outlined the assignments and activities we incorporated in our classes with EPSTs and explored our reasons for our pedagogical decisions. We then analyzed our collective dialogue against the literature on addressing EPSTs' fears, anxieties or beliefs about mathematics teaching and learning. We found that this literature base did not currently have a framework, which fully captured the complexity of EPSTs' perspectives. Such a unifying framework could move the field further

[1] We later came to use the language of mathematical wounds to describe these limiting views.

towards re-humanizing mathematics teacher education programs. The phrase *mathematical wounds* emerged through our conversations to capture our shared problem of practice. In analyzing our pedagogical decisions, we saw themes of care, emotion, and love. Mathematical wounds addressed the care we took to address perceived injuries that lead to limiting views of mathematics in our EPSTs. While in education literature we see "care" and "love" from education researchers like Noddings (1988, 1995, 2012), but better fit examples of care, love and healing are found in literature on nursing (Adib-Hajbaghery & BolandianBafghi, 2020) or feminist medicine (Farley, 2002).

Through our continued discussions, we further decomposed our shared problem of practice (many EPSTs are mathematically wounded) to more explicitly identify the nuanced kinds of mathematical wounds our EPSTs carried with them. We started by discussing the following question: What are the different kinds of mathematical wounds our EPSTs carry with them? To cast the widest net possible, we brainstormed an exhaustive list of the different mathematical wounds we observed in our courses. This included but was not limited to statements we often heard our EPSTs state in group or individual settings when in our courses. We kept a running record using google docs as a shared virtual platform. For example, some of the wounds on our running record were: "Math rarely makes sense, I just follow the rules", "Math is a solo sport", and "I'm not good at math". After brainstorming this list, we discussed the following questions: How are these wounds related? How are these wounds distinct? Through critical and curious discussions (Swaffield & MacBeath, 2010), we clustered individual wounds that seemed to be related. This led us to the identification of the following three broad wound categories: EPSTs' views about mathematics, EPSTs' views about the teaching and learning of mathematics, and EPSTs' views about selves as doers and teachers of mathematics.

From there, we engaged in further conversations about the ways in which we worked to address our EPSTs' mathematics wounds in our courses. We each began by filling out a graphic organizer (**Table 2**) to reflect on how we were attending to or could attend to these wounds in our courses. After independently filling out the graphic organizer, we discussed the classroom experiences we were providing for EPSTs to begin to address their mathematics wounds (columns one and two). Specifically, we discussed questions such as: What are the activities, structures, assignments, and routines that we already use in our course to address these wounds? How do these activities, structures, assignments, and routines address students' wounds? What are new activities, structures, assignments, and routines we might consider adopting to further address students' wounds? Through these discussions, we shared activities, structures, assignments, and routines with one another, and created a shared database.

Table 2. Graphic organizer to brainstorm ways we address EPSTs' mathematical wounds

MTE name	What are some of classroom experiences we provide for EPSTs to attempt to address their mathematics wounds?	Which mathematical wounds are you healing through this particular experience?	What is the generalizable practice or approach evident in this classroom experience?

Next, we sought to unpack the generalizable principles that undergirded our activities, structures, assignments, and routines (column three). We did so by discussing questions such as: Why did we perceive that these activities, structures, assignments, and routines were reasonably successful at addressing students' mathematics wounds? How can we more consciously target wounds in our courses by utilizing the lens of mathematical wounds? What broad principles could we unpack from these activities, structures, assignments, and routines that we might share with other MTEs? Through these discussions, we identified three principles, which involved providing our EPSTs with shared experiences as a step towards acknowledging and beginning to address their mathematical wounds. The three principles require them to:

(1) unpack their previous schooling experiences learning mathematics,

(2) engage in the process of doing mathematics, and

(3) enact high-quality teaching practices.

Finally, during two meetings, we discussed what questions could we, and other MTEs, use to reflect on activities used in our methods and content courses to intentionally attend to EPSTs' mathematical wounds. Based on our reflections and discussions, we generated a list of reflection questions to foster awareness of EPSTs' mathematical wounds in content and methods course work. We present these questions for MTEs to reflect on when considering their assignments or activities later.

