Effective Strategies to Build and Sustain Partnerships Between Stakeholders in Math Education

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Comprehensive Exam Question

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Original Prompt: Provide specific examples of effective strategies that have been used to build and sustain partnerships between stakeholders in math education (e.g. K-16 teachers/instructors at different schools, parents, administrators). In your response, make sure to ground these strategies in relevant research.

Effective Strategies to Build and Sustain Partnerships Between Stakeholders in Math Education

The relationship between practice and research in education continues to address the question of how best to effectively create and maintain partnerships that benefit all stakeholders in the education community, particularly through the lens of mathematics education and STEM education in society today. Mathematicians and mathematics education researchers recognize the need to make the content of K-16 mathematics accessible and relevant to their students (Bush, 2019; Schoenfeld, 1993), and the current state of mathematics and STEM education recognizes that mathematics is accessible to students because of its relevance in the 21st century today (Sondergeld & Walten, 2016). This review of literature studies the effectiveness of various strategies for all levels of stakeholders in the mathematics education community, including policymakers at the international and national levels, outside businesses and STEM organizations that require mathematics knowledge and critical thinking skills, and administrators, teachers, parents, and students in K-12 mathematics classrooms. It is the goal of this literature review to make clearer the path to effective partnerships among all these stakeholders in the mathematics education community, as well as to provide practical implications and guidelines for future research and future partnerships between K-16 mathematics educators, students, administrators, and community members.

Background of the Study

By recognizing the need to answer the question of how best to strategically partner all stakeholders in the mathematics education community, this review of literature takes a broad look at the motivations and goals of the members of the community. This study, then, can inform how to appropriately incorporate various research studies that are designed to impact all stakeholders so that researchers can advance their knowledge of mathematics students and their learning, teachers can implement best practices for student learning, and policymakers can ensure that both of these stakeholders are funded and provided with resources to maintain the partnership and the success of achievement of the values and goals for each stakeholder involved (Bush, 2019; Shroyer, Yahnke, Bennett, & Dunn, 2007; Turley & Stevens, 2015). As a result of this synthesis of research studies, this paper will report on the current state of mathematics education research about the communication and collaboration between all stakeholders in the mathematics education community. Further, it will expound on possible future directions that all members of the community can take to successfully maintain partnerships with each other through honest communication and sensitivity to each other’s needs (Otterbourg, 1998; Sondergeld & Walten, 2016; Turley & Stevens, 2015). Finally, as a result of this review of literature, research concerning specific classroom practices can begin to take shape to inspire best practices to most effectively impact practices for current mathematics teachers and practitioners in the classroom.

**Purpose**

The purpose of this review, then, is to summarize previous research and its approach to understanding how to effectively partner all stakeholders in a mathematics education community. By grounding this review in relevant research and summarizing the findings, this literature review can identify and delineate possible steps to continue to move forward with advancing partnerships that benefit students, families, teachers, administrators, businesses, and policymakers in mathematics education. Therefore, implications for future practice and areas of research will also be provided. Particular attention will be given to contexts and classroom settings in which previous research has already been summarized to maintain successful partnerships for all the stakeholders within the mathematics education community (Building, 2013; Johnson, 2012). This review will finally provide purposeful areas of success and indicators of improvement for these partnerships.

Review of the Literature

The literature for effective partnerships in education for K-16 mathematics is both broad and deep, but the field continues to grow. It is necessary, then to recognize the sequential steps for successfully establishing and maintaining partnerships among all stakeholders in the mathematics education community. As the literature reveals the value in each of these necessary actions, highlights about both practical suggestions and future implications for effective strategies for maintaining successful partnerships amongst stakeholders in the mathematics education community will be discovered.

**Identify the Stakeholders**

An important precedent to identifying effective strategies for maintenance of successful partnerships is recognizing who all are stakeholders or potential stakeholders in the mathematics education community. By recognizing and identifying every stakeholder, questions can be posted to guide the directions and goals for the mathematics education learning community (Building a Math Village, 2013). It is evident that major stakeholders include the students, the teachers, and the mathematics education researchers in this partnership, as often the disconnect comes between the preparation of teachers and the preparation of students for mathematics at the university and the K-12 mathematics classrooms themselves (Johnson, Severance, Penuel, & Leary, 2016). However, it is important to also note that other stakeholders that influence student learning are the parents in out-of-school environments, as well as administrators and policymakers who impact mathematical learning outside of the direct instruction by the teacher.

