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Teaching for Excellence and Equity in Mathematics

TODOS
Mathematics for ALL

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TEACHING FOR EXCELLENCE AND EQUITY IN MATHEMATICS

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IN THIS ISSUE

From the Editors

Marta Civil, Anthony Fernandes, Ksenija Simic-Muller, M. Alejandra Sorto, and Craig Willey

As this new issue of *TEEM* reaches you, we are nearing the TODOS 2021 Virtual Conference (https://www.todos-math.org/conference), which we hope you will be able to attend. It will be an opportunity to reflect back on this very unique past year and recharge for the next school year. What will the new school year be like? While we do not know the answer yet, we know that this past year has given us an opportunity to reflect more on the inequities in our educational system and in the world at large. We hope that this issue of *TEEM*, as all the previous issues, provides you with valuable resources to address these inequities. We encourage you to read the articles and discuss them with colleagues.

In "Using Interviews to Identify the Resources of Multilingual High School Students," Megan D'Errico and William Zahner collaborate as teacher-researchers to investigate the impact of engaging high school teachers in ways to identify students' home and community resources. The authors describe how the teachers conducted structured interviews and discuss how other teachers might adapt the activity to their context.

Kelley Buchheister, Christa Jackson, and Cynthia E. Taylor, the authors of "Using the What-How-Who Structure to Plan an Equitable Mathematics Lesson," describe a first-grade teacher's lesson sequence based on a Shel Silverstein poem. The lessons prompt students to organize, represent, and interpret data, and use the What-How-Who structure to ensure that the mathematical explorations and discussions are rooted in fairness and equity.

The article "Helping Preservice Teachers Connect to Students, Subject, and Self" highlights the need for teachers to interrogate their own identities in relation to mathematics as a means to ready themselves to see and capitalize on the strengths of children. The authors, Megan Burton and Gwendolyn Williams, showcase two learning experiences that support preservice teachers to find and leverage the mathematics in the community, consider sociocultural dimensions of mathematics pedagogy, and process why this matters for multilingual learners.

As editors, we are extremely grateful for the dedication and expertise of all our reviewers and authors. We are also very appreciative of the excellent editorial support provided by Associate Editor Lawrence M. Lesser and Layout Editor Susie W. Håkansson. *TEEM* gratefully acknowledges the support of all the leaders in our sponsoring organization, TODOS: Mathematics for ALL. We hope *TEEM* continues to serve the TODOS membership and that this issue serves as a resource for the community and a source of inspiration for future contributions to the journal.

As always, we would like to encourage you to consider submitting an article to *TEEM*. If you have an idea and are not sure if or how it may fit, please contact us (teem@todos-math.org) and we will be happy to discuss it with you. We are very interested in articles written by or with classroom teachers. Also email us if you have an idea for a special issue. Keep in mind the guidelines and scope for *TEEM* (https://www.todos-math.org/newteemwb) and the TODOS mission (https://www.todos-math.org/mission-goals).

We also would like to call your attention to a new *TEEM* special issue that is currently in preparation. Its theme is Antiracism in Mathematics Education. The deadline for submitting a paper is September 15, 2021. See page 33 in this issue for more details.

We close this editorial with the sad news of the May 12, 2021 passing of a beloved Brazilian educator and researcher, Ubiratan (Ubi) D'Ambrosio. Ubi's legacy as the founder of ethnomathematics will continue to support our efforts towards a more equitable and peaceful world. Now we share just a few glimpses of his powerful ideas. In D'Ambrosio (2007)[1], we read, "Mathematicians and math educators must accept, as priority, the pursuit of a civilization with dignity for all, in which inequity, arrogance and bigotry have no place" (p. 25). In writing about the goals for education, he shares, "We do not want our students to become citizens who obey and accept rules and codes which violate human dignity" (p. 26). At the core of his concept of ethnomathematics are the "ethics of diversity", which he describes as "respect for, solidarity with, and cooperation with the other (the different). This leads to quality of life and dignity for all" (p. 28).

In "what is ethnomathematics and how can it help children in schools?", D'Ambrosio (2001)[2] provides an insightful reflection on the interactions between mathematics and culture. As he writes, "an important component of mathematics education today should be to reaffirm, and in some instances to restore, the cultural dignity of children" (p. 308). In this essay D'Ambrosio explains how an approach grounded on ethnomathematics can help students and teachers understand and

[1] D'Ambrosio, U. (2007). Peace, social justice and ethnomathematics. *The Montana Mathematics Enthusiast*, *Monograph 1*, 25-34.

[2] D'Ambrosio, U. (2001). What is ethnomathematics and how can it help children in schools? *Teaching Children Mathematics*, *7*(6), 308-310.

value the role of culture in the teaching and learning of mathematics. He also calls for the need to move beyond a focus on only Eurocentric contributions to mathematics and to make sure that students know about the contributions of many other cultural groups. As he writes, the teaching of mathematics is often acultural so that "the values, traditions, beliefs, language, and habits reflective of the culture of the student are ignored" (p. 309).

Readers wanting to learn more about ethnomathematics may enjoy browsing issues of *Journal of Mathematics and Culture* (https://journalofmathematicsandculture.wordpress.com/), the refereed journal of the North American Study Group on Ethnomathematics (NASGEm: https://nasgem.wordpress.com/). The latest TODOS podcast describes the program of ethomathematics at the University of Hawaii Manoa (https://www.todos-math.org/todos-podcasts).

To read tributes to Ubi's memory and legacy from across the world, visit: https://bit.ly/3wytIQh. We invite readers to learn more about Ubi's work and to continue his legacy by advocating through our work and actions for dignity for all.

Ubiratan D'Ambrosio (December 8, 1932- May 12, 2021)
Photo courtesy of Daniel Clark Orey

TODOS Live!

TODOS Live! began with funds obtained through a NCTM Mathematics Education Trust grant. Through the years TODOS Live! has had many excellent sessions and presenters. These sessions are generally an hour in length and occur in the late afternoon when classroom teachers can participate. A list of previous recordings and upcoming sessions can be found at https://www.todos-math.org/todos-live. Please note that due to limitations to online storage, access to some of the sessions has been lost. Currently, sessions are being stored on a TODOS Live! Vimeo Channel (https://vimeo.com/user56336191).

Using Interviews to Identify the Resources of Multilingual High School Students

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Abstract

The resources that multilingual students bring to school mathematics are often ignored. During a teacher-researcher collaborative project focused on creating more equitable learning environments in high school math classrooms, we noted an initial tendency to focus on the challenges and barriers facing multilingual students. To counter this tendency, we worked with two teachers to engage in a structured teacher-student interview to identify and highlight secondary multilingual students' home and community resources. We adapted a module from TeachMath to guide the activity and facilitated surveys, debriefs and teacher-research conversations to unpack this experience. After the interview, the two secondary mathematics teachers reported they were more familiar with their students' resources in the areas of language, family, school/mathematics class and out of school activities. We close by discussing how other teachers might do this activity in their local context.

Discussion And Reflection Enhancement (DARE) Pre-Reading Questions

Think of one of your multilingual students who is classified as an English Learner.

1. Write down what you know about this multilingual student beyond the fact that they are classified as an English Learner.

2. Make two lists: one of what you think are the student's *resources* and one of their *challenges* related to learning math.

3. How can you learn more about this student's resources, particularly their interests and knowledge base? How would knowing about the student's resources help you teach this student mathematics better?

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William Zahner (bzahner@sdsu.edu) is an Associate Professor in the department of Mathematics and Statistics at San Diego State University. Zahner teaches mathematics courses for prospective secondary teachers and is the principal investigator of research projects focused on language diversity and mathematics. Prior to his work as a faculty member, Zahner was a high school mathematics teacher in Chuuk, Federated States of Micronesia and San Jose, California.

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Using Interviews to Identify the Resources of Multilingual High School Students

Megan D'Errico and William Zahner

Emergent multilingual students who are labeled English Learners[1] (ELs) are often denied access to high quality learning experiences in secondary mathematics (Kanno & Kangas, 2014; Mosqueda & Maldonado, 2013). Many multilingual high school students are relegated to mathematics classes where learning activities focus on practicing routine skills and procedures, and little attention is given to conceptual development (e.g., Zahner, 2015; de Araujo, 2017). We know from prior research that multilingual learners can engage in classroom mathematical discussions and can benefit from participating in conceptually-focused discussions of important mathematics concepts (e.g., Turner et al., 2013). Yet, at the high school level, few studies have investigated how to create mathematics learning environments in which multilingual students can similarly benefit from discussions. In order to transform the realities of tracking and the overemphasis of procedurally-focused mathematics lessons for multilingual learners at the high school level, we are working with ninth grade teachers to develop conceptually-focused activities and lessons that create opportunities for multilingual ninth graders to participate in classroom discussions.

