South Carolina Association for Middle Level Education Journal

Volume 3 Article 5

3-1-2024

Uniting Students with Literacy Connections in Mathematics

Bridget K. Coleman
University of South Carolina Aiken, BridgetC@usca.edu

Michelle Rasheed
University of South Carolina - Aiken, Michelle.Rasheed@usca.edu

Nancy B. Ruppert
UNC-Asheville, Professor Emerita, nruppert93@gmail.com

Toni M. Williams
University of South Carolina, tmwilli2@sc.edu

Recommended Citation

Coleman, B., Rasheed, M., Ruppert, N., & Williams, T. (2024). Uniting students with literacy connections in mathematics. South Carolina Association for Middle Level Education Journal, 3, 112-116.

Published online: March 2024

Uniting Students with Literacy Connections in Mathematics

Bridget K. Coleman, Ph.D.
University of South Carolina Aiken
bridgetc@usca.edu

Michelle Rasheed, Ph. D.
University of South Carolina Aiken
Michelle.Rasheed@usca.edu

Nancy J. Ruppert, Ph. D.
University of North Carolina Asheville
NRuppert@unca.edu

Toni M. Williams, Ph. D.
University of South Carolina
TMWILLI2@sc.edu

Abstract: Literature provides opportunities for students to connect to mathematics, as well as each other. Reflecting on personal identities, storytelling, and place-based connections are avenues to enhancing the relevancy of content across the curriculum. Literature can bridge the divide for students reluctant to see the beauty in mathematics. It can also be the impetus in helping unite students as they gain a better understanding of cultures and places beyond their own. Stories, along with interactive tasks, give context for collaborative experiences. This article shares resources and strategies for building understanding and collaboration among students using cross-curricular connections between mathematics and literacy.

Keywords: Mathematics, literature, interdisciplinary, literacy, storytelling

Introduction

The 2020's are challenging unity among young adolescents in American society. Troubling issues include social justice concerns, a mental health crisis, wars and rumors of war. Young adolescents are often caught "in the middle" of the larger societal and personal challenges, and often mathematics is taught using little cultural connections (Sagun, 2010). Our young adolescents are beginning to show their resilience from the global pandemic that cut many people off from social engagement but are needing more opportunities to develop their ability to communicate socially and academically. So, how can educators help unite students in classrooms that engage them in creative, integrative ways that also enhance academic skills in a social context? Particularly in mathematics classrooms where algorithms and procedures usually take the forefront, we believe educators who promote unity and listening to one another while also providing rigorous content help young adolescents connect their lives to mathematics. We suggest teachers can be intentional about better understanding students by uniting them using literacy as a conduit for problem solving. What can we do to help students consider their relationships with each other and stories they read? In this article, we share resources and strategies for building understanding and collaboration among students using cross-curricular connections in mathematics to literacy. We believe four elements provide deep connections between mathematics and literature: storytelling, journaling, hearing all voices, and focusing on place-based learning. For each of these elements we provide a discussion and how to integrate a literacy connection.

SCAMLE South Carolina Association for Middle Level Education

Our Identity Stories: Storytelling as a Tool

First, building a classroom environment where everyone has value and collaboration is key. A place where it is expected that we make mistakes and learn from them begins with trust. We must teach our students to trust the process, trust one another, trust that eventually each of us will know more. We believe two things must accompany trust: A growth mindset (Dweck, 2006) and productive struggle (Hiebert & Grouws, 2007). These two elements are conduits to helping students find solutions to problems (Toney, 2019). Toney (2019) examined the impact of three different mindset strategies on middle school math students' attitudes toward math: "yet", "process praise", and "celebrating success". He found that sixth graders show the greatest impact using the celebration of successes where they had struggled!

In order to create a culture that challenges and embraces struggle, we believe we start by building a community of learners who trust and accept unknowns. Helping students build relationships takes effort and the teacher sets the tone. A tool for engaging students, building community, and exploring challenges can happen with literacy skills (Sircey, 2017) and more specifically, story-telling (Landrum, Brakke, & McCarthy, 2019). Sircey (2017) examined middle school math students' who were given specific literacy tools such as storytelling as a strategy to help build a classroom environment conducive to learning math and providing experiences to learn about each other. Reading allows students to learn through others' stories. In our writing, we each can learn through personal stories.