Beyond simply identifying these stakeholders, literature notes that an effective partnership even identifies potential stakeholders in the community, including those who perhaps may engage in the future or can become an additional stakeholder to assist with or collaborate with current stakeholders (Ottersbourg, 1998). Even further, Johson (2012) states that in developing and identifying stakeholders in the community, it is necessary to indicate potential leaders among the stakeholders, as they will likely guide decisions and actions that the community will take and will impact all stakeholders as policy, instruction, and/or other experiences are implemented or adapted for the sake of mathematical learning.

**Define a Partnership**

Secondly, it is necessary to define a partnership so that the stakeholders may best understand their roles in the relationship. In order to best create a partnership, in which both parties mutually benefit from the connection, it is necessary to respect and identify the motivation that each stakeholder has in the partnership (Johnson, 2012; Scherer, 2008), as this will be continuously revisited as the partnership moves forward in decisions to make and actions to implement. At the same time, as the partnership identifies the motivations for mathematical learning for their students, they must also focus on the results they hope to achieve (Shroyer, Yahnke, Bennett, & Dunn, 2007), and respect the goals of other stakeholders as they assess the results of their impact throughout the partnership. Shroyer, Yahnke, Bennett, & Dunn (2007) encourage envisioning education along a continuum, and that the results of one year of school should impact how one views his or her goals and how one moves forward into the next year. By respectfully defining the motivations of each stakeholder, as well as assessing the results of the relationship and keeping in mind the end goals of each stakeholder in the relationship, the partnership defines clearly their intentions and their criteria for assessment and improvement in the future.

Within the educational learning community, particularly for mathematics education, it is also important to note that the definitions of the stakeholders and their partnership will be different depending on the contexts that these stakeholders are in (Building a Math Village, 2013; Johnson 2012). As context changes – perhaps because of changing demographics of students or different teachers, just as an example, the partnership may change as various stakeholders may bring in different people or alter their goals or motivations to best serve the students and best improve mathematics education for the students and other stakeholders in the mathematics education community.

**Define Goals**

Defining the goals of any partnership is necessary within the education community, particularly after identifying the stakeholders and the definition of their partnership. The definition of goals allows all partners to buy in, giving them a chance to express where they hope to improve as well as be sensitive to the areas of interest of other stakeholders (Bay-Williams, Scott, & Hancock, 2007). To look at the various needs of all stakeholders, particularly within the mathematic education community, certain specific factors must be considered.

**Budget.** From a practical standpoint, budget realistically guides the possibilities of a partnership as the mathematics education partnership looks to improve their current state of education by perhaps implementing new resources, which do not come without a cost (Ottersbourg, 1998). Leahy, M., Davis, N., Lewin, C., Charania, A., Nordin, H., Orlič, D., Butler, D., & Lopez-Fernadez, O. (2016) state that it a clearly stated financial plan at the beginning of the partnership assists in maintaining accountability to the budget and avoiding tensions among any stakeholders in the future.

**Advancement of students.** Because the K-16 mathematics education community spans student ages across several stages of their growth and mathematical abilities, it is necessary to view students and the mathematics content both within the context of their learning and how they want to move forward (Cai, J., Morris, A., Hohensee, C., Hwang, S., Robison, V., & Hiebert, J, 2017; Turley & Stevens, 2015). In particular, Scherer (2008) poses the question about how best to support secondary student mathematical learning while also considering the need for admissions into university schooling for several high school graduates. All stakeholders within the mathematics education community must be sensitive to the actions that students and teachers take as students age and become more invested in different levels of their schooling.