In an early phase of our project, we interviewed the participating teachers and examined tasks from their curriculum. In these task-based interviews we asked the teachers to identify both the *challenges* multilingual students might face in working on the problems and the *resources* these students might draw upon to meet these challenges (Zahner et al., 2018a). However, while analyzing the interviews, we noted that our conversation usually focused on students' challenges. Reflecting on these early data, we wondered if we were unintentionally reinforcing deficit framing of multilingual students in the project. This reflection led us to seek resources to help our teacher collaborators—and ourselves—identify and highlight the cultural and linguistic resources of multilingual students.

One avenue for such work is to identify students' Funds of Knowledge (FoK; González, Andrade, Civil, & Moll, 2001). While several projects have examined multilingual mathematics learners' funds of knowledge at the elementary level, few studies have addressed this topic at the secondary level, possibly because there are relatively fewer students who are classified as ELs in high school than elementary school. For example, in California, 25% of students in grades K-5 are classified as ELs in 2019-20, while only 11% of students in grades 9-12 were classified as ELs (California Department of Education, 2020). Nonetheless, given patterns of disparate educational outcomes for students classified as ELs in high school, there is an equity imperative to meet the needs of multilingual secondary students.

In what follows, we introduce a student interview activity that we (both the researchers and collaborating teachers) did to identify student resources. First, we set the stage with background research and the context in which the activity took place. Then we describe the interviews that two participating teachers did with their students. We also describe how we (as collaborating researchers) collected data to understand what the teachers reported learning. We close by discussing how other teachers might do this activity in their local context.

Background Research

The educational potential of identifying and building on linguistically diverse students' everyday resources was described by Civil and colleagues (Civil, 2002; Civil & Andrade, 2002; González, Andrade, Civil, & Moll, 2001) who designed mathematics activities to incorporate students' Funds of Knowledge (FoK) in elementary

[1] We use the term "English learners" when describing the label that the state uses for multilingual students who are learning the language of teaching and learning. However, we and many educators who work closely with students who are classified as ELs, find this term problematic because it highlights what students lack, rather than the resources multilingual students bring to school. Therefore, throughout this paper we use "multilingual students" to describe students and "ELs" only when talking about student classification from the school system.

mathematics classrooms (González, Moll, & Amanti, 2005). FoK is defined as "historically accumulated bodies of knowledge and skills essential for household functioning and well-being" (González, Andrade, Civil, & Moll, 2001, p. 116). Civil's work illustrated how teachers can build on FoK in school mathematics, and recent research has extended Civil's work by highlighting the multiple ways Latinx parents support their childrens' mathematics learning in home life (Williams et al., 2020). Teacher educators have built upon and extended this work by developing a series of activities called TeachMath for prospective elementary teachers (Aguirre et al., 2013; Foote et al., 2015). The TeachMath materials have been used to show elementary teachers the resource bases of students from non-dominant communities. We conjectured that engaging in discussions about multilingual secondary students' FoK would also be useful for our collaborative work with secondary math teachers. Thus, we adopted one of the activities from the TeachMath materials to guide the in-service secondary teachers with whom we were collaborating to learn more about students' backgrounds and out-of-school experiences through student interviews (paralleling the research in Zavala, 2014).

Situating Ourselves as Researchers

The first author came to this project while working as a post-doctoral researcher in science education and says: "I was interested in investigating ways to empower STEM teachers to advance change in their classrooms, and the tools that could be used to promote more equitable learning environments. Following this project, I went on to direct a program for underrepresented science and math students (some bilingual) in a 4-year college in northern California. I identify as White, cis-woman and monolingual."

The second author is the principal investigator of the research project within which this activity took place and says: "I started my mathematics teaching career 20 years ago in a high school where all students were multilingual and learning mathematics in a second language. As an emergent multilingual white cis-male teacher, I started developing an understanding of how language, identity, culture, and mathematics are closely related, despite the commonly held belief that mathematics is the 'universal language'. My experiences as a math teacher led to my current research interest. I currently work as a mathematics professor and mathematics teacher educator."

In this activity we investigated the following question: What can high school mathematics teachers learn about their students, who are classified as ELs, through engaging in a structured interview activity focused on students' out-of-school experiences? Specifically, what resources do the teachers identify in the students' lives and community?

Context

For this activity, which was part of a larger project, we worked with two of our collaborating ninth grade integrated mathematics teachers at City High School[2] a comprehensive public high school located in an urban area of Southern California with a large immigrant population. Despite being located in a diverse city, City High was (and continues to be) effectively segregated by income and student race/ethnicity. The majority of City High students were Latinx (75%), followed by Asian (11%) and African-American (9%). Additionally, over 80% of the students were eligible for free or reduced-price lunch, a proxy for low family income. City High was also linguistically diverse: 30% of 9th and 10th graders were classified as English Learners and an additional 50% of City High's students were formerly ELs (California Department of Education, 2015). The most common languages other than English were Spanish (75%), Vietnamese (5%), Burmese (2.5%), Somali (2 %) and multiple other languages each spoken by fewer than 2% of students.

For this activity, we focus on our work with two participating teachers who were willing and able to engage in this interview activity. The two teachers, Mr. S and Ms. G, were credentialed to teach mathematics. Mr. S had 8 years of experience and Ms. G had 12 years of teaching experience, all at City High. Mr. S is bilingual (Spanish and English) and identified as Latino. Ms. G is monolingual (English speaking) and identified as White.

[2] All names are pseudonyms.

The students who were interviewed for this project were selected by the teachers (see below for an explanation for how the teachers selected students), and at the time of the study, they attended City High as ninth graders. Each student was taking Integrated Math 1 (IMI) and also spoke Spanish as their first language. Mr. S planned and carried out an interview with Maya, a young woman who recently immigrated from Central America. She was classified as an "emerging" EL. Ms. G interviewed Jarrah and David, two boys in her ninth grade mathematics class who were classified in school records as Latino and were both formerly ELs.

Student Interview Activity

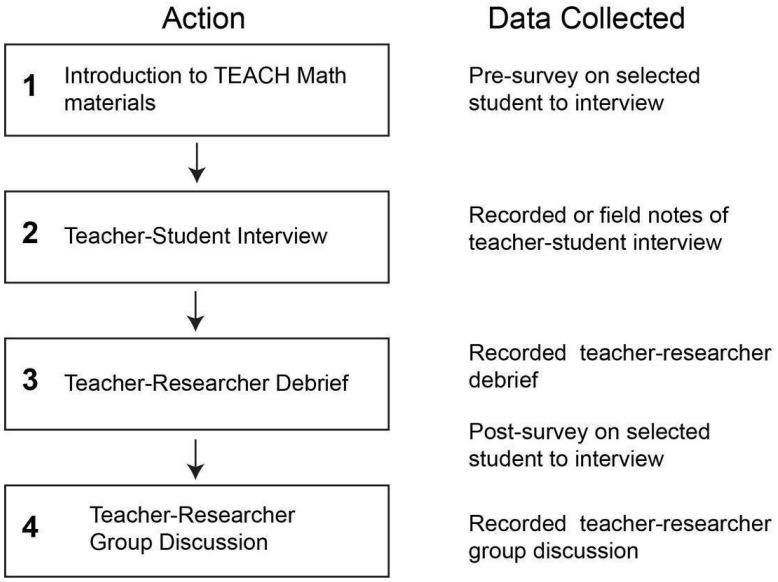
We *flexibly* adapted the "Getting to Know You" Interview from the Case Study module from the TeachMath materials (Foote et al., 2015). We chose this interview protocol because it aligns with the aims for the overall project. We introduced the student-teacher interview activity during one of our regular teacher-researcher meetings in early 2017 (Action 1, Figure 1). Following the guidance in the TeachMath materials, each teacher was asked to interview a student who was different from themselves in one or more socio-cultural ways, who was classified as an EL, and who had consented to the larger study. Mr. S chose to interview Maya. Ms. G had initially planned to interview a student named Josue, but due to a scheduling mishap, she ended up interviewing Jarrah and David.

The interview materials (from TeachMath) included questions about the student's interests and activities outside of school, home and community knowledge base, and home and community resources. The teachers reviewed these suggested questions (Foote et al., 2015 pp. 7-8), then adapted and changed the full list of interview questions to focus on a few relevant questions during their interview. They completed a pre-survey (Appendix 1) prior to conducting their interviews. Figure 1 shows the sequence of activities and data we subsequently collected, which we will explain next. The activities in Figure 1 took place across three weeks.

