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Abstract

Student enrollment statistics indicate an increase in linguistically and culturally diverse students in the United States. Along with the increase in the diversity of the preK–12 student population, one would also expect to see a parallel increase in equitable learning opportunities for all students. Equity and inquiry are the key principles of the *Framework for K–12 Science Education* (the Framework) as well as the *Next Generation Science Standards* (NGSS). Due to the growth of minority populations and the increase in the enrollment of minority students, there is an increasing need to address the underrepresentation of linguistically and culturally diverse students. In this article, we intend to bring to the forefront issues related to the education of a diverse student population, including students from different racial and ethnic groups as well as English language learners, in the Western cultural views in science classrooms. We also intend to shed light on the responsiveness of Western science education, the Framework, and the NGSS to linguistically and culturally diverse students. In addition, we introduce some of the challenges that face diverse students. Finally, we provide some recommendations to meet the needs of diverse students.

Keywords: English language learners; Equity; *Framework for K–12 Science Education*; Inquiry; Minority students; Multicultural education; *Next Generation Science Standards*

The term *diversity* is an overarching term that may extend to include different groups, which include

> the four accountability groups defined in [the] No Child Left Behind (NCLB) Act of 2001 and the reauthorized Elementary and Secondary Education Act (ESEA), Section 1111(b)(2)(C)(v):
>
> - economically disadvantaged students,
> - students from major racial and ethnic groups,
> - students with disabilities, and
> - students with limited English proficiency.
>
> Further, student diversity is extended by adding three groups:
>
> - girls,
> - students in alternative education programs, and
> - gifted and talented students. (NGSS Lead States, 2013, p. 26)

In this article, the term *diversity* is directed toward minority students from diverse racial and ethnic groups and English language learners (ELLs).

The demographics of student diversity indicate an increase in the population of diverse students in classrooms. According to the National Center for Education Statistics (NCES; KewalRamani, Gilbertson, Fox, & Provasnik, 2007), over the past 2 decades, the U.S. population has become more culturally and linguistically diverse because the population of minority groups has increased more rapidly than the White population has. Villegas and Lucas (2002) stated that "one of every three students enrolled in elementary and secondary schools is of a racial or ethnic minority background" (p. 20). "Substantial growth for minority population groups is projected to continue over the next 20 years (U.S. Department of Commerce 2004)" (KewalRamani et al., 2007, p. 6).

> Between 2010 and 2050, the U.S. population is projected to grow from 310 million to 439 million, an increase of 42 percent. The nation will also become more racially and ethnically diverse, with the aggregate minority population projected to become the majority in 2042. (Vincent & Velkoff, 2010, p. 1)

According to the NCES (KewalRamani et al., 2007), "by the year 2020, minorities are predicted to represent 39 percent of the total population" (p. 7).

> In 2005, minorities made up 33 percent of the U.S. population. Hispanics were the largest minority group, representing 14 percent of the population. They were followed by Blacks (12 percent), Asians/Pacific Islanders (4 percent), and American Indians/Alaska Natives (1 percent). (KewalRamani et al., 2007, p. 7)