Let's begin with asking our students to share their own stories as opportunities for young adolescents to get to know one another, connect to literacy, and discuss unknowns. Two experiences students can engage in are timelines and text lineages. Bishop, Downes, and Farbe (2021), wrote *Personalized Learning in the Middle Grades*. They share how asking students to explore and examine their own lives and goals allows them to grow and monitor their own challenges and successes. We suggest two books to use in helping

students think about their own lives: *The Dot and the Line* and *The Day You Begin.*

***The Dot and the Line: A Romance in Lower Mathematics (1963)* by Norton Juster**
What better than a light-hearted mathematical romance to fire up a classroom of young adolescents? In *The Dot and the Line* (Juster, 1963), a relationship grows when the dot wants to impress the line. The story depicts love across boundaries. After reading the book, there are two areas to explore – 1) geometry concepts and 2) questions relating the story to young adolescent identities, relationships, and self-concepts.

Related Math Activities:

- Analysis of introductory geometry vocabulary
- Student drawings of introductory geometry vocabulary - hand-drawn and utilizing interactive software such as the DESMOS Geometry tool. https://www.desmos.com/geometry
- Comparison of mathematical relationships
- Exploration of architecture

***The Day You Begin* (2018) by Jacqueline Woodson**
Jacqueline Woodson (2018) wrote, *The Day You Begin*. This picture book allows students to relate challenges in their lives to mathematical struggles. A growth mindset is illustrated by the main character. Using this book to talk about how we overcome challenges is a great segue to connecting perseverance in the math classroom and can open up discussion in a variety of ways. Woodson's YouTube version (2021) features the author introducing the book. It is a nice book to introduce preservice teachers how to integrate math into an ELA class. After reading the book, the following questions are used for reflection and discussion:

- What are your cultural connections? What stands out?
- What feelings/memories come forth for you?
- In what ways can you connect some part of this book to one content area? How would the standards fit?
- How might you extend the content connection to another content?
- Why does this book matter for students? For identity? For class community building? For fostering a love of literacy?
- What do you notice about the pictures in the book?

Journaling

We often associate journaling with language arts, but the mathematics classroom is another appropriate place for student expression. Journaling is a great way for students to share their ideas, their concerns, and a way to monitor their growth as budding mathematicians. We can begin the year or the semester asking students to reflect on their own mathematical journey, their past, and their hopes for the future. One way to do this is by sharing *The Girl with a Mind for Math: The Story of Raye Montague* (Mosca, 2018). This is a story of dreams and prejudices and ultimately success. After reading the story, students can write their own math autobiography. Students can describe their math journey in written narratives, verbal stories, by drawing pictures, and/or by creating a timeline of milestones. After reading, the following questions can stimulate students' sharing their own journeys:

- What did you find particularly insightful in the book?
- What were the pivotal moments in your own math journey?
- What experiences impacted you as a mathematician?

Text lineage is also a form of journaling. Goldie Muhammad (2018) uses text as a way for students to share their own journeys. A text lineage is an illustration, usually written in words, but could use images, and books that influence our own ideas related to perseverance and dreams.

In the math classroom we can ask students to design and display their own experiences that impacted their journeys. *The Housekeeper and the Professor* (Ogawa, 2003) is the story of a mathematician who experienced a traumatic head injury and can only remember things for 80 minutes at a time. The characters are the housekeeper and her son who learn to grow and trust, and, in turn solve problems together. Together a class could create a text lineage to describe the professors, the housekeeper, or her sons' lives. Teachers can use the literature to help students get to know one another and examine mathematical literacy. Japan is the setting of this story. Consider the equation the professor loved. There is a consistent theme of productive struggle and perseverance. For example, the professor had a "a special feeling for what he called the 'correct miscalculation,' for he believed that mistakes were often as revealing as the right answers. After reading, students can then create their own text lineages to talk about how they attempt or are challenged by problems and how they persevere. Allowing students to explain their world in numbers can give them the opportunity to explore their worlds mathematically.

Related Math Activities:

- Lineage - personal, story characters, and/or historical figures
- Examination of 'amicable numbers' as noted in the story (Ogawa, p. 18-22)
- Analysis of student collected data of heights and birthdays
- Place-based data analysis - population through historical periods, median income, demographics, climate, ecosystems
- Measurements with scaled maps (geography of Japan's islands), cartography, explorations of landforms

Hearing All Voices: Listening and Learning

Whose stories do we hear? As teacher educators, we want to bring various perspectives to our students as well as stories that can bring multiple meanings to our future teachers. We ensure that instruction fosters learning that is active, purposeful and democratic (Bishop & Harrison, 2021).

