Strengthening Collaborative Communities to Improve Mathematics Teaching and Learning

A Position Statement from NCSM: Leading with Technology

Our Position

NCSM Leadership in Mathematics Education believes intentional collaboration, clear communication, and aligned goals between various stakeholders who support PreK-12 mathematics teachers continues to be a priority. As such, there is a need for stakeholders to strengthen their collaborative communities (Feygin et al., 2020) to better support the teaching and learning of mathematics. These collaborative improvement communities can include stakeholders such as teachers; teacher leaders, who include principals, state or provincial education directors, curriculum directors and instructional coaches; policy making groups; external consultants; and post-secondary institutions that prepare mathematics teachers. However, these varying stakeholders work within different systems and do not necessarily understand the nuanced needs of the other stakeholders or the specific parameters within which they are required to operate. While these stakeholders may share common interests and outcomes in the teaching and learning of mathematics, their individual systems of support and collaboration may not always efficiently or effectively create the outcomes they desire. As such, NCSM Leadership in Mathematics Education calls for strengthening collaborative improvement communities through purposeful collaboration, aligning goals within and between systems, and engaging in mutually beneficial mentoring processes to strengthen mathematics teaching and learning.

Communities of Collaboration

Mathematics teachers at different stages of their careers may require comprehensive support to navigate changing and complex challenges they may face at different times in their careers. For early career teachers, they often experience feelings of isolation, overwhelming workloads, and a lack of mentoring, contributing to higher attrition

rates (Sabina et al., 2023). To address these issues, effective induction programs, mentoring supports and tailored professional learning opportunities are crucial (Spencer et al., 2018). For more established teachers, clearly understanding their individual professional aspirations and providing tailored coaching or mentoring to support these aspirations can increase their job satisfaction (Admiraal et al., 2019). This means purposefully leveraging partnerships and resources from key stakeholders is needed to build and support communities of collaboration.

On-going and collaborative communities for professional learning are also vital for enhancing the pedagogical skills and content knowledge of mathematics teachers. Participating in content-specific professional learning opportunities can help deepen teachers' mathematical knowledge and instructional strategies as well as regular participation in communities of practice (Jakopovic & Johnson, 2023). These communities of practice, when they become part of the culture and nature of teachers' work, facilitate the exchange of effective teaching practices and foster a culture of continuous learning and instructional improvement. Therefore, a combination of mentoring, tailored professional development, and collaborative structures are essential elements when creating or sustaining a supportive ecosystem that empowers mathematics teachers to thrive in their profession (Yee et al., 2023). Such targeted professional development not only enhances teachers' pedagogical content knowledge but also provides practical tools for addressing the diverse learning needs of students in their mathematics classroom.

Furthermore, the role of professional collaborative networks and communities of practice in supporting mathematics teachers continues to be important. Participation in professional learning communities, or other collaborative communities, fosters a sense of belonging and shared purpose, allowing teachers to benefit from the collective expertise of their peers, and can shift both teachers' instructional practices and beliefs about teaching (Tam, 2015). Likewise, these communities provide a platform for collaborative lesson planning, resource sharing, and reflective discussions on effective teaching practices as well as opportunities to address other emerging challenges or issues in a timely manner.

Mentoring for all Leaders of Mathematics
Mentoring is a practice wherein individuals or groups collaborate and work together to develop their professional praxis; it is not for individuals or early career teachers alone. Effective and proactive mentoring is not solely to support a particular individual, but that of various partners and teams. Cognitive coaching, a form of peer-mentoring, also has the potential to strengthen relationships within and across key stakeholder groups and for developing the effectiveness of those involved (Bair, 2017).

