Focusing on Cultural Competency in STEM Education

By Alicia Santiago, Ph.D.

Introduction

The U.S. Education system is becoming more and more diverse and educators must adapt to continue to be effective. Educators must embrace the diversity of language, color, and history that comprises the typical classroom; this means becoming culturally competent. In doing so, comes with it the prospect of using culture to enhance the learning experience for students and the educator. Although the process of becoming culturally competent can be outlined, the realization of a culturally competent educator depends on changing one's own perceptions and beliefs. The need for cultural competency and the spectrum of cultural competency are explained, and practical activities are provided to aid the educator in creating a culturally active learning environment.

Teachers and educators need to see culturally relevant teaching to support the needs of culturally diverse student populations.

The Changing Demographics of America Reflected in the School Population - Students in America are More Diverse than Ever.

The United States is undergoing a crucial demographic change. According to the U.S. Census Bureau, by the year 2050 there will no longer be any clear racial and ethnic majority. The non-Hispanic white population - which is currently the majority group, as it is both the largest racial and ethnic group and accounts for greater than a 50% share of the nation's total population – will cease to be the majority group by 2044 (U.S. Census Bureau, 2014). Interestingly, the United States is already a minority-majority nation as minority babies are the majority among the nation's infants (Pew Research Center, 2016). Among newborns, minorities slightly surpassed non-Hispanic whites. Census Bureau estimates indicate that 50.3% of children younger than 5 were racial or ethnic minorities in 2015. Children identified by their parents as white with Hispanic origin were the largest minority, making up 22 percent of the 19.9 million children under age 5, followed by African American children, who make up 15 percent. The population aged 6 to 17 are also a bridge to a more diverse America as whites comprise just over half (51.5%) of this population. As American demographics is becoming more culturally diverse, these national population trends are also reflected among students in the nation's schools.

The United States public schools are a snapshot of a changing nation. In 2014, children of color became the new majority in America's public schools. The changing demographics of America has resulted in a decline in the number of whites in classroom even as the total number of public school students has increased. Data from the National Center for Education Statistics (NCES) show that between 2003 and 2013, the percentage of white students enrolled in public schools decreased from 59 to 50 percent. In contrast, the percentage of Hispanic students enrolled increased from 19 to 25 percent (NCES, 2016). This overall shift has important implications for teachers and educators as they try to find effective ways to engage students from diverse backgrounds; culture is becoming more and more an important consideration in U.S. education.

Promoting Educators' Cultural Competence: Sparking and Increasing Diverse Students' Interest in Science Learning

Considering the rapid and substantial demographic changes in the United State's school-aged population, improving science education for all students has become a critical priority. Ethnic and racial groups (people of color) who are rapidly becoming the demographic majority in the United States are particularly underrepresented in the fields of science, technology, engineering and mathematics (STEM) and make up only a fraction of science and engineering students. As students in the education system become more ethnically and culturally diverse, educators need to respond to the needs of diverse student populations by becoming culturally competent. Culture is influential and powerful as it affects our perception, behavior, and the learning process. A culturally competent educator has the ability to understand, communicate with, and effectively interact with students from different cultures, and successfully engage them in science learning. Culture is central to student teaching and learning because learning is a cultural process enacted through experiences and actions (Erickson, 2002; Lee, Spencer & Harpalani, 2003; Rogoff, 2003; Nasir, Rosebery, Warren & Lee, 2006). Thus, engaging students in meaningful activities that incorporate their own culture, skills, experiences and prior learning, allows students to make connections that inspire and engage them in STEM. *What is cultural competency?*

Cultural competence is defined as "a set of congruent behaviors, attitudes, and policies that come together in a system, agency, or among professionals and enables that system, agency, or professionals to work effectively in cross–cultural situations" (Cross et al., 1989; Isaacs & Benjamin, 1991). Cultural competence is a key factor that allows educators to be effective with and successfully teach students from different cultures. Developing cultural competence is a dynamic and complex process that involves continuous expansion of one's cultural knowledge, ongoing self-assessment, and developing certain personal and interpersonal awareness and sensitivities that allows us to understand people outside one's own cultural context. Lindsey, Robins, and Terrell (2003) define three conditions of cultural competence: 1) recognizing the differences among students and families from different cultural groups, 2) responding to those differences positively, and 3) being able to interact effectively in a range of cultural environments. These elements, taken together, underlie effective culturally responsive and cross-cultural teaching.