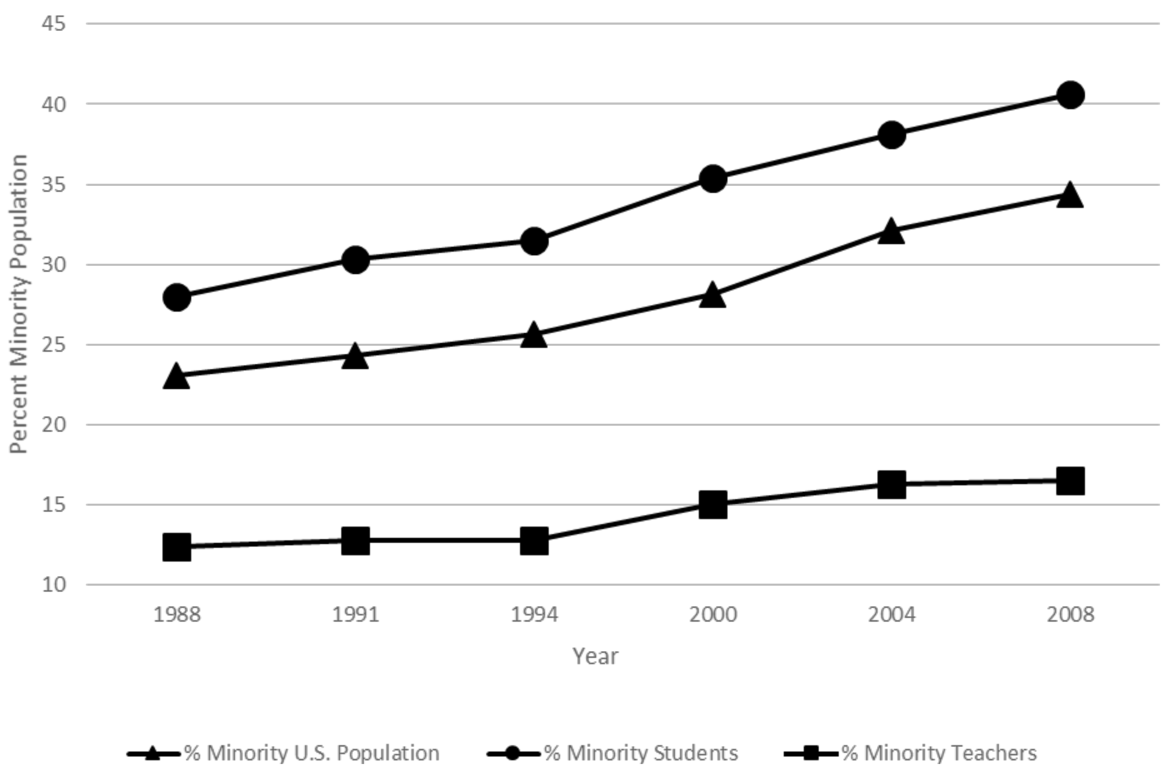

Figure 1. Percentages of U.S. minority population from 1988–2008. The data included in this graph are taken from Table 3 (p. 19) in Ingersoll and May (2011).

Besides the underrepresentation of minority students in science education, there is a disproportionate representation rate of minority teachers in which "only 14% of all teachers are from minority cultures. The proportions are even lower by science subject area" (Rodriguez, 1997, pp. 24–25).

In their report about the shortage of minority teachers in the United States, Ingersoll and May (2011) show the increasing disparity between the percentage of minority students and the percentage of minority teachers. In the 2007–2008 school year, minorities made up 34.4% of the U.S. population, minority students made up 40.6 % of the population, and 16.5% of teachers were minorities (Ingersoll & May, 2011, p. 19). Figure 1 shows a graphical representation of the data found in Ingersoll and May (2011) showing the increasingly disproportionate percentage of minority students in comparison to minority teachers over 20 years. In order to reduce this disparity, schools must make efforts to recruit more science teachers from minority cultures. Seeing teachers from their ethnic backgrounds as leaders in schools and in science fields would empower minority students and would enable minority students to increase their achievement scores.

Challenges of Culturally Diverse Students

Linguistically and culturally diverse students are faced with challenges that persist despite the science education research regarding students' cultural background that has been done. Krugly-Smolska (1995) stated that

> A cultural context for science education did not appear to be recognized by science educators until the late 1970s in response to the crisis in science education . . . . Even then, the issue of culture was seldom met head-on and dealt with explicitly, but was treated in terms of 'science and society' and 'scientific literacy' in statements on goals, aims and objectives of science education. As a result, cultural implications for science education often must be inferred. (p. 48)

Some of the challenges that linguistically diverse students and students from nondominant groups face include inadequate instructional practices in science and inequitable learning opportunities, among other challenges, and "students from nondominant groups perform lower on standardized measures of science achievement than their peers" (Bell, Lewenstein, Shouse, & Feder, 2009, p. 209). Banks et al. (2007) stated that

> Being born into a racial majority group with high levels of economic and social resources—or into a group that has historically been marginalized with low levels of economic and social resources—results in very different lived experiences that include unequal learning opportunities, challenges, and potential risks to learning and development. (p. 15)