Simply stated, a mentor brings to the relationship knowledge and experience which requires an investment of time, energy, and resources but this mentor need not be "just down the hall." However, mentoring for mathematics teachers and

teacher leaders must extend beyond the confines of the school and include external stakeholders to provide a more holistic support system (Hobson & Maxwell, 2020). Leveraging external partnerships to support research-informed partnerships allows the various stakeholders to gain a deeper understanding of the broader context in which teachers work and the ways research-based practices can be implemented to provide more relevant and targeted support (Wentworth et al., 2023). This integration of external stakeholders also supports the belief that effective teaching is not developed only within the school walls or during instructional class periods but is a collaborative effort involving multiple facets of the broader education community (NCTM & NCSM, 2024).

Furthermore, mentoring is a critical component of every educator's growth and success in better meeting the needs of students. Historically, education systems have focused on providing mentors for early career educators typically within their first couple of years. While this is important, it is also crucial to provide opportunities for all educators to receive mentoring and to ensure that the mentoring extends beyond simply managing teams or classrooms or simply attending to other organizational structures. The attention needs to be on advancing the work of the collaborative community that helps teachers and teams improve student learning. This means all educators should have access to thought partners as they strive to better meet the needs of those they serve. Additionally, mentoring relationships do not have to be viewed as a dichotomy of expert and novice practitioners, but rather as colleagues working to improve their practices.

Having someone to share ideas, discuss potential strategies, and then reflect upon the implementation is often pivotal for continued growth for all involved. However, these partnerships do not necessarily need to be between educators in the same role or with the same responsibilities and not even a one-to-one relationship; teams of mentors can be leveraged to build a stronger collaborative community. For example, a secondary mathematics teacher could be paired with a curriculum specialist, a principal with a strong instructional background, and/or a special education teacher with expertise in assessing learning in different ways. Likewise, an elementary educator could be paired with a middle school teacher with more content expertise or a regional/state level specialist who works with many different elementary schools and could provide insight based on their vast experience across elementary grades, and/or an expert from higher education as these people may have unique perspectives that might best align with the needs of the partnership. Additionally, various professional organizations offer mentoring support, such as NCSM and the American Mathematical Society, and these opportunities should be considered when creating or refining mentoring opportunities. Regardless of who is involved in the mentoring process, a clear understanding of what is to be accomplished during this relationship and when reasonable benchmarks can be met, is important to ensure the process maintains its focus and so the teams can feel successful in their efforts.

Lastly, there are often various positions that are not typically afforded mentoring partnerships. However, for a collaborative improvement community to be more effective leaders of mathematics education, considering how to provide mentoring support to those who serve as instructional coaches, grade level leads in elementary schools, department chairs in secondary settings and even higher education faculty, or regional and state specialists should be considered. When the community better understands the work of the other stakeholders, the entire community is better positioned to meet their mutual goals (As such, when evaluating current mentoring relationships and structures, it is important to consider who is currently not involved, whose voices could be included, to strengthen the team and thus the systems of support.

Attending to the Nature and Structure of Collaborative Systems

A cohesive system begins with clear and ongoing communication within and between stakeholders. This also means a culture of collaboration needs to first be established wherein the challenges, affordances, and successes can be shared and attended to jointly. In much the same way professional learning communities operate within schools, a similar approach can be taken for larger systems and teams. This means being clear on outcomes, understanding the data needed to gauge strengths and opportunities as well as areas of immediate and long-term attention. This also means that all stakeholders approach the work from a perspective of learning from each other; listening first to understand the challenges unique to the system.

Likewise, a variety of support is needed for those in different positions within this system. For example, teacher leaders, at all levels, guide most of the work in schools and districts and this means structures for effective vertical mathematics teams and professional learning communities must be in place. While district level leadership is needed to ensure the time exists for such teams, sufficient training for these teams is also important to understand nuanced challenges and success with implementation. Along with time, sufficient funding needs to be allocated to see meaningful change. In identifying what funding sources may be available to districts, such as Title I or Title II, or to the broader collaborative improvement community, like grants, the community can be innovative in financially supporting the work (Hamilton, 2024). Likewise, carefully identifying who serves in these collaborative communities is important. Some early career teachers may be better suited for supporting mathematics even if they have fewer years experience and some secondary department leads/chairs, while they may have a wealth of institutional knowledge, may be less open to change, having hard conversations, or guiding a group towards better outcomes.