Developing Cultural Competence - Stages and Steps of Cultural Competency

Becoming culturally competent is an ongoing process that happens over time; it is a sensibility that is cultivated throughout our lifetime. According to Cross, cultural competence is a complex framework, and the process of achieving cultural competency occurs along a continuum (Cross, 1989). Mason – building on the work of Cross – developed a five-stage cultural competence continuum. This continuum helps delineate the meaning of cultural competence and gauge our proficiency. Each stage indicates unique ways of perceiving and responding to differences: **1) cultural destructiveness, 2) cultural incapacity, 3) cultural blindness, 4) cultural pre–competence, and 5) cultural competence** (Mason, 1993). *Cultural destructiveness* is the most negative end of the continuum and refers to practices, behaviors, or policies that eliminate aspects of others' culture(s). They are destructive to cultures and individuals within them (*e.g., Not allowing students to speak Spanish at all at school*). *Cultural incapacity* is characterized by the lack of capacity to respond effectively to the needs, interests, and preferences of culturally and linguistically diverse groups. Characteristics include but are not limited to: believing and behaving in ways that disrespect, devalue, or denigrate other's culture, and having lower expectations for some cultural, ethnic, or racial groups (e.g., implicit bias – subconscious stereotypes that influence our behavior toward people of color – see Gilliam, 2016). *Cultural blindness* is a philosophy of viewing and treating all people as the same. It consists of an intent to be unbiased and believing and acting as if cultural differences do not matter. It is characterized by equal treatment. Examples may include people who encourage assimilation, and teaching approaches that ignore cultural strengths. *Cultural pre-competence* is characterized by efforts to recognize and respond positively to cultural difference, but the efforts are largely superficial and correspond to the easily visible aspects of culture (e.g. music, art, food). *Cultural competence* is demonstrated by an acceptance and respect of cultural differences, continued self-assessment of cultural awareness, paying attention to the dynamics of cultural differences, and continued expansion of cultural knowledge and resources in order to better meet the needs of others. The culturally competent educator respects and honors differences among cultures; views diversity as a benefit, and interacts knowledgeably and respectfully among members of diverse cultural groups.

Becoming culturally competent involves gaining knowledge and experience in three areas:

It is important for the educator to recognize that becoming culturally competent involves life-long learning and experience, but more importantly a desire to actively gain and use experience in these

areas. Purnell and Paulanka (2003) define culture as "the totally of socially transmitted behavioral patterns, arts, beliefs, values, customs, life-ways, and all other products of human work and thought characteristics of a population of people that guide their world view and decision making." which guides the educator to consider history, location, and the individual when thinking about culture.

Cultural knowledge – refers to gaining knowledge of different cultural practices and worldviews, familiarization with cultural characteristics, history, values, beliefs, and behaviors of members of another ethnic or cultural group. Although these factors are commonly thought to be dominant elements of culture, gender, age, geographic location, socioeconomic status, and lifestyle, are also powerful factors that influence culture. Cultural assumptions can often lead to wrong conclusions. For example, it could be wrong to assume that a racial or ethnic group categorized broadly as African American, Hispanic, or Asian American, share a common culture. These larger groups may share only physical traits, language or spiritual beliefs. These broad categories are sometimes misleading because they can mask substantial differences within groups. For example, a Mexican couple may immigrate to the U.S. and raise their children in a suburban area. As a result, the children may identify much more with European American popular culture than the Mexican culture of their parents or the culture of an urban environment. Understanding this is important as it can lead to a better understanding of the complexity of cultural diversity. It is important that educators understand their students' specific cultural backgrounds so they can translate that knowledge into engaging and effective instruction.

Cultural awareness – It is about developing sensitivity and understanding of another ethnic group. It is the ability to stand back and become aware of our own cultural values, beliefs and perceptions, and recognize that people from other cultures may not share them. It involves internal changes in terms of attitudes. This may mean changing biases or prejudgments we may have of someone's cultural beliefs and customs. Understanding our own culture shapes the sense of who we are. It helps educators understand how they fit into their school, community, society, and how they interact with students.

Cultural sensitivity – It is about valuing diversity; accepting and appreciating the differences that exist among cultures without assigning judgments (good or bad, right or wrong, better or worse) to those cultural differences. These differences could be related to cultural backgrounds and customs, different traditions and values, and different ways of communicating, etc.

