

Giving All Students a Voice in the Elementary Mathematics Classroom

Megan Burton, PhD

Assistant Professor of Elementary Mathematics, University of South Carolina
Columbia, South Carolina USA, Burton3@gwm.sc.edu

Abstract

Strategies for supporting culturally and linguistically diverse students in elementary mathematics classrooms were implemented in a second grade classroom and then passed on to preservice teachers. Various strategies and research to support the mathematics education of English Language Learners in the classroom were evaluated due to the growing need for support of linguistically diverse students. In addition to providing support for the language differences, students' cultures and community were respected and included as a part of the mathematics learning environment. Students' cultural identities need to be acknowledged and integrated while also supporting their understanding of others' perspectives. To tackle this objective while also covering content is a challenge, but also an exciting possibility. Students found success in mathematics when appropriate support and instructional strategies were used.

Introduction

“There are those who suggest that mathematics is ‘culture free’ and that it does not matter who is ‘doing’ mathematics: the tasks remain the same. But these are people who do not understand the nature of culture and its profound impact on cognition.”
(Ladson-Billings, 1997, p. 700)

Today's American elementary classrooms contain such diversity in student backgrounds and needs. As a global society, teachers in public schools should understand and respect diverse cultures and ways of thinking about the world. However, they often lack the experience, training or support needed to reach these students. Teachers are offered very little professional support in the area of providing a meaningful, equitable education to students with such diverse backgrounds and language needs in the specific content area of mathematics. This could be due to the common inaccurate belief that mathematics is a universal language and these diverse backgrounds shouldn't affect appropriate instruction (Ladson-Billings, 1997). Meeting these diverse needs and challenging students to reach their highest potential can be overwhelming. There is a great need to explore various strategies to support English Language Learners in the mathematics classroom. Mathematics can be a barrier or a bridge for our culturally diverse students, depending on the approach teachers take. However, these students can find success when appropriate support and instructional strategies are used.

This project and exploration into research emerged out of the need of one classroom teacher to reach all students at an elementary school with a large population of English Language Learners. While there was professional development for teachers about English Language Learners and pedagogical approaches to support these learners, there wasn't any preparation in how to reach these students in the specific area of mathematics.

Vision of a mathematics classroom

When beginning the quest to meet the needs of the culturally and linguistically diverse students, a clear vision of the mission of mathematics at the elementary level must remain in focus. This mission is to support every child in understanding mathematics, making sense of problems, and strengthening the ability to think mathematically. However, to fulfill this mission requires that both the students and the teacher see the relevance of the mathematical tasks themselves. Students need to see how mathematics connects to the teacher and to themselves in meaningful ways. George Polya (1981) expressed the need for teachers to be passionate about the subject in order for students to believe it is important. He further explained that if teachers aren't enthusiastic, then students won't be either. That the way content is taught is as crucial as

the actual material being shared. In order for teachers to reach their students they must find a way to connect the subject to their lives as well as the lives of their students.

Allowing students to share their mathematical understanding of various concepts is a vital way to connect the students to each other, teachers, and the subject. Communicating mathematical reasoning is insightful to teachers and peers into the mathematical thinking of students and yet is often neglected in the mathematics classroom, particularly those with linguistically diverse students, because of the challenges it entails. This process standard as described by the National Council of Teachers of Mathematics (NCTM) in *Principles and Standards for School Mathematics* (2000) is essential to conceptual development among students. Children naturally use language to reflect, share experiences, work together for a common goal, predict possibilities, discuss alternatives, explore how and why questions, develop relationships, visualize solutions, share problems, and justify thinking (Whitin & Whitin, 2000). Mathematics classrooms need to be places where students feel comfortable sharing their explorations and thoughts about the problems they encounter. While often language is reduced to meet the needs of linguistically diverse students, communication can be a powerful part of their understanding and of connecting the mathematics between all students.

Identifying key cultural influences

In order to reach students, one must know what is important to them. Knowing what is offensive, what is outside of their schema, and what is well respected are elements that can draw students in or alienate them from the classroom community teachers strive to attain. Thomas (1997) stresses the importance of understanding the cultural influences of students. Students must feel safe, included, and comfortable before lasting learning may be achieved.

Some ways to understand a student's home and community culture are home visits, community nights at the school, having class meetings where students can draw or act out the important parts of their lives outside of school, reading about the culture of immigrant students, allowing students to have a choices on activities and observing the types of activities a student is drawn to participate in during this time. However beyond this, it is important that teachers educate themselves on the various cultures of their students through professional readings and training. Learning about the way various cultures communicate among themselves, social norms, and educational issues among various ethnic groups can be helpful in connecting with students from these groups. However, it is important to view each child as a individual, rather than making assumptions based on generalizations. Using the general information about a culture in combination with the personal information about a student can provide a wealth of information to allow teachers to connect with each student.