Additionally, collaboration across partnering stakeholders can be beneficial for the success of all involved (Feygin et al., 2020). For example, state and local school boards

may not be aware of the importance of developing students' mathematical thinking, the critical role mathematical practices play in increasing mathematical competencies, or the ways in which teachers promote mathematical identities as a means of supporting equity and inclusion in the mathematics classroom. So through these partnerships and collaboration they become better informed and policies can be created or amended to better support teachers and schools in their efforts. Likewise, being aware of current and relevant research to inform such things as equitable grading and assessment practices in the mathematics classroom can be time consuming for teachers, principals and other district or regional specialists. However, by partnering with higher education and state level mathematics leaders, who have this expertise, high leverage research practices can be considered and implemented in a more timely manner. And then, those in higher education roles can better understand the challenges with implementing research-based practices to help develop solutions and strategies targeted to specific contexts as there are often nuanced hurdles when taking theory and applying it to practice. Essentially, when on-going communication and collaboration is occurring in productive ways, everyone grows and develops their individual expertise and thus leads to a stronger partnership and better outcomes for all.

Recommendations

Given the inherently complex nature of aligning the work of multiple stakeholders in creating a robust collaborative improvement community, the following recommendations are broken down according to the various roles and responsibilities of these groups. And while these responsibilities are separated into discrete groups, the work and responsibility does not not lie within these groups alone and some experts may belong to more than one group. That is, each group may take a lead in this work but the on-going and collaborative interactions across stakeholder groups will be what ultimately leads to successful outcomes.

Mathematics Teachers

For mathematics teachers, effective mathematics instruction requires educators to actively engage in ongoing professional learning to ensure the teaching and learning of mathematics is grounded in research-based practices. These practices should focus simultaneously on developing students' conceptual understanding, procedural fluency, the integration of technology and the use of mathematical modeling to make efficient and deliberate decisions with mathematics (NCSM, 2024). Also, mathematics teachers are encouraged to collaborate in processes like Lesson Study (Akiba et al., 2019) that promote open discussions and critical conversations about teaching and learning. When stakeholders understand that these structures are not about evaluating teaching, and focus conversations and actions to support learning for all students, tremendous gains in student learning occur.

State and District Level Leaders

For those in principal positions or district level leadership positions, emphasis on

developing mathematics teacher leaders within and across schools is important. This requires principals and other district level leaders to develop their own coaching and instructional leadership capacity to promote research-aligned practices and to cultivate a positive culture for collaboration. For instructional leaders, becoming a "warm demander" (Safir, 2019; Ware, 2009), means setting high expectations for teachers but creating a trusting space to try, and likely fail at, implementing different pedagogical approaches. Especially for leaders who are responsible for annually evaluating teachers, the need to use a more learner-center observational protocol (Bennett et al., 2015), rather than teaching and teacher-centered rubrics or evaluation guides, will be important.

Likewise, state and district level leaders should develop processes to train and equip emerging mathematics teacher leaders and build the collective capacity of all mathematics teachers (NCSM, 2020). This would include helping these emerging teacher leaders facilitate and participate in professional learning efforts, help build or maintain supportive structures focused on student well being and academic growth, and foster a collaborative culture of reflection and continuous improvement as found in formal professional learning communities (DuFour et al., 2024). This might also mean helping teacher leaders find appropriate mentors or mentor groups to guide their work. Regardless, dedicating the time and resources is central to success and principals, district leaders, or state leaders are often the gatekeepers for both the time to collaborate with others and the resources necessary to implement initiatives.