In the next sections, we begin by discussing the three types of mathematical wounds we identified from the analytic process described above, and then turn to describe the three principles that we leverage to attempt to address our EPSTs' mathematical wounds.

RESULTS

Types of Mathematical Wounds

By grouping common beliefs that might hinder mathematics teachers and students, we provide a framework that gives us the ability to discuss the myriad of views that EPSTs hold. This also gives language to explore ways to bring healing. In general, MTEs lack the time to realistically address every wound for every EPST in a university-based program. Instead, we need to find ways to address different wounds simultaneously, and in a variety of ways, to attempt to support EPSTs' mathematical healing.

Figure 1 shows the three wounds and our approaches for addressing them. In **Figure 1**, examples of common statements associated with each wound are provided. We recollected these common statements during our conversations as we reflected on engagement with our EPSTs over the years. This is not intended to be an exhaustive list of descriptive statements, but as some

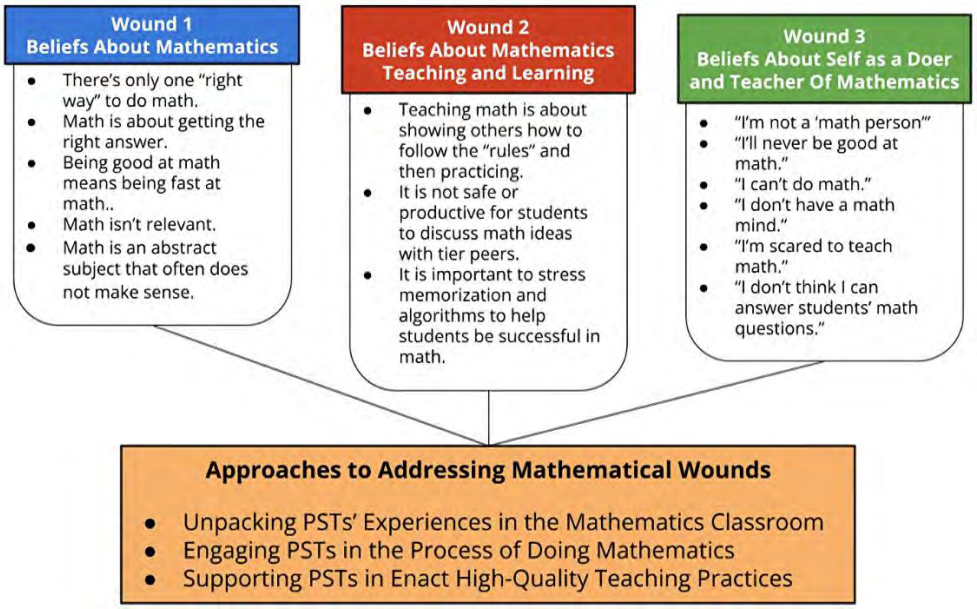

Figure 1. Types of mathematical wounds and ways to address them (Source: Authors' own elaboration)

illustrative examples of how each wound is different. In this section, we discuss each type of mathematical wound, and connect each to mathematics education literature. Later in the article, we discuss our approaches to healing EPSTs' mathematical wounds.

EPSTs' wounds may develop from a series of mathematical experiences, or even traumatic instances, resulting in any combination of these three types of wounds. For example, if an EPST was subjected to years of "failing" memorization-based timed multiplication tests, the EPST may believe mathematics is about speed and getting the right answer (wound 1), multiplication flash card races are a preferable teaching method to promote speed and efficiency (wound 2), and that they are not good at mathematics or may be bad at teaching it (wound 3). Other EPSTs who experience a similar event, such as the one described, may develop different mathematical wounds, or none at all, depending on a variety of contextual and individual factors. Much like any other area in life, each experience has differing impacts on each person, depending on the context, environment, and a host of other factors at the time.