We had to be flexible in multiple ways. Our participating teachers conducted the student interviews (Action 2) in a way that made sense for them and their students. Specifically, the teachers arranged to meet interviewees during the lunch period, food was provided, and the teacher audio recorded the conversation for the sake of recalling what the students said. The approximately 35-minute lunch period limited the amount of time for the interviews, but the teachers and students

Figure 1

Data Collected at Each Action Throughout the Intervention



found it easier to meet during lunch than after school. To triangulate the teachers' surveys responses, and to debrief the student interview activity experience as a whole, we asked the teachers to do a written reflection and conducted two follow-up debrief interviews and group discussions (Actions 3 and 4) with the teachers. The materials we used are available as an online supplement at https://bit.ly/3uuDYrr.

Learning from the Interview Process

As noted in Figure 1, we (the researcher-collaborators) collected additional data to help us understand what the teachers experienced before, during, and after conducting the student-teacher interview. The pre-survey included questions (Appendix 1) about what the teachers knew about their interviewee and why they selected their interviewee. In Figure 2, we provide examples of questions that the teachers asked in their student interviews, but we note that these questions were tailored to the students (e.g. Mr. S, knew that Maya had recently immigrated from Central America, and he wanted to learn more about her experience of immigration so he asked questions about that experience).

The teacher-student interview between Mr. S and Maya was recorded, translated, and transcribed by a bilingual research assistant. Because of the change in plan for Ms. G's lesson, I (the first author) collected field note observations during the teacher-student interview between Ms. G and Jarrah and David since they expressed a preference to not be filmed. After the interviews were complete, we gave out a post-survey and conducted the debriefs. The surveys and transcripts (of both the student-teacher interviews as well as the teacher-researcher discussions) were coded using an open-coding process (Miles, Huberman, & Saldaña, 2014). Our final codes focused on language, family, activities outside of school, school, and mathematics.

Figure 2

Selected Interview Questions That Mr. S Asked (Action 2 in Fig. 1)

2) Teacher-Student Interview

- How many brothers and sisters do you have?
- Do you walk to school? What do you see when you do?
- How old were you when you left [Home Country]?
- What's the last math class you took? In [Home Country]?
- What do you like to do when out of school?
- What do you want to be when you grow up?
- Do you listen to music? Do you like music?

Interview Activity Reflections

Pre-Interview Activity

Responses from the pre-interview survey indicated that both teachers had a wide range of prior knowledge of all their students, but couldn't provide very many details about the potential interviewees' interests, family life or community (we note that this level of familiarity is not a sign the teachers do not know their students, but rather reflects the teachers' choice to interview a student they did not feel like they knew well). Mr. S knew Maya, the student he planned to interview, had relatively low grades in his math class and felt her low grade was "certainly a language demand issue". He knew that Maya spoke Spanish and had a history of immigration, but did not know what country she was from or when she had immigrated. He wrote "she puts forth effort, and wants to be successful, but is struggling". When asked about his knowledge of Maya's life outside of the classroom, Mr. S. knew very little about her interests and home life, but reported that she was social with other students. He planned on translating the interview questions into Spanish and asking her in both Spanish and English to make her more comfortable answering.

Although Ms. G did not interview the student she initially selected, in her pre-interview survey, she

reflected that she hoped to learn "a lot more about Josue, his interests in and out of school, details about his family". Given all other survey questions were specific to her perspective student she planned to interview, these data are not relevant.

Post-Interview

One of the successful elements of this project, in relation to our goals, was the re-focusing we observed in the teachers' perspectives of their students. Initially, our questionnaires and discussions about the students prompted responses that highlighted their students' relatively low achievement in mathematics. Both teachers conjectured this was due to being distracted in class, or not understanding enough English to follow lessons. After Mr. S's interview with Maya, the fact that Maya had only been in the U.S. for two years appeared to shift to a positive framing, where Mr. S realized Maya was more motivated than he had known to learn more English (both at school and at home listening to pop songs in English). He commented, "She's starting from scratch with English…she's done a pretty good job". We saw a similar change in Ms. G, who reported, "I liked knowing about their families…and what their life was like outside of school". She highlighted her students' passions for sports and drawing, as talents that she did not know about and that she could encourage them to try out for a team and ask them about it in the classroom in the future.

Another related outcome of implementing the interview was that the teachers reported it led to enhanced teacher-student interactions. The teachers shared that they had gained a better understanding of their students, and they ended up with more motivation and hope for positive future classroom interactions. Ms. G reported that "knowing more about the students makes me think of them differently, and respond to them differently in class". We also found some evidence that the students who were interviewed, in turn, increased their interactions with their teachers. After the interview, Ms. G had some e-mail communication with David's mother, which Ms. G noted resulted in David being motivated during classroom work time. Overall, Ms. G reported she was more motivated to keep David and Jarrah on task and she was planning to encourage them to try out for sports teams: "I have a stronger connection with them, which makes me believe that future interactions will be more meaningful".

Mr. S reflected that the interview established trust with Maya and he hoped that she would be more comfortable asking for help. However, in his post-interview reflection, Mr. S also reflected on the challenge of sustaining positive relationships with students given the structured interactions in secondary schools where both students and teachers have busy schedules and limited contact time in a classroom period. An excerpt from Mr. S's reflection was:

> *Maya was an interesting case because she is so quiet and shy. I would definitely say that she was more likely to ask me for help after class after the interview, but she still didn't ask for help in class whatsoever. She seemed to have a sharply increased interest in doing make up work and bringing her grade up, but it wasn't maintained. It sort of trailed off as time passed. After I interviewed Maya she did come to me after school for help. There were a handful of times that we had made plans for her to come after school, but that she either couldn't stay or was absent from school on that day. I would greet her at the door and she would smile and say good morning, but she's still so quiet. I really attribute much of her trepidation to speak, not so much with discomfort with me, but discomfort with speaking English, and just speaking in general. She never really found someone in class, a peer, that she was comfortable asking for help either. All in all I do believe that the interview had a positive effect on our interactions. In this particular case however, I think I needed to do a little bit more of my own outreach to her to get better results in terms of her success as a student.*

Despite the hurdles expressed by Mr. S, we do believe the knowledge the teachers gained about their students positively changed the teachers' outlook and perspective on future interactions with their students.

Discussion and Conclusion

In this study, we set out to investigate the power of asking high school mathematics teachers to get to know their multilingual students through conducting an interview. In general, we found that the interview and reflection process from TeachMath materials allowed two ninth grade teachers to expand their knowledge about their

multilingual students' home and community *resources*, instead of focusing on students' *challenges* related to language and mathematics. This resonates with prior work at the elementary level, and one strength of using the materials from the TeachMath project was that the interview activity and guiding questions focused on students' Funds of Knowledge (Aguirre et al., 2013).

While the TeachMath materials and the original FoK research were done with elementary-age students, we were encouraged to see that, with minor adaptations (e.g., making sure the questions were relevant to high school students), these materials could also be used by teachers in high school math classrooms. We note that in this project we used just a small slice of the available resources from TeachMath. In future work, we plan to continue to use the "Getting to Know You" interview process with other high school mathematics teachers. We also plan to supplement this interview with modified versions of math-problem solving interviews and activities from TeachMath, adapted for use with high school students.

For others who seek to do this activity, we note that the success of this activity appeared to be supported by a stance of flexibility. We designed the activity so that the teachers chose their students to interview, and allowed the teachers and students to find a time to meet. We also encouraged each teacher to pick and modify questions of the TeachMath interview protocol. These modifications made it possible for the in-service high school teachers to do this activity with one of their students. One additional important factor in the success of this activity was the fact that the teachers started with a stance of openness and willingness to learn about their students. We believe such a stance is prerequisite for the success of this activity.

The activity we describe in this article was done in the context of a teacher-researcher collaborative. As researchers and designers, we found that knowing a student's background, including their familial, cultural, and linguistic resources, has provided a foundation for our ongoing work of co-developing and redesigning mathematics problems from the curriculum to support emergent bilingual students (Zahner et al., 2018b). However, this activity could work in different structures and we offer these suggestions for teachers:

1. Do a version of this activity in a collaborative, reflective setting. For example, this interview activity could be done as part of a sequence of professional learning community meetings or as a stand-alone professional learning activity with a group of colleagues. In a reflective setting, the group members can focus on student resources and to design lessons that are more responsive to students' lives.
2. For teachers who do not speak the same first language of emergent multilingual students who are at the early stages of language development, we would encourage doing the interview with the help of a bilingual colleague to allow multilingual students to communicate using their full linguistic repertoire. Alternatively, the interview can be translated and a student could respond in writing. In addition, if multiple students in your class speak the same home language, consider doing the interview as a small group, allowing students to discuss their responses (as Ms. G flexibly did with her participants).
3. Last, a prerequisite for the success of this activity is that teachers must be open to learning from their students and believe their multilingual students are capable. We are aware that it is possible that a teacher who starts with negative beliefs about students might find evidence to support his/her beliefs through conducting an interview such as this. To counteract this possibility, we suggest that teachers who plan to engage in this activity also engage in critical dialogue about their own biases before engaging in this activity. Resources for such conversations can be found in books such as White et al. (2016).