**Policy.** A major factor in change and actions within the mathematics education community is the role that policy has on classroom expectations and practices. Because researchers and practitioners both can benefit from changes implemented for the stakeholders (Bush, Karp, Lentz, & Nadler, 2014), stakeholders must discuss and understand that there the partnership has the intent and potential to mutually benefit each other. Further, Cai et al. (2017) recommends that the stakeholders emphasize both learning of content knowledge and preparation of students for 21st century skills, as the ability to critically think and the foundational knowledge of mathematics are both well-represented in K-16 mathematics at all levels. The goals set forth by different stakeholders can guide how policy chooses to guide mathematics education and possible interventions and applications of new policies made.

**Maintenance of a Partnership**

For any partnership, particularly in the realm of mathematics education, various characteristics must be upheld and fulfilled to maintain the mission and the success of the goals set forth by different stakeholders within the partnership. Multiple research studies in the past have provided particular guidelines that best serve the mathematics education community as they proceed in defining and creating partnerships that serve all stakeholders in the community.

Primarily, several research studies have emphasized the necessity of planning and making goals for the long-term benefit of the community (Horne & Makar, 2013; Johnson, 2012; Jenkins, Brown, Fink, Lahr, & Yanagiura, 2018). By keeping an eye on the initial goals for what students will be able to achieve and learn in K-16 mathematics, the community members are informed on how best to move forward and adapt or make changes, particularly in implementing new tools or strategies for mathematics education that advances student learning. To accompany this necessary step in developing a successful partnership, mathematics education community stakeholders must also maintain persistence and patience in working towards these goals and in working and communicating with one another (Horne & Makar, 2013; Johnson, 2012). Because a partnership recognizes that different stakeholders have different values, learning to listen and discuss with one another requires regular communication where they must persist through times of difficulty and misunderstanding. Leahy et al. (2016) even state that taking risks helps move the community forward in their persistence with accomplishing the goals set forth for the community.

As stakeholders learn to work with one another, it is understood that both respect for each other and for the professional goals of mathematics education maintain the quality of the partnership between stakeholders. By being able to respect each other, stakeholders remain forward-thinking in their thoughts (Nader, 2008), allowing stakeholders to understand each other’s motivations and come to more agreement as they communicate regularly about how best to make decisions to positively impact the mathematical learning community. Specifically concerning mathematics education researchers and classroom teachers, Nader (2008) states that this mutual respect and willingness to think forward will allow teachers to consume high-quality research that will allow them to see how research can be incorporated into the classroom, and the objectives of the mathematics learning will be met in a way that satisfies all stakeholders in the learning community.

Although communication has been regularly intertwined in the necessary elements of a successful mathematics education partnership and discussed in previous aspects of this paper, current research emphasizes just how valuable feedback and communication is in maintaining a successful partnership between the stakeholders in the community (Cai et al., 2017; Johnson et al., 2016). By choosing to be positive in wanting to both discuss thoughts and hear others’ ideas, stakeholders can be honest with each other and truthfully respect and trust each other as they discuss decisions or changes to be made that can and will impact teacher interventions and student learning in K-16 mathematics education.

**Implications**

The establishment of certain criteria necessary for successful mathematics partnerships among all stakeholders in the learning community guides different implications for practice at different levels within the community. This paper has discussed different practices that impact students differently the K-12 level vs. the university level, but both of these levels of schools have tangible recommendations for moving forward within the partnership.

**For schools.** Although it may be obvious, a partnership of K-12 schools with other stakeholders requires schools to maintain the standard and the objectives of their stakeholders via official guidelines set within their standards and policies (Schoenfeld, 1993; Howell, Carpenter, & Jones, 2013; Johnson et al., 2016). By writing expectations into the standards, an official document helps ease tension and provides support to guide stakeholders in their decisions as they progress through the partnership.

Additionally, schools must ensure that they support their teachers as they choose to engage in a partnership that expands the community to include others’ ideas, beliefs, and values. Specifically, if K-12 teachers will now work with mathematics education researchers to improve their practices to result in more advanced mathematical learning for their students, schools must give teachers to the time to collaborate and plan different tasks and activities (Henrick, Muñoz, & Cobb; 2016; Horne & Makar, 2013). Even further, teachers may need access to more and different resources to meet the goals set forth by the community (Jenkins et al., 2018). Teacher support is a vital step that schools can take to promoting the mathematical partnership to be successful for all their stakeholders.