To clarify, we do not claim that every EPST has each of these wounds, or that they developed from the same experiences. However, we have found these wounds to be prevalent enough that we believe that considering them in the preparation of EPSTs in our programs is worthwhile. While wading into the area of psychological and emotional impacts of EPSTs' past experiences on their future teaching can indeed be messy and complicated, we posit that working to heal these wounds is essential to our work as MTEs.

Wounds Related to EPSTs' Views of Mathematics

The first type of wound is related to EPSTs' conception of mathematics (Ball & Bass, 2000; Beswick & Callingham, 2014; Beilock et al., 2010, Kalder & Lesik, 2011; Maasepp & Bobis, 2014). In our shared practice, we found that EPSTs commonly believe that there is only one way to solve a mathematics problem, that mathematics is about finding the right answer, and that speed (e.g., how quickly one can complete their multiplication facts) is a good indication of whether or not one is good at mathematics (Burton, 2012; Beswick & Callingham, 2014; Cobb et al., 1992; Schoenfeld, 1988). Unfortunately, such pervasive experiences can have a lasting negative effect in shaping EPSTs' views of mathematics as a fact-based subject that mainly requires one to remember teacher-directed procedures rather than one that involves creative processes that include conjecturing, justifying, revising and reasoning (Burton, 2012; Beswick & Callingham, 2014). Such experiences can lead EPSTs to see mathematics as devoid of problem-solving and sense-making (Ma, 2010), and potentially contributing, albeit implicitly, to the perception that the ability to make sense of mathematics is not accessible to the majority of learners.

EPSTs often develop a belief that certain individuals are naturally "math people", while others are not. These beliefs are not limited to those who struggled with mathematics but are also found among those who experienced success in mathematics (Burton, 2012; Feldhaus, 2014). Such views about mathematics can have negative consequences impacting the experiences of their future students, given that EPSTs' "own experiences in mathematics content classes will influence their beliefs about the nature of mathematics and, consequently, how they should teach it" (Lubinski & Otto, 2004, p. 336).

Wounds related to EPSTs' views about teaching and learning of mathematics

The second type of mathematical wound is related to EPSTs' perception of quality mathematics instruction and how students learn mathematics. This is important to consider in light of research demonstrating that teachers' beliefs about mathematics teaching and learning are intricately connected to their practice (Beswick, 2012; Ernest, 1989; Van Zoest et al., 1994). Based on their experience as a student in a K-12 classroom, observing mathematics instruction for years, EPSTs have a preconceived vision of what "good" mathematics teaching entails (Beswick & Callingham, 2014; Lortie, 1975; Lubinski & Otto, 2004). This vision often includes procedurally focused, teacher-centered instruction that does not value student sensemaking of mathematics.

Unfortunately, this can lead EPSTs to have a view of high-quality mathematics instruction that does not align with the overwhelming research base demonstrating the benefits of mathematics instruction that is student-centered, focused on promoting conceptual understanding as a foundation for procedural fluency, and values student sensemaking (Beswick & Callingham, 2014; Cobb et al., 2018; National Council of Teachers of Mathematics [NCTM], 2014). Given that "teachers will teach as they perceive they have been taught" (Lubinski & Otto, 2004, p. 336), it is important for MTEs to consider the ways in which they may address this particular type of wound in the context of mathematics methods and content courses. In this vein, Lubinski and Otto (2004) found that when their methods course focused on building conceptual understanding, included fewer mathematics topics to promote deeper engagement, and incorporated group work, EPSTs were able to shift from traditional to standards-based beliefs about how mathematics should be taught. However, research suggests that structuring a methods course in this way may not be enough to overcome EPSTs' biases towards computational procedures (Borko et al., 1992).

