Incorporation of Culture in the Science Classroom

Mariah Guthrie

Abstract: Few science classrooms incorporate an understanding of the effects of culture into the way science is taught. Yet few minority students continue onto careers in hard sciences, and the methods of instruction of these courses throughout primary and secondary years may be contributing to this. With the rising recognition of and respect for diversity within classrooms across the country, the teaching styles of many schools need to be revised to recognize and account for the cultures which students bring with them into the classroom. The practice of culturally inclusive instruction for all students is called Culturally Responsive Pedagogy (CRP). Culture is central to learning. It plays a role not only in communicating and receiving information, but also in shaping the thinking process of groups and individuals. For this reason, Culturally Responsive Pedagogy is necessary if we wish to include all students in science education.

Introduction

Science is not seen as a viable career path for many of our young students, especially those from groups that have been historically underrepresented in scientific fields. Numerous reports confirm that minority members rarely enter fields requiring advanced science and mathematics degrees. If we wish to break this pattern, teachers need to improve the way they incorporate culture into their science classrooms. As schools become more diverse, they must develop a curriculum which reflects the needs of their diverse students, and must focus more on how the various specific school subjects may be made relevant to all their students. Using Culturally Responsive Pedagogy (CRP) in the teaching of science may encourage these young minds to continue or increase their interest in the field. Teachers should think about the needs of all their students and consider the distinct backgrounds and situations that may change how the student views science. Science classrooms should incorporate student cultures into the curriculum to build upon the pedagogy for all students.

Addressing Diversity

Why is there a need to address diversity in the school community to begin with? There is a growing recognition that schools must meet the needs of students from all types of backgrounds and cultural upbringings, as described by Quinton (2011). New, more effective methods should be brought into classrooms in order to teach and engage these students. Classrooms already contain students with varying cultures, languages, abilities, and many other characteristics. The way that the students are being taught needs to mirror and connect to their lives. Richards, Brown, and Forde (2007) states it best:

> To meet this challenge, teachers must employ not only theoretically sound but also culturally responsive pedagogy. Teachers must create a classroom culture

> where all students, regardless of their cultural and linguistic background, are welcomed and supported and provided with the best opportunity to learn (p. 64).

School cultures and those cultures that students are a part of outside of the classroom can conflict, which can cause a disconnect in the learning process. In order for students to fully grasp learn and comprehend, teachers need to look for bridges between the culture of the home life and the school life. Moreover, according to Heath (1983) a culturally responsive instructional environment minimizes the students' alienation as they attempt to adjust to the different world of school. Culturally responsive pedagogy is a tool that can be used to bridge these gaps, one which is especially useful in the science classroom.

Cultural Responsive Pedagogy in Science

According to Richards, Brown, and Forde (2007), in a culturally responsive classroom, effective teaching and learning occurs in a culturally supported, learner-centered context, whereby the strengths that students bring to school are identified, nurtured, and utilized to promote student achievement. Culturally responsive pedagogy is meant to foster the inclusion of students of any background and ethnicity. This inclusion is seen in the science classroom in three different ways. As Butler (2017) describes, culturally responsive pedagogy in science education takes the form in demonstrating care for the students, getting to know your students on a meaningful level, and responding to ethnic diversity while delivering instruction. To connect with students on a purposeful level, teachers need to identify what each student is interested in and what they value in the subject. This can start from learning about their home life, traditions, or even styles of communication. By getting to know their students, teachers develop caring relationships that acknowledge both school and home cultures, and which respect the ways in which these students learn. This helps make the classroom a safe place for pupils to learn and achieve. The last step is responding to students' ethnic diversity by actively seeking out ways to integrate the students' lives and cultures into the curriculum. These three steps build a foundation for using the students' cultures as entry points to teach science.

