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KENTUCKY JOURNAL OF MATHEMATICS TEACHER EDUCATION

President's Message

On behalf of the Kentucky Association of Mathematics Teacher Educators (KAMTE), I hope you enjoy this issue of the *Kentucky Journal of Mathematics Teacher Education*. We are proud to offer this publication for educators to share professional knowledge and to learn from one another. I encourage you to engage in conversations about the articles with colleagues.

I am often traveling to school sites across the Commonwealth, which means I spend a fair amount of time in my car. I use that as an opportunity to expand my knowledge from a variety of podcasts. One I want to highlight for you here is the *Teaching Math Teaching* podcast from AMTE, in particular Episode 87, "Critical Conversations: AMTE Standards for Preparing Teachers of Mathematics in Social and Political Contexts," featuring our very own Jenny Bay-Williams, as well as Liza Bondurant, Yvonne Lai, Richard Velasco, and Eva Thanheiser. The podcast may be found here: https://www.teachingmathteachingpodcast.com/87, and it can also be found on most podcast platforms. I love that this episode engages in content from the conference and shares other valuable, timely resources.

Two of our board members facilitated a book study featuring Building Thinking Classrooms by Peter Liljedahl. Our spring 2024 pre-service event featured a dive into the potential for Desmos in multiple grade bands and an in-depth conversation with Kentucky math teachers about classroom assessment. We held an in-person retreat for members in May at the University of Louisville, where we engaged in a math activity together, discussed mathematics teacher recruitment and retention with *Get the Facts Out*, explored artificial intelligence in the mathematics classroom, and discussed the opportunities and implications presented by new legislation designed to expand training and support for math teachers in Kentucky.

What's Inside…

I encourage you to join our community and stay in the know about our 2024-2025 events. We are planning two free online conferences for pre-service teachers (one in early November and one in the spring, dates TBA). Each year, we engage in a book study, selecting texts that expand our perspectives and/or dive into research and issues that impact our work as math educators.

Feel free to reach out with ideas for KAMTE activities and any questions you have.

KAMTE Website: https://kcm.nku.edu/KAMTE/index.php

KAMTE Membership Form: https://forms.office.com/r/C3jMa4bir4

Dee Crescitelli
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AMTE Announcements

The 2025 AMTE Annual Conference will be held in Reno, Nevada, February 6-8, 2025. Save the Date! Registration information will be posted on the AMTE website soon.

AMTE has two press releases currently available. The Role of Elementary Mathematics Specialists in the Learning and Teaching of Mathematics and the AMTE Statement on Technology both inform readers about the AMTE stances on two important issues in mathematics education.

The AMTE Connections for summer is available! The Summer 2024 edition includes a collection of articles as part of a series on Artificial Intelligence in Mathematics Teacher Education. A second collection will appear in the Fall 2024 Connections issue. This Connections issue also includes updates from the Mathematics Teacher Educator (MTE) journal, including how to contribute a research commentary to MTE.

Review for KJMTE

KJMTE is *your* journal. Reviewing articles for potential publication is a great way to have input into the types of articles KJMTE publishes for its readers.

The journal's aim is to provide a space for the exchange of ideas to advance mathematics teacher educator practice. Peer review of articles strengthens KJMTE's ability to meet this aim.

Interested in reviewing for KJMTE? Find out more at KJMTE.org.

Questions about KJMTE? Contact the KJMTE Editorial Team at editors@kjmte.org.

A Message from the Editors

Dear KJMTE Readers,

In this issue of the *Kentucky Journal for Mathematics Teacher Education* (KJMTE), you will read about a community-building framework used at three different institutions by three different mathematics instructors. The article Fostering Communities in Practice by Melissa Gunter, Jamie-Marie Miller, and Katrina Rothrock offers reflections of the three instructors with the hope that readers will envision the positive changes that community building can bring to their own classrooms.

In this issue, we also present the new president of KAMTE, Dr. Dee Crescitelli. The KJMTE Co-Editors send a special "thank you" to Dr. Jonathan Thomas for his leadership the past year. We look forward to Dee's presidency and the passion and enthusiasm she brings to KAMTE and KJMTE.

As you read this issue of KJMTE, please consider submitting your own work for publication. We know you are doing great things in your classrooms and readers of KJMTE would love to learn from you.

KJMTE publishes articles and commentaries which appeal to mathematics teacher educators – this includes mathematics educators, mathematicians, teacher leaders, school district mathematics experts, and others. We encourage the development and sustenance of an equitable and welcoming environment for all individuals interested in mathematics education. If you are thinking about submitting an article for publication, please feel free to contact either of us to discuss your ideas. We would love to hear from you.

We hope that you enjoy reading this issue of KJMTE. We look forward to getting your submissions and reading about the inspiring work you do and thinking about the ideas you set forth. You can also contribute to KJMTE by reviewing manuscripts. Your reviews are vital for this journal to meet the needs of mathematics teacher educators.

Finally, we hope that you find inspiration in this and every issue of KJMTE.