With an open mind, a teacher has the power to become aware of students' home and community knowledge and resources, which can help the teacher be more effective in supporting the mathematics learning of linguistically diverse students.

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Discussion And Reflection Enhancement (DARE) Post-Reading Questions

1. The introduction described how our early discussions with teachers focused on multilingual students' challenges, even though that was not our intention. Have you seen this happen in your discussions with colleagues about teaching math to multilingual students? What can you do to disrupt this powerful tendency to focus on students' challenges?

2. One teacher interviewed a student in Spanish. How do you think relating to your multilingual students in their first language might allow you to learn more about their Funds of Knowledge and to incorporate these resources in math lessons?

3. Try This**:** Identify a multilingual student who is classified as an EL in your mathematics class and who is different from you in one or more socio-cultural ways. Try adapting the "Getting to Know you Interview" from the TeachMath Materials. Meet with your colleagues and share what you learned.

Appendix 1: Instruments of Data Collection

Pre-Survey Prompts	Post-Survey Prompts
1. What is one thing you like about teaching math at [City High School]? 2. How well do you know your students? 3. If you could rank how well you know your students from 1 to 10 (with 1 being a complete stranger and 10 as knowing them like a friend or family member)? 4. Which student do you plan on interviewing? Why? 5. In what ways is this student different from you? 6. In what ways is this student similar to you? 7. Is this student a low, medium or high achiever in your math classroom? Why did you choose that category? 8. What do you already know about the student's ideas and their attitudes towards math? 9. What do you know about the student's interest and activities (in school/out of school)? 10. What do you know about this student's home and community? 11. What do you expect to learn from this interview?	1. What is one thing you like about teaching math at [City High School]? 2. How well do you know your students? 3. If you could rank how well you know your students from 1 to 10 (with 1 being a complete stranger and 10 as knowing them like a friend or family member)? 4. Which student did you interview? Why? 5. Did you discover anything new about that student that makes them different from you? 6. Did you discover anything new about that student that makes them similar to you? 7. After interviewing, do you think the student is a low, medium or high achiever in your math classroom? Why did it change or stay the same? 8. What did you find out about the student's ideas and their attitudes towards math? 9. What do you know about the student's interest and activities (in school/out of school)? 10. What do you know about this student's home and community? 11. What did you learn (or take away) from this interview?

Using the What-How-Who Structure to Plan an Equitable Mathematics Lesson

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Abstract

This article describes how a first-grade teacher used the What-How-Who structure to plan a series of mathematical tasks focused on fairness and equity in a real-world situation. The teacher used Shel Silverstein's "Band-Aids" poem as a catalyst to plan mathematical activities that would prompt students' analysis of skin-toned bandages as they organize, represent, and interpret data.

Discussion And Reflection Enhancement (DARE) Pre-Reading Questions

1. How would you plan a primary mathematics lesson that addresses fairness and equity?
2. How can stories and poems get students to explore fairness and equity?
3. How can students view mathematics as a tool to investigate real world issues?

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Using the What-How-Who Structure to Plan an Equitable Mathematics Lesson

Kelley Buchheister, Christa Jackson, and Cynthia E. Taylor

The **What-How-Who** structure provides teachers a lens to plan, facilitate, and evaluate mathematical investigations that not only value contributions of each and every student, but also provide opportunities for students to engage in mathematical tasks focused on fairness and equity. Children's literature may serve as a catalyst in designing these mathematical investigations because it has the potential to facilitate connections between mathematical ideas and students' experiences, even out of school (Moyer, 2000; van den Heuvel-Panhuizen & Elia, 2012). Literature, such as stories or poems, may help primary students see the relevance of mathematical content and investigate social issues that exist in today's society (Flevares & Schiff, 2014; Moyer, 2000). The **What-How-Who** used as a planning structure provides an impetus for teachers to consider **what** tasks will provide opportunities for students to explore ideas, engage in reasoning and problem solving, and have multiple entry points for all learners while simultaneously meeting the mathematical goal of the lesson. After attention is given to tasks, teachers should consider **how** to structure the activities in the lesson to foster rich mathematical discourse and provide opportunities to engage each and every student in rigorous tasks. Furthermore, teachers should attend to **who** contributes to the mathematical storyline and **who**se voice is shared as a valuable part of the conversation; thus promoting an environment in which all learners have the opportunity to see themselves as thinkers and doers of mathematics. In this article, we describe how a first-grade teacher, Mr. Elliott (pseudonym), applied the **What-How-Who** structure (Buchheister, Jackson & Taylor, 2019) for the first time to plan a series of lessons that address the state mathematics standard for organizing, representing, and interpreting data, while simultaneously using children's literature as a foundation to provide students an opportunity to investigate fairness and equity.

The WHAT-HOW-WHO Structure

Using the **What-How-Who** structure in planning mathematics lessons, Mr. Elliott focused on **what** tasks can be explored through children's literature, **how** to structure the tasks to initiate conversations around equity and fairness, and **who**se voice is heard in the mathematical discussions.

What

When integrating literature into mathematics instruction, **what** stories teachers select and **what** tasks emerge from the storyline contribute to opportunities that promote deep mathematical reasoning. Teachers can select from three categories of literature that provide a foundation for mathematical activities: content-explicit, content-implicit, and content-invisible (Columba, Kim, & Moe, 2009). Content-explicit literature includes an intentional focus on mathematical ideas, such as counting or shapes, with little to no storyline or character development. Authors of these stories intentionally highlight mathematics in the writing, and these books are often selected for the purpose of learning specific mathematical concepts. In contrast, content-implicit literature weaves mathematical ideas into the context of an intriguing storyline that could stand on its own; whereas content-invisible literature represents books or poems in which the author has not intentionally emphasized mathematical content.

Mr. Elliott purposefully selected Shel Silverstein's "Band-Aids" poem (Silverstein, 1974, p. 140) because he viewed the content-implicit storyline as a context for organizing and interpreting data.

BAND-AIDS
I have a Band-Aid on my finger,
One on my knee, and one on my nose,
One on my heel, and two on my shoulder,
Three on my elbow, and nine on my toes.
Two on my wrist, and one on my ankle,
One on my chin, and one on my thigh,
Four on my belly, and five on my bottom,
One on my forehead, and one on my eye.
One on my neck, and in case I might need 'em
I have a box full of thirty-five more.
But oh! I do think it's sort of a pity
I don't have a cut or a sore!

Additionally, Mr. Elliott explained how the poem could provide a segue for investigations related to fairness and race. He noted his school district and class was comprised of primarily white, middle-class families, and he wanted to expose his students to situations that they may not have encountered.

> I think that the biggest issues for people in my community is honestly the lack of exposure to diversity, and I want to do this lesson as a way to think about social justice math lessons. I remember how the teacher in the [Chao & Jones (2016)] article got Pre-K kids to think about race, which I think can be hard for kids to discuss" (Mr. Elliott, 2019).

He further explained how the Pre-K article reminded him that children see race in the people and images they encounter each day. However, Mr. Elliott also recognized how racial bias was pervasive in products like bras, underwear, crayons, and bandages that claimed to reflect "peoples' skin tones," and described how selecting Shel Silverstein's poem pushed him to investigate more about race and skin-tone bandages. Mr. Elliott shared excerpts from articles he found about a 45-year-old man named Dominique Apollon who described his experience of using skin-tone bandages for the first time:

> "As a black person, I'm not used to seeing products geared to me in national online retailers. The default is typically some type of Caucasian skin tone" (Chen, 2019).

> "This felt like belonging. Like feeling valued. Sadness for my younger self and millions of kids of color, esp[ecially] black kids. [Bandages were] like a reminder of countless spaces where my skin is still not welcomed" (Brito, 2019).

> "I just started feeling sad that I'd spent my entire life — 45 years — perhaps without ever having experienced that before. It's impossible to say, but how might I have felt if I'd had that experience of care as a kid. It's a product that said to me, 'We see you. You're valued.'" (Chen, 2019).

Mr. Elliott wanted to ensure each of his students, especially his students of color, felt a sense of belonging as they engaged in problem solving tasks. It was at this juncture that Mr. Elliott wanted to rehumanize his mathematics teaching by planning a lesson on fairness and equity that focused on skin-toned bandages. Mr. Elliott expressed that he wanted every learner in his class to think critically and reflect on who is or who is not being privileged in our society—even subtly through the availability of skin-toned bandages. In other words, Mr. Elliott wanted to create opportunities for his students to question how society positions people who are non-white and consider how to examine these issues mathematically, which in turn can spark curiosity within his students that could potentially lead to change.