Diverse learning opportunities expose students to "multiple, diverse perspectives and viewpoints" (Bishop & Harrison, 2021, p. 27). We invited our colleagues to talk about their own experiences:

> "I never considered myself a mathematician, always a reader and a writer. Math has always been a daunting subject for me. My math teachers always explained concepts too fast for me and I was always afraid to ask questions for fear of being embarrassed or feeling "dumb". I wanted to learn the concepts and understand how they all build on one another, but I let my fear control my ability to ask questions before, during or after math class. When I felt brave and confident enough to ask questions, I was left feeling humiliated and I let myself be ok with "getting by" in math.
>
> It was late in life that I encountered an individual who not only had a love for math, but a passion for teaching it and then I was able to build my confidence in the content. However, my love for reading and writing was unhinged. I began as a timid reader and writer, and was sent to "reading lab" for a short while, so my mother and father would read to me and take me to the library and bookstores to expose me to the kinds of books that I enjoyed reading. After some time, I turned my book collection into a library, and I would rent out books to friends. I developed a community of readers among my friends and soon after my best friend and I started writing plays and acting them out. This was how my love of reading and writing started.
>
> I always ask students if they are readers or writers and then ask them to explain why. We begin class with a read aloud, journal writing or a brief discussion on the journal topic." - (Literacy Professor)

Giving voice to students requires a variety of avenues for participation including written, verbal, and signal responses. Classroom questioning techniques include volunteer and non-volunteers. Tools such as equity sticks or random name generators like WheelofNames.com help ensure diversity in how teachers select participants. Technology tools such as Menti and Flip where students provide responses give voice to more students, encourage participation by all, and offer opportunities for collaboration. Integrating the technology can help make all students feel seen and heard and help the class make democratic decisions.

Sharing *The Girl with a Mind for Math: The Raye Montague Story* (2018) by Julia Mosca can inspire students to overcome adversity to solve problems and attain their goals. Raye Montague is an empowering example of how a young person was able to share her voice. Personal stories allow our students to identify with and learn about the uniqueness of individuals. This book includes a timeline of milestones in Ms. Montague's life. Additionally, *The Girl with a Mind for Math* can be a springboard for STEAM activities.

Related Math Activities:

- Creation of timelines - personal or of historical figures and/or events
- Analysis of measurements of naval ships and submarines
- STEAM Activity: Peer collaboration in simulated ship building. Teams build a ship utilizing a limited number of various materials provided - paper, paper clips, wood sticks, straws, aluminum foil sheet
- Comparison of mathematical identities: Raye Montague's story of mathematics and engineering
- Sharing heritage: Place-based connections using literature

Place-Based Connections

A third experience young adolescents can learn from is using place-based connections. Books are sometimes windows, offering views of worlds that may be real or imagined, familiar or strange. These windows are also sliding glass doors, and readers have only to walk through in imagination to become part of whatever world has been created or recreated by the author" (Bishop, 1990, p. ix). When we provide our students with opportunities for exploration of new places, concepts, histories, and people, they gain understandings about places near and far. At a time in their lives when so much is unknown, middle school students deserve opportunities for engaging, enriching lessons that introduce concepts, places, and people who can inspire them to think deeply about their place in the world. These windows, mirrors, and sliding glass doors await and entice our students to go beyond what and where they know to learn more about the world in which they live. For example, we can virtually visit Peru while reading *Patterns in Peru* (2007) by Cindy Neuschwander. In this story, Bibi and Matt Zill must use their algebraic knowledge of patterns along their adventure to navigate their way. The patterns in the story include repeating, positional, and growing patterns. There is even a T-chart in the book! The main characters must think critically to extend patterns to guide their way to the Lost City when they are suddenly separated from their parents.