Bethany Noblitt, Ph.D. and Nicholas Fortune, Ph.D.
Co-Editors, KJMTE

KAMTE Board Members

KAMTE would like to announce changes in the board. First, we extend a warm welcome to Dr. Daniel Clark who joins the KAMTE board as the new President-Elect. Dr. Dee Crescitelli, who has served most recently as the President-Elect, is now the new KAMTE president. Dr. Jonathan Thomas will continue to offer leadership as the Past-President.

Dee Crescitelli, President

Dr. Dee Crescitelli is a Director at the Kentucky Center for Mathematics and teaches as adjunct at Georgetown College and the University of Louisville. She also serves as a Professional Learning Coach for Kentucky Adult Education. She is working to improve mathematics education from pre-K through college. Her teaching experience ranges from elementary through graduate school, adult education, and teacher preparation - threading real numeracy through all those levels.

Daniel Clark, President-Elect

Dr. Dan Clark is a mathematics educator in the Department of Mathematics at Western Kentucky University (WKU) where he works with preservice K-12 teachers as well as practicing secondary mathematics teachers and aspiring elementary mathematics specialists. He started working at WKU in 2016 after earning his Ph.D. in Mathematics Education from Michigan State University. His research interests include preservice teacher education, teaching and learning mathematics for social justice, and how teacher preparation programs structure mathematical experiences for preservice teachers.

Jonathan Thomas, Past-President

Jonathan Thomas is an Associate Professor of Mathematics Education and Chair of the Department of STEM Education at the University of Kentucky. Prior to his tenure at UK, he was a faculty member at Northern Kentucky University. He holds a B.A. in Elementary Education from the University of Kentucky, an M.Ed. in Educational Leadership and an Ed.D. in Mathematics Education, both from the University of Cincinnati. Dr. Thomas also serves as a faculty associate for the Kentucky Center for Mathematics (www.kentuckymathematics.org) and facilitates professional learning experiences for teachers across the commonwealth. His research interests include investigating responsive mathematics teaching practices, equity concerns in the elementary mathematics classroom, non-verbal patterns of mathematical interaction, and cognitive progressions of children's mathematical construction.

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Jamie-Marie Miller, Secretary

Jamie-Marie Miller is an Assistant Professor in the Department of Teaching, Learning, and Educational Leadership at the Eastern Kentucky University. She received her Ph.D. from the University of Kentucky in STEM Education. Dr. Miller teaches elementary and middle/secondary mathematics methods courses, geometry for elementary teachers to undergraduates along with graduate courses in elementary mathematics education and intervention strategies for struggling learners. Her research focuses on the progression of algebraic thinking in students, math-specific literacy strategies, assessment, and visible learning practices.

Sue Peters, Treasurer

Susan Peters is an Associate Professor in the Department of Middle and Secondary Education at the University of Louisville, where she teaches mathematics methods courses and graduate courses in mathematics education. Her research focuses on statistics education and mathematics teacher knowledge, particularly teacher knowledge and education in statistics. When she's not working with teachers, she enjoys relaxing walks in nature.

Michele Cudd, At-Large Representative

Michele Cudd is an Assistant Professor in the Department of Early Childhood, Elementary and Special Education at Morehead State University, where she teaches future elementary, middle, and high school teachers. She is interested in supporting novice teachers to develop more student-centered discourse practices. In her free time, she often is hiking on trails with her dog.

Kate Marin, At-Large Representative

Kate Ariemma Marin is an Assistant Professor of Math Education at the University of Louisville. She has taught elementary and middle school and served as a math coordinator in schools across Massachusetts. Prior to the University of Louisville, she was a faculty member at Stonehill College. She teaches mathematics education courses and supports the development of pre-service and in-service teachers. Her research interest is in teachers' development of Mathematical Knowledge for Teaching and generational differences in teachers. She is committed to supporting teachers and promoting the knowledge that they bring to the profession.

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KAMTE Membership

Membership to the Kentucky Association of Mathematics Teacher Educators (KAMTE) is always open for any faculty member that works with preparing pre-service and in-service teachers at any level. To join, contact Treasurer Sue Peters at s.peters@louisville.edu.

Upcoming KAMTE Events

Fall

Preservice Teacher Virtual Conference	November, date announced soon

Spring

Preservice Teacher Virtual Conference	Date announced soon
KAMTE Member Retreat	May, date announced soon

Year-long

Book Study (book announced soon)	Monthly, November - April

Upcoming Conferences

Sept. 25-28, 2024	NCTM Annual Conference	Chicago, IL
April 2-5, 2025	NCTM Virtual Conference	
February 6-8, 2025	Annual AMTE Conference	Reno, NV
March 3-4, 2025	KCM Conference	Lexington, KY

Call for Manuscripts

The editors of KJMTE are soliciting manuscripts for publication in the next issue of *the Kentucky Journal of Mathematics Teacher Education* that builds on the theme of the first issue: "The Next Generation of Mathematics Teachers."