"Arguably, the most pressing challenge facing U.S. education is to provide all students with a fair opportunity to learn [(Moss et al., 2008; Porter, 1993; National Research Council, 1996)]" (National Research Council [NRC], 2012, p. 281). Although desegregation began in the 1950s, some schools have continued to bar minority students from achieving equitable educational opportunities, segregating students, including African American students, by assigning their academic schedules through special education programs in which they are overrepresented relative to their White peers (Young, 1990). This is just one practice that reflects the disproportionate representation of minority students in special education programs in comparison to their White counterparts. Hosp and Reschly (2004) stated that "the disproportionate representation of minority students in special education has been a constant and consistent concern for nearly 4 decades" (p. 186). This placement into special education programs stigmatizes and may discourage African American students and other minority students from pursuing educational degrees, including majoring in science disciplines. Although minority students are underrepresented in some areas of education, specifically in science education, at the same time, they are overrepresented in special education programs.

Minority students are indispensable in the educational system because of the different views, experiences, and ways of knowing that they bring to the learning environment. Diversity should be celebrated because it enriches our schools through continually broadening teachers' and students' perspectives. According to the National Research Council (NRC; 2012),

> There is increasing recognition that the diverse customs and orientations that members of different cultural communities bring both to formal and to informal science learning contexts are assets on which to build—both for the benefit of the student and ultimately of science itself. (p. 28)

As the student population in the nation's schools becomes more linguistically and culturally diverse, it is essential to establish a knowledge base to promote academic achievement and equitable learning environments for students with diverse languages and cultures (Garcia, 1999; KewalRamani et al., 2007; Lee, 2003; NRC, 2012).

"Science for all" is a phrase that has been utilized and emphasized by many educators. In response to the barriers and challenges that are faced by students from diverse groups, the *Next Generation Science Standards* (NGSS) were created in a culturally responsive manner to address challenges and issues that are inherent to the increasing diversity in classrooms. This could be done through providing accessible and equitable learning opportunities to all students in which they are able to engage in scientific practices in formal and informal settings (e.g., museums, nature centers, zoos, after school programs; Bell et al., 2009; NGSS Lead States, 2013).

The developers of the *Framework for K–12 Science Education* (the Framework) developed and articulated a broad set of expectations

> to ensure that by the end of 12th grade, *all* students have some appreciation of the beauty and wonder of science; possess sufficient knowledge of science and engineering to engage in public discussions on related issues; are careful consumers of scientific and technological information related to their everyday lives; are able to continue to learn about science outside school; and have the skills to enter careers of their choice, including (but not limited to) careers in science, engineering, and technology. (NRC, 2012, p. 1)

The repetition of "all students" throughout this framework highlights the need to provide equitable opportunities for all students to have access to and succeed in science. Rodriguez (1998) stated, "The basic premise of multiculturalism is that all learners at any grade level must be provided with equitable opportunities for success" (p. 591). Equity is central to the advancement of science education and scientific discovery, which is the predominant purpose of science (Atwater, 1996; NRC, 2012; Rodriguez, 1998). According to the NRC (2012),

> Equity as an expression of social justice is manifested in calls to remedy the injustices visited on entire groups of American society that in the past have been underserved by their schools and have thereby suffered severely limited prospects of high-prestige careers in science and engineering. (p. 278)

Atwater (1996) emphasized the importance of "providing equitable opportunities for *all* students to learn *quality* science (Atwater, 1993; Atwater & Riley, 1993)" (p. 822). The NRC (2012) stated that

> Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. (p. 28)

In pursuit of science for all, equity was a focal point that was emphasized in hopes that it would "motivate and inspire a greater number of people—and a better representation of the broad diversity of the American population—to follow these paths than is the case today" (NRC, 2012, pp. 9–10).

From a science educator's point of view, establishing and achieving equity should be a noble end goal of education. Achieving educational equity requires "rigorous standards that apply to all students" (NRC, 2012, p. 29). "The research demonstrates the importance of embracing diversity as a means of enhancing learning about science and the world, especially as society in the United States becomes progressively more diverse with respect to language, ethnicity, and race" (p. 29). "Clearly, a science education system must be responsive to a variety of influences—some that emanate from the top down, some from the bottom up, and some laterally from outside formal channels" (p. 244). "Science education aims to nurture equitable opportunities for success for *all* students (United Nations Educational, Scientific, and Cultural Organization, 1994)" (Aikenhead & Jegede, 1999, p. 273).

