

# Addressing Social Justice in the Science Methods Classroom through Critical Literacy: Engaging Preservice Teachers in Uncomfortable Discussions

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## **Abstract**

The purpose of this paper is to exemplify how teacher candidates can be engaged in discussions around social justice and equity in science methods courses while also learning about and practicing essential science teaching strategies and skills. Our aim is that science teacher educators who do not feel confident enough to explicitly address these important issues in methods courses are encouraged to think creatively about how they can modify or alter their current practices in a way to prepare science teachers for the changing demographics of science classrooms. We present an engineering design activity that is coupled with critical literacy skills, called ‘Build a Child.’ Upon identifying the problem, we introduce the context of the preservice teachers’ science methods course and reason for this work, followed by defining critical literacy and how it pairs well in science education. We then share the “Build a Child” engineering project and how we asked preservice teachers to critique and reflect on their creations, thus bringing in a critical literacy framework to the curriculum. Next, we share three findings based on our data analysis, and we end with the importance of science methods courses implementing social justice education and suggestions on how to reexamine our science curriculum to make it more culturally relevant and equitable for all students.

## **Introduction**

In 2016, a white, female, science teacher in an 8<sup>th</sup> grade classroom in Baltimore, Maryland grabbed a black male student by the hood of his jacket and told him he was a “punk a\*\* n\*\*\*\*\* who is going to get shot” as she hauled him out of the classroom. She then turned to the rest of the students, most of whom were students of color, and called them “idiots” and

“stupid” (Green, 2016). In March 2018, a white, female teacher in Crystal River, FL was fired after her white nationalist and racist podcast unearthed (Stevens, 2018). In December 2018, another white, female, science teacher in South Fresno, California was caught on camera forcibly cutting a student’s hair in front of his peers as she sang the U.S. national anthem loudly (Hutcherson, 2018). In March 2019, a white, male, science teacher was suspended after allegedly using the “n-word” during a science class in Pens Groove, New Jersey (Brown, 2019).

A quick Internet search will show that the aforementioned incidents are hardly unique. As science teacher educators we have seen more than a dozen of news stories like these in the media over the last decade. We could not believe that a teacher would behave in such a deplorable way and possibly blame them for not acquiring the required dispositions to teach, especially in a context that is racially, ethnically and linguistically diverse. What we ignore, however, is the role we, as science teacher educators, play in these teachers’ inability to understand and interact with students who are culturally different from them. It is about time we revisit our complicitness with teacher candidates’ stereotypes of people from other cultures and races different than their own.

Over the last three decades, science educators’ agendas have heavily focused on changing classroom science teaching practices from traditional lecture and cookbook labs format to constructivist and inquiry-oriented teaching and learning approaches. We have focused on developing teachers’ (both prospective and inservice) and students’ scientific argumentation skills and improving their understanding of scientific ways of knowing. While emphasizing these issues are important, teacher educators rarely, if at all, center instruction on social justice and equity, and thus, fall short in preparing teachers for the changing demographics and needs of their classrooms.

Teacher candidates’ perceptions of preparing to become a science teacher are not any different from ours. They come to our courses with the expectation that we will address the science content knowledge they need to know and teach the strategies and techniques necessary to “deliver” the content (Ball & McDiarmid, 1990; Feiman-Nemser, 2012). Rarely teacher candidates find concepts, such as understanding the needs of their culturally diverse students, practicing culturally relevant teaching practices, or learning to properly integrate reading and writing in science instruction to help their students develop their language literacy skills as important and relevant as learning to teach science (Silverman, 2010). The news stories we shared above provide evidence that science teacher preparation is and should be indeed more than just preparation of teachers for the content expertise.