Related Math Activities:

- Construct algebraic patterns with color tiles (or other manipulative) and discover linear functions
- Place-based data analysis - population through historical periods (South America, The Inca Civilization, Machu Picchu), median income, demographics, climate, ecosystems
- Measurements with scaled maps (geography of South America, Peru, Machu Picchu), cartography, explorations of landforms
- Mathematical analysis of cultural designs in art and clothing

Where stories take place and/or using stories that relate to students locally can inspire students to problem solve and work strategically to understand how people live in

community. Incorporating literature into math lessons allows students opportunities to get to know one another, learn about careers which prioritize math, examine mathematical applications through authentic situations, and gain insights about historical figures who made contributions in STEM fields. While connecting students to their own communities is critical, books can allow students to take adventures into other cultures. Since the books are being used as entry points to connect with students, it is not necessary for the books to align with the reading level of the students. Relevancy can be established in adolescent literature, children's books, and picture books.

Examples highlighted in this article include: *The Dot and the Line: A Romance in Lower Mathematics (1963)* by Norton Juster; *The Day You Begin (2018)* by Jacqueline Woodson; *The Housekeeper and the Professor (2003)* by Yoko Ogawa, set in Japan; *The Girl with a Mind for Math: The Raye Montague Story (2018)* by Julia Mosca; and *Patterns in Peru (2007)* by Cindy Neuschwander. Each of these narratives weaves mathematical concepts with elements of history and allows students to develop their geographical knowledge. The stories offer glimpses into the lives of mathematicians, engineers, researchers, and writers. Through these stories students are able to see, hear, and discuss how math concepts are applied to real life situations in different places. Lessons can be extended for students to create their own math stories and through this, they can see themselves as mathematicians, engineers, architects, researchers, and/or writers. Elements of adventure, art, suspense, and rich characterizations provide high interest and engagement for concepts that might otherwise be difficult to garner students' attention. Each story immerses students into a particular place – the faraway lands of Peru and Japan, for example.

Exploration of the settings of the stories can serve as connections to our students' lives and provide opportunities for place-based lessons which add authenticity to our lessons. The interdisciplinary possibilities with math and literature are numerous. According to the Association for Middle Level Education (AMLE), curriculum should be relevant, challenging, integrative, and exploratory. AMLE promotes education that is responsive, challenging, empowering, equitable, and engaging (2024). *The Successful Middle School* (Bishop & Harrison, 2021) explains integrative curriculum as including inquiry of significant problems and societal issues. Communication and collaboration are essential in the process. Finally, three of NCTM's (2014) seven Effective Mathematics Teaching Practices include: facilitating meaningful mathematical discourse, supporting productive struggle in learning mathematics, and posing purposeful questions.

Conclusion

While we work to unify our students, we should keep in mind that collaborating with our colleagues sets a powerful example. Reaching across the hallway to share ideas can provide the benefit of a cross-curricular approach. While teachers explore the mathematics of the literature in one class, colleagues can spotlight and expand upon additional discipline-specific content. Intentionality is key. What do middle schoolers spend their time thinking about and doing? In a path forward for one's own ideas, consider books and media, and community-based connections, along with questions and interests from students. The intent is to make learning student-centered and student-focused, helping students see the relevancy of content and collaboration. As we work through authentic tasks, we develop as citizens collaborating with each other at increased levels of engagement. We create a culture of engagement, curiosity, and collaboration when we give our students opportunities to make connections and explore their wonderings.

References

Bishop, P. A., & Harrison, L. (2021). *The successful middle school: This we believe.* Association for Middle Level Education.

Bishop, P.A., Downes, J.M., and Farbe, K. (2021). *Personalized learning in the middle grades*. Harvard Education Press.

Bishop, R.S. (1990). Mirrors, windows, and sliding glass doors. *Perspectives*, *6*(3), ix-xi.

DESMOS Geometry. Retrieved from https://www.desmos.com/geometry.

Dweck, C. S. (2006). *Mindset: The new psychology of success*. Random House.

Hiebert, J., & Grouws, D. A. (2007). The effects of classroom mathematics teaching on students' learning. *Second handbook of research on mathematics teaching and learning*, *1*(1), 371-404.

Juster, N. (1963). *The dot and the line: A romance in lower mathematics.* Chronicle Books.

Landrum, R. E., Brakke, K., & McCarthy, M. A. (2019). The pedagogical power of storytelling. *Scholarship of Teaching and Learning in Psychology, 5*(3), 247–253. https://doi.org/10.1037/stl0000152

Mosca, J. F. (2018). *The girl with a mind for math: The story of Ray Montagu.* Washington: The Innovation Press.

Muhammad, G. (2020) *Cultivating genius: An equity framework*. Scholastic.