Specifically, we ask authors to consider the following: What are the next generation of mathematics teachers? What are their needs? What role do mathematics teacher educators have in meeting those needs? How can mathematics teacher educators best prepare the next generation of mathematics teachers for their work?

The journal's aim is to provide a space for the exchange of ideas to advance mathematics teacher educator practice. The journal welcomes manuscripts that support this aim. Of particular interest are manuscripts that address an issue in mathematics teacher education and the methods/intervention/tools that were used to investigate the issue along with the means by which results were determined and the impacts on practice. Manuscripts should fall into one of the following categories:

Manuscripts that describe effective ways of influencing teachers' knowledge, practice, or beliefs. This might include a description of activities, tasks, or materials that are used by a teacher educator to influence teachers in some way. These manuscripts would include a rationale for the intervention, a careful description of the intervention, discussion of the impact of the intervention, and how it might be used by others.

Manuscripts that describe the use of broadly applicable tools and frameworks in mathematics teacher education. This might include a classroom observation protocol, a task analysis framework, assessment tasks, or a framework for a teacher education program. These manuscripts would include a careful description of the tool or framework, what it is designed to capture, its use, and a discussion of the outcomes. The manuscript should include an explanation of how to interpret the results of the data captured by the tool. The tool should be made available for other professionals to use, modify, enhance, and study.

Additionally, KJMTE also publishes commentaries. Commentaries differ from manuscripts described above in that their goal is to highlight critical issues for Kentucky teacher educators and/or administrators. These are more likely to be drawing attention to a call to action and less about the practices of educating future teachers as described above. Importantly, commentaries are not peer-reviewed, they will be edited by the editors in consultation with authors. Authors are also encouraged to respond to commentaries that appear in KJMTE in their own commentary.

If you are interested in writing a manuscript for an issue of KJMTE, please visit the KJMTE Current Call for Manuscripts for the Author Toolkit where you can find formatting guidelines and information for preparing and submitting a manuscript to KJMTE.

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Fostering Communities in Practice

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Abstract

In this article, three mathematics educators reflect on their use of a community-building framework in each of their different contexts to foster real-time, meaningful community among students. The community built in their classrooms serves as the foundation for belonging, learning, and professional growth, as well as a model for the students who are pre-service teachers. Through reading their work, the authors hope that other practitioners of mathematics and mathematics education will envision how purposeful community building can bring positive change to their own classrooms.

Keywords: mathematics education, teacher education, community

As early-career faculty members in mathematics education, it is always a delight to discover colleagues who share some of the same ideas about teaching, and such was the case with the three of us. Specifically, through our conversations about teaching we found that, despite teaching different kinds of courses at universities in three different states, we shared a similar framework aimed at deliberately fostering a sense of community in our classrooms. Here we share some strategies for developing communities of practice in both mathematics methods and content courses, as well as some insights into what we feel has made those experiences so effective for our students.

Melissa teaches a combination of mathematics content and elementary and secondary methods at a regional university located in New England. Largely a commuter school, the overwhelming majority of students are in-state residents and over 40% identify as a minority ethnic or racial group. Jamie-Marie teaches elementary, middle, and secondary methods along with geometry at a regional university located in Appalachia. Approximately 42% of the students at this university are first generation college students. Katrina teaches mathematics content courses at a regional university in the upper Midwest. Many of the students are graduates of small high schools from around the state. The content courses that Katrina teaches are split between courses for elementary or secondary preservice teachers (PSTs), and large enrollment courses for students who placed below college-level mathematics.

Communities of Practice Framework

In 1991, Lave and Wenger offered an important alternative theory about learning that differed from mainstream philosophies focused on individual actions (Haneda, 2006). Lave and Wenger (1991) proposed that learning occurs within social contexts, rather than as an individual effort, and does so through the sharing of knowledge, practices, and identities as individuals participate in the social world. These communities of practice exist not only in classrooms, but anywhere that learning occurs (Haneda, 2006) and are described as “groups of people who share

a concern or a passion for something they do and learn how to do it better as they interact regularly" (Wenger-Trayner & Wenger-Trayner, 2015).

When designing their courses, teachers can intentionally plan social interactions and collaborative activities that provide the foundation for a community of practice to develop within the classroom (Forman, 2003). One framework, proposed by Wenger (1998), includes three dimensions of a community of practice: mutual engagement, the participation of the community members with one another as they work to engage and build relationships; a shared repertoire, a common collection of resources that members develop over time; and a joint enterprise, which provides purpose to the community and is continually negotiated and redefined as the community evolves (see Figure 1). Once people perceive they belong to such a community through the development of these three dimensions, they feel that they matter, tend to respect others' ideas and participation, and are more willing to participate in the community by offering ideas, giving critical feedback, and reflecting on their own learning; ultimately, they become owners of their learning (Wenger, 1998).