Scholars (e.g., Gay, 2010; Ladson-Billings, 1995, 2014; Nieto, 2005; Sleeter, 2005) recommend increased emphasis on culturally relevant teaching pedagogy in teacher preparation courses. Preservice teachers are in need of preparation that places culturally relevant teaching at the forefront in order to prepare future teachers with issues that may arise regarding race, culture, and gender, for example, in their classrooms, and culturally

relevant pedagogy provides ways of centering the cultures, languages, and experiences that diverse learners bring to classrooms (Villegas & Lucas, 2002). However, too often science teacher educators themselves are not knowledgeable about how to cater to the unique needs of culturally diverse students of science or what culturally relevant teaching approaches should look like in science classrooms. Considering the lack of science teacher educator knowledge and experience with culturally relevant teaching, our goal is to exemplify how teacher candidates can be engaged in discussions around social justice and equity in science methods courses while also learning about and practicing essential science teaching strategies and skills. Our hope with this article is that science educators like Nazan, who do not feel confident enough to explicitly address these important issues in methods courses are encouraged to think creatively about how they can modify or alter their practices in a way to prepare science teachers for the changing demographics of classrooms.

We want to clarify, however, that we do not claim that this single activity that spans over a couple of days makes big changes in the worldviews preservice teachers have developed over their lifetime. However, it is through engaging and thought-provoking activities such as the one we explain below that both science teacher educators and preservice teachers will engage in conversations that they may find difficult and uncomfortable. For real change to happen, more of these conversations and engagements must happen in the entire curriculum of a program.

We begin by introducing the context of the preservice teachers' science methods course and reason for this work, followed by defining critical literacy and how it pairs well in science education. We then share an engineering design project and how we engaged preservice teachers in critical conversations by critiquing and reflecting on their creations. Next, we share conversations preservice teachers had among themselves and with us, and the themes that emerged from these audio-taped conversations. We end with the importance of science methods courses implementing social justice education and suggestions on how to reexamine our science curriculum to make it more culturally relevant and equitable for all students.

## **Context**

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In 2016, the Department of Teacher Education at this Midwestern university adopted a mission statement which highlighted our commitment to preparing teachers for confronting social injustices in all educational settings. This commitment required a shift in what was in the center of our curricula. As we revised our course curricula by centering it on learners and focusing on culturally relevant pedagogical approaches, it became obvious that Nazan's lack of expertise and experiences in these approaches were obstacles in effective implementation.

Nazan is an international scholar who was born and raised in a non-English speaking and Muslim country. She was one of the eight female students out of 60 who studied and earned a bachelor's degree in Physics prior to pursuing a graduate degree in the U.S. Her personal and academic experiences and worldviews have been shaped by her perceived minority identities (ethnic, religious, and gender). While she could empathize with injustices that other minority groups (e.g., LGBTQ+ and people of color, or POC) faced with and became allied to related causes such as Black Lives Matter, she failed to recognize her dominant white identity and its impact on the communities in which she was engaged. Through the process of critical introspection in faculty meetings, learning communities, and audited courses with social justice foci, she started to acknowledge her white identity and the need to address issues of social justice in her science methods courses.

Sharing scholarship at the faculty meetings and ideas during hallway conversations enabled us to identify the exemplary work already been done by colleagues. Katherine, for example, had her English Language Arts education majors select print and nonprint linked texts, centering on a social justice theme (e.g., Black Lives Matter) and then critique their texts through a critical literacy lens to address their implicit biases (Batchelor, DeWater, & Thompson, 2019). What attracted Nazan to this work was that Katherine was able to meaningfully weave the new mission with the content of her course (ELA), which her students were expected to teach.

The question for Nazan was, How could the same be done in a science methods course? This is how the idea of integrating engineering design and critical literacy came to coexist for us. Early Childhood Education majors in Nazan's science methods course had just learned engineering design principles as addressed in the *Next Generation Science Standards* (NGSS, NGSS Lead States, 2013). The critical literacy infused engineering design activity, called "Build a Child" mentioned below, would create a context for the preservice teachers to apply principles of engineering design they previously learned while enabling us to engage them in uncomfortable discussions and identify any implicit bias preservice teachers might have about their future students. In a study conducted with a comparable sample of preservice teachers, Bautista, Misco, and Quaye (2018) found that preservice teachers often "have *submerged epistemologies* (e.g., implicit biases) about the world that may or may not show themselves in teacher preparation classes and the schools in which they may teach" (p. 166). Batchelor (2019) research also revealed that preservice teachers' sociocultural experiences and intersectionality awareness influenced their thinking about bias. Therefore, engaging preservice teachers in an explicit discussion about their child creations using a critical literacy lens would encourage this engineering design activity to become a platform for culturally relevant teaching.