By integrating cultural knowledge, awareness, and sensitivity, educators become culturally competent and have the capacity to adjust behaviors, actions, and practices to meet the needs of diverse students (Ladson-Billings, 1994). A culturally competent teacher uses the students' culture to empower the student and help them achieve success in school or learning environment. A culturally competent teacher/educator works to understand who their students are in terms of their cultural and social identities, learning styles, personal, academic, and social needs. A culturally competent

teacher/educator also understands their own culture and how it may influence the behavior of others and use this knowledge to adapt accordingly. Together these traits allow educators to create relevant curriculum, and develop teaching strategies that contribute to the identities of all students without the student being the focus of instruction.

The Operationalization of Cultural Competency in the Learning Environment - Essential Elements for Culturally Responsive Teaching Practices

When applied to education, cultural competence is demonstrated through the practice of culturally responsive teaching (CRT). CRT is defined as a pedagogy that recognizes, respects, and uses cultural characteristics, experiences, and perspectives of ethnically diverse students and backgrounds as meaningful sources for creating optimal learning environments and teaching them more effectively (Ladson-Billings, 1994, 2014; Nieto 2000; Gay 2000, 2002). Ladson-Billings (2009) also defines culturally relevant teaching as a "pedagogy that empowers students intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills, and attitudes" (p.20). When students' skills, knowledge and culture are included in teaching strategies it makes the information more personally meaningful and relevant to the student, has a higher interest appeal, and is learned more easily and thoroughly. If students are taught through their own culture and experiences the learning experience is meaningful.

CRT emphasizes best practices in terms of management of the learning environment, teaching styles, and ways of delivering and reinforcing curriculum that reflect students' cultural background – and differ from traditional teaching methods. Several studies show that CRT increases student achievement and interest in STEM, especially in students from underrepresented groups (Ladson-Billings, 1995; Gay, 2000; Delaney 2016; Bruyere, 2010). Gay (2000) stated "culturally responsive teaching is a means for unleashing the higher learning potentials of ethnically diverse students by simultaneously cultivating their academic and psychosocial abilities" (p.20). Gay believes that ethnically diverse students can be more successful in schools or learning environment if educators become culturally responsible and teach in a way that students can understand. To do this, educators must incorporate relatable aspects of students' daily lives into the curriculum such as language, prior knowledge, and extracurricular activities to name a few. A common misconception about culturally responsive teaching is that educators must teach the "Latino way" or "black way". It is not about having to tie lessons' content to Latino or African American students' racial background. It is about improving the academic achievement of diverse students by considering students' culture, prior knowledge, experiences, and

perspectives to teach them in a familiar context; thus making the teaching more effective. Gay (2002) describes five elements of culturally responsive teaching: 1) *develop a cultural diversity knowledge base*, 2) *design culturally relevant curricula*, 3) *demonstrate cultural caring and build a learning community*, 4) *provide cross-cultural communications*, and 5) *use cultural congruity in classroom instruction*. Using these five elements can help students, especially those who are ethnically and culturally different from mainstream America.

The first element of being a culturally responsive educator is to develop a knowledge base about cultural diversity. Educators must have an understanding of the cultural characteristics and contributions of different ethnic groups. It is also important to develop cultural awareness and sensitivity as this positively impacts our interactions with others. Developing cultural awareness and sensitivity requires a willingness to learn, give, and the humility and ability to self-evaluate. Overcoming ethnocentrism (judging others by the standards of one's own culture) is an important step to develop genuine intercultural sensitivity, which leads to a more interesting and motivating learning environment. This is key for developing a cultural diversity knowledge base.

The second element "*designing culturally relevant curriculum"*, is about converting the knowledge base about cultural diversity into culturally responsive curriculum and teaching practices. This requires integrating cultural awareness and sensitivity into the curriculum. A culturally relevant curriculum builds on students' personal and cultural strengths. According to various researchers, a culturally responsive curriculum is integrated and interdisciplinary (Scherer, 1991-1992; Spars, 1990; Banks, 2001); meaningful, student centered, and connected to the student's real life (Chion-Kenny, 1994; Dickerson, 1993); develops higher-order knowledge and skills (Villegas, 1991; Hilliard, 1991-1992); utilizes a variety of learning strategies, such as diverse learning styles and cooperative learning (Gay, 2000), and is developmentally appropriate to meet the students' affective, cognitive, and educational needs (Gay, 2010).