> *Status and Trends in the Education of Racial and Ethnic Minorities* examines the educational progress and challenges of students in the United States by race/ethnicity. This report shows that over time, the numbers of students of each race/ethnicity who have completed high school and continued their education in college have increased. Despite these gains, the rate of progress has varied, and differences persist among Whites, Blacks, Hispanics, Asians, Native Hawaiians or Other Pacific Islanders, American Indians/Alaska Natives and students of two or more races in their performance on key indicators of educational performance. (Aud, Fox, & KewalRamani, 2010, p. iii)

Differences among students can be related to students' culture, class, gender, religion, economic status, and other factors.

Race and gender are some of the factors that directly influence a student's experiences, which in turn influence and shape their mental models and intellectual orientation and understanding (Krugly-Smolska, 1995; McDowell, 1990). Other factors include class, personal experiences, culture, language, and religion (Krugly-Smolska, 1995; Lee, 2003). This raises the question of how to integrate the science disciplines with students' languages and cultures? There is no single answer to this question. Regarding culture, which can be defined as sets of beliefs, values, norms, and behaviors of a group, Lee (2003) emphasized the importance of using linguistic and cultural resources that diverse students bring into science classrooms, even though such resources may not be easily recognized by the mainstream. Thus, drawing in some examples and bringing in resources from cultures other than the dominant one ensures equity for diverse student populations in education. Doing so enriches the learning process and maximizes the opportunities of diverse students not only to be engaged in meaningful learning but also to share their experiences with students from other cultures.

Students from diverse cultures who may speak different languages come to schools with previously constructed knowledge that is shaped and influenced by their culture and through their personal experiences. Providing culturally diverse students with equitable learning opportunities helps them to "capitalize on their linguistic and cultural experiences as intellectual resources for the new scientific knowledge" (Udokwu, 2009, p. 62; see also Lee, 2003). However, challenging issues may arise, especially when culturally diverse students' experiences are not in harmony with the dominant culture or with the science discipline in Western culture. Like "students in developing countries . . . [who feel] that school science is like a foreign culture to them (Maddock, 1981)" that clashes with the system of their native cultural beliefs, history, and values, "many students in industrialized countries [like the United States] share this feeling of foreignness as well (Aikenhead, 1996; Costa, 1995)" (Aikenhead & Jegede, 1999, p. 269; see also Maddock, 1981; NRC, 2012).

> Cultural clashes between students' life-worlds and the world of Western science challenge science educators who embrace science for all, and the clashes define an emerging priority for the 21st century: to develop culturally sensitive curricula and teaching methods that reduce the foreignness felt by students. (Aikenhead & Jegede, 1999, p. 269)

Diverse students also face additional challenges when they are engaged in scientific inquiry. Scientific inquiry is the focus that the NRC promotes in its Framework, and it is also a focus of the NGSS. Scientific inquiry is also at the heart of science education and is necessary for meaningful science learning to occur. Brown and Abell (2007) indicated that scientific "inquiry-based instruction [can] help bridge cultural backgrounds and foster science learning success" (p. 60). The process of inquiry requires engaging students in discussion, raising questions, designing investigations, analyzing data, and presenting data. Inquiry is a valuable teaching methodology that can draw in more voices and bring in experiences and examples from across cultures. It "may help all students develop authentic science interactions and learn science in a context that is meaningful and relevant to their lives" (Brown & Abell, 2007, p. 60). In addition, because the practice of inquiry in science engages students in scientific discourses in social interactions for constructing scientific knowledge, "science and engineering practices can actually serve as productive entry points for students from diverse communities—including students from different social and linguistic traditions, particularly second-language learners" (NRC, 2012, p. 283).