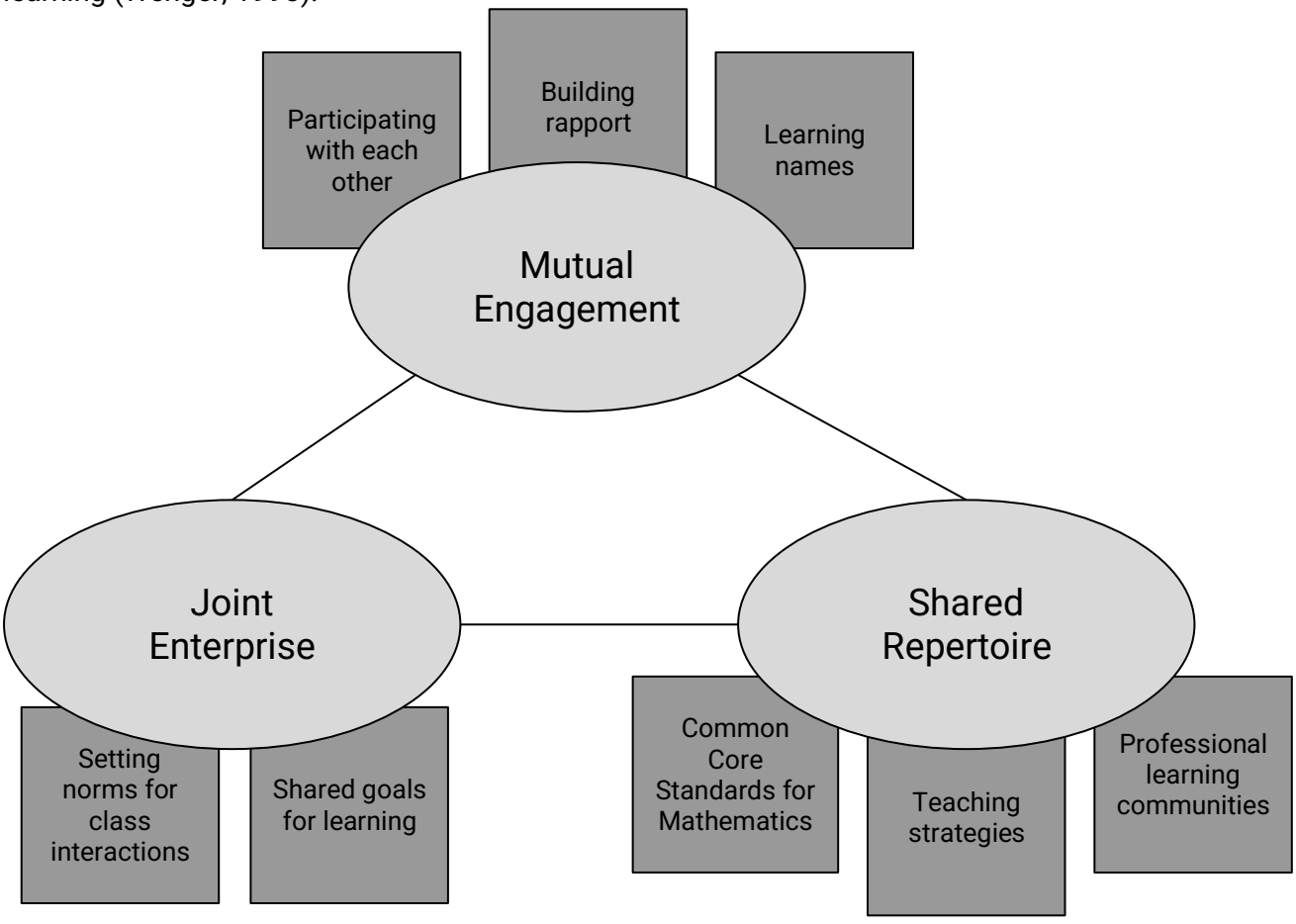

Figure 1. Adaptation of the three dimensions of a community of practice proposed by Wenger (1998).

Reflecting on our work and its ties to Wenger's Communities of Practice, we saw connections to these dimensions shown in Figure 1. We adapted the initial framework to include instructional practices from our classrooms related to facilitating mutual engagement, shared repertoire, and joint enterprise among our students. Mutual engagement is built through cooperative activities which help us learn names, build rapport, and engage with each other, which

in turn increases participation and engagement in our courses. A shared repertoire is built through our intentional connections between the Common Core Standards for Mathematics and teaching strategies, which are created and shared through the professional learning communities we build. Finally, we support a joint enterprise by centering students in setting classroom norms and goals to elevate their own purpose for learning rather than centering our own, instructor-created goals.

Building such communities of practice is especially important in mathematics classrooms. For many, mathematics is a subject that conjures anxiety (Luttenberger et al., 2018). The mathematical identities students develop as they interact in their mathematics classrooms influence their sense of belonging, beliefs about what they can achieve, and ultimately their interest in and ability to exhibit productive learning behaviors (Boaler et al., 2000). This is especially significant in mathematics classrooms, where students are continuously evaluating their confidence in their knowledge and skills, feelings when participating in classroom activities, and perceptions of how others respond to them (Aguirre et al., 2013). Although teachers cannot control how students feel or choose to interact in a classroom, they can shape their classroom environments in ways that students are more likely to find the social and cognitive support needed for participation (Cornelius & Herrenkohl, 2004).