Because there are no mathematical questions within the "Band-Aids" poem, Mr. Elliott needed to create high quality tasks that would incorporate multiple solutions or entry points, require high levels of cognitive demand, and encourage connections among mathematical ideas (Breyfogle & Williams, 2008). He planned a variety of activities that would encourage his students to analyze relations among the given information and provide space for students to pose questions and demonstrate deep mathematical reasoning. For example, Mr. Elliott planned to have his students create visual representations of how they would sort the data from the poem (e.g., tally chart for where the bandages were placed on the body). In addition, he planned questions that simultaneously focused on the mathematical content and his intended goal of equity and fairness such as:

- *Why do we have different color bandages?*
- *How do companies decide the number of each size, shape, and color of bandages to put in each box?*
- *Does every student in our class have an opportunity to choose bandages that match their skin color?*

Now that he was satisfied with **what** tasks he would use for his problem solving activities, Mr. Elliott could plan **how** to structure the tasks into a cohesive sequence of activities.

How

Mr. Elliott considered **how** he could best sequence the activities that would use data analysis to develop students' mathematical reasoning and promote classroom discussions around equity and fairness. He wanted to integrate multiple modes of presentation, engagement, and expression (Buchheister, Jackson, &

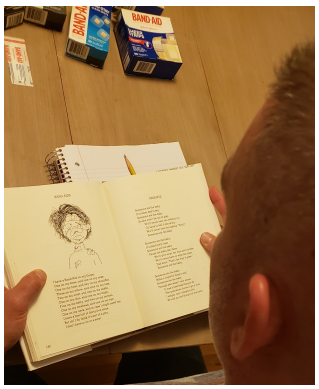
Taylor, 2017; Rose & Meyer, 2000) in the lesson sequence as the students explored different features of the bandages: size, shape, and color. To build the background for the powerful discussions he wanted to generate, Mr. Elliott structured the bandage exploration over three days (see Table 1).

Across the series of lessons, Mr. Elliott thoughtfully considered how he could organize the activities in order to stimulate his students' curiosity, promote problem solving, analyze anticipated strategies, emphasize key concepts, compare strategies or representations, and evaluate students' mathematical thinking.

For each lesson, Mr. Elliott planned to foster his students' problem solving strategies and facilitate mathematical discourse by following the launch, explore, summarize lesson structure (Lappan et al., 2014; NC2ML, 2017). For example, Mr. Elliott planned to use notice and wonder tasks as a springboard to collect and organize data about the locations of the bandages in the poem, as well as a mechanism to generate questions that would prompt discussion about equity and fairness. As he thought through the problem solving tasks, Mr. Elliott anticipated how his first graders would respond to the activities and planned specific questions (see Table 1) that would extend and support his students' thinking as they investigated the

Table 1

Sequence of Activities Exploring Equity and Fairness Through Data

	Lesson Launch	Problem Solving Exploration	Summary of Big Ideas
Day 1	Read "Band-Aids" poem.  Ask, *What do you notice about Shel Silverstein's poem, "Band-Aids"? What are you wondering (e.g., how many bandages are on the child's head? How many bandages were used all together? Are there more bandages on his head or feet?)?*	Give each table a two-column chart, construction paper, and a box of bandages to create their object graphs and tally charts. Students use observations from the launch to create an object graph and tally chart to visually represent where the bandages are placed on the character in the poem.	Compare the visual representations of the data and look at the distribution of the bandages in the object graphs and tally charts. After students share representations where bandages were located on the child in the poem, have students make observations about the types of bandages in the object graphs. Ask, *Did each table use the same kind of bandage for their object graph? Are all bandages the same? What is different about the bandages? Are they all the same size? Are all bandages the same color? Why do we have different color bandages?*

	Lesson Launch	Problem Solving Exploration	Summary of Big Ideas
Day 2	Look at the picture of your store's bandage aisle.  *What do you notice about the bandage boxes? What are you wondering?*	These (examples below) are pictures of the bandage boxes from the same store. *How can we sort the pictures of the bandage boxes? (Note: Cut out pictures of bandage boxes and make them into cards).*  Have students work with partners to sort the pictures in at least two ways. Partners use the picture cards to create an object graph that represents one way they sorted the boxes.	Students share graphs, and discuss how their graphs represent their sorting categories. Ask, *What do you notice about the size, shape, and color of the bandages in the boxes? Why do you think there are different sizes, shapes, and colors? How do companies decide the number of each size, shape, and color of bandages to put in each box?* Sequence the discussion to end with the following observation (if no student group notices the color of the bandages, have a graph ready to discuss the following prompts): *Why do you think there are different colors of bandages? Does every student in our class have an opportunity to choose bandages that match their skin color? Do you think every student in our city has an opportunity to choose bandages that match their skin color? Why do you think this is important?*
Day 3	Examine a variety pack of bandages and discuss how the box contains various sizes, shapes, and colors of bandages. 	Students work with a partner to create a box of 35 assorted (sizes, color, and/or shape) bandages. Ask questions that prompt students to explain why they included the various bandages in their box (e.g., *Why did you include [these] bandages but not [these]?*).	Students share the box they created. Then ask, *What box would you buy? Why would you buy this assorted box? How do we know we are getting the same number of bandages? Does everyone have an opportunity to choose a bandage that matches the color of their skin if they bought this (hold up a box) box of bandages?*

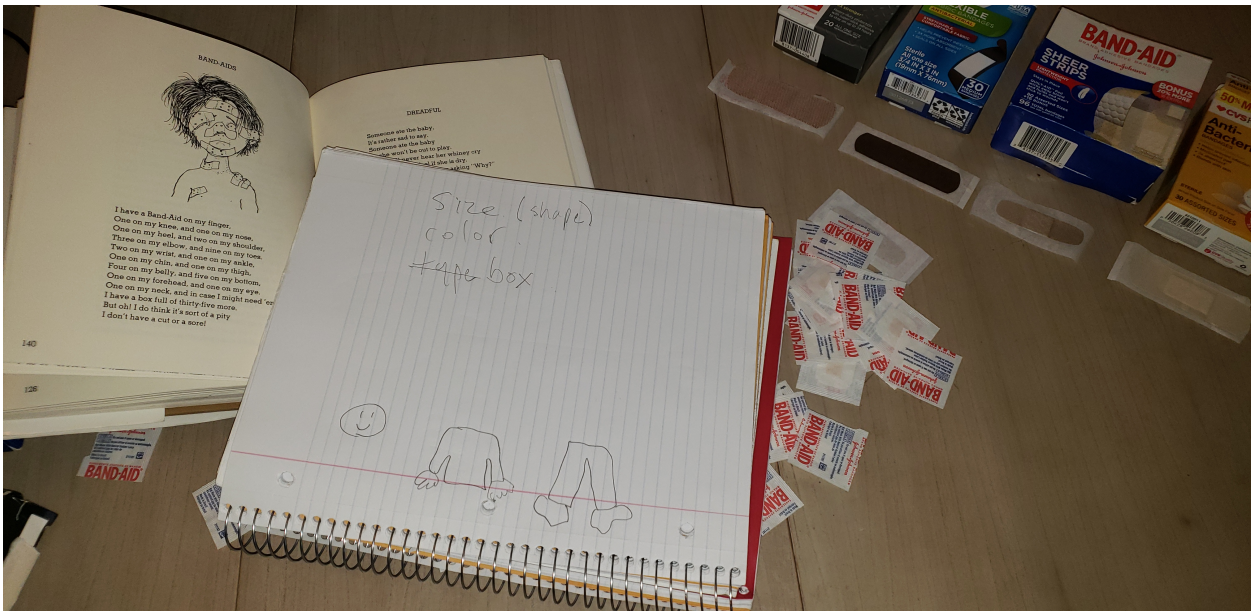
mathematical concepts in the exploration. For example, when he considered how students would sort pictures of the bandage boxes from the store aisle and represent the data, he anticipated students would sort the bandages by size, shape, color, and box (See Figure 1). Mr. Elliott intended to use the summary as an opportunity to have the students share their mathematical thinking and reasoning. Therefore, he purposefully planned how he would sequence the students' sharing and use their discussions of the data to engage in critical conversations around equity and fairness—specifically emphasizing skin-toned bandages. Now that he was satisfied with **what** tasks he would use to engage his students in integrated investigations of mathematics and equity, and **how** he had planned the structure and sequence of the tasks, he began thinking about the most integral component of the lesson—**who**se voice would be heard.

Who

To truly define equitable instruction, it is vital teachers attend to **who**se voice is heard, **who**se contributions are recognized, **who** is encouraged to contribute to the mathematical discussion, and **who** has opportunities to make meaningful connections to the mathematical experience. Before being introduced to the **What-How-Who** structure, Mr. Elliott had never fully considered

Figure 1

Categories Mr. Elliott Anticipated His Students Would Use to Sort Bandages



how to plan participatory methods in his mathematics lessons. In fact, he stated,

> Sometimes, actually most of the time, I'm trying to get my students to STOP talking. And, I have a cup of name sticks—little popsicle sticks with their numbers on it—and I use those to make sure I call on different kids each time. But, *now* [emphasis added] I'm thinking there's more to planning these lessons.