Cultural influences upon learning of mathematics

Ethnomathematics is a growing area of research which involves acknowledging and integrating students' cultural identities into the mathematics content one teaches while also supporting the understanding of others' perspectives and backgrounds (Gutstein, 2003). Abreu, Bishop, and Pompeu (1997) found that in certain instances the school mathematics culture and home culture are opposites and contradict each other. Teachers need to find ways to connect the home culture and school mathematics in order to empower students and motivate them to succeed. Drawing upon the ways mathematics influences students' in their home lives and cultures can be one way to connect these often contradicting worlds. Whether it is using mathematics at a store, a sporting event, when mailing letters, during travel, to explore the temperature of various countries, or when building various objects, every culture uses mathematics. Students need to be made aware of how they and their community use mathematics. By bringing in the relevant issues to their lives and seeing how mathematics is important to their culture, they become connected to mathematics.

Mathematics is a powerful tool and language. A teacher's awareness of the ways in which students from diverse backgrounds are often marginalized is an important part of overcoming this injustice and empowering these students to succeed. Supplying students with the tools to speak the powerful language of mathematics is critical to empowerment. The connection between cultural mathematics and the international language of mathematics is a link that teachers need to facilitate for students. These are challenging goals to achieve, but they can help connect those linguistically diverse students, who are often disenfranchised, to the social, economic, and political power that comes from mathematics proficiency.

Connecting culture and mathematics for success

Connecting mathematics to real world situations and to students' cultural identities is critical to promoting understanding and engagement (Gutstein, 2003). It is important that students believe they are part of an active, meaningful learning community. They must see themselves as mathematicians and understand that math should make sense. For this reason, the classroom teacher for this project challenged her second graders to use their mathematical knowledge in everyday examples that were meaningful to them. For example, they used various grocery store fliers to determine the best bargains and to calculate money. In addition, they raised funds for a class pet, help measure out spaces for the community mathematics night, counted out materials when necessary, and used geometry concepts to create a scale model of the gymnasium for various school events. Each of these projects enabled students to bring mathematics to their daily lives in school, but not necessarily their daily lives in the community. Even though home visits and community math nights were successful; having community guests and using community wide problems was not successfully achieved this year. However, the teacher hopes the relationships are building and that in the future she can help bring mathematics outside of the school community alive for students.

Including situations and strategies that encourage students to explore how culture intertwines with mathematics is another way to enact change and empower students. Using patterns, numbers, and geometry skills within the context of a student's culture is a way to create meaning in these skills. For example, examining the different monetary amounts of coins in various cultures and exploring patterns in dress and native crafts were two activities that interested students in this class and helped educate and involve all students in learning about each other, culture, and mathematics.

Modifications to consider

Connecting culture to mathematics is essential in motivating linguistically diverse students and drawing them into the discussion of mathematics. It is also a bridge between the two worlds that helps empower students and connect them to this powerful language of mathematics. However, language is still a barrier that needs to be addressed in order for students to cross this bridge between cultures and mathematics. While modifications are necessary, decreasing the rigor or taking away the communication factor of mathematics, which are the modifications often made, does not best serve the student for future mathematical empowerment. There are many simple strategies a teacher can implement that can help students cross this bridge and be an active part of the learning community.

English Language Learners, like all students, need to understand the schedule in a mathematics classroom, feel comfortable to take risks and communicate, and must be challenged to continue to expand their knowledge. An example of a schedule that can help students with all these areas can include: daily data, a number of the day, small group instruction, problem solving, games, and a summative discussion. This type of schedule provides opportunities for students to comfortably assume ownership in their learning, support each other as a community, and challenge to students to develop their individual mathematics identity.

Daily data involves allowing students an opportunity to collect meaningful data about themselves, an issue that is important to them or a concept they are learning. Each day students are asked questions such as the number of siblings, how many vowels are in their name, their favorite vegetable, or the color of their shirt. They answer these questions by placing their name on a graph the teacher has created. Using pictures beside the words can help linguistically diverse students participate, develop graphing skills, and help students learn about each other.

Number of the day involves allowing students to explore the flexibility of numbers. For example, if the number of the day is 28, then students can represent this by writing the number word, pictures, coins, or a mathematical sentence such as $20+10-2$. Students are able to see the various ways of looking at one number, communicate mathematically at their skill level, and participate in this community activity. This helps students become involved in sharing with each other various forms of mathematical language such as words, pictures and symbols, which Thomas (1997) says is a vital part of reaching linguistically diverse students.