## **Critical Literacy Paired with Science in Preservice Teacher Education**

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There is a disparity between children's diversity and the standardizations and curricula associated with them (Genishi & Dyson, 2009). With 80% of teachers identifying as white, middle class, monolingual females, it's not hard to see why (Nieto, 2000; Villegas & Lucas, 2002). Children need to see themselves in the curriculum, but without the pedagogical backbone of culturally relevant teaching, this can become a roadblock to curricular choices for some teachers, especially future teachers. One way to combat this void is through the practice of critical literacy. Critical literacy provides pathways for teachers who are seeking to engage in culturally relevant teaching practices since it is rooted in democracy, injustice, and considered a lens of literacy as well as a practice engaged to encourage students to use language to question their everyday world experiences. In particular, it centers on the relationship dynamic between language and power, positing that text and education are never neutral. It is a sociopolitical system that either privileges or oppresses, especially regarding race, class, and gender. Critical literacy meshes social, cultural, and political worlds with how texts (in the broadest sense) work, in what context, and discusses who benefits and is marginalized within the boundaries of these text uses (Lewison, Leland, & Harste, 2014), which is one of the tenets of culturally relevant teaching: developing a critical consciousness (Gay, 2010; Ladson-Billings, 1995), meaning, students are able to critique cultural norms and values society has deemed worthy.

There is no set "how-to" on how to enact critical literacy in the classroom. This is because each experience is contingent upon the students' and teachers' power relations and the needs and inquiries of each child. However, the most commonly used practices that support critical literacy in the classroom include: reading supplementary texts; reading multiple texts; reading from a resistant perspective; producing counter-texts; having students conduct research about topics of personal interest; and challenging students to take social action (Behrman, 2006).

Critical literacy practices and inquiry-based science pair well since both encourage instructional strategies that build on students' curiosities of the world around them and enhance literacy skills. Additionally, scientific literacy requires the ability to critique the quality of evidence when reading various media, including the Internet, magazines, and television. Moreover, providing opportunities for students to question and ponder what students find meaningful is important to promote an inquiry-based classroom, whether it be in science or language arts.

Both critical literacy and science education encourage students to meaningfully and actively participate with others in a global society. For example, DeBoer (2005) suggests, "Science education should develop citizens who are able to critically follow reports and discussions about science that appear in the media and who can take part in conversations about science and science related issues that are part of their daily experience" (p. 234). Therefore, the many benefits of including critical literacy practices in science education should be examined with preservice teachers as well as practicing teachers.

## Preparing Preservice Teachers for the Critical Conversations

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In the days leading to the engineering design and the critical conversations, preservice teachers read articles by Montgomery (2001), Moll et al. (1992) and Yosso (2005) focusing on creating culturally responsive and inclusive classrooms and students' funds of knowledge. They conducted a diversity self-assessment adopted from Bromley (1998). They shared their self-assessment responses in small groups and discussed the ideas that emerged from these small groups as a whole class. Perhaps the most important aspects of these discussions was that most preservice teachers initially shared their own stories of being stereotyped. For instance, identifying herself as feminine, Bekah expressed that people often assumed she could not use power tools, such as a drill press, or do physical hard work (e.g., putting up a drywall). Yufang, the only international student in the methods class, explained how she felt silenced and invisible in most of her college courses by peers and professors as she could not speak English fast enough during her freshman and sophomore years. Nazan, then guided preservice teachers to consider their future students experiencing similar or other biases (e.g., racial, religious, etc.) and what actions they might take to reach out to these students. Using Moll's (1992) funds of knowledge and Yosso's (2005) cultural wealth model, preservice teachers compiled ideas to make their future students feel included in their classrooms and were encouraged to add new ideas to the class list for the rest of the semester. These classroom discussions set the stage for the "Build a Child" engineering design activity, which they started in the following class meeting.