After reflecting on the **What-How-Who** structure, Mr. Elliott now realized he needed to plan intentional strategies that would not only stimulate his first graders' participation in a variety of ways, but also recognize the contributions of each and every student in the class. Mr. Elliott reviewed his activities and considered ways he could incorporate novel participatory structures in each part of the lesson sequence so each student could enter the mathematical conversations. As he planned to create a risk-free classroom environment where each student had an opportunity to contribute to the mathematical discussion, Mr. Elliott explained how he planned to value his students' mathematical reasoning—regardless of whether or not their answer was correct,

> I think one way we can encourage our students to feel comfortable is by allowing them to have an opportunity to succeed and fail without consequence. I can pick a student who got part of the problem wrong and use that to deepen their mathematical thinking. This fosters an environment where it lets kids know it is safe to make a mistake.

In these environments, the students would have time to make observations about the given situation, and discuss their ideas in different formats such as a think-pair-share or a jigsaw activity (Kagan, 2009). Mr. Elliott also wanted to incorporate students' inquiries and encourage student-led discussions. He planned to use students' responses to discuss equity and fairness as they compared, analyzed, and evaluated various strategies, solutions, and mathematical representations of the data.

As Mr. Elliott planned, he also considered how to include the voice of students who are often reluctant to talk in large groups. He explained how some students are hesitant in presenting their ideas to a large group and brainstormed different strategies to include in his lesson plans. For example, he planned to provide students advance notice that he wanted them to share their ideas and also planned to give them a choice in how they wanted to share. He described how students could either display their representation and have another student in the class explain what was presented, or he could show the class the student's representation and the student could explain it themselves. He also planned for students

to participate with nonverbal communication (e.g., student circles the set of objects with greatest number of bandages) or gestures (e.g., student points to parts of two visual representations to compare data) so that every student could share ideas that would contribute to the mathematical storyline. Mr. Elliott described how these participatory structures gave his students agency as doers and thinkers of mathematics as they used their representations of data to critically examine a variety of bandage boxes and the availability of skin-toned bandages in their community.

Reflection on Implementation

The **What-How-Who** structure gave Mr. Elliott a framework to analyze how his activities extended beyond the tasks to focus on the students and their mathematical experience. At first, Mr. Elliott expressed concerns about incorporating "sensitive" topics such as race into his math time,

> My school does not have a lot of people of color. I am afraid [talking about race] would really make [students] and their parents uncomfortable with me being a white man. I really thought the kids would focus on how there are different sizes and shapes and colors [of bandages]. Or, that they would talk about what happens if someone doesn't get the Band-Aid they want. I thought those talking points would be a good transition into the math content with counting and comparing with data, but it could also be a transition into thinking about fairness in a less tricky way.

However, when reflecting on the activity through the lens of the **what,** the **how,** and the **who**, Mr. Elliott described how the lesson generated children's conversations about race and equity.

As he reflected on the lesson, Mr. Elliot compared his initial perceptions when planning the lesson to what he noticed when analyzing the experience. He described how the poem, the images, and the physical products motivated first graders to pose questions and discuss what they noticed and what they wondered. Mr. Elliott explained how students' comments initially focused on the sizes, shapes, and "fun" colors of the bandages, but the conversation did not stop there. Through the discussion, students also addressed the cost of bandages and the access to high-quality products. They noticed words on the boxes Mr. Elliott displayed such as "invisible" and "clear," and these observations were the catalyst to critical conversations:

> *"Some of those [bandages] don't even work. But we have to get those because my mom seen the others but she said they too much money."*
>
> *"Those ones we get don't have different colors and stuff. They just all that pink color."*
>
> *"Why do they make the Band-Aids clear?"*
>
> *"Are they really invisible? Like totally invisible?"*
>
> *"Why they Band-Aids look shinier on [student]?"*
>
> *"Those kind are more invisible for [student]."*

Mr. Elliott described how he provided the space for his students to investigate the bandages' colors and "invisibility." He encouraged them to apply the mathematical concepts in his planned activity and posed purposeful questions that prompted his first-graders to see the counting and data collection process as a relevant and meaningful tool to address their inquiries. He shared,

> The kids' conversations surprised me. We took the time to talk about what they noticed, which I think is even more important for equity's sake. They seemed to be more active in our discussions and, in my opinion, this is because they felt more included and counted. I think asking kids about their feelings on the lesson—wherever it may lead—is extremely important; like here they started to see that there are people who don't fall into the standard 'flesh' tone. I think by responding to their questions makes their ideas more heard and made them feel more valued, which added to their feelings of worth.

Reflecting on the experience of using the **What-How-Who** structure, Mr. Elliott described several benefits to his teaching and his students' mathematical learning. The most powerful takeaway from the experience, however, was how Mr. Elliot referred to the approach as "only the beginning."

Conclusion

In this article, we described how Mr. Elliott used the **What-How-Who** structure to plan a series of mathematics lessons that could prompt students' analyses of different bandages. By planning to have

students organize, represent, and interpret the data from real-world contexts, Mr. Elliott intended to engage his students in discussions on skin-toned bandages and how the product reflects equity and fairness. While initially hesitant to incorporate explicit conversations about a "sensitive issue" such as race, after engaging in the planning process and analyzing the lesson implementation, Mr. Elliott described how his thought process changed. He commented,

> After doing this lesson [my grade level team] and I spent a lot of time talking about the math behind everyday things. We need to get our students going on these ideas EARLY! Having students realize how we use math to problem solve is so valuable in the real world. I know [the race and equity discussions] don't stick to "traditional curriculum," but this is an opportunity to get ALL of our students thinking about these situations from a very early age.

Mathematics is a tool each and every student can use to explore critical issues in our society. As Mr. Elliott explained in his reflection, using the **What-How-Who** structure in the planning process opened his mind to consider how early childhood teachers could approach these conversations with young children. It is imperative that classroom teachers have the resources and strategies to help them recognize these opportunities and plan intentional investigations that foster discussions about race, equity, and injustice that permeate our daily lives. Mathematical investigations that provide opportunities to critically examine race, culture, and equity can be done, even with the youngest learners. Planning activities and reflecting on the implementation of lessons through the lens of the **What-How-Who** structure can stimulate teachers to look beyond the tasks as they are presented in the classroom and instead envision how these experiences could stimulate students' identities as powerful mathematicians who can use mathematics to advocate for change.

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Discussion And Reflection Enhancement (DARE) Post-Reading Questions

1. How can you integrate the **What-How-Who** structure in your practice?
2. How can you use mathematical content to address fairness and equity?
3. What other examples of children's literature lend themselves to equity explorations?

The mission of TODOS: Mathematics for ALL is to advocate for equity and high quality mathematics education for all students—in particular, Latina/o students.

Five goals define the activities and products of TODOS: Mathematics for ALL

1. To advance educators' knowledge and ability that lead to implementing an equitable, rigorous, and coherent mathematics program that incorporates the role language and culture play in teaching and learning mathematics.
2. To develop and support educational leaders who continue to carry out the mission of TODOS.
3. To generate and disseminate knowledge about equitable and high quality mathematics education.
4. To inform the public and influence educational policies in ways that enable students to become mathematically proficient in order to enhance college and career readiness.
5. To inform families about educational policies and learning strategies that will enable their children to become mathematically proficient.

Helping Preservice Teachers Connect to Students, Subject, and Self

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Abstract

Effective teaching involves connecting to the strengths of all students. Teacher candidates need opportunities to explore their own identities, while also finding ways to relate to the assets and perspectives their students bring to the classroom. It is critical that they recognize the strengths of multilingual students. This article shares two experiences that can help teacher candidates consider these elements within the context of mathematics in meaningful ways.

Discussion And Reflection Enhancement (DARE) Pre-Reading Questions

1. How can you validate students' cultural values and practices in your lessons?

2. How do you create opportunities in teacher education courses to challenge teacher candidates to examine their own beliefs, biases, and experiences?

3. What are ways teacher candidates can explore meaningfully connecting students, subjects and self in their lessons and instruction?

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Gwendolyn Williams (gmw0015@auburn.edu) is an associate professor of ESOL education at Auburn University. Her experiences as a content-based ESOL educator for secondary students have directed her research and teaching to focus on enabling teachers to provide access to meaningful content area instruction for English learners in a variety of settings.

Helping Preservice Teachers Connect to Students, Subject, and Self

Megan Burton and Gwendolyn Williams

> Math is something I am uncomfortable with myself, so trying to think of how to help someone who struggles in math is difficult for me…. Then you add on that they aren't solid in English…that terrifies me. I don't want to mess up.