Wounds related to EPSTs' views of themselves as doers and teachers of mathematics

The third mathematical wound is related to EPSTs' views about themselves as doers and teachers of mathematics, including their self-efficacy, anxiety, mindset, and identity as a learner in a mathematics classroom. Such psychological factors are all distinctly different, but all impact the degree to which EPSTs view themselves as capable and competent in mathematics. Decades of research has investigated how elementary EPSTs feel and think about themselves in a mathematics classroom (Ball, 1988; Bursal & Paznoks, 2006; Ma, 1999; Mizala et al., 2015; Stoehr & Olson, 2021). High levels of mathematics anxiety and low self-concept are common among EPSTs (Bursal & Paznokas, 2006; Stoehr, 2017), which can often be attributed to their negative experiences as primary students themselves (Uusimaki & Nason, 2004). Feelings of doubt and anxiety are not limited to testing situations, as is commonly considered, but can impact EPSTs in their daily classwork, their identity within a classroom, and their overall views of belongingness and competence within a mathematics classroom (Stoehr, 2017). For EPSTs who have negative views of themselves as doers of mathematics, such views can impact virtually every facet of their experience in mathematics content and methods courses. Such beliefs can not only impact EPSTs' experiences as a doer of mathematics but may have meaningful impacts on their teaching and future students (Beilock et al., 2010) including having lower expectations for students' success in mathematics (Mizala et al., 2015). Consequently, it is critical for EPSTs to confront such insecurities and anxieties before entering their future classrooms, which makes university-based content and methods courses ideal spaces to consider and confront such wounds.

Our Approaches for Healing EPSTs' Mathematical Wounds

Through this analytic process, we identified three broad approaches that we use for addressing EPSTs' mathematical wounds in the context of our content and methods courses. We seek to provide EPSTs with *shared experiences* that require them to:

(1) unpack their previous schooling experiences learning mathematics,

(2) engage in the process of doing mathematics, and

(3) enact high-quality teaching practices.

We acknowledge that these approaches are not new practices in teacher preparation in and of themselves. However, with the framing of mathematical wounds, we attempt to make the implicit work of healing explicit by integrating it into our teaching practices, thereby treating EPSTs' wounds as a significant component of the work we do in our courses. Below, we describe and provide one illustrative example of how we enact each approach.

Unpacking EPSTs' previous schooling experiences

Many EPSTs' mathematical wounds stem from their prior schooling experiences learning mathematics. Hence, we have found that it is productive to support EPSTs in unpacking these prior experiences, and reflecting upon how these experiences may have resulted in any combination of the three wounds. While brief discussions of EPSTs' experiences learning mathematical topics is certainly commonplace, MTEs can take these discussions a step further by explicitly engaging EPSTs in rich discussions of shared and unique experiences learning mathematics. For example, several times a semester in her content courses, Skultety engages her EPSTs in a group discussion, using questions such as: How were you taught (topic) when you were in school? How did it make you feel learning about (topic) in that way? What do you think were the lasting impacts of your experiences with (topic)? What did these experiences tell you about what it means to "do mathematics" or "be good at mathematics"? Can you imagine ways that you could have been better supported in your learning of (topic)?

We came to a consensus as we reflected on these questions, that through these conversations, EPSTs can not only find support and feel less isolated in negative experiences but can also benefit when hearing positive experiences from their peers. MTEs can encourage the class to pinpoint specific aspects of these positive experiences that they can assimilate into their future practices. In some instances, EPSTs may also have the opportunity to see how a teaching practice that they enjoyed (e.g., timed multiplication fact tests), was deeply problematic for their peers. In these conversations, EPSTs begin to realize that the teaching practices they experienced contributed to how they see mathematics. For example, in these conversations, some EPSTs start to understand that they were not the "problem" for the first time. For years, some EPSTs had internalized that they struggled in mathematics because they were "stupid" or "not a math person." Through these conversations, they come to see that had they experienced mathematics in a different way, they might view themselves as mathematically capable. These discussions help address all three wounds, where EPSTs can see that:

(a) they may not be unique in their struggles with a mathematics topic,

(b) that they may have received some false messages about what it means to do mathematics, and

(c) they can reimagine how they teach a topic to support their future students to avoid perpetuating negative experiences.