### "Build a Child" Engineering Design Challenge

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We called the activity, composed of three phases, "Build a Child" because of both its literal and symbolic meanings. While constructing a product using cardboards and Makedo tools as part of the engineering design process in the first phase, we asked preservice teachers to imagine who they were building and who the child was as a whole with his/her/their background, race, ethnicity, struggles, communities he/she/they lived, etc. (second phase). Through these reflective and critical discussions, preservice teachers would become more aware of the stories their future students would bring to their classrooms and the ways in which they needed to build strong relationships with these students (third phase).

#### *Phase 1: Engineering Design*

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Preservice teachers first practiced engineering design principles as they built a child using cardboards and Makedo™ construction toolkit<sup>[1]</sup>. Engineering design is the method that engineers use to identify and solve problems. What distinguishes engineering design from other types of problem solving is the nature of both the problem and the solution. The problems are open-ended in nature, which means there is no single correct solution. Engineers must produce solutions within the limitations of their context and choose solutions that include the most desired features. The solution is tested, revised, and re-

tested until it is finalized, and different groups of engineers can end up with different valid solutions. See Figure 1 for the tasks and rules we provided to the preservice teachers to complete this task successfully.

Figure 1 (Click on image to enlarge)

*Rules and Criteria Provided for the “Build a Child” Engineering Design Activity and Used to Evaluate Preservice Teachers’ Creations*

- You are only allowed to use the cardboards and the Makado™ tools provided.
- The cardboard child can be 2-D or 3-D and should be between 40 and 50 inches tall.
- The design must have at least 4 moving parts and the motion has to be done with a makado tool (e.g., use a screw to move the arm. Bending the cardboard to move it is not accepted).
- Each of you has to build their own cardboard child; however, you can assist each other (e.g., brainstorm together or provide suggestions for improvement).

Once the designs were ready, Nazan, as the instructor, tested each of them to verify whether the designs followed the rules provided in figure 1. Based on the results, preservice teachers either moved on to the next section or revised their design based on the feedback provided until their design was re-tested and approved.



## **Phase 2: Essays**

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In the next phase of the lesson, the cardboard children came alive. Preservice teachers individually wrote a background story about their children, detailed enough for the class to get to know each child well. We provided some questions to guide them as they wrote the stories (see figure 2). Since the class time was not long enough to finish these essays, they finalized them and submit them to the instructor prior to the next meeting, which would start with everyone presenting their stories.

Figure 2 (Click on image to enlarge)

*Guiding Questions for the “Build a Child” Essays*



- What is the child's gender, race, ethnicity, etc.?
- Describe the child's personality, likes and dislikes, hobbies, etc.
- Describe the child's family and social environment.
- Where does the child live? Describe the environment.
- What is the child good at and what is difficult for "it"?
- What is the child looking forward to this year?
- What are the child's goals this year?
- How is the child's academic performance?
- What is the child's favorite and least favorite subjects?

**Phase 3: Critical Conversations**

The next phase, critical conversations, began when we asked preservice teachers to imagine that the children they built and narrated would be the children in their future classrooms. We provided the questions in figure 3 to engage them in the critical conversations. We reassured our students before discussion began that acknowledging our own privileges is never easy, and talking about them is even harder, especially when it comes to unpacking implicit biases we all hold. Tensions will arise, but it is through these tensions that we outgrow our thinking. Both Nazan and Katherine shared personal experiences with implicit biases they carried in order to build trust and share that even though they are “seasoned teachers,” they too were challenged with personal biases they carried. By revealing these moments and prefacing the conversation on tension producing reflection, preservice teachers were more willing to share beliefs about their children in small group settings.

Figure 3 (Click on image to enlarge)

*Critical Conversation Questions Used to Guide Explicit Discussions*

- Who are/men't represented in your classroom? [Alternatively: Who did we neglect?]
  - Whose voice is likely to be heard? Whose voice is likely to be lost? [Alternatively: Whose voice is dominant? Whose voice is dominated?]
  - How similar is the composition of the cardboard student classroom to the composition of our classroom?
  - What does this activity say about who we see and find important and who we will we recognize as our target audience in classrooms? [Alternatively: What assumptions or biases exist about our future students?]
  - How do you plan to build relationships with students who are culturally different than yourself?
  - After this experience, what are some major takeaways in regards to what it means to be a socially-just science teacher?
- While discussing, consider variables such as gender, race and ethnicity, sexual orientation, religious affiliation, socioeconomic status/poverty, and access to resources as well.