This quote, written by a teacher candidate (TC) on the first day of a mathematics methods course, reflects the sentiments often expressed by many TCs as they enter a mathematics methods course (Bartels, Rupe, & Lederman, 2019). A challenge for many elementary education mathematics methods instructors (MMIs) is supporting growth in TCs' identities as mathematics educators, while also shifting their perspectives to view emergent bilingual learners' experiences as positive contributions to classroom instruction (Civil, 2016), rather than focusing on deficit thinking, which has been used too often by scholars, teachers, policymakers, and others to describe English learners (de Araujo, Roberts, Wiley, & Zahner, 2018). Through the analysis of vignettes and experiential learning, TCs can investigate their own identities as mathematics teachers and learners. Such activities foster confidence in planning and facilitate an equitable, rigorous, and coherent mathematics program that incorporates language and culture into the teaching and learning mathematics (TODOS, 2019).

Mathematics Methods Courses for Teacher Candidates

"Good teachers join self and subject and students in the fabric of life," (Palmer, 2007, p. 47). To do this, teachers must know their students, the content area (mathematics) and themselves. Mathematics methods courses allow TCs to explore how to teach and learn mathematics, which entails learning to leverage the diverse assets and needs of learners. Helping all students see their ability to effectively use mathematics in their lives involves understanding the lives of students (Aguirre et al., 2013). Teachers play a critical role in shifting student status to focus on the contributions bilingual learners' experiences add to the classroom (AMTE, 2015; Civil, 2016), rather than utilizing deficit thinking when discussing bilingual learners (de Araujo et al., 2018).

Experiential Learning

TCs must learn to relate mathematics to the personal lives of their students (Ewing et al., 2019). In order to support TCs in this action, MMIs must model this behavior for their students. The key to effective equitable instruction centers on relationships that acknowledge, build upon, and celebrate the identities of individuals and understand the theories that underpin the mathematical or instructional strategies being implemented (AMTE, 2015). One way to highlight the mathematics in the lives of TCs and their students is to provide experiences that emphasize this connection.

Example: Mathematics Photos Outside of School

In one lesson, TCs were asked to photograph examples of fractions, decimals, and percentages that they encountered. This included what they saw in their surroundings and those they used in their daily lives. Then they were asked to think about how contextualizing fractions, decimals, and percentages in students' and TCs' home lives could be beneficial to instruction. TCs reflected on recipes, shopping sales, gas prices, and measuring in their initial homework assignment (see Figure 1).

After having reflected on these experiences in their own home environment, TCs explored the neighborhood where their students live. TCs engaged in a community walk in order to locate examples of fractions, decimals, and percents they could share in their classrooms. Some of the images that were collected were windowpanes, food items, pie graphs from the newspaper, bookshelves, money, clocks, and bento boxes. Figure 2 is a photograph taken on the community walk showing produce at the Asian supermarket that was $1.98 per bunch, noted by one student that these were on sale at 20% off.

Figure 1

Examples of Fractions and Decimals Shared by TCs

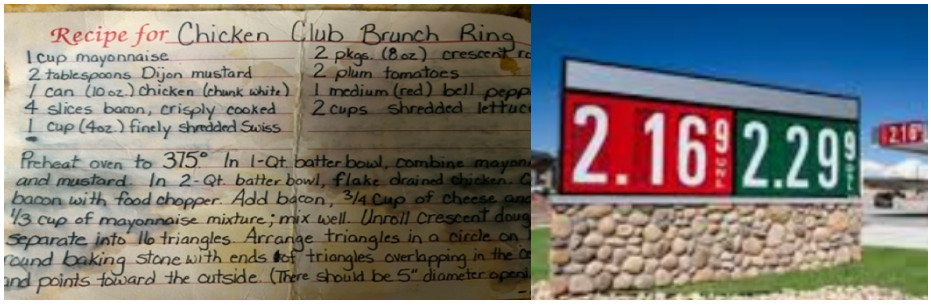

Figure 2

Example of Decimals and Percentages From Community Walk

TCs discussed how the items they photographed from their personal experiences before the community walk may or may not be relatable to learners in their classroom. These objects resonated with the TCs and were familiar to them. One TC mentioned that as a child, she didn't care about gas prices, so why would she expect students to care about it? Therefore, the TCs acknowledged the need to bring in a variety of photos and examples for their students to relate to.

As an extension of the preceding activity, MMIs asked TCs to encourage their students to email a photo of fractions, decimals, or percentages being used in their home (or to draw pictures if these were more accessible). These photographs were shared in the mathematics methods course as TCs designed lessons with the images they collected. Expanding the activity to involve parents and children finding fractions, decimals, and percentages at home proved to be extremely fulfilling. TCs recounted various family traditions and hobbies involving fractions, decimals, and percentages, such as cooking family recipes, dividing pies, stitching quilting patterns, constructing buildings, and reading music. They reflected on how excited students become when sharing stories about their families. TCs also observed that many more uses of fractions, decimals, and percentages were acknowledged through involving the family and community. Sports, pie graphs from the newspaper, bookshelves, money, clocks, and bento boxes are some examples of the images collected that TCs had not originally considered but upon closer examination of each they discovered fractions.

Through the analysis of these images, TCs discussed identifying the whole, equi-partitioning, unit fractions, associating fractions with decimals, and other critical elements of fractional reasoning (Flores, Burton, & Hinton, 2017). They also gained insight into the world in which their students live and the ways the students see mathematics around them. For example, one TC

remarked that a student's father, who works in construction, showed the student multiple ways that he uses fractions in his work. The TC said the student is typically shy but was eager to share this information with the class. Photos and drawings can foster understanding and alleviate anxiety over vocabulary questions that the emergent bilingual learners might have (Miller & Warren, 2014).

TCs investigated ways to utilize the photos students shared to assess thinking, to involve students in discussions, and to extend their mathematical learning. Too often students do not see the intersection of mathematics in questioning and problem solving to the world where they live (Felton-Koestler, Sutherland, & Tracy, 2016). These ideas push the teacher educator to examine the mathematics teaching practices and strategies to reach multilingual learners.

Unpacking Experiential Learning

Experiences should link mathematics inside the classroom to the mathematics students already encounter in their communities (Felton & Koestler, 2015). This activity encouraged TCs to relate mathematics to various communities and recognize the linguistic and cultural capital of their students (Cancienne, 2009). For example, one TC who had never visited the Asian supermarket found a wealth of new resources to integrate in her teaching. While many of the mathematical examples could be found at any store or supermarket, utilizing examples from the neighborhood where the school is situated, and products that are familiar to students, is important. Such an exercise highlighted the students' and TCs' cultural funds of knowledge that are portrayed through the photographs of mathematics in their lives (Aguirre, Zavala, & Katanyoutanant, 2012) and focused on conceptual understanding (Moschkovich, 2013). Experiential learning builds on student responses and active learning (Banse, Palacios, Merritt, & Rimm-Kaufman, 2017), while maintaining the focus on mathematical content (Moschkovich, 2013). Considering different perspectives allowed TCs to probe the cultural nature of mathematics (Planas, 2018).

Instructional Vignettes

Instructional scenarios/vignettes also help teachers and TCs inspect and examine elements of teaching and learning (Turkan, 2016). Providing TCs with multiple examples of mathematical concepts is important to mathematics teacher education (Dreher & Kuntze, 2015). Specifically, vignettes provide real life situations through which TCs can study the sociocultural factors involved in how students may respond to mathematical experiences (Civil, 2016). Scenarios also show concrete examples of how language and mathematics are intertwined. Such a focus is critical for emergent bilingual students who face challenges in accessing mathematics instruction due to a limited vocabulary and developing conversational skills (Banse et al., 2017).

Vignettes serve as a springboard for TCs to reflect and interrogate their own identities and perspectives as mathematics teachers and learner as well as to relate to the identity of students in elementary mathematics instruction. This pedagogical method is useful to MMIs because it enables the TCs to reflect individually on a common classroom scenario before participating in a larger class discussion (Wilkerson, Kerschen, & Shelton, 2018). Scenarios should be short situations that readers can use to deconstruct and gain insight into teaching and learning. The following vignette is a sample of several that were given to TCs throughout the semester. Each situation was distributed on a sheet of paper with follow-up questions that they were to respond to in groups of four before participating in a whole class debriefing

Example Vignette: Play to Understand Representations and Connections

This example (see Figure 3) illustrates how teachers can empower bilingual students and utilize their cultural capital that emerges naturally during informal play. It allowed TCs to see the role they play in equalizing status among students and the way language is perceived.