Engaging EPSTs in process of doing mathematics

As previously discussed, many EPSTs have limiting perceptions about what it means to do mathematics and what it means to be "good" at mathematics. They may believe that mathematics is about getting the right answer, that there is only one correct way to do mathematics, or that mathematics is solely about memorizing procedures and algorithms without understanding (Cobb et al., 1992; Philipp, 2007; Schoenfeld, 1988). To begin to address these mathematical wounds, we routinely provide our EPSTs with opportunities to do mathematics using structures that encourage collaboration and multiple representations and rely on student-invented strategies to problem-solve.

To disrupt the notion that doing mathematics is solely about quickly arriving at a correct answer, Bajwa intentionally starts the semester modeling a safe environment where all students' contributions are valued as they engage in problem-solving. Bajwa sets up classroom norms that emphasize mathematical sense-making. Her EPSTs are told that they cannot rely on pre-learned formulas that provide answers. This classroom norm serves to help level the playing field in terms of prior beliefs about competency in solving mathematical problems. Bajwa emphasizes that EPSTs' contributions do not need to be correct or complete answers and that they are welcome to pursue any strategy, provided they can describe the underlying mathematical reasoning. By making it essential for everyone to contribute and focusing on the process rather than solely on the answer, students begin to make conjectures, attempt strategies involving different representations, and focus on the reasoning behind their steps within the problem context (Arcavi et al., 1998). Over the course of the semester, EPSTs become comfortable in revising their problem-solving strategies on their own, extending a peer's strategy or representation, and making connections between their strategy and someone else's representation. An important part of this involves shifting the authority to EPSTs in the classroom as they determine which representations they want to use as they grapple with the problem and whether an answer and solution strategy is correct or incorrect.

Bajwa's entire class session typically involves focusing on and discussing just one or two problems. One example of such a problem is: Rewrite 126.04 million dollars in at least four different ways. The process involves sharing multiple strategies and representations by students (as a result of working in small groups or independent work), defending strategies to determine which answers make sense, and sometimes making connections between the problem at hand and another problem they had solved earlier. This way, discussion on most problems involves deconstructing and making sense of the incorrect answers and not just the correct ones. Students quickly realize that their contributions–small or big–correct or incorrect–are essential, valued, and expected at every step of solving the problem and that problem-solving often requires perseverance and making sense of a strategy concerning the context of the problem. The process of defending multiple strategies and representations, and establishing norms contribute to EPSTs seeing mathematics as more than getting to the correct answer.

Having EPSTs enact teaching practices

Last, we believe that EPSTs need to move beyond unpacking their previous experiences learning mathematics and engaging in the process of doing mathematics. As MTEs, we must also provide EPSTs with a series of shared experiences to practice enacting high-leverage teaching practices in low-stakes settings. In doing so, we provide experiences for EPSTs to practice teacher moves that may explicitly counter their past understanding of what it means to teach mathematics well. While engaging our EPSTs in such practice, we strive to strike the delicate balance between being explicit with our EPSTs, so they understand how to enact each teaching practice, while also being cautious about not being overly prescriptive so as to allow space for autonomy, individuality, and responsiveness. By providing our EPSTs with a series of shared experiences where they have meaningful opportunities to practice new ideas, not just learn about them, we hope to further heal their mathematical wounds to be confident future teachers of mathematics.

In her elementary mathematics methods course, Saclarides engages EPSTs in a micro-teaching assignment (Saclarides et al., 2022). Through this assignment, EPSTs work in groups of three-four as they plan a teaching through problem solving lesson (Lester & Charles, 2003) that centers on a high-cognitive demand mathematical task (Smith & Stein, 1998) that is challenging for their college-level peers. After planning the lesson, Saclarides meets with groups of three or four to give EPSTs feedback on their lesson plan and address any concerns EPSTs may have about the enactment of their lesson. EPSTs then have the opportunity to implement their teaching through problem-solving lesson during class time, as they wear the hat of the teacher, and their peers wear the hat of the student. EPSTs have about 30 minutes to cycle through the before, during, and after (van de Walle et al., 2018) segments of their lesson, and after their peers submit anonymous feedback and engage in reflective debriefing of the lesson that includes feedback from both their peers and the instructor. Through these experiences, EPSTs have the opportunity to see the importance of planning mathematics lessons with their specific students' background in mind, building on their strengths, and recognizing that students will have different needs during the same lesson. This activity also aims to build the belief about the importance of formative assessment to check for understanding and then plan appropriate next steps based on the evidence gathered.