Demonstration of cultural caring and building a learning community is Gay's (2002) third element for culturally responsive teaching. Cultural responsive caring "places teachers in an ethical, emotional and academic partnership with the ethnically diverse students, a partnership that is anchored in respect, honor, integrity, and resource sharing" (Gay, 2000, p. 15). In this process cultural characteristics of culturally diverse students are shared and honored, which helps students develop the knowledge, skills and abilities needed for a meaningful and successful 21st century work and life. The process of teaching and learning is maximized when a relationship of trust and caring has been established between the student and educator. Valenzuela (1999) stated that as teachers seek for students to care about school, students seek for teachers to care about them as an individual. Teachers who teach with their students in mind and seek to care for and understand their students, help create an environment

where students are more willing to participate in their own learning and encourages constant achievement.

Effective cross-cultural communication is Gay's (2002) fourth element of culturally responsive teaching. Effective communication with culturally diverse students is key to determine what students know, can do, and their potential capabilities. For this to occur, teachers must respect and understand the communication styles and behaviors of ethnically diverse students. It is important to understand that communication styles vary among diverse students. Some examples include linear (straight line discussion) versus a circular approach; direct (meaning conveyed by words) versus indirect (through suggestion); detached (objective presentation) versus attached (expressive style), and concrete (example driven discussion) versus abstract (theory driven discussion) (Alusine, 2011). A culturally responsive educator understands how communication styles of ethnically diverse students reflect values and shape learning. With this understanding, educators know how to modify their interactions with students to reflect the communication style and patterns of their students. Furthermore, understanding the cultural differences of vocabulary usage, delivery, logic and rhythm, role relationships of speakers and listeners, intonations, gestures, and body movements, help educators better communicate with their students.

The fifth element of Gay's (2002) culturally responsive teaching is the notion of cultural congruity in classroom instruction. This deals with the actual delivery of instruction to ethnically diverse students. According to Gay (2000) "culture is deeply embedded in any teaching; therefore teaching ethnically diverse students has to be multiculturalized". That is, the curriculum has to be organized around a multicultural perspective, which means matching instructional techniques to the learning styles of diverse students. The learning style of ethnically diverse students has eight key components that educators need to understand, construct, and adjust to increase students' participation and maximize their learning potential. These include: 1) techniques for organization and to convey ideas and thoughts; 2) preferred content, 3) ways to work through the learning tasks; 4) physical and social settings for task performance; 5) interpersonal interaction styles; 6) structural arrangements of work, study, and performance space; 7) perceptual stimulation for receiving, processing, and demonstrating comprehension and competence, and 8) motivations, incentives, and rewards for learning. These elements provide different emphasis and points of entry for matching teaching to learning styles of diverse students. Furthermore, another powerful way to establish cultural congruity in teaching is using culturally relevant examples that help connect prior knowledge with new knowledge, the known with the unknown, and abstractions with lived realities. Research shows that using culturally relevant examples has positive effects on the academic achievement of culturally diverse students (Garcia, 1999; Lipka, 1998; Moses 2001, and Tharp, 1988).

Key Strategies for Developing Culturally Responsive Out-of-school STEM Programs

Research tells us that inquiry-based approaches to science learning provide promise and possibility for engaging students from diverse cultural backgrounds in STEM (Minstrell, 2000; O'Neill, 2004, and Geier, 2008). However, inquiry-based instruction without culturally relevant pedagogy may not be sufficient to support diverse students in science learning (Meyerand Crawford 2011). Research in STEM education shows a positive correlation between improving the cultural competence of STEM teaching and increasing students' STEM achievement. For example, research by Lipka (2005) shows significantly higher math achievement for Yupik students from Alaska when taught math using culturally based content and pedagogy compared to a control group of their peers who were taught using traditional content and methods. Similarly, American Indian students showed significantly higher achievement on tests when taught using a research-based science curriculum that integrated cultural content in their lessons (Gilbert, 2006). Boykin (2004) reported that African-American middle school students had higher test scores in math and geography when taught using a communal method than their peers who were taught using a competitive method that focused on individual effort. Similarly, culturally relevant teaching for seventh grade African American students increased student science achievement and participation in the classroom (Paulk, 2015).