Unpacking the Example Vignette

In this vignette, TCs are able to analyze the role of play in early childhood mathematics classrooms, while also noticing the role of language. Play is a vital element in creating space for problem solving, real world

Figure 3

Vignette and Follow-up Questions

Vignette: Bilingual Play

Three children are playing with blocks at centers: One student's preferred language is Spanish, another student speaks fluent English and Spanish, and the third student knows only English. As they play, students make hand gestures and use Spanish and English to communicate about which blocks they need and how to build the structures. After the free play, they are asked to reflect upon their time. They share that they have learned words from each other and that they could communicate by drawing the shape if the words were difficult to understand. They also described how they put two cubes (cubos) together to make a rectangular prism (prismas rectángulares), when they were out of rectangular prisms. Initially, they used two-dimensional terms (square, rectangle, cuadrado, and rectángulo) in the debriefing, but the teacher encouraged them to find the English and Spanish words on their iPads for the three-dimensional shapes.

After reading the scenario, respond to the following in your mathematics journal and be prepared to discuss with your group.

1. List the mathematical knowledge and/or practices demonstrated in this scenario.
2. How did the discussion benefit each student?
3. Do you agree or disagree with the teacher's extension? Why?
4. What might you ask or do to follow up and extend this learning?
5. How could you utilize this discussion in small group debriefing?

applications, discourse, perseverance, and identity development (Wager & Parks, 2014). Through play, students communicate and clarify their thinking using visuals, language, and gestures, each of which are important for clarifying meaning for all students, including emergent bilingual students (Moschkovich, 2013). This natural exploration also provides opportunities to use and correlate multiple representations of mathematical concepts (Dreher & Kuntze, 2015; Moschkovich, 2013). Instruction should enable students to access their funds of knowledge from their multiple linguistic repertoires (Aguirre et al., 2012; de Araujo et al., 2018), which is something that play promotes. These ideas about teaching and learning emerge from the analysis of the vignette. The TCs gained a deeper awareness of how their students' linguistic capital factors into their learning of mathematics. For instance, when TCs delved into this scenario, one TC immediately commented to her discussion group:

> With all the vocabulary and things [that] I am learning in this class I can't imagine knowing another language as well. I also think about how it is helpful having the bilingual student to help understand all that the Spanish speaking student knows, but how it's not fair to expect that student to always translate. What would I do if there weren't a bilingual student?

When pressed by group members, she explained:

> I mean often students could make these connections across languages with symbols and gestures, how can I help them see the value in understanding each other and in learning different ways to communicate? I love that they even drew pictures when needed. It's cool that so many of the words are similar in both languages and that they are learning together.

As this example demonstrates, she was able to see the significance of language in the process of constructing meaning within a mathematical scenario.

Teacher educators can share vignettes such as this to encourage TCs to notice what mathematics they recognized, what assets were revealed, and what their next steps might be. As TCs analyze this vignette and similar scenarios, the elements of diversity and multilingualism need to emerge in the conversations. For example, one TC shared:

> I think hearing the similarities in language helps connect students. However, it also makes me think about all the other things the student who speaks Spanish could teach us and what else she could contribute to our learning. Like, I could ask all students where they find these shapes at home and all students could bring in different experiences. It makes me want to incorporate more things that she can share, not only to help her, but to help all of us.

TCs compiled different ways they might assist, elucidate, and deepen student mathematical thinking during and after this vignette. For example, one TC explained that extension activities could be finding other shapes that can be formed by combining shapes, sorting shapes by characteristics, or asking students to describe shapes. Having students investigate the properties of shapes creates more opportunities for language development while also strengthening their understanding about shapes. TCs reflected on the roles that culture and home language hold in the classroom vignette. One TC revealed that in her mathematics methods clinical placement, a student constantly called the cube a box, which prompted a conversation on how to incorporate students' experiential vocabulary with the mathematical terms they were learning.

Vignettes allow TCs to notice specific themes that are present in a narrative in order to build their professional content knowledge (Dreher & Kuntze, 2015). However, it should be acknowledged that TCs need practice in order to hone their noticing skills which the analysis of vignettes are designed to supply.

Connecting Mathematics, Culture and Identity

MMIs must focus on holistically empowering TCs in mathematics teaching and learning. TCs need to discover their immense power over not only the content, but also their students' attitudes towards mathematics. Their enthusiasm and wonder for both the subject and students are essential (Zavala, 2016). Helping students recognize their ability to effectively use mathematics in their lives involves "attending to the multiple identities—racial, ethnic, cultural, linguistic, gender, mathematical, and so on—that students develop and draw on as they learn and do mathematics." (Aguirre et al., 2013, p. 9).

In order for TCs to learn to effectively teach mathematics students, MMIs must offer both "mirrors and windows" into identities so that TCs see new perspectives on the world while still being able to see themselves reflected in the content that (Bishop, 1990). Examining mathematics through multiple languages and cultures can produce deeper insight, junctures, and understanding of content (Planas, 2018). Emergent bilingual learners can draw from a wealth of knowledge in their various languages to make meaningful correlations between their personal knowledge and the concepts of math (Aguirre et al., 2013). Designing activities that examine classroom norms, unpack multiple strategies to solutions, forge various cultural associations in mathematics, and compile multiple resources empowers TCs to deliver more effective instruction (Moschkovich, 2002). TCs should search for assets each student brings to the learning situation, authentic learning opportunities where mathematics is explored, and experiential learning opportunities that support all learners' mathematical identities (Miller & Warren, 2014; Moschkovich, 2002).

Closing

By integrating vignettes and experiential learning activities into math education courses, TCs can examine their identities, the identities of students, and the practices of effective mathematics teaching and learning. Then they are encouraged to consider how others view the content and how to maximize the unique identities of their learners. Each situation provides opportunities for TCs to analyze biases they may have about students and mathematics. It also pushes them to examine strengths of encouraging various strategies for teaching mathematics. For example, at the end of the semester one TC reflected on these activities and concluded:

Before this class I was nervous about how to work with students that struggle with English and I thought about it as a struggle and weakness. Now I realize how much each student brings to the classroom and how much I can learn from them. It helped me see that using what they know as a strength and connecting the math to it is important for all of us.

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Discussion And Reflection Enhancement (DARE) Post-Reading Questions

1. How does your mathematics instruction incorporate the students' funds of knowledge?

2. What roles do your own experiences and learning play in the way you perceive mathematics teaching and learning?

3. How would these activities support (or not support) the development of the teachers with whom you work? What adjustments could you make to improve the impact of these experiences?

4. What activities can you provide to teacher candidates (TCs) to connect their students, the mathematics content, and themselves, as Palmer (2007) suggests?

5. What additional insights on the areas from this article can you find in the three TODOS monographs archived at https://www.todos-math.org/todos-publications?

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***TEEM* Special Themed Issue**

Antiracism in Mathematics Education

Call for Submissions

Submission Deadline: September 15, 2021

The momentum around defining and enacting antiracism in the mathematics classroom is growing. We have resources now that help us conceptualize and move forward in our commitments to making classrooms spaces that are truly welcoming to all students and their families, in ways that honor the humanity of all people, and recognize the power and potential in students to know, learn and critically engage with mathematics. We will not debate the need for antiracist mathematics education - we are moving forward with examples, ideas, and case studies. For this special issue, we grapple with, "What does antiracist mathematics education look, sound, and feel like across PreK-12 and teacher education?" In particular, for this special issue, we are interested in the following:

- What are the stories from the classrooms, districts, and other spaces where antiracism in mathematics work is being done?
- What are the tensions and resolutions arising from engaging in antiracism work?
- What are productive points of inflection or change, in terms of institutional policy, teacher practice, personal disposition, etc.?

The *TEEM* Guest Editors for this special issue are Ksenija Simic-Muller (Pacific Lutheran University) and María del Rosario Zavala (San Francisco State University).

We understand pandemic times have made it hard to find time to write, especially for potential authors who are parents/caregivers. Additionally, we hope to make our journal a space to encourage creative and boundary-pushing forms of scholarship. For these reasons, we encourage formats such as shorter, narrative descriptions of first-person experiences, video testimonies, and other creative works as alternatives to manuscripts conforming to all *TEEM* guidelines. We strongly encourage both newer and experienced PreK-12 classroom teachers, possibly in collaboration with researchers, to share your experiences and observations, informed by the TODOS statement on antiracism. We envision this issue as a snapshot of successes, struggles, questions, and myriads of ways we are finding our footing as we do complex work of antiracist mathematics teaching. Therefore, pieces need not be fully polished, as they reflect how authors themselves are in-process. Email **teem@todos-math.org** (subject line TEEM antiracist special issue) with your submissions or with any questions about the suitability of your possible topic/format.

Guidelines:

- Manuscripts should make explicit connections to the conceptualization of antiracism in the TODOS Position statement from 2020 (https://www.todos-math.org/statements)
- Authors should send their submissions via email to the *TEEM* special issue editors at TEEMAntiracismIssue@gmail.com. The subject line for submissions should read "Antiracism Special Issue".
- Additional Guidelines can be found at www.todos-math.org/TEEM.

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