Indeed, micro-teaching and/or rehearsing assignments have become rather popular in the context of mathematics methods courses, as well as the focus of a growing body of research (Anthony et al., 2015; Cheng, 2017). And yet, we wish to draw attention to the fact that such assignments can be effective at healing EPSTs' mathematical wounds. For one, given that the teaching through problem solving lessons often features tasks embedded in contexts that are relevant or interesting to the EPSTs themselves, and that multiple representations and solution strategies are privileged, this assignment helps EPSTs develop more productive beliefs about what mathematics is and can be. Furthermore, given that student-to-student discourse is expected and promoted, and that student-invented strategies are valued, micro-teaching also helps to disrupt EPSTs' notions about what high-quality mathematics teaching and learning should look like.

Addressing Multiple Wounds Through Intentional Learning Experiences

There are a plethora of activities, experiences, and assignments that can be used by MTEs to address potential mathematical wounds impacting their EPSTs. MTEs are encouraged to consider how a single activity can be used to manage multiple wounds at one time. To illustrate this idea, consider a common methods class experience such as EPSTs learning about the number talks routine. MTEs can plan a progression of experiences for their students such as participating in sample number talks facilitated by their instructor, observing classroom videos of number talks, and then planning and leading their own number talks in small groups of their peers. It is important to consider how this progression might be used intentionally to address and heal mathematical wounds. The EPSTs begin by experiencing this teaching routine several times as students in a safe and encouraging environment while developing and sharing their own mathematical strategies. Experiencing the variety of mathematical strategies that are shared during these talks can help foster the belief that there are many correct and creative approaches to a single mathematical question (wound 1). As they create and share their own strategies, this has the potential to help students see themselves as flexible mathematical thinkers and become more willing to share their ideas (wound 3). Through observation of and reflection on actual classroom number talks videos, EPSTs gain a vision for high-leverage practices that can be implemented to enhance student learning (wound 2). As they are given a chance to prepare and practice leading number talks in a small group of their peers, EPSTs can gain confidence in their ability to engage in unscripted mathematical discussions (wound 3).

However, experiencing this progression of sample experiences does not guarantee that wounds have been effectively addressed nor that any healing has occurred. In fact, if not implemented intentionally by MTEs, this progression could actually serve to re-open or exacerbate existing wounds. For example, if the MTE selects topics for the number talk that many students do not have the background on which to develop potential strategies, or only calls on the "stronger" students in the class to share ideas, then this may unintentionally confirm some students' feelings that they are not capable of creative mathematical thinking (wound 3). When presenting their number talks in small groups, if safe norms have not been established and an EPST feels ridiculed by their group for making a mistake, they will be less inclined to implement unscripted mathematical discussions in their classroom and stay with more teacher-centered approaches (wound 2). Thus, the role of the MTE is essential in implementing such a progression in ways that consider these mathematical wounds so that there is ample opportunity for healing. MTEs who are not intentionally considering the role of mathematical wounds in their EPSTs may unintentionally exacerbate existing wounds in ways that undermine the core goals of the activity.

DISCUSSION

Framing Practice to Address EPSTs' Mathematical Wounds

The majority of the activities and assignments in our methods and content courses were not originally created with the intention of specifically addressing EPSTs' mathematical wounds. We planned our courses to align with teaching practices that supported EPSTs in the development of their content and pedagogical knowledge, and we suspect that many of the experiences that we have described in this article are common for many MTEs. However, we found that these experiences did not always produce the positive results that we had intended.