In addition to the science learning that occurs in schools, informal science education (ISE) – or out-of-school-time (OST) experiences also provide powerful opportunities for diverse students to experience and learn about science. Organizations such as informal learning and community-based organizations, libraries, schools, institutions of higher education, government agencies, private companies, and philanthropic foundations dedicate time to develop, document, and improve science learning in informal environments for learners of all ages and cultural backgrounds. Many ISE programs hosted by science centers, museums, and other community-based organizations, are effective in allowing youth to develop science interests, engage in science inquiry, and reflect on their experiences. ISE programs improve youth's attitude about science, science literacy and academic achievement, positively influence youth's critical thinking skills and behaviors, technology and study skills, classroom behavior, and academic pursuits and career goals (Bell, 2009; Biricini, Konur, 2011; NRC, 2009). Furthermore, the ISE experience has also been shown to have a positive effect on the students' feelings of competence and self-confidence, creativity, interpersonal and teamwork skills, relationships with peers and family, work ethic, tolerance of others, and social awareness and responsibility (Baum, 2000; Beane, 2000; Librero, 2005; Intrator 2006; Koke, 2007; Sneider, 2011; Luke, 2007; Mielke, 2012). These outcomes

have also been demonstrated for underserved minority groups such as Latinos, (Siegel, 2007), and women, (Fadigan, 2004; McCreedy, 2013).

Participation in afterschool programs has consistently increased over the past decade. Interestingly, youth from groups traditionally underrepresented in STEM, are more likely to participate than non-Latino whites (Afterschool Alliance, 2012). Furthermore, Latino parents place a high value on afterschool education programs and express high interest in ISE programs for their children (Bruyere, 2010). In spite of this, studies show ISE programs still struggle in reaching minority groups (Fadigan, 2004; Allison, 2004; Hong, 2006; Bell, 2009). This discrepancy has prompted research into the barriers that prevent Latinos and other minority groups from participating in ISE programs. These barriers are identified as cultural factors consisting of personal motivations that depend on beliefs, values, skills, and interests, and practical factors such as availability of programs and time, financial resources, and lack of transportation (Rideout, 2000; Allison, 2004; Hong, 2006).

While many organizations recognize the need to engage diverse audiences, they often struggle to adapt to cultural and linguistic differences. Thus, developing culturally responsive ISE programs is key to engaging diverse youth in STEM, as these programs take into account the perspectives, contexts, and meet the needs of diverse populations. The following are strategies used by ISE programs to effectively engage diverse youth in science learning. These strategies are commonly used to develop culturally responsive STEM programs for Latino youth and their families:

1. *Develop awareness, knowledge and skills through cultural competence training* (Hall, 2016).
    - Requires that organizations make a commitment to continually learn about the cultural values, prior experiences, and social structures of the target group.
    - Requires STEM educators and practitioner's self-exploration and understanding of their own belief system and worldviews.
    - Provide ongoing staff training and support for developing cultural competence. Training should focus on:
        - Cross-cultural communication, and cultural awareness and sensitivity.
        - Culturally responsive teaching strategies.

2. *Develop partnerships with organizations that have established trusting relationships with the target community* (Hobbs, 2009).
    - Establish partnerships with organizations and community members that are trusted by the target audience (e.g. community-based organizations, churches, schools).
    - Develop knowledge about existing partnerships in the community. Who is doing what, and what else could be done?

- Establish collaborations to overcome constraints to outreach (e.g. money, time, staff limitations).

3. *Structure programs with an awareness of cultural and practical considerations to meet the needs of the target audience* (Sorensen, 2007; Bruyere, 2009).
   - Identify cultural and practical barriers to participation. This offers insight to the structure, design and promotion of the program. Examples of practical considerations include: time, cost, transportation issues. Examples of cultural considerations include: language, messages of empowerment, lack of representation of divers people in STEM fields – and in staff.

4. *Utilize culturally relevant advertising and promotion strategies* (Bruyere, 2010).
   - Develop culturally effective promotion strategies such as word of mouth networks, advertising via schools, churches, community centers, etc.
   - Produce quality translations using appropriate and accurate language and advertising materials.

Conclusion

In light of the demographic changes currently taking place in the U.S. - also reflected in the rapid growth in the numbers of culturally and linguistically diverse students in schools and out-of-school programs – cultural competency needs to be emphasized to respond to the nation's need for a stronger STEM education and workforce. For this, educators need to develop new competencies and teaching strategies to effectively engage the country's changing populations in STEM learning. Building educators' cultural competence is key to successfully engage and teach students from diverse cultures. It is a dynamic and complex process that entails acquiring specific knowledge about people outside one's own cultural context; increasing personal and interpersonal cultural awareness and sensitivity by becoming culturally self-aware, and understanding and valuing other's cultural values, beliefs and perceptions. Culturally responsive teaching (CRT) is how educators demonstrate their cultural competence. CRT integrates the students' knowledge, skills, experiences and culture to make the learning experience more personally meaningful and relevant to the student and can be put in practice in both formal and informal learning environments and settings.