During these small group discussions, both authors sat in on conversations and listened. When conversations were in lull, they would pose questions to extend and nudge students to provide more thinking behind their decisions to create a child with a particular race or



gender, for example, and ask them to delve deeper into their own experiences as a student and what they witnessed in school, and more importantly, build empathy toward their created child's story.

Critical literacy and culturally relevant teaching empower students and teachers to be risk-takers, for voices to be shared and heard. Therefore, when small group discussions concluded, both authors gathered the class back as a whole and asked them to share the highlights of their conversations; question and critique who is in power in making curricular decisions, and generate ideas as to how they would address some of these issues as they make curricular decisions in the future.

## **Effectiveness of Preservice Teachers' Critical Conversations**

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Following the tenets of culturally relevant teaching (Gay, 2010; Ladson-Billings, 2014; Nieto, 2005), modeling it with and for our students, we engaged in instructional conversations based on meaningful topics, such as systemic issues in education, making the conversation more student-based than teacher-based, and we used open-ended questions to elaborate meaningful discussion. Nieto (2005) discussed ways to support future and practicing teachers by assisting them to “reflect deeply on their beliefs and attitudes” (pp. 217-218), which will hopefully over time, provide opportunities to engage in sustainable culturally relevant pedagogy. We are fully aware that changing students' beliefs or what Gay (2010) called “ideological anchors” can be challenging at best, even recognizing that some of our preservice teachers will walk away with some of the same preconceived notions as when they started our courses. However, both authors assert that this doesn't mean we stop trying. We work through the initial resistance, confusion, and assumptions with which students enter our courses, and offer opportunities to unpack them in a space that supports deconstructing implicit biases.

As stated in the introduction, our university division committed to teaching for social justice, thus providing numerous opportunities for guest speakers, professional development, and collaboration supporting this endeavor both for faculty and students. Because of this commitment, educators better prepare future teachers to talk about issues of race, privilege, and marginalization, for example, because they themselves are also practicing it in their courses. Preservice teachers in the program now experience the overarching theme of social justice woven into each of their courses through dialogic practice, readings, and modeling culturally relevant pedagogical tenets. It is because of this overarching thread that Katherine's students were prepared and even eager to engage in complicated conversations centering on their created children.

For the purpose of this article, we gathered the “Build a Child” essays written by the 12 preservice teachers and the audiotaped small-group and whole-class conversations. These data sources allowed us to check how effective we were in bringing submerged beliefs to the surface for open dialogue and how well the instruction worked in engaging preservice

teachers in meaningful conversations about social justice and equity issues. Based on our analysis, the following three themes emerged from the thematic review of the data sources: 1) emerging awareness of various forms of diversity; 2) blindness to identity; and 3) stereotypes about gender and gender binary.

### **Emerging Awareness of Various Forms of Diversity**

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Overall, preservice teachers' designs included children from different racial, ethnic, and socioeconomic groups, children with physical and learning disabilities, and children who were in different points of the gender spectrum. However, gender far outweighed the other forms of diversity represented. For example, six of the 12 designs were girls and five were boys. Katie initially described her design as a boy, but later in the essay identified him as non-binary gender queer and changed her gender identifier from "him" to "them."

Regarding racial identity, one of the child designs was Black, one was multi-racial (Latina and White), and one was an immigrant (born in China), while the rest were White. Not surprisingly, the Black, female child was built by a Black, female preservice teacher, Brianna, and the Chinese child (boy) was built by a Chinese preservice teacher, Yufang. Children designed by Debi and Yufang were bilingual.

Looking at living situations, the cardboard children had very supportive families and communities, with the exception of one child who "came from an abusive family." All children were identified as living in middle class neighborhoods, while one lived in an upper, middle class town with a low unemployment rate. Two were in lower, middle class communities with both parents working or a single parent working multiple jobs. Only one preservice teacher, Brianna, mentioned that their cardboard child attended a "diverse school." Three of the children lived with only one parent along with their siblings and grandparents, and only one preservice teacher mentioned divorce as part of their child's family situation.