The framing of mathematical wounds provides a lens to interrogate existing practices, assignments, and activities within methods and content courses to consider how they are supporting EPSTs in their healing. An MTE can begin implementing the mathematical wounds lens by regularly reflecting on the ways mathematical wounds might be exhibited and reinforced in class and coursework. An MTE can then explore coursework that might support EPST healing. Additionally, there is no need to undertake an overhaul of every course activity or assessment. It is reasonable to rethink one or two activities a semester and gradually build a repertoire of activities that intentionally consider EPSTs' mathematical wounds and how healing might be promoted through participation in the activity. **Table 3** shows a list of possible reflection questions to consider when evaluating how EPSTs' existing mathematical wounds may need to be considered within a particular assignment or activity and how that assignment or activity may bring some healing to EPSTs.

Table 3. Reflection questions to foster awareness of EPSTs' mathematical wounds in course work

Questions
1. Is this activity accessible to all EPSTs, regardless of what wounds they may have?
a. How might EPSTs who do not see themselves as competent or capable in mathematics respond to this activity?
b. How might EPSTs who do not see mathematics as a sense-making opportunity respond to this activity?
c. How might EPSTs who think that rote memorization and teacher-centered instruction is most beneficial to students' understanding of mathematics respond to this activity?
2. If EPSTs' mathematical wounds might hinder them from fully engaging with the activity, what adjustments can be made or supports can be added to support EPSTs in meaningfully working through the activity?
3. How might this activity potentially exacerbate existing wounds? As the MTE, what do I need to be aware of in relation to my own mathematical wounds while enacting this activity?
4. How might this activity positively impact EPSTs and address their mathematical wounds?
a. How can this activity help EPSTs unpack or relate to their experiences as a mathematics learner?
b. How can this activity invite EPSTs to collaboratively engage in doing mathematics together?
c. How can this activity support EPSTs in practicing high-leverage teaching practices in low-stakes settings?
5. What assessment considerations might need to be adjusted with this activity to capture EPSTs' learning and support the healing of their unique mathematical wounds?

These reflection questions are a model for MTEs to consider taking traditional course activities and shifting to see them through the lens of mathematical wounds. While most of the questions are self-explanatory, the fifth question may require further clarification. The fact of the matter is that EPSTs need to be well-equipped to teach in their own classrooms by the end of their university-based teacher preparation program, regardless of what mathematical wounds they may have. This can lead to some tension between honoring where EPSTs are in relation to their mathematical wounds and needing to demonstrate competence in particular areas of mathematics teaching. For example, consider an EPST who has high anxiety and is uncomfortable leading a whole class mathematical discussion. Assessment adjustments might be appropriate at the start of the program, where maybe they lead small group discussions or work with their peers to lead a whole group discussion. Additionally, questions and conversations around coping with anxiety during those activities may be beneficial. However, by the end of the program, even with high anxiety, the EPST does need to lead a classroom discussion alone, as the reality is that they will soon be the sole teacher in their classroom. This inherent tension pushes us to consider if assessments accurately reflect EPSTs' learning considering their possible mathematical wounds. Continuing with the same example, if an EPST with high anxiety is assessed on leading classroom discussions, it is possible that the assessment more so reflects their anxiety than their understanding of students' thinking, crafting of questions, or sequencing of students' strategies. This is not to say that such assessments are not beneficial or should be avoided, merely that it is necessary for us as MTEs to consider such tensions in the design and implementation of our course activities.