Incorporation into the Science Classroom

Though culturally responsive pedagogy belongs in every classroom, the focus here is on how it can be applied in a science course. Because science courses are often perceived as challenging subjects for many students, it is particularly important to create inclusive, culturally responsive science classrooms. When teachers make real-world connections that build on the diversity of students in their schools, they can make the learning process feel more worthwhile and comfortable for students. For example, Wallace and Brand (2012) offers an exploration of how to properly represent and incorporate culture in the science classroom. Her research revealed that teachers' ability to grapplw with the sociocultural and political realities of diverse groups requires those teachers to develop a framework of pervasive social constructions of race. In particular, her analysis revealed that the teachers' beliefs and prac-

tices were informed by their critical awareness of social constraints imposed upon their African American students' identities. Though African American children are not the only historically underrepresented minority group in the school system, they are the group of minority students most common in many urban school districts. Wallace and Brand found that the teachers with more connection to the student's cultures outside of school were more successful at engaging those students in the study of science inside of the classroom. The hands-on tactics used by these teachers simulated those that could be used in the community of their students. Some of these approaches were as simple as listening to the students in ways that felt more responsive to them. One teacher from the study used the approach of showing her students that even though she was of different ethnicity, her students should feel safe in her classroom. She addressed the fact that her home life may be different from her students, but that she empathized with each of her students' situations. These teachers' philosophies were built from the culture of their students. As Wallace and Brand explain, the teachers needed three types of "sociocultural awareness" to be able to develop these approaches:

> (1) Teachers' background experiences provoked a critical awareness of societal constructions of race;
>
> (2) Teachers' critical awareness of the influence of societal constructions of race influenced their teaching philosophies; and
>
> (3) Teachers' sociocultural awareness informed their perspectives of students' needs and behaviors (p. 354)

As these teachers gained more experience, they developed better understandings of the culture that surrounded the students, meaning these teachers were better prepared to serve their students' needs. Cooperating with the outside world of the students helped to keep them engaged in the science.

Brand (2014), also explored this subject, examining the pressing issue of how best to prepare teachers to effectively teach students from culturally diverse backgrounds. She also focused on the development of teachers' sociocultural consciousness, which she defined as "understanding that people's ways of thinking, behaving, and being are deeply influenced by such factors as race/ethnicity, social class, and language." (p. 61). She advocates for a type of culturally responsive pedagogy that asks teachers to enter the classroom with a non-judgmental attitude, and drawing no prior conclusions about their students. Brand argues that this is key if teachers wish to understand the needs of students who have been socio-culturally disadvantaged and to develop and employ strategies that align with their students' needs. Incorporating these struggling students' needs into the equation can make the difference between engagement and disengagement, and success and failure. Understanding their background gives these students a leg up in the competition of the science field.

These two articles begin to show what culturally responsive pedagogy can look like in a classroom. But how can it be put into action by classroom teachers? Two examples of methods that teachers can use in their classroom while considering the culture of the students are (1) place-based education and (2) targeting specific science content.

With place-based education, the focus of student's science experiences is made relevant to the community that the students are living in. This also creates the opportunity for science classes to engage in scientific inquiry, as students develop their own scientific questions about their communities. Science teachers can use place-based instruction to provide opportunities for students to establish connections between their own knowledge and basic science concepts, to challenge and develop their own theories, and to communicate their ideas to others, as noted by the National Resource Council (1996). Giving students a chance to improve their critical thinking skills while finding solutions to problems in their own communities can strengthen their bond with how science is conducted and accomplished. A prime example of this in the science classroom is having the students learn outside of the classroom. A lesson that deals with the issues in the community connects the students to their social culture and the science needed to fix a particular issue. For example, a school may be in the vicinity of a watershed that supplies drinking water for the community. Having students learn about the water quality of their community's watershed and the potential problems that may be occurring in that watershed can allow them to use their critical thinking skills to develop a possible solution to help their community. Place-based education can be as easy as monitoring a local issue that students can identify and explore resolutions for.

Targeting specific science content can be as simple as showing students that the field of science is a viable career path for them. Despite the underrepresentation of minorities in scientific fields, role models and historical figures are available as models for students. Bardwell and Kincaid (2005) advocate for making these figures visible to students. As they explain "[m]inority students will identify with these role models, and thus begin to personalize the science concepts and consider careers in science." For example, teachers should discuss the diversity of scientists throughout history as well as major scientists presented in many textbooks. Teaching about African American scientists outside of Black History Month also falls under this category. Having concrete examples to show the students the cultural significance of science in their society can make the connections easier and show the variety of individuals in the field.