In general, all students struggle with scientific inquiry. More specifically, however, culturally different students often struggle more because their cultural norms prioritize respect for teachers and other adults as authoritative sources of knowledge rather than developing theories and debating based on evidence and reasoning (Brown & Abell, 2007; Lee, 2003). Although diverse students come to science classrooms with styles of interactions that may differ from what teachers expect or differ from what is considered appropriate, teachers can help all students to learn science by allowing diverse approaches to scientific reasoning in their classrooms (Brown & Abell, 2007; Krugly-Smolska, 1995).

Both the Framework and the NGSS articulated the concepts of equity, inquiry, and diversity and made the standards as applicable to all students as possible. However, in the Framework, these concepts were utilized in general terms and specific situations that are exclusive to mainstream students as opposed to inclusive to all students, including both majority and diverse minority students. "Increased classroom diversity has brought equity issues to the forefront of the education reform agenda" (National Center for Education Statistics, 1999, p. 48). In light of the growing rate of population of culturally diverse students, diversity as well as equity should be more visible in the Framework. That is, the pursuit of these two integral parts of the Framework requires that more attention be given to students from diverse groups and that they be effectively included in textbooks through vignettes or examples that provide a broader variety of cultural examples that do not focus exclusively or are not dominated by the interests of one gender, race, or culture. An example that was captured and critiqued by Rodriguez (1997) is found in the *National Science Education Standards* (NSES). The author's critique of the examples found in the NSES is that the individuals in these examples "have been robbed of ethnic identity" (p. 21). The teachers themselves are "faceless" individuals with an invisible ethnic background, and they are teaching in "ethnically and culturally neutral classrooms" (p. 21). However, this example could also provide an opportunity for science teachers to attend to the diversity that is not addressed in the NSES by identifying the "faceless" or "deidentified" teacher with a Latino name, for example, that reflects the diversity in science education in the United States.

Recommendations

The United States "is not a melting pot wherein human diversity fuses into a uniform America. On the contrary, ours is a mosaic of vibrant, diverse colors in which a cultural medley forms a variegated whole called the American culture" (Chisholm, 1994, p. 43). Chisholm (1994) also stated that "this multicultural mosaic unequivocally pervades our American schools" (p. 43). However, the underrepresentation of minority students in education, particularly in the STEM disciplines, requires educators' attention to provide students from all cultural backgrounds with appropriate opportunities to learn. "A growing evidence base demonstrates that students across economic, social, and other demographic groupings can and do learn science when provided with appropriate opportunities" (NRC, 2012, p. 298). Considering the needs of diverse students may enhance their learning. Lee (2003) indicated that learning can be enhanced when it occurs in contexts that are linguistically and culturally meaningful and relevant to students' lives.

The differences in student achievement between minority and majority students, especially at the high school level because of the disproportionately high dropout rate, as well as the overrepresentation of minority students in special education programs have all been well documented in recent decades; therefore, instead of researchers simply continuing to document patterns of academic achievement relative to population demographics, their focus should be shifted "toward taking action and developing solutions" (Hosp & Reschly, 2004). Educators should be moving toward education that is multicultural for increasingly diverse classrooms. Chisholm (1994) suggested that preparing quality teachers and raising awareness about increasingly diverse classrooms starts with multicultural teacher preparation programs in which preservice teachers learn to see themselves as active participants in and facilitators of students' academic success. According to the NCES (1999)

> Addressing the needs of students with limited English proficiency or from culturally diverse backgrounds has recently become a central concern mainly because of growing student populations with these backgrounds. Therefore, teacher training to meet these needs might be particularly important to schools with large minority student populations. (p. 22)

Increasing the number of professional development programs that address the needs of students from diverse cultural backgrounds is crucial because teachers are likely to have participated in professional development programs that focus on educational reform, curriculum and performance standards, implementing new teaching methods, or assessment techniques; however, they are unlikely to have participated in professional development programs addressing the needs of diverse students (National Center for Education Statistics, 1999).