References

Afterschool Alliance (2012). Afterschool Essentials: Research and Polling. Retrieved from http://www.afterschoolalliance.org/documents/2012/Essentials_4_20_12_FINAL.pdf

Allison, M. T., & Hibbler, D. K. (2004). Organizational barriers to inclusion: Perspectives from the recreation professional. Leisure Sciences, 26, 261-280.

Alusine, M. D., & Kanu, A. M. (2011). Experiencing Interactive Interpersonal Communication. Xlibris Corporation.

Banks, J.A., McGee, B., & Cherry, A. (2001). Multicultural education: Issues and perspectives (4th Ed.). New York: John Wiley & Sons, Inc., p. 176.

Baum, L, G.E. Hein, and M. Solvay. 2000. In their own words: Voices of teens in Museums. Journal of Museum Education, 25(3): 9-13.

Beane, D.B. 2000. Museums and healthy adolescent development: What we are learning from research and practice. Journal of Museum Education, 25(3): 3-8.

Bell, P., Lewenstein, B., Shouse, A.W., & Feder, M.A. (Eds.). (2009). Learning science in informal environments: People, places, and pursuits. Washington, DC: The National Academies Press.

Birinci Konur, K., Şeyihoğlu, A., Sezen, G., & Tekbiyik, A. (2011). Evaluation of a science camp: Enjoyable discovery of a mysterious world. Educational Sciences: Theory & Practice, 11(3), 1602-1607.

Boykin, A.W., Coleman, S.T., Lilja, A.J. & Tyler, K.M (2004). Building on children's cultural assets in simulated classroom performance environments: Research vistas in the communal learning paradigm. CREDE Report #68, February 2004.

Bruyere, B. L., & Salazar, G. (2010). Engaging Latino audiences in out-of-school programs about science. Journal of Extension, 48(3), 3RIB4. Retrieved from: http://www.joe.org/joe/2010june/rb4.php.

Bruyere, B. L., Billingsley, E. D., & O'Day, L. (2009). A closer examination of barriers to participation in informal science education for Latinos and Caucasians. Journal of Women and Minorities in Science and Engineering,15(1).

Cross, T., Bazron, B., Dennis, K., & Isaacs, M. (1989). Towards a Culturally Competent System of Care, Volume 1. Washington, DC: CASSP Technical Assistance Center, Center for Child Health and Mental Health Policy, Georgetown University Child Development Center.

Culture, abilities, resilience, effort (CARE): Strategies for Closing the Achievement Gap (2011). National Education Association. (4th edition). Retrieved from http://www.nea.org/assets/docs/CAREguide2011.pdf

Delaney, C. & Lee, K.S. (2016). Culturally Responsive Teaching with Technology: Increasing STEM Participation of Underrepresented Groups. In G. Chamblee & L. Langub (Eds.), Proceedings of Society for Information Technology & Teacher Education International Conference 2016 (pp. 482-485). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE). Retrieved from https://www.learntechlib.org/p/172314.

Erickson, F. (2002). Culture and human development. Human Development, 45(4), 299–306.

Fadigan, K.A., & Hammrich, P.L. (2004). A longitudinal study of the educational and career trajectories of female participants of an urban informal science education program. Journal of College Student Development, 41(8), 835-860.

García, E. (1999). Student cultural diversity: Understanding and meeting the challenge. Boston: Houghton Mifflin.

Gay, G. (2010). Culturally responsive teaching: Theory, research, and practice (2nd ed.). New York, NY: Teachers College Press.

Gay, G. (2002). Preparing for Culturally Responsive Teaching. Journal of Teacher Education, 53(2), 106-116.

Gay, G. (2000). Culturally responsive teaching: Theory, research, and practice. New York: Teachers College Press.

Geier, R., Blumenfeld, P., Marx, R. W., Krajcik, J. S., Fishman, B., Soloway, E., et al. (2008). Standardized test outcomes for students engaged in inquiry-based science curricula in the context of urban reform. Journal of Research in Science Teaching, 45(8), 922–939.