National Council of Teachers of Mathematics (2014). *Principles to actions: Ensuring mathematical success for all.* Reston, VA: Author.

Neuschwander, C. (2007). *Patterns in Peru: An adventure in patterning.* New York: H. Holt.

Ogawa, Y. (2003). *The housekeeper and the professor.* Picador.

Ruppert N., Coleman B., Pinter H., Johnson D., Rector M., & Diaz C. (2022). Culturally sustaining practices for middle level mathematics teachers. *Education Sciences, 12*(12):910. https://doi.org/10.3390/educsci12120910

Sagun, T. (2010). *Urban schools that have narrowed the achievement gap: Middle school math achievement in an urban setting* (Order No. 3403756). Available from ProQuest Central. (497092396). Retrieved from https://login.proxy177.nclive.org/login?url=https://www.proquest.com/dissertations-theses/urban-schools-that-have-narrowed-achievement-gap/docview/497092396/se-2

Sircey, S. T. (2017). *Building middle school teacher capacity to implement reading comprehension strategies for improved student academic performance* (Order No.

10267653). Available from ProQuest Central. (1896117562). Retrieved from https://login.proxy177.nclive.org/login?url=https://www.proquest.com/dissertations-theses/building-middle-school-teacher-capacity-implement/docview/1896117562/se-2

Toney, R. P. (2019). *The effect of growth mindset strategies on perseverance and engagement in middle school math classrooms* (Order No. 13810298). Available from ProQuest Central. (2240083486). Retrieved from https://login.proxy177.nclive.org/login?url=https://www.proquest.com/dissertations-theses/effect-growth-mindset-strategies-on-perseverance/docview/2240083486/se-2

Woodson, J., & López, R. (2018). *The day you begin.* New York, NY, Nancy Paulsen Books.

Woodson, J. (2021). The day you begin. Retrieved from https://www.youtube.com/watch?v=KDs5d_qFbEs

About the Authors

Bridget K. Coleman, Ph.D. is a professor at the University of South Carolina Aiken. She serves as the coordinator of the university's Math Education programs and director of the Educator Leadership, M.Ed. Dr. Coleman teaches courses related to mathematics methods and leadership.
ORCiD: https://orcid.org/0000-0001-9545-4037

Michelle Rasheed, Ph.D., is an Assistant Professor at the University of South Carolina Aiken where she teaches literacy courses in the School of Education. Her experiences in teaching range from first grade to graduate school, general education to special education, and substitute teacher to pre-service teacher educator. Dr. Rasheed's research interests include equity and access for underserved rural populations, poverty, and literacy.

This article is open access by the South Carolina Association for Middle Level Education (SCAMLE). It has undergone a double-blind peer review process and was accepted for inclusion in the SCAMLE Journal.

Nancy Ruppert, Ph.D., began her career at Busbee Middle School in Lexington District II and taught at Charleston Southern University. She was a middle school math teacher for 20 years and served as the president of both the National Professors of Middle Level Education and the AMLE Board of Directors. Dr. Ruppert has been recognized nationally as the AMLE John H Lounsbury award recipient and in North Carolina as the recipient of the C Kenneth McEwin Middle Level Service Award. She is professor emeritus from UNC Asheville and currently resides in Florida.

Toni M. Williams, Ph.D., is an Associate Professor in the Department of Teacher Education at the University of South Carolina. Her research and scholarship build on social justice, equity, culturally sustaining pedagogies in middle level teacher education. She is focused on community heritage, strength, knowledge and humanizing methodologies and pedagogies (Friere, 1970) in Middle Level education. This emphasis supports educators to better understand how those histories might be re-centered in educational spaces and the consequent impact on students' learning. She is committed to engaging and supporting pre-service middle level teacher candidates as they transition to novice middle school educators. In addition to serving as the Middle Level Program coordinator, she teaches undergraduate and graduate courses and presents at national and international conferences. Dr. Williams has published in a wide range of journals including Research in Middle Level Education, She is currently the editor of the *Middle Grades Research Journal* and serves on the Association for Middle Level Education (AMLE) Board of Trustees.

Recommended Citation (APA 7th ed.)
Coleman, B., Rasheed, M., Ruppert, N., & Williams, T. (2024). Uniting students with literacy connections in mathematics. *South Carolina Association for Middle Level Education Journal, 3,* 112-116.

Published online: March 2024