Tensions

We wish to highlight some tensions we have experienced ourselves, or imagine other MTEs may encounter, when seeking to heal EPSTs' mathematical wounds. For one, as MTEs, we keenly recognize the need to support our EPSTs in developing skills, dispositions, and knowledge needed to be effective mathematics teachers. EPSTs' preparation in their programs includes ensuring that they have deep content and pedagogical knowledge, as well as an understanding of student learning trajectories. This also encompasses supporting EPSTs to learn how to analyze student work, administer meaningful formative and summative assessments, and teach in ways that are culturally and linguistically responsive to a diverse student population. Clearly, as MTEs we have many goals to accomplish with our EPSTs and never enough time to do so. Thus, it may feel like the goal of working to heal EPSTs' mathematical wounds takes away from building pedagogical or content knowledge. We acknowledge this tension, but from our experiences, we believe that these goals are mutually reinforcing. That is, by working to heal EPSTs' mathematical wounds by engaging EPSTs in some of the experiences discussed above, this will simultaneously help develop the desired skills, dispositions, and knowledges EPSTs need to be effective mathematics teachers. Additionally, we draw attention to the fact that, in the context of this article, to analytically describe these mathematical wounds, we discussed each singly. However, we highlight that these mathematical wounds are deeply interconnected. That is, how an EPST thinks about mathematics impacts their beliefs about the teaching and learning of mathematics. Hence, these wounds should very much be thought of as interconnected and interdependent. Finally, our goal in sharing the activities, structures, assignments, and routines above was not meant to be prescriptive. Instead, we hope to spark conversation as to what and how the activities we design for EPSTs work. MTEs must get to know their EPSTs and unique contexts and decide which kinds of experiences will best meet their EPSTs' needs.

CONCLUSIONS

Using collaborative self-study, we have isolated three wounds, which address EPST beliefs about themselves and their students as mathematics doers and about how mathematics should be taught. In identifying these types of mathematical wounds often carried by EPSTs, we propose a framework for course construction and approaches that promote healing for these mathematical wounds. Drawing from prior work and our experiences, our goal is to share an adaptable path for MTEs to address deep rooted wounds that do harm. This framework offers one way to develop a teaching practice to support mathematics teacher preparation within existing content and methods courses based on the current landscape of mathematics learning. By exploring these wounds and the barriers they pose to best practice, we found that we as MTEs developed activities and assignments that sought to heal mathematics wounds in EPSTs from a position of care. This tool provides MTEs an opportunity to examine their own practice and evaluate the ways they attend to or neglect to attend to EPSTs' mathematical wounds. In this paper, we provided examples from our own classrooms as well as a set of questions MTEs can use to reflect on their practice.

We acknowledge that these approaches might not make a measurable difference in EPSTs' beliefs at the end of their university-based programs. Indeed, decades of research has demonstrated how such beliefs are challenging to measure (Philipp, 2007) and can be stubborn to change or fluid and changeable depending on the context (Fives et al., 2015). However, we take the stance that regardless of measurable outcomes, this work is worthwhile even if healing is not fully realized. These approaches may be instrumental in shaping mathematics teacher education research for (re)humanizing mathematics, by (re)humanizing the work of mathematics teacher education. By taking a stance of care, we intentionally address mathematical wounds with the intention to start a path towards healing for EPSTs.

Given the complex and multi-faceted nature of this work, there is still much to learn regarding how to heal EPSTs' mathematical wounds most effectively. We conclude by sharing our wonderings about this work. For one, we acknowledge that none of us are wound free. Even as MTEs, we carry with us mathematical wounds from our prior schooling experiences. Hence, we wonder how can we, as MTEs, hold ourselves accountable so that we are not perpetuating cycles of trauma for EPSTs? Furthermore, we wonder about the potential of our approaches in promoting long-term healing for our EPSTs. In other words, in the short amount of time we have our EPSTs in our methods and content courses, we feel confident that–in the short-term–we are making strides in attempting to address and begin to heal our EPSTs' mathematical wounds. However, in the long-term, when EPSTs have their own classrooms and are situated in schools on teams that may not promote such healing approaches, how will

they respond? Will they perpetuate cycles of negative experiences by promoting harmful pedagogical practices that inflict mathematical wounds on their students? Or will they be agents of change? Last, we wonder how issues of equity intersect with our framework for healing EPSTs' mathematical wounds. Clearly, there is still much work to be done and we invite other MTEs to continue grappling with us about this important problem of practice.

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