This could be applied to science education through embracing appropriate epistemologies. Science education can be a means to face the increasing diversity of student populations in a social context in which minority students are part of the larger community. With its emphasis on engineering, the NGSS will enable all students to be engaged in learning opportunities. Engineering can be inclusive of students from different cultures by recognizing the contributions of their cultures (NGSS Lead States, 2013). In the NGSS, the science and engineering practices support science learning for all, including ELLs. This helps with redefining the epistemology of science, which in turn defines school science curriculum (NGSS Lead States, 2013). An appropriate epistemology that integrates students from different backgrounds is constructivism, particularly social constructivism, which is grounded in the work developed by Vygotsky (1978). This epistemology helps educators to learn how knowledge is constructed by individuals in a multicultural science educational environment given that social constructivism emphasizes the influence of context and culture in shaping "the unique experience of each of us" (Crotty, 1998, p. 58). Atwater (1996) stated that "multicultural science education research continues to be influenced by class, culture, disability, ethnicity, gender, and different lifestyles" (p. 821). Infusing multicultural education "creates awareness, understanding, and respect for the various cultural groups in [a pluralistic] society" (Reed, 1991, p. 122). To effectively integrate multicultural science education, social constructivism is best suited for a multicultural science education in which all students, including minority students, are given opportunities to participate and examples from their cultural backgrounds are provided.

> The essence of social constructivism and its implications for multicultural science education research includes an understanding of whatever realities might be constructed by individuals from various cultural groups and how these realities can be reconstituted, if necessary, to include a scientific reality. (Atwater, 1996, p. 821)

According to Banks (2007),

> The multicultural education movement, which emerged out of the civil rights movement of the 1960s and 1970s, seeks to reform schools, colleges, and universities so that students from diverse racial, ethnic, language, and social-class group will experience educational equality. (p. 54)

Embracing multicultural or cross-cultural science education is one of the priorities of educational practitioners in the 21st century, a time in which we have seen a dramatic change in the nation's student population. According to Banks (2007), it is imperative to integrate multicultural education because it "help[s] students and teachers to reenvision, rethink, and reconceptualize America" (p. 81). Despite the complexity of the multicultural environment, embracing multicultural science education in a multicultural environment "is one of the most important ideas in this century because it emphasizes both the ways that we are each unique and the ways that we share parts of our identity with others" (Connerley & Pedersen, 2005, pp. 22–23). "Complexity is our friend and not our enemy because it protects us from accepting easy answers to hard questions," and this is apparent in accepting or rejecting scientific theories (Connerley & Pedersen, 2005, p. 28). If one views "science as a set of practices that define a singular 'culture of science' that would-be scientists must acquire . . . . [, that] culture of science does not reflect the cultural values that people bring to science" (Bell et al., 2009, p. 212).

Ignorance of other cultures, due to dependence upon one dominant culture, has been demonstrated to be dangerous (Connerley & Pedersen, 2005). "To effectively conceptualize and implement multicultural education curricula, programs, and practices, it is necessary not only to define the concept in general terms but to describe it programmatically" (Banks, 2007, p. 83). In regard to balancing the current curriculum in a diverse and multicultural school environment, Rodriguez (1997) recommended "teaching science in more inclusive and multicultural ways" (p. 32), especially with the growing population of students from different cultures.

Another action may take the form of "improving teacher training in working with students from culturally and linguistically diverse backgrounds" in hope of reducing the disproportionate representation of minority students in special education (Hosp & Reschly, 2004, p. 186). Preservice teachers should be placed in appropriate field experiences and with teacher supervisors who incorporate a multicultural focus (Chisholm, 1994). Preservice teachers should observe diversity in the classroom and how effective classroom teachers apply multicultural teaching practices in classrooms with diverse students.

Ford (1991) suggested a model for developing teachers with a multicultural perspective in multicultural classrooms. This model encompasses four stages: (1) "developing awareness . . . of one's own [culture] and other cultures" (p. 135); (2) "building knowledge and skills" through multicultural education and coursework that include "activities, research, development of thematic interdisciplinary units, case studies[,] and a foundation for multicultural exploration" (p. 135); (3) "providing experiences" that offer students direct "exposure and active involvement with multicultural populations in non-threatening situations" (p. 136); and (4) "providing resources and support" through graduate programs in education, "parents, care-givers, churches, and community agencies" (p. 137).