As schools move forward into these tasks and activities that they plan for mathematical learning, they must recognize that the tasks they make are common for all their students, making the vocabulary, the content, and the materials accessible to all types of learners (Bush; 2019; Bush et al., 2014; Howell et al., 2013). The accessibility of the information and materials to all students makes any reform or implementation of a new mathematical task or tool worthwhile so all stakeholders may benefit. Additionally, the tasks chosen for the mathematics classrooms must be meaningful to the students and to the spirit of mathematics (Bush et al., 2014; Johnson et al., 2016). Because these tasks can change the routines or the regular lessons of a mathematics teacher, the different resources or lesson approaches can and will change the work environment for the teacher and the students (Cai et al., 2017), which is something that is necessary for the risk-taking required to create change and improve the mathematics education community. Johnson et al. (2012) even recommends that stakeholders at all levels regularly celebrate their wins in any reform or changes made to the community, as this positivity will keep all stakeholders focused on moving forward in achieving their goal. The goal of several mathematics education partnerships is to improve the quality of mathematics education for the community’s students, and appropriate but challenging mathematical tasks and activities are a major component to achieving success in the partnership.

One final recommendation for schools is an important one that different stakeholders should enforce to truly engage in the mission of the community. Professional development for the teachers must be adapted to the needs of the community, particularly as students are assessed and mathematical learning is impacted by the specifically-tailored professional development for the K-16 mathematics teachers (Johnson et al., 2016; Shroyer, Yahnke, & Heller, 2007; Shroyer, Yahnke, Bennett, & Dunn, 2007). This could potentially impact both the teachers at the K-12 level and the professors and other stakeholders at the university level who provide the professional development for mathematics education practitioners.

Concerning university stakeholders, Turley and Stevens (2015) and Wang and Apraix (2018) recognize the value of combining research with practice. University stakeholders communicate well with K-12 practitioners to ensure that any current and relevant mathematics education research impacts the K-12 teachers to wisely adapt and modify their lessons to best serve students so that they learn the mathematics in a more advanced manner. This willingness to adapt and to learn also inspires how universities prepare their future mathematics teachers.

A stakeholder that is capable of impacting great change in the mathematics education learning community, pre-service teachers (PSTs) are an important stakeholder who can create change for the betterment of learning for K-12 mathematics students. Howell et al. (2013) provide clear suggestions for preservice teachers in mathematics education so that upcoming mathematics teachers will know how best to serve their students, including gradually being given more responsibility over time, creating and recognizing boundaries for teachers with their students in their first experiences of teaching, and developing a common language and understanding of mathematical and scholastic expectations.

Pre-service teachers are also held to certain expectations that help them to best engage in the partnership so that their K-12 students can achieve high levels of mathematical learning, and the pre-service teachers themselves can begin to understand their identity as a teacher in the community (Wang & Apraix, 2018). As PSTs learn to plan their activities and manage behavioral skills among their students, they are able to build relationships with their students but also with each other, so that the communication between different stakeholders within the mathematics education community stays open and sensitive to each other. Wang and Apraix (2018) even suggest that a community-based approach to mentorship for pre-service teachers vs. a model with one mentor helps guide pre-service teachers to truly recognizing and accomplishing goals that best impact student learning in the K-12 mathematics education community. Further, Walker & EPI (2007) maintain that pre-service teachers gain official licensure in education to be able to officially become a mathematics educator for K-12 mathematics students, which is a practice that is regularly followed within the mathematics education community.

**For families and parents.** Although sometimes they are considered lower in importance of the stakeholders in the mathematics education community, families and parents play an important role in the community as they support student learning of mathematics outside of the classroom. Legnard & Austin (2014) recommend that parents even engage in a contract with the school to find and use times and spaces outside of classroom to foster their children’s engagement and abilities to practice and use mathematics, such as in the car when driving or when cooking and using measurements to practice numeracy. Further, Building a Math Village (2013) recognizes that it is important to ask questions about how to transfer mathematical understanding and learning from the classroom to areas outside of school for students in K-12 mathematics. Parents can be a vital stakeholder in the community of mathematics education by engaging their children in excitement for and advancement in mathematics outside of the school context.