As for physical and mental disabilities, one child was identified as a "struggling student," "having ADD" and another child had an amputated leg. Maddie's child had an illness called "cardboard-itis," which affected his ability to memorize, and Luna's child had severe allergies, which prevented him from attending school. One child struggled with social and emotional needs and was labeled as "Gifted."

We asked students to assume that the 12 children they created were in their classroom and to reflect on how the created classroom demographics looked similar or different from our current class group. Regarding gender identity (9 female, 1 male, and 2 non-binary gender queer in the classroom versus 6 female, 5 male, and 1 non-binary gender queer with the cardboard child creations), the cardboard children leaned more toward a "traditional" elementary science classroom and less resembled the preservice teachers' class. However, regarding racial identity (10 White preservice teachers, 1 Black preservice teacher, and 1

Chinese preservice teacher versus 9 White cardboard children, 1 Black cardboard child, 1 Chinese cardboard child, and 1 multiracial cardboard child), the resemblance was almost identical and is also reflective of the teacher population in the United States currently with 80% White teachers.

### **Blindness to Identity**

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Classroom conversations revealed that preservice teachers' awareness of forms of diversity did not mean that they had an informed understanding of how to interact with or approach students with these identities. They expressed the desire to learn about the differing needs of students in order to provide appropriate support and opportunities; yet, they stated they would treat all students the same regardless of differing needs and opportunities.

Identified by the authors as problematic, the conversations among preservice teachers eluded to how their future students are equal no matter their identity, which led to the naive notion of "colorblindness."

Specifically, we called out the students' misconception that it is not appropriate to acknowledge differences, especially regarding race. We shared with them our noticings of how each preservice teacher when sharing their child's background did not identify the child's race, with the exception of Brianna, the single Black preservice teacher in the course. It was only when asked specifically what the child's race was that they addressed it. This viewpoint combined with an attitude of "everyone is equal" is problematic since race provides meaning, context, and history, just to name a few (Sensoy & DiAngelo, 2012).

### **Stereotypes About Gender and Gender Binary**

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Interestingly, preservice teachers felt comfortable enough to construct a child representing the opposite sex (e.g., male student built a female child or vice versa) but those who considered themselves straight were not comfortable in building a child who identified on the LGBTQ spectrum. Additionally, regarding gender equity in science education, it was refreshing to witness how evenly distributed the children's gender was in the science classroom, especially regarding their cardboard children's attitudes and proclivity toward science. For example, one preservice teacher stated their child wanted to be an astronaut when he grew up (albeit a male child), and another preservice teacher's female child claimed to be "good at math and science," while a third, female, cardboard child stated math was her favorite subject.

However, conversations also revealed additional stereotypes about gender roles. For instance, when asked why she built a boy, Kim said her child had short hair and as a result, she imagined the child being a boy. She then turned to Luna who had short hair and identified as gender fluid and apologized. Similarly, the cardboard male students built by Jackie and Kim assumed traditional male roles in their essays. Jackie, stated that her

cardboard child was the only boy in the family and he got to be the king while his three older sisters were princesses. Kim stated that her cardboard child had to “step up for his mother and younger sisters after their father walked out on them.”

## Discussion

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The ultimate goal of this three phase instruction was to push preservice teachers out of their comfort zones by engaging them in critical conversations around issues of social justice. Although the results may not have produced any unordinary instances, we believe that we were able to achieve this goal. Overall, our findings revealed that preservice teachers who state they have the best interests in their future students' education while appreciating the diversity students bring to their future classrooms have biases about students who have identities that differ from their own. Furthermore, considering societal norms and expectations as “normal” (e.g., heterosexuality), some expressed feeling uncomfortable to openly talk about their students' gender and racial identity when the students do not exhibit the identities that are “normal.”