The National Council of Teachers of Mathematics' (NCTM) Principles to Actions (2014) emphasizes the importance of fostering classroom communities that encourage students to engage in productive and meaningful discourse in order to help all students thrive in their mathematical learning. Additionally, the Association for Mathematics Teacher Educators' (AMTE) Standards for Preparing Teachers of Mathematics (2017) describe that effective teacher preparation programs teach content by modeling effective teaching methods. Modeling the teaching practices that are expected of future teachers is powerful because preservice teachers have the opportunity to experience those practices personally as learners (Urbani et al., 2017). In particular, future teachers gain important experience when the development of a community of practice is modeled within a preservice teaching classroom (Bradley & Fogelsong, 2021).

Building the Foundation for Communities of Practice

All three of us intentionally engage our students in similar ways to cultivate community in our classrooms. Below, we describe strategies that helped us, and our students, build relationships within our classrooms, and develop shared resources that reinforce the purpose and value of our classroom communities. We do so by remembering and using each other's names, facilitating collaboration, building on past mathematics experiences, and developing shared goals for learning; together, these strategies invite and encourage our students to participate in our classroom communities of practice.

Facilitating Collaboration for Mutual Engagement

To be mutually engaged, students must have a desire to collaborate with one another. We each begin the semester using strategies that help to initiate that collaboration, ensuring that both we and our students learn everyone's names and a little bit about each other. We have used name tents that allow students to share their preferred names and pronouns so that they can be addressed by classmates in their preferred manner. Icebreakers like "Two Truths and a Lie" have offered opportunities for students to share personal interests and life stories which often result in unexpected connections with others. These important first steps begin the development of a sense of familiarity among individuals in the classroom that is needed before implementing other strategies that build community in our classrooms.

Learning is active and socially constructed, and therefore involves varying forms of collaboration within each of our courses. Jamie-Marie encourages collaborative thinking among students by using a Google Jamboard, allowing students to both contribute their own ideas and

offer feedback to others. Melissa asks that students engage in peer review to learn to both offer and accept critical feedback. All three of us employ a handful of structures to encourage small group discussion such as think-pair-share and assigning group roles in small group work. Because of the size and nature of the developmental mathematics classes, Katrina intentionally creates a structure that allows for similar small group discussion structures. Katrina asks undergraduate upperclassmen, who are also mathematics tutors for the course, to facilitate small group discussions within the larger lecture hall. Shifting the perceived size of the class by creating smaller communities of learners creates the social environment that encourages students to feel safe to ask questions, discuss the meanings of mathematical words, and consider together the possible solutions of various mathematical tasks. The small groups not only encourage students to build community, but they also offer the tutors, who are usually future mathematics teachers, a unique opportunity to practice developing such a community and observe how students choose to interact within it (see Figure 2). These small communities meet weekly throughout the semester, which shapes and sustains a safe environment for participation through mutual engagement, the first dimension of communities of practice. Students know other group members' names and continuously build rapport as they participate together in tasks and engage in conversations that purposefully include all group members.

It's a Tuesday at 10:50am and students are arriving in the lecture hall for their Intermediate Algebra class. As they do, they first wander up to the front, check in at the attendance station and grab their name tent. Katrina greets students as they check in, and hands them a set of practice problems and thinking prompts which supplement the homework they completed online in preparation for the class. By 11:00am, most of the 92 students have arrived, and have made their way to their seats in small groups around the room.

Katrina begins, "Hello, everyone! I'm so glad to see you today! Did you know that today is National Math Storytelling Day? Did you even know there WAS a National Math Storytelling Day? I didn't! Let's take a moment to celebrate by sharing a math joke or a story about a favorite game that you remember playing in math class."

Katie, a junior in secondary mathematics education, turns to her group of 14 students, mostly freshmen. "Devin, how did your concert go last weekend? And Anna, weren't you headed home to celebrate your brother's birthday? How did that go?" Devin and Anna seem excited to respond briefly about their experiences. Katie continues, "So, National Math Storytelling Day – huh. Have you ever heard of that? Professor Rothrock suggested thinking about a math joke or class game…do any of you remember some fun math classroom games you used to play, or maybe have a joke you are willing to tell?"

The room is bubbling with conversation as all the small groups begin to talk, each group led by upperclassmen who also act as tutors in the tutoring center. Now that it is October, the Intermediate Algebra students seem to be connecting more easily with their group leaders and each other since they've had some time to get to know each other.

Katrina interrupts after a few minutes, "Thanks for sharing your stories with each other! My day is certainly better for hearing some jokes! If you would please, now take a minute to look over today's practice problems by yourself and draw a star by anything that you want to talk about with your group." The class is quiet, but after about 30 seconds, students start looking at each other's sheets and whispering. Katrina continues after waiting one minute, "Groups, take it away!"