State and Local Policy Makers

For those mathematics leaders in local and state boards of education, they play a critical role in advancing mathematics proficiency by adopting or amending policies and allocating budgets that prioritize equitable access to resources and professional learning opportunities (Patrick et al., 2023). To ensure alignment with research-based best practices, leaders must support district efforts to streamline systems, instructional priorities, and resource distribution. This also means purposefully creating opportunities to hear from the other stakeholders about trends, challenges, and opportunities to make meaningful change to support educators' growth and development. Additionally, a commitment to accountability is essential, as leaders should regularly monitor district-wide mathematics performance data to evaluate progress and ensure equitable outcomes for all students. By focusing on these areas, leaders can foster a systemic culture of excellence and equity in mathematics education and support other stakeholders as they implement these policies for the benefit of all students.

Higher Education Faculty

For those in higher education, be they in teacher preparation programs or mathematics departments who work with K-12 education settings, attention to the alignment of courses and programs to both K-12 teachers and higher education faculty is essential (Stewart & Blankenship, 2022). These courses should be comprehensive in offering opportunities to learn and discuss concepts from a theoretical perspective as

well as how those theories are practically implemented in schools. Content and coursework should focus on such things as developing deep pedagogical content knowledge and fostering equitable and culturally responsive mathematics instruction. This includes requiring methods courses focused on specific mathematical domains that address modern demands in quantitative reasoning, algebraic reasoning, and statistical reasoning, emphasizing progressions and rigor (NCTM & NCSM, 2024), as well as dedicated coursework on supporting K-12 students' mathematical habits of mind and habits of interaction.

Additionally, higher education faculty should seek input from other external stakeholders to ensure mathematics teacher preparation programs include timely and relevant issues schools and districts face (Goldhaber, 2019). For example, if a district indicates many of their students struggle with persistence, having a healthy mathematical identity, or modeling with mathematics higher education faculty can integrate research and learning experiences on these topics into the coursework. Also, as with each stakeholder group, higher education faculty have much to learn from other stakeholders; learning which can inform further research as well. This means they should be reaching out and asking to be a part of current and ongoing collaborative teams rather than waiting for an invitation. This might include asking how they can support regional or state level committees, participating in on-going professional learning communities within schools, or attending principal meetings at the district level. Additionally, higher education research faculty might consider using "research broker" partnerships (Wentworth et al., 2023), wherein external partners

Professional Learning Providers

Multiple people and various entities provide formal professional learning opportunities and experiences for teachers, schools and districts. This includes faculty from higher education, consultants from external agencies or other professional organizations, curriculum and pedagogy experts within districts, as well as school administrators and building level teacher leaders. Given the breadth of providers who support professional learning, a comprehensive approach to improving mathematics education should focus on integrating research-based practices, equity-focused initiatives, tailoring learning to role-specific contexts, and include sustained collaboration. This means beginning by encouraging the creation of professional learning communities (DuFour et al., 2024) to listen and understand nuances within different contexts. Then, professional learning providers can co-develop and share best practices and further collaborate on implementing instructional or assessment strategies that support all students. And while the professional learning may be tailored for different groups, an emphasis on understanding and aligning standards as well as fostering student engagement through culturally responsive practices should be at the forefront of the work.

Likewise, fostering cross-district and cross-state collaborative networks for resource-sharing and collective problem-solving should be considered as it will broaden the

circle of collaboration and support. "Ambitious instructional reforms often require district central offices to reach out to external partners for guidance," (Farrell et al., 2019, p.983). However, the targeted outcomes, and a clear understanding of the district's and/or schools' contexts and conditions, need to be explicitly clear to all so the professional learning aligns. Otherwise, districts risk limited and unenthusiastic interaction from teachers and participants.

Summary

Creating and leveraging a collaborative community to improve mathematics teaching and learning allows for issues to move from conversations to deliberate plans and then to intentional actions. Through purposeful collaboration, aligning goals within and between systems, and engaging in mutually beneficial mentoring processes, key stakeholders across systems can be more successful in strengthening mathematics teaching and thus improving students' learning of mathematics.

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