Science methods courses provide the necessary context and the opportunity to address preservice teachers' implicit biases about their students and the communities these students belong to. Science teacher educators must explicitly address that teachers' values and beliefs influence the way they teach content and curriculum and how they interact with their students. Content mastery cannot be ensured without “seeing” and “understanding” the whole child, which is more than knowing his or her favorite color, game, or animal. It is, in fact, part of their “job” to understand how to effectively teach the content by making it culturally relevant to their students.

To start, science teachers can examine their curriculum through a critical literacy lens, noting whose voices are marginalized and left out of the science conversation. This includes providing a variety of role models in science who represent diversity in all its senses: gender, race, sexuality, ability, age, etc. For example, if examining a unit on inventors and inventions, use Alan Turing's computer responsible for breaking the Nazi Enigma code during World War II, and provide his background and how he identified as gay. When studying space exploration, mention Sally Ride's, the first American woman in space, female life partner. Look at how diverse (or nondiverse) the scientists represented in the science textbook or supplementary texts are and provide numerous non-White, examples. For example, show clips of the Oscar-winning movie *Hidden Figures* (2017), to showcase the life work of four, Black, female pioneer NASA scientists. Promote Indigenous science role models by reading *The Girl Who Could Rock the Moon* (Cointreau, 2019), an inspirational story of the first Native American female scientist, Mary Golda Ross. Talk about the possible barriers and tensions these scientists overcame in order to open the doors for conversations surrounding social justice in science.

Our first implementation of this activity was toward the end of the semester. These conversations were extended into their final project, titled Community Asset Map for Science Teaching and Learning. Preservice teachers were encouraged to consider ideas generated from these conversations as they developed the asset maps for the partner schools where they completed their clinical experiences. However, Nazan has now altered the course curriculum to include this activity at the beginning of the semester so continued conversations can unpack preservice teachers' implicit biases surrounding their created children as well as use this experience as an "A-ha!" moment for students to return to throughout the semester, connecting it to future readings and discussions. We have also thought about pairing this activity with students taking an implicit association test (IAT) (see Greenwald, McGhee, & Schwartz, 1998) to acknowledge various biases, such as gender and race. We could then have students match their implicit bias test results to their created-child's story, thus, making a deeper connection.

Most importantly, we believe our future teachers need to have continued support throughout the rest of their program and into their beginning years of teaching in order to make culturally relevant teaching a realization in their future science classrooms. We need to ask repeatedly, "What does culturally relevant teaching look like and feel like in the science classroom?"

## **Conclusion**

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Our research revealed that more needs to be done regarding preparing future science teachers to be culturally relevant practitioners. Science education must address social justice, which means, science teachers must learn how to disrupt the current curriculum, create nurturing and supportive learning environments that are conducive to all children, and how to engage in critical conversations. This effort starts with the future of education: Preservice teachers. Teacher educators must teach them to question and examine their preconceived notions of gender, race, sexuality, able-ism, etc. Moreover, there is a need for more research to examine power relations and how culturally relevant practices are enacted in the classroom, especially science classrooms.

Overall, children need to see themselves in the curriculum, and when practicing teachers as well as future teachers are given the opportunity to examine curriculum in this manner, more voices can be included. Modeling culturally relevant science teaching approaches for future teachers as well as engaging them in "difficult" conversations about race, ethnicity, sexuality, and gender in the context of science teaching are first steps toward proper preparation of teachers for the increasingly diverse classrooms.

## **Notes**

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<sup>[1]</sup> Makedo Tools are child-friendly (3 years and up) tools specifically designed so as to not cut or punch skin (as described at <https://www.make.do/>).