Katie and the other group leaders begin conversations with their groups. Some gather a tally of the problems students identified in order to go over them as a whole group, while others encourage partners and trios together to work on practice problems. All group leaders have a list of common errors and misconceptions associated with the day's practice problems, prepared by Katrina, and address those with their small groups at some point during the class period within their small groups.

As groups work together, Katrina floats around the room, answering questions, offering alternative perspectives, and having casual conversations with students, being intentional about using their names from their name tents. While doing so, Katrina gathers a list of topics to use as a summary at the conclusion of the class period.

When there are just a few minutes remaining, Katrina addresses the full class again, highlighting both challenges that students encountered as well as connections students made. Katrina also reminds students of the upcoming quiz, encourages students to use the tutoring center to clarify any remaining questions, and finally sends wishes for a happy and productive day.

During the tutor meeting at the end of the week, the tutors who serve as small group leaders share updates on what seems to be working to get their students talking and collaborating, as well as any challenges they experienced. Katrina and other tutors offer ideas to help and celebrate successes when there are signs that students feel part of a community.

Figure 2. Making small-group discussion work in a large lecture classroom.

Professional Learning Communities Build a Shared Repertoire

In their methods courses, both Melissa and Jamie-Marie provide opportunities for groups of students to work together to negotiate the meaning of various mathematical tasks in which there is not one particular individual who is considered more mathematically experienced. Students work to understand how various instructional strategies support mathematical understanding based on their shared repertoire of how people learn math. They discuss why and how a particular instructional strategy works, then they are given the opportunity to try out these instructional strategies in their group. We include these methods of collaboration in order to prepare students who are PSTs for membership and participation in professional learning communities (PLCs) in their future teaching positions.

DuFour (2004) described the work and purpose of a PLC as a group of educators who regularly work together to share instructional ideas, analyze student work samples, and collaborate on next steps to increase student achievement and improve their own pedagogy. Three questions that drive DuFour's PLC model include: What do we expect students to learn? How will we know when they learn it? and How will we respond when some students do not learn it?

PLCs are similar to communities of practice in that both situate a group of individuals who have a shared interest in strengthening their own understanding of teacher practice and impacting the learning of others. PLCs are used often in schools as a way for teachers to examine their curriculum and teaching practices in reference to student data. The ability to analyze these facets is not something that is developed overnight, but rather taught and honed over time. If preparing PSTs for the classroom is a major goal for teacher preparation programs, then preparing PSTs to be contributing members of PLCs is something that math teacher educators must negotiate as they plan learning experiences in their courses.

Melissa and Jamie-Marie help students develop a shared repertoire in their methods courses by organizing opportunities for PSTs to learn, practice, and provide feedback on commonly used research-based instructional practices such as talk partners, manipulatives use, and number talks. An example of a number talk in Jamie-Marie's classroom is provided in Figure 3, in which students develop common language and discuss multiple strategies that are tied to the Common Core Standards for Mathematics in the context of relevant mathematics content.

After a month of observing and participating in recorded number talks led by Jamie-Marie, PSTs are divided into PLCs of four based on their grade-level interest. The PLCs look at the relevant mathematics standards and talk through the meaning of them as well as any special considerations in order to develop a number talk based on a chosen standard for class the next week.

The following week, multiple PLCs are conducted in the same room simultaneously. Jamie-Marie moves among PLCs to listen and provide support. As one of the PSTs leads the group in a two-problem number talk, Jamie-Marie reminds the PSTs that their focus is not only providing strategies for answering the problem, but also for determining if the number talk is aligned to the standard and providing guidance/support to the PST leading the number talk.

A PLC that focused on 2nd and 3rd grade (led by Kaitlyn with other PLC members, Tatyana, Bella, and Sam) had an interesting conversation centered around the standard, 2.NBT.5 "Fluently add and subtract within 100 using strategies based on place value, properties of operations and/or the relationship between addition and subtraction." One of the problems in the number talk included: 42 + 39. After the PST finished leading the number talk, the PLC debriefed:

Tatyana: I thought your choice of problems was appropriate and aligned to the standard. If you look at the standard, the problem is supposed to be within 100 and yours was.

Kaitlyn: I saw that in the standard and tried to make sure that I followed the required numbers. I remember last week when we talked about what standards we picked, Bella pointed out that so many standards told you exactly what numbers to use.

Sam: Yeah, I am glad Bella made that catch because for my number talk dealing with third grade fractions, I wanted to use tenths, but went back to see that denominators of 2, 3, 4, 6, and 8 are allowed.

Bella: I just remember that Dr. Miller keeps saying to bring it back to the standards. Kaitlyn, I think we gave you a lot of strategies during your number talk. Did any of them surprise you?

Kaitlyn: Yes, my arm got tired writing down the group ideas. I think the one that shocked me was when Sam said that to solve for 42 + 39 she first would take 2 away from 42 and then add it to the 39. My mind doesn't work that way, why did you do that? I was so caught up in writing down what you said that I didn't have you to explain. I got nervous with all the different strategies and kinda stopped asking you all to explain how you got your answer.