Developing "culturally sensitive curricula" (Aikenhead & Jegede, 1999, p. 269) is a necessity; therefore, already existing science curricula must be restructured into culturally sensitive curricula. Multicultural science education for all students espoused with new teaching delivery mechanisms help students from diverse cultures to receive meaningful learning by bringing in their linguistic and cultural experiences as valuable resources in science classrooms and enables them to be more engaged in science practices and, subsequently, show academic achievement gains (Aikenhead & Jegede, 1999; Krugly-Smolska, 1995; Lee, 2003; McDowell, 1990). In addition, developing culturally sensitive curricula aims "to reduce the [feeling of] foreignness felt by [linguistically and culturally diverse] students in education and in science classrooms," a "feeling [that] stems from fundamental differences between the culture of Western science and their indigenous [or native] cultures (Aikenhead, 1997; Jegede, 1995)" (Aikenhead & Jegede, 1999, p. 269). This feeling of foreignness toward science can be alleviated "when the culture of science [and science instructional delivery methods] harmonizes with a students' [cultural beliefs or] life-world culture"; this process is called *enculturation* (Aikenhead & Jegede, 1999, p. 274).

Traditional classroom practices may serve students whose discourse practices at home resemble those at school; however, such practices may also serve as a gatekeeper that bars students not in the dominant group from engaging in science discourse (Aikenhead & Jegede, 1999). To address this concern, effective science teaching methods should be applied to help linguistically and culturally diverse students make a smooth transition into a culture that differs from their native culture and to provide them with opportunities for the expansion and enrichment of their culture (Aikenhead & Jegede, 1999; Lee, 2003; Maddock, 1981; NRC, 2012). Such initiatives call for science teachers to make a necessary shift in their science instructional methods in order to prepare all students for college and future careers (NGSS Lead States, 2013).

However, science culture and "science instruction . . . can disrupt the student's worldview by trying to force that student to abandon or marginalize his or her life-world concepts and reconstruct in their place new (scientific) ways of conceptualizing" (Aikenhead & Jegede, 1999, p. 274). This process of *assimilation* can disrupt students' cultural beliefs and cause them to marginalize their own culture to replace it with Western ways of conceptualizing science (Aikenhead & Jegede, 1999; see also Maddock, 1981). "Alternatively, attempts at assimilation can alienate students from science," keeping them from "learning the content in a . . . [meaningful] way" (Aikenhead & Jegede, 1999, p. 274). The process of assimilation often makes this transition into a "hazardous border crossing" for minority students because of the discontinuity between the Western culture of science and the cultures of students from culturally different groups (Aikenhead & Jegede, 1999). Thus, the process of assimilation can result in lower achievement for minority students and the overrepresentation of minority students in special education programs. Students from cultures that do not encourage students to ask questions or engage in logical argumentation in scientific discussion based on scientific evidence, even when they have scientific understanding, might be perceived as lacking the intellectual ability or the scientific understanding to be in the science disciplines (Lee, 2003).

Even though the Framework and the NGSS clearly affirm science for all, multicultural groups are still invisible and are not recognized in the Framework. This is consistent with what Krugly-Smolska (1995) found in his study of multicultural science classrooms in Canada in which "multiculturalism did not pervade the science curriculum, and indeed there was no recognition of the multicultural context in the science classroom" (p. 51). Additionally, "there was little indication of recognition of individual cognitive or learning style differences" (p. 53). Because it is hard to pinpoint the exact cultural influences on students' academic achievement, similar findings can be predicted for the lack of representation of minority students in science classrooms in the United States. To enlighten science teachers about the differences in learning styles of diverse students, the NGSS present case studies "that are not intended to prescribe science instruction, but to illustrate an example or prototype for implementation of effective classroom strategies with diverse student groups" (NGSS Lead States, 2013, pp. 25–26). They also present "learning opportunities and challenges to all students, particularly non-dominant student groups" (p. 26). For example, the NGSS emphasize the role of language as ELLs engage in science instruction. This draws teachers' attention to the critical role of instructional practices as well as helping educators to understand "the critical role that language plays in the CCSS and the NGSS" as well as in instruction and "that the new standards cannot be achieved without providing specific particular attention to the language demands inherent to each subject area" (p. 27). In dealing with assimilation, the NGSS emphasize applying effective teaching strategies that help teachers to "understand how disconnections may vary among different student groups, as well as how to capitalize on connections" (p. 30).

