Equity Dispatch

Equity in Science Instruction

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"The world has changed in such a way that scientific literacy has become necessary for everyone, not just a privileged few; science education will have to change to make that possible."

-James Rutherford and Andrew Ahlgren, 1991, p. xvi

Did You Know

Many Regions Around the World Have Contributed to Science, Not Just Europe

The prominent view of science education in U.S. schools presupposes science as

a Western concept and thus, forces students to embrace a Western viewpoint. This Western viewpoint alludes to the notion that the birth of modern science begins in the 17th century and was led by European scholars; however, there are many indicators that suggest modern science predates such Eurocentric boundaries (Emeagwali, 2016). The Eurocentrism in the history of science and technology that dominates traditional science instruction in most U.S. schools reinforces an inaccurate view that people from European descent were the primary constructors of scientific and mathematical knowledge. This historical inaccuracy has facilitated the centering of science within Western ways of knowing and being; thus, the heritages, cultures, contributions and lived experiences of historically underserved individual and groups have been excluded from most science curriculum (Lynch, 2001).

A more accurate and pluralistic depiction of science is needed to debunk the Eurocentric and male-centered narrative and to provide an inclusive, culturally responsive and sustaining model for science education. Mainstreem science education omits the considerable influcence of, and contributions made by people of color, women and people with dis/abilities and as a reslult, reinforces stereotypes and promotes a discourse of invisibility (Rodriguez, 1997; Ragusa, 2013). A discourse of invisibility means that within the science curriculum development, there has been little or no consideration as to how issues of inequity impact historically marginalized students and groups of students in science education. Students of color, students from lower socio-economic backgrounds, students with dis/abilities, linguistically diverse students, female students, etc. are treated as if they are invisible in science education (Rodriguez, 1997).

Traditional methods of science education have been closely adapted to meet the cultural histories and community practices of predominantly upper and middle class White males, and have ignored the cultural histories and practices of students who identify differently (Pinder, & Blackwell, 2013). For example, textbooks have been inundated with negative cultural portrayals and stereotypes about historically marginalized groups of people. As textbooks have traditionally been designed to be reflective of the dominant culture, they reinforce the notion of White male supremacy in science education (Pinder, & Blackwell, 2013). It is not surprising then that by middle school, students who do not see themselves reflected in the science curriculum either lose interest in or develop negative attitudes towards science (Barton, 2002). Implementing a more culturally responsive and inclusive model of science education allows ALL students to themselves represented in and connect with science study in meaningful and authentic ways.

A culturally responsive and inclusive model of science education is one in which the scientific contributions of ALL groups are equally valued and respected. The most pervasive models of science education overwhelmingly emphasize contributions by White males and fail to mention contributions by others. For example, often overlooked are such historical facts as the significant advances in mathematics (multiplication, algebra and calculus) made by Indian mathematicians a millennium before that of European mathematicians. Therefore, students will likely learn about Galileo Galilei, the Italian astronomer, it is unlikely that any mention will be made of the accomplishments of Ibn al-Shatir, an Arab astronomer who developed the theory of planetary motion 150 years prior to Copernicus (Teresi, 2002). Excluding the accomplishments and contributions of historically marginalized groups trivializes the impact they have made and denies

them the legitimacy typically afforded to their White, male counterparts (Teresi, 2002). Moreover, when educators teach historical inconsistencies such as crediting Copernicus rather than Ibn al-Shatir with the development of the theory of planetary motion they reinforce the exclusivity of science by positioning it as a Eurocentric concept.

Traditional science instruction in the U.S. privileges Eurocentric scientific processes as the only legitimate approach to knowledge generation (Cobern, 1995). Historically marginalized groups of students often receive science instruction as static concepts of knowledge and decontextualized from their lived experiences (Barton, 2002). Traditional science education reflects a Western or Euro-American culture in that it limits the context of scientific ideas to science alone which excludes all other ways of knowing (e.g. personal knowledge, beliefs, faith etc.) (Allen & Crawley, 1998). In some instances, traditional science education may be in direct opposition to the worldviews of others. A worldview can be an integral part of one's culture and can be defined as a way of thinking about self, environment, and abstract ideas such as beauty or time (Allen & Crawley, 1998). For instance, American Indian values regarding the natural world tend to be more aligned with spirituality, cooperation, and harmony, whereas Western values regarding the natural world tend to be more focused on the material and decontextualized. In this way, traditional science educations would be in direct opposition to the worldviews of many American Indians (Allen & Crawley, 1998).