## Supplemental Files

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APPENDIX-A.docx

### References

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- Batchelor, K.E., DeWater, K., & Thompson, K. (2019). Pre-service teachers' implicit bias: Impacts of confrontation, reflection, and discussion. *Journal of Educational Research and Innovation*, 7(1), 1-18.
- Batchelor, K.E. (2019). Using linked text sets to promote advocacy and agency through a critical lens. *Journal of Adolescent and Adult Literacy*, 62, 379-386.
- Bautista, N.U., Misco, T., & Quaye, S. (2017). Early childhood open-mindedness: An investigation into preservice teachers' capacity to address controversial issues. *Journal of Teacher Education*, 1-15.
- Ball, D. L., & McDiarmid, G. W. (1990). The subject-matter preparation of teachers. In W. R. Houston & M. H. J. Sikula (Eds.), *Handbook of research on teacher education* (pp. 437-449). New York: Macmillan.
- Behrman, E. H. (2006). Teaching about language, power, and text: A review of classroom practices that support critical literacy. *Journal of Adolescent & Adult Literacy*, 49, 490-498.
- Bromley, K. D. (1998). *Language art: Exploring connections*. Needham Heights, MA: Allyn & Bacon.
- Brown, S. (2019, March 15). NJ middle school teacher calls students 'N word.' *The Charleston Chronicle*. Retrieved from <https://www.charlestonchronicle.net/2019/03/15/nj-middle-school-teacher-calls-students-n-word/>
- DeBoer, G. E. (2005). Scientific literacy: Another look at its historical and contemporary meanings and its relationship to science education reform. In J. K. Gilbert (Ed.), *Science education: Major themes in education*, (pp. 220-245). New York: Routledge.
- Feiman-Nemser, S. (2012). *Teachers as learners*. Cambridge, MA: Harvard Education Press.
- Gay, G. (2010). Acting on beliefs in teacher education for cultural diversity. *Journal of Teacher Education*, 61(1), 143-152.
- Genishi, C., & Dyson, A. H. (2009). *Children, language, and literacy: Diverse learners in diverse times*. New York, NY: Teachers College Press.

Green, E. (2016, November 17). Baltimore teacher caught on video using 'N' word as she berates black students. *The Baltimore Sun*. Retrieved from <https://www.baltimoresun.com/education/bs-md-ci-teacher-video-20161117-story.html>

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, 74, 1464–1480.

Hutcherson, K. (2018, December 10). California teacher faces charges after forcibly cutting a student's hair while singing anthem. Retrieved from <https://www.cnn.com/2018/12/08/us/california-haircut-teacher/index.html>

Ladson-Billings, G. (2014). Culturally relevant pedagogy 2.0: A.K.A. the remix. *Harvard Educational Review*, 84(1), 74-84.

Ladson-Billings, G. (1995). But that's just good teaching! The case for culturally relevant pedagogy. *Theory into Practice*, 34, 159-165.

Lewis, M., Leland, C., & Harste, J. (2014). *Creating critical classrooms: Reading and writing with an edge* (2nd ed.). Hoboken, NJ: Taylor & Francis.

Melfi, T., Gigliotti, D., Chernin, P., Topping, J., Williams, P., Schroeder, A., Walker, M., ... Twentieth Century Fox Home Entertainment, Inc.,. (2017). *Hidden figures*.

Moll, L., Amanti, C., Neff, D., & González, N. (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory into practice*, 31, 132-141.

Montgomery, W. (2001). Creating culturally responsive, inclusive classrooms. *Teaching Exceptional Children*, 33(4), 4-9.

NGSS Lead States (2013). Next generation science standards: For states, by states. Washington, DC: The National Academies Press.

Nieto, S. (2000). *Affirming diversity: The sociopolitical context of multicultural education* (3rd ed.). New York: Longman.

Nieto, S. (Ed.) (2005). *Why we teach*. New York, NY: Teachers College Press.

Sensoy, Ö., & DiAngelo, R. J. (2012). *Is everyone really equal?: An introduction to key concepts in social justice education*. New York: Teachers College Press.

Silverman, S. K. (2010). What is diversity? An inquiry into preservice teacher beliefs. *American Educational Research Journal*, 47, 292-329.

Sleeter, C. E. (2005). *Un-standardizing curriculum: Multicultural teaching in the standards-based classroom*. New York: Teachers College Press.

Stevens, M. (2018, March 7). Florida teacher says her racist podcast was 'satire.' *The New York Times*. retrieved from <https://www.nytimes.com/2018/03/07/us/florida-teacher-racism.html>

Villegas, A. M., & Lucas, T. (2002). *Educating culturally responsive teachers: A coherent approach*. Albany: State University of New York Press.

Yosso, T.J. (2005). Whose culture has capital? *Race, Ethnicity and Education*, 8(1), 69–91.