The NGSS (NGSS Lead States, 2013) provide some effective teaching strategies that serve nondominant groups and help them create and establish connections to school science.

> Effective strategies for students from major racial and ethnic groups fall into the following categories: (1) culturally relevant pedagogy, (2) community involvement and social activism, (3) multiple representation and multimodal experiences, and (4) school support systems including role models and mentors of similar racial or ethnic backgrounds. (p. 31)
>
> The research literature indicates five areas where teachers can support both science and language learning for English language learners: (1) literacy strategies for all students, (2) language support strategies with ELLs, (3) discourse strategies with ELLs, (4) home language support, and (5) home culture connections. (p. 31)

Taking one or all of the previously mentioned initiatives helps science teachers with achieving some of the NGSS practices and crosscutting concepts related to the understanding of the nature of science, which are presented in "the Nature of Science (NOS) Matrix":

> The basic understandings about the nature of science are:
> - Scientific Investigations Use a Variety of Methods
> - Scientific Knowledge Is Based on Empirical Evidence
> - Scientific Knowledge Is Open to Revision in Light of New Evidence
> - Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
> - Science Is a Way of Knowing
> - Scientific Knowledge Assumes an Order and Consistency in Natural Systems
> - Science Is a Human Endeavor
> - Science Addresses Questions About the Natural and Material World. (NGSS Lead States, 2013, p. 97)

The concept "Science Is a Human Endeavor" is a theme that is directly related to diversity. This theme illustrates that scientists and engineers come from diverse cultural backgrounds and have contributed to the advancement of science and engineering.

Conclusion

The intent of this article is to present a call to action for the U.S. educational system to meet the needs of the increasingly diverse student population. According to the NRC (Bell et al., 2009),

> Science is a sociocultural activity; its practices and epistemological assumptions reflect the culture, cultural practices, and cultural values of its scientists. Diversity in the pool of scientists and science educators is critical. It will benefit science by providing new perspectives in research, and it will benefit science education by providing a better understanding of science. Informal environments for science learning are themselves embedded in cultural assumptions. People from nondominant cultural groups may tend to see these institutions as being owned and operated by the dominant cultural group. Furthermore, science may be broadly construed as an enterprise of the elite. (p. 236)

However, after reviewing the Framework, the NGSS, and other related articles, it seems that in developing a culturally responsive science framework, math and science education have not yet received the attention of those concerned with the widening achievement gap and lack of proportional representation of minority students. Statistics show that linguistically and culturally diverse students and teachers are still underrepresented in secondary education, specifically in science education. The underrepresentation of minority students in secondary education leads to their underrepresentation in higher education. Rethinking science education is a necessity in light of the growing population of diverse students from different cultural backgrounds. Culturally diverse students come to school with alternative ways of knowing science that should be recognized as valuable assets for science learning (Lee, 2003). "Infusing diversity components" into science teacher education is a promising practice that requires rethinking already existing science curricula to meet the needs of every unique culture (Lim & Able-Boone, 2005, p. 225). Teachers should integrate their knowledge of students' language and culture with knowledge of science if they are to make meaningful science learning accessible to all students (Lee, 2003). In fact, preservice teachers can be influenced through teacher preparation educational programs, which are developed to help with the development "of teachers' thorough understanding and knowledge of the diverse needs and characteristics of families, children, and their communities in order to successfully create meaningful and quality teaching and environments for all children" (Lim & Able-Boone, 2005, p. 227), including culturally and linguistically diverse students. The above mentioned recommendations are developed in hope of making up for the lack of material resources and instructional support to provide exemplary science education for all students, including linguistically and culturally diverse students, in addition to the development of the students' identities as competent and motivated learners. "Learning science depends not only on the accumulation of facts and concepts but also on the development of an identity as a competent learner of science with motivation and interest to learn more" (NRC, 2012, p. 286).

> It is critical to consider diversity issues and the science learning of nondominant groups for several reasons: to ensure equitable treatment of all individuals; to continue to develop a well-trained workforce; to develop a well-informed, scientifically literate citizenry; and to increase diversity in the pool of scientists and science educators who can bring new perspectives to science and the understanding of science" (Bell et al., 2009, p. 210).

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