As educators embrace and acknowledge diverse forms of student knowledge; they should consider how non-traditional ways of knowing can be incorporated into the curriculum to better support learning for ALL students. When educators are dismissive of other ways of knowing they may be unintentionally send a message to students that their way of understanding the world is inadequate and insufficient for science education (Cobern, 1995). Because science education has traditionally been gendered, raced, classed, etc., historically marginalized students and groups of students are often expected to make sense of the world in prescribed ways, that reflect the community practices and world views more familiar to individuals from the dominant culture (Cobern, 1995).

The lack of diversity in the content presented, coupled with the presumption of a singular way of knowing, imposes constraints on students and reinforces the notion that inclusion and diversity are exempt from science education (Fusco, 2001). A culturally responsive and inclusive model of science education can support pedagogical strategies which build on students' ways of knowing (e.g. caring, cooperation, etc.) even when those ways of knowing may not be an obvious fit for the science curricula (Fusco, 2001).

Why It Matters

Experiencing Science in an Authentic Way Helps Students Build Capacity Now and in the Future

Helping ALL students acquire an equitable and inclusive science education prepares them to function in the technologically advanced global society in which we live (Barton, 2002). When students' perspectives, language, and lived experiences are incorporated into science education, students demonstrate greater understanding and attainment of lesson content. A greater understanding and attainment of science today can open the door to higher paying careers for students in the future, provide a knowledge base by which students can better understand issues that impact their quality of life, and help students advocate for improved environmental conditions (Barton, 2002). When educators assist students in incorporating their lived experiences into the science curricula they begin to see sciences as a relevant part of their everyday lives. Making science relevant for students now can inspire them to pursue careers in STEM related fields later (Januszky, Miller, and Lee, 2016). As we know, it is estimated that by 2018 there will be 8 million jobs available in the U.S. in STEM related industries (GLEC, 2013). Moreover, half of all income earned belongs to individuals working in science-related fields such as health care, engineering, and science (Bullock, 1997). Educators have a significant effect on student career choice and therefore, can impact the level of diversity and representation within science professions (Kurz, Yoder, & Zu, 2015).

Environmental issues such as air and water quality and pollution are global concerns and effect everyone on Earth. When educators commit to ensuring that ALL students acquire an equitable and inclusive science education they help students demystify issues related to global warming, air pollution, etc. and equip students with the tools to advocate for better and more equitable environmental conditions. In this way educators help students link science content to the needs of society and in so doing demonstrate the need to be a good citizen of the Earth (Barton, 2002). When educators provide students a more safe and inclusive learning environment in which they have the opportunity to link classroom activities to their ways of understanding the world, students feel more valued and included (Lynch, 2001). Ensuring that all students have the opportunity to succeed in science education provides them with a sense of self-efficacy, and the confidence to explore the world around them (Lynch, 2001). Students having a sense of self-efficacy may be more likely to persist even when concepts are difficult or confusing. This kind of perseverance and determination are essential in student and educator success in and out of the classroom (Linnenbrink-Garcia, Pugh, Koskey, and Stewart, 2012).

For Equity Now

Understanding Students' Intersectional Identities and Interests Can Transform Science Instruction

Moving towards teaching science in equitable and diverse ways can be challenging. Embracing change in traditional science instruction means that educators must have the ability to view their students both as individuals and as members of diverse groups (Bianchini et. al. 2007). As educators begin to understand and acknowledge student diversity and incorporate students' worldviews and lived experiences into

science education, it becomes a more meaningful and impactful experience for ALL students (Bianchini et. al. 2007).

Some strategies for creating more culturally responsive and inclusive science instruction include:

Provide students with a world view of science
Discuss the contributions of people of color, women as well as people with dis/abilities. In this way educators can assist students in challenging the notion that science is a Western concept (Januszky, Miller, & Lee, 2016).

Learning needs to be meaningful, exciting, and culturally relevant
Students must be able to relate to the content being taught, therefore educators should place phenomena and problems in home and community contexts. Doing so will help students build on their everyday experiences and language, and make connections between school, community, and home (Januszky, Miller, & Lee, 2016).

Ensure that the science lessons are reflective of students' interests
Incorporating the interests students already have into the science curriculum is another way of ensuring the inclusion and representation of all students (Cobern, 1995).

Partner with parents/caregivers and community members
As students learn and become more aware of issues in their own communities (e.g. lack of green spaces, the need for community gardens, need for conservation plans etc.), they can become advocates and able to educate and inform community members (Bouillion, 2001).

Create a more natural and authentic learning experience for students
Examine real world problems with students and allow students to make observations and reflect on issues of importance to them. Ask open-ended questions of students that allow them to use their prior knowledge and lived experiences to better understand concepts (Bouillion, 2001).

Allow the use of students' native and/or informal language in the classroom
When students feel they can relate to the science curricula, they may participate more. Using more informal and/or students' languages adds an element of acceptance, inclusion, and validation that educators value the home culture of the students (Dunca-Morgan, 2015).

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