Sam: Well, I like dealing with nice round numbers, you know, ones that end with zero. So, if I took 2 off of 42, it makes it 40. I also know that if I take 2 off a number, I need to add it back to the other number. So, I added 2 to the 39 to get 41. This makes the problem a lot easier for me to work in my head as 40 + 41 = 81.

Bella: We didn't offer this, but I wonder if a kid would use an open number line, like start at 39 and draw a hop of 1, then do 4 hops of 10 and a final hop of 1 to get to 81?

Tatyana: Or do a hop of 1 from 39 to 40 and then just make a big hop of 41 to land at 81?

Sam: I have kids in my placement that would struggle to explain how they solve it but could show you with base 10 blocks. I wonder if we could allow them to use these in number talks to help them feel more comfortable when they are explaining their strategy?

Jamie-Marie: PLC…you all are talking like seasoned veterans! I love that you keep coming back to the standards. When you have your own classrooms and you are a PLC member, it is key to keep your instruction, assessment, and conversations grounded in standards. Your PLC did an excellent job in providing a lot of strategies that kids may use in the classroom. Kaitlyn, thank you for being honest and

sharing that you got overwhelmed. I think we all feel this way as we start using a new teaching method. It does get better over time. This is a positive of PLCs…bouncing ideas and strategies off each other.

Kaitlyn: I like being in this PLC, it helps me to see others' ways of thinking. I think this will make me a better teacher…now Sam why did you do that… take 2 off and add 2 on again?…haha!

Figure 3. Creating PLCs Experiences Around Number Talks in Jamie-Marie's Class.

Additionally, Jamie-Marie provides opportunities for PSTs to collaboratively break down mathematics standards into learning targets, identify potential misconceptions, and model the development of high-quality questions which have the potential to change an ordinary mathematics task into a rich task that invites cognitive challenge for all learners. Through the work of these groups, PSTs collaborate to sharpen their own mathematical skills and understanding of mathematical standards while practicing strategies they can use in their future classrooms. In all our classrooms, small group conversations offer opportunities for social interactions and that mutual engagement Wenger discussed, where students of any discipline can share ideas, receive gentle guidance about their thinking or their work which offers an important opportunity to monitor the quality of their own work and develops common resources and ideas as their shared repertoire.

Negotiating a Joint Enterprise with Shared Learning Goals

To develop a joint enterprise, students must be united in the purpose for their learning. All three of us begin our courses with students completing a Math Autobiography assignment to help us better understand each student's math story, offering a window into each student's previous interactions and experiences with mathematics. Jamie-Marie supplements that assignment by inviting PSTs to share a few of those mathematical learning experiences, both positive and negative, with their classmates. These personal stories help students build trust within the classroom community as they recognize similarities and differences in their experiences. The stories also frame students' perspectives about what highly effective mathematics teaching might look like. Reflecting on those stories, PSTs create a list of questions and topics they want to learn more about during their methods course; these lists of questions and topics guide the creation of shared learning goals for the class. Throughout the semester, as the class discusses effective mathematics teaching, PSTs are encouraged to reflect on how those discussions connect to their own and others' shared experiences.

Similar to the creation of shared learning goals, Katrina and Melissa invite students to construct shared classroom norms by reflecting on the actions and behaviors they value in their classroom interactions, and what it would take for each student to feel included as a member of the class (see Figure 4 below). Through sharing what they believe to be desired actions and behaviors, students are communicating about their own needs while also gaining perspective about what others value and need. Building consensus around shared values requires that students be open and honest with one another, which strengthens trust among everyone in the classroom; this ultimately builds community to help all students reach their personal and shared learning goals as they unite behind their joint enterprise.

On the first day of class, once the schedule and syllabus have been shared, Melissa addresses the class. "Now that we've seen some of my goals for the class, I'd like for us all to consider our own, personal goals for our semester together. Please think for a few minutes about what your goals for the semester are and then share with a neighbor."

After some partner discussion, Melissa asks students to share some of these goals with the whole group. These individual goals become more collective as a result and Melissa records them so everyone can see.

Sophie shares, "I'm really looking forward to learning more about lesson planning in math," and several others nod their heads in agreement while others snap their approval.

"Learning more about strategies in Common Core is one of my goals," Emily adds, "Because I only learned it the one way and sometimes the other ways confuse me."

After a few minutes, the goals of the class are recorded. "These are great goals," Melissa agrees, gesturing at the list. "Now let's think about what we will do in class together to make sure that we reach our goals? What are the actions we will take here to make this possible? Discuss with someone nearby."

Maxwell raises his hand. "Could it be just normal stuff? Like stay off our phones?"

"That's a great question," Melissa replies. "I think we can share any ideas we have and come to an agreement. If you think staying off our phones should be normal in our class, then we can list it. Even things that we think are obvious should be listed. We're trying to make these implicit policies more explicit for all of us, so we know what to expect."