Real-Life Implications

To put this issue into a more real-world perspective, I present my own experience as a way to illustrate the need for culturally responsive science teaching of science in schools. As a young woman in the field of science, I can reflect on the things that happened in my schooling that made me want to continue into a science career. In fact, all through primary and secondary school, I never had a minority teacher, and I only had one female science teacher; the teachers I did have did not offer culturally responsive pedagogy. These factors alone made me feel as though I was not represented in the field and that this was not the best choice of career for me to pursue, despite my own interest in science. The event that changed my perspective on the science community was a summer internship at the University of Toledo. It was a three-month-long program where the students worked closely with doctors and researchers at the medical college. This was the first point where I saw role models who made me feel that science was open to me. There were plenty of female doc-

tors and researchers, and the staff was more diverse than those I had encountered in my schooling. I was also assigned a mentor who was very helpful in supporting my journey into the STEM fields. She showed me many other programs and fellowships that connected science to my community, making it more interesting to me. This mentor did more to inspire me to stay in the STEM field than any of my teachers had done in the classroom. She showed me the cultural significance of the scientific work that she did, and why it was important to her community. This is what teachers need to be bringing into the classrooms.

Another example comes from a case study of a first-year teacher from Yerrick and Ridgeway (2017), who tells the story of first-year teacher Krista, who described feeling overwhelmed. Krista explained that:

> this is my first-year teaching and my first time even being in the city. Then there is also administration coming into see where I am in the curriculum pacing and always reminds me how poorly my students performed last year and important 'maintain structure' in the classroom. He always tells me to focus on the curriculum guide and maintaining structure that is what my kids need to perform better this year. I feel like my students aren't connecting at all with what I am trying to teach. It isn't working for our class. They want me to focus on procedures and curriculum materials but my students dislike both. Some have blank looks, others are trying to write down everything I say, others are having side conversations or putting their heads down. I am not connecting with my students. (pp. 94-95).

After Krista described these feelings to her mentor teacher, Emmet, Emmet mentored her as she worked to make her classroom more culturally inclusive. This came through a series of one-on-one planning meetings which including culturally responsive reading materials and follow up observations to view the implementations of their meetings. What happened next was that Krista began to re-shape and re-think her science instruction. Krista planned an outdoor ecology lesson in which her students would use the school's iPads for her students to take photographs, record sounds outside, and video record their experience in the park. She was excited to share with Emmet her students' images, which contained organisms that were a part of the ecology of the creek, and which provided the scientific evidence and data to help drive the classroom instruction. Student work, displayed throughout her room, offered evidence of environmental impact, interaction, symbiosis, adaptation, and much more. Emmet observed that her students were incorporating outside experiences and resources to constructively build knowledge and engage in science differently from their historical roles as school learners.

Before she had made these changes, Krista had had trouble connecting with her students, not only on the level of the school community, but also on a personal level. Without that connection, there was a loss of interest in the curriculum on the part of the students. This was because the curriculum was not tailored to the daily lives of the students. After incorporating more culturally responsive pedagogy into her curriculum, this young teacher started to foster connections for her students that made the learning of science more enjoyable and productive.

Conclusion

Culturally responsive pedagogy is the way of the future when it comes to education in the science classroom. To create a culturally responsive classroom, teachers must first understand why diversity is important in the curriculum. Reshaping the curriculum to reflect the lives of their students can have a great impact on these pupil's grades and possible career paths. Culturally responsive pedagogy is meant to include all walks of life, and to encourage educators to teach together with their students rather than to teach at their students. Incorporating this type of pedagogy into the science classroom can help students, especially those from historically underrepresented backgrounds, to pursue an interest or even a career in the STEM fields. For these reasons, designing the curriculum to fit the needs of their students should be the main priority of science teachers when formulating all lessons. Culturally responsive pedagogy may be the solution to the inclusion of all students in the science field.

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About the Author

Mariah Guthrie currently holds a bachelor's degree in biology with a minor in environmental science, and a master's in AYA science education. Her teaching philosophy is to meet every student where they are, but not to leave them there.