For years educators have found benefit in working with student in flexible small groups for reading, but this is rarely seen in mathematics. By working in small groups, teachers can listen to their students, informally assess more accurately, and tailor instruction to the student's needs. Teachers are more able to reach students with their linguistic, cultural and mathematical needs. Thomas (1997) suggests allowing additional time for students to develop conceptual understanding, when they are still learning a new language. By working in small groups, teachers are more able to gauge the appropriate time needed and how to effectively use this time to support conceptual understanding. At first small group instruction might appear more time consuming, but in actuality, it allows the teacher to be more effective in the instruction students need and thus maximizes this time. While working with small groups, other students can be learning from each other through games and problem solving activities.

Problem solving activities are opportunities for students to work cooperatively and individually. It provides an opportunity for students to make sense of mathematics in a meaningful setting. Providing problems that are culturally relevant and at students' instructional levels can promote growth and motivate students to learn. Problem solving activities should be meaningful, related to students' daily lives, and appeal to students' background knowledge. They need to encourage students to communicate logically and reasonably (Reys, Lindquist, Lambdin, Smith, & Suydam, 2004). Allowing opportunities for students to make sense of mathematics in small groups can help develop communication skills and community, when students feel safe and part of a team. However it is important to encourage all learners in a group to be involved and respected. Teaching students to communicate not only with words, but to use mathematical tools and pictures alongside words to help communicate thinking can empower students of all learners to be engaged in the discussion.

Games can provide meaningful opportunities for students to improve logical thinking skills, procedural skills, social skills, and linguistic development. Another benefit of games is the opportunity for students to interact, enjoy, and communicate mathematically without the teacher's assistance or direction. Students can solve problems that encourage them to tackle new information or concepts previous learned in new contexts. It is a time when many linguistically diverse students practice and improve their verbal communication skills.

Concluding each day with a discussion allows students to share successes, concerns, and questions. It is important to end the mathematics lesson as a community. This enables the teacher to assess future direction as well as allowing the teacher to emphasize important elements or findings of the day. This also allows a forum for connecting students with the learning of their peers. It also provides organization and a summary for students in order to help raise their awareness of the objectives they have met.

Conclusion

In order to successfully include students from diverse backgrounds in a mathematics community, teachers must begin by identifying key cultural influences in their class community. The ways these cultural influences affect student learning of mathematics must then be examined based on research and their observations. Finally teachers are challenged to find ways to positively integrate new avenues culture into mathematics to raise student awareness, achievement, and motivation.

Using the strategies and concepts mentioned above, the classroom teacher and researcher found mathematical success for their second grade students. This came from connecting mathematics with parents and the community, encouraging students to express how a mathematical concept made sense to them, and discovering how mathematics is used in various cultures. While this project found success in many areas, there were still areas for improvement. For example, one future goal was to help students see mathematics in their everyday lives outside of school, by involving the community members as guests and connecting students to community projects that involve mathematics.

Through routines and activities, such as those described above, teachers can provide opportunities for all students to be successful in their mathematical growth. The strategies that can support linguistically and culturally diverse students also support all students in meaningful engagement with mathematics. By creating a positive learning environment, avoiding negative experiences that increase anxiety, establishing clear expectations, and expecting students to explain the way mathematics makes sense to them, a diverse mathematics classroom can be exciting and successful.

References

- Abreu, G. de, Bishop, A.J., & Pompeu, G. (1997). What children and teachers count as mathematics. In T. Nunes & P. Bryant (Eds). *Learning and teaching mathematics: an international prespective*. Hove, UK: Psychology Press. 233-264.
- National Council for Teachers of Mathematics (2000). *Principles and Standards for School Mathematics*. Reston, VA: National Council of Teachers of Mathematics.
- Gutstein, E. (2003). Teaching and learning mathematics for social justice in an urban, Latino school. *Journal of Research in Mathematics Education*, 34, 37-73.
- Ladson-Billings, G. (1997). It doesn't add up: African American students' mathematics achievement. *Journal of Research in Mathematics Education*, 28, 697-708.
- Polya G. (1981). *Mathematical discovery: On understanding, learning and teaching problem solving (2 vols.; combined ed.)*. New York: John Wiley & Sons.
- Reys, Lindquist, Lambdin, & Smith. (2007). *Helping Children Learn Mathematics (8th edition)*. New York: John Wiley and Sons.
- Thomas, J. (1997). Teaching mathematics in a multicultural classroom: Lessons from Australia. *Multicultural and gender equity in the mathematics classroom: The gift of diversity*. Reston, Va: National Council of Teachers of Mathematics. 34-46.
- Whitin, P. & Whitin, D. J. (2000). *Math is language too: Talking and writing in the mathematics classroom*. Urbana, IL: National Council of Teachers of English, and Reston, VA: National Council of Teachers of Mathematics.