Students discuss for a short time and then are ready to share. "Dr. Gunter, if we're going to learn about more strategies for math then I think we should always feel free to ask questions," Sophie contributes.

Melissa records Sophie's norm suggestion, as Olivia adds, "And keep an open mind too, because sometimes another strategy might not make sense at first."

"We can help each other, too, when stuff doesn't make sense," Alex proposes.

Suggested norms are shared and negotiated like this for several minutes before the list is finalized, typed in the course slides that students always have access to in their learning management system. Melissa encourages the students to create norms that tell us what to do in our classroom, rather than what not to do, so the suggestion of "don't call on random people to answer" becomes "volunteer to answer questions or share." Below is a sample list of classroom norms that students negotiated in this way:

- *Be present and engaged*
- *Volunteer to answer questions or share*
- *Persevere in problem solving*
- *Support one another/be collaborative*
- *Keep an open mind; questions are always welcome*
- *Respectful actions and voices*

The norms are revisited several times over the first few weeks of class, and again whenever necessary as the semester continues.

Figure 4. Creating Norms in Melissa's class.

Building Communities of Practice: Challenges to Implementation

For all the success each of us has experienced in our classrooms, by no means do we intend to suggest that there are no challenges when trying to develop communities of practice. We have needed to find ways to support students as they work to subdue their fear of mathematics, help students better understand how their own math identity can influence their interactions with others, to debunk traditional views of how to teach mathematics, and prepare students to feel comfortable participating in classroom communities of practice.

Melissa and Jamie-Marie have taught several semesters of mathematics methods at their respective institutions. Both feel that a large number of elementary methods students are wary of classroom mathematics, which can hamper their participation in communities of practice. We make sure to include in our classroom norms that it is not only okay to make mistakes, but also that we learn from each other through those mistakes. We also choose tasks that are scaffolded and open to provide adequate accessibility to our students. If students feel they can have a voice and it is valued, then they are more likely to participate.

The opposite attitude towards mathematics is often seen in our middle and secondary methods students. Because they are required to take so many mathematics courses, these students are not at all wary of classroom mathematics. Instead of the timid nature we see in so many elementary methods students, we see many more middle and secondary methods students who are highly confident - even sometimes a bit too confident - in their mathematical ability. This confidence can yield students who are not as receptive to feedback or collaboration. Often, they may overshare and as a consequence eliminate the space for other voices. In this case, Melissa and Jamie-Marie actively work to ensure all voices are heard by explicitly providing opportunities for all students to share their ideas and thinking and assigning various roles such as rotating group communicators.

Sometimes PSTs follow the old adage of “we teach as we were taught.” Many of them have had great success in mathematics by being in classrooms that primarily use worksheets and direct instruction. Some of those students are reluctant to consider other methods that acknowledge mathematics learning as a social construct. Students in our mathematics courses often report initially that they are uncomfortable thinking and sharing ideas with others about the tasks assigned and would prefer to observe how to do it while they dutifully take notes. This is another purpose for our ice breakers, puzzles, and robust real-world math tasks; as we involve all students in mathematics problems that are interesting to them, we help them to see that not only can they have fun with mathematics, but also, they learn more when they can personally connect to it.

In our methods classes, we focus on involving our PSTs first as learners of mathematics by having them experience a variety of instructional strategies. We have them to reflect on how their learning experiences shape their mathematical understanding, and then we ask them how this could affect learning in their own classroom. Additionally, we share research behind the instructional strategies to help them see the connection of theory to practice and help provide evidence that using only worksheets and direct instruction is not a broadly effective strategy.

Conclusion: Building Communities of Practice

Building community is important because learning is a social activity; it is essential to the fabric of our classrooms. Each and every student plays a unique role in our classroom communities, and therefore needs to feel a sense of belonging where mathematics is being learned and practiced. Wenger (1998) described that a community of practice involves mutual engagement, a shared repertoire, and a joint enterprise. We intentionally invite students to participate in our classroom communities, create shared learning goals, and value and build on the contributions offered by each student, thereby sustaining a productive community that evolves as individuals choose to participate. By doing so, we also intentionally model the development of classroom communities for our PSTs and demonstrate that we value those communities as an integral part of classroom learning. Centering our students in the development of our classroom community prompts them to respond as changes occur, which maintains inclusion and participation for all members.

Wenger (1998) asserted, “learning that is most personally transformative turns out to be the learning that involves membership in these communities of practice” (p. 6). Through our

reflective collaboration, all three of us have broadened our perspectives about how to develop and sustain productive communities of practice. Katrina has experimented with using tools such as Google Jamboard to encourage full group participation; Jamie-Marie has started allocating time for students to collaboratively create learning goals and norms of interaction; and Melissa has begun using the PLC structure in small group discussions. By attending to the careful development of our communities of practice as we plan and design our courses, we aim to ensure students are empowered to access course content and future teachers view it as essential to the structure of their future classrooms. We invite and encourage our mathematics and mathematics education colleagues to consider how they, too, will carefully plan to build communities of practice in their own practice.

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