**For policy.** Although policy has been previously discussed in this paper, it is important to note that recommendations for policy in mathematics education are to begin small (Johnson, 2012; Sondergeld & Walten, 2016). By setting small goals, stakeholders are able to see success and keep motivation to continue working towards their goals established at the beginning of the partnership. Further, policy must be written so that practical steps can be taken to achieve attainable goals (Turley & Stevens, 2015). Examples of suggestions by Turley and Stevens (2015) include providing enough funding to support teachers, ensuring trust and communication among researchers and teachers, respecting each other’s times while still setting an optimistic timeline, and sharing all information with each other via a shared database. Policy can be shaped according to realistic goals and expectations of each stakeholder in the mathematics education community so that students may benefit from the changes and the actions taken by teachers, parents, and policymakers in the community.

**Using technology.** With the rise of 21st century skills necessary for the job market in society currently (Sondergald & Walten, 2016), research suggests that stakeholders at all levels be able to communicate and access information online, largely due to accessibility and speed of current technology that supports these means (Building a Math Village, 2013; Leahy et al., 2016). Also, Cai et al. (2017) understands that an online curriculum, as an example, allows all stakeholders to regularly access the goals set forth at the beginning of the partnership.

**Recommendations**

With these several different implications for future research practice and mathematics education research, there are still areas of improvement that provide recommendations for future studies and practices for K-16 mathematics education partnerships. Although it was previously mentioned that pre-service teachers are a valuable stakeholder in the mathematics education community, past research studies have emphasized the recommendation that future preparation of mathematics teachers should ensure that clinical practices directly connect to the preparation that the students are receiving academically from the university classroom (Howell et al., 2013; Wang & Apraix, 2018; Walker & EPI, 2007). By connecting pre-service teacher learning with their teaching experiences in the field, pre-service teachers begin to see their identity more as a teacher (Wang & Apraix, 2018) and can engage deeper in the mathematics education community.

Secondly, most all research studies continued to discuss that communication between all stakeholders in the community maintains a healthy partnership. Johnson et al. (2016) states that a direct line of communication allows teachers and researchers, as an example, to discuss any tensions they feel even early on in the partnership, allowing them to listen to each other, develop trust, and modify any actions or goals as necessary. Shroyer, Yahnke, and Heller (2007) and Sondergeld and Walten (2016) both emphasize that collaboration will open up new connections to other possible stakeholders, including businesses and other real-world applications of mathematics in the education learning community. Finally, Wang & Apraix (2108) recognize that communication builds relationships for pre-service teachers to all stakeholders, not just their students. Further, this same ability to communicate encourages collaboration and communication among all stakeholders in the mathematics education community, not just the pre-service teachers. Overall, maintaining open communication that fosters trust and understanding among all stakeholders will benefit successful partnerships.

Finally, past research studies have recommended the need for teachers and pre-service teachers to be prepared to approach mathematics education with a community engagement lens. Building a Math Village (2013) posed questions about how best to support partnerships between schools and communities, which will foster student appreciation and application of mathematics beyond the school walls. Sondergeld and Walten (2016) believe that recognition of community engagement will give teachers and pre-service teachers more resources for 21st century learning and mathematics, as they can utilize businesses, colleges, and other community members to see practical applications and value in mathematics education through STEM career and opportunities in society today. These examples of valuing the community and engaging pre-service and in-service teachers in community engagement open up the minds of these stakeholders to partner with other stakeholders for a successful relationship within the mathematics education community.

**Conclusion**

This review of the literature provided a purpose for uncovering effective strategies to maintaining successful partnerships between different stakeholders in K-16 mathematics education communities. By delineating specific findings and successful stories of past research studies, one can better understand the roles and goals of different stakeholders and how to structure them so that stakeholders can communicate and work with one another for a successful partnership that promotes the overall goal of advanced mathematics education for their K-16 students. Practical applications, implications for different stakeholders, and recommendations for future studies and future mathematics education learning communities help guide successful research and practice for practitioners in K-16 mathematics classrooms. By reviewing the literature and recognizing successes and areas of improvement for effective K-16 mathematics education partnerships among stakeholders, the mathematics education community can move forward with innovative studies and practices to continue positively impacting their mathematics students.

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