Gilbert, W. G., (2004). Native Science Connections Research Project: Integrating Relevant Cultural Knowledge into the Science Curriculum for Grades 4-6th 2007 from the U.S. Department of Education. Retrieved from: http://www.ed.gov/rschstat/research/pubs/oieresearch/conference/gilbert_200501.pdf

Gilbert, W. S. (2006). Native science connections research project: Integrating relevant cultural knowledge into the science curriculum for grades 4-6th. In annual meeting of the American Association of Colleges for Teacher Education, San Diego, CA.

Gilliam, W. S., Maupin, A. N., Reyes, C. R., Accavitti, M., & Shic, F. Do Early Educators' Implicit Biases Regarding Sex and Race Relate to Behavior Expectations and Recommendations of Preschool Expulsions and Suspensions?

Hall, J. C., & Theriot, M. T. (2016). Developing Multicultural Awareness, Knowledge, and Skills: Diversity Training Makes a Difference? Multicultural Perspectives, 18(1), 35-41.

Hilberg, R. S., Tharp, R. G., & DeGeest, L. (2000). The Efficacy of CREDE's Standards-based Instruction in American Indian Mathematics Classes. Equity & Excellance in Education, 33(2), 32-40.

Hong, A., & Anderson, D.H. (2006). Barriers to participation for Latino people at Dodge Nature Center. The Journal of Environmental Education, 37(4), 33- 44.

Intrator, J. 2006. Discovery youth: A museum-based program connecting youth with community. The Evaluation Exchange XII (1/2): 11.

King, M. A., Sims, A., & Osher, D. (2000). How is cultural competence integrated in education. Center for Effective Collaboration and Practice. Retrieved from http://cecp.air.org/cultural/Q_integrated.htm

Koke, J. & Dierking, L.R. (2007). Engaging America's Youth retrospectivestudy Final report. Unpublished technical report. Edgewater, MD: Institute for Learning Innovation.

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

Ladson-Billings, G. (1994). The dreamkeepers. San Francisco: Jossey-Bass Publishing Co.

Lee, C. D., Spencer, M. B., & Harpalani, V. (2003). Every shut eye ain't sleep": Studying how people live culturally. Educational Researcher, 32(5), 6–13.

Lee, O. (2011). Effective STEM strategies for diverse and underserved learners. Paper presented at the National Research Council's Workshop on Successful STEM Education in K–12 Schools, Washington, DC, May 10–12, 2011.

Librero, D. 2005. Helping young people make choices for the long run. Curator: The Museum Journal. 48(2): 129-133.

Lipka, J**.,** Webster, J. P., & Yanez, E. (Eds.) (2005). Introduction: Factors that affect Alaska Native students' mathematical performance. [Special Issue]. Journal of American Indian Education, 44(3), 1-8.

Lipka, J., & Mohatt, G. V. (1998). Transforming the culture of schools: Yup'ik Eskimo examples. Mahwah, NJ: Lawrence Erlbaum.

Lujan J. Cultural Competence-Are We There Yet?. The Internet Journal of Allied Health Sciences and Practice. 2009 Oct 01;7(4), Article 5.

Luke, J. J., Stein, J., Kessler, C., & Dierking, L. D. (2007). Making a difference in the lives of youth: Mapping success with the "Six Cs". Curator: The Museum Journal, 50(4), 417-434.

Mason, J. L. (1993). Cultural competence self-assessment questionnaire. Portland, OR: Portland State University, Multicultural Initiative Project.

Meyer, X., & Crawford, B. A. (2011). Teaching science as a cultural way of knowing: Merging authentic inquiry, nature of science, and multicultural strategies. Cultural Studies of Science Education, 6(3), 525-547.

Mielke, M., LaFleur, J., Butler, A., & Sanzone, J. (2012). 4-H science initiative: Youth engagement, attitudes, and knowledge study. Washington, D.C.: Policy Study Associates. Print.

Minstrell, J., & van Zee, E. H. (Eds.). (2000). Inquiring into inquiry learning and teaching in science. Washington, DC: American Association for the Advancement of Science.

Moses, R. P., & Cobb, C. E., Jr. (2001).Radical equations: Math literacy and civil rights. Boston: Beacon.

Nasir, N. S., Rosebery, A. S., Warren, B., & Lee, C. D. (2006). Learning as a cultural process: Achieving equity through diversity. In The Cambridge Handbook of Learning Sciences (1st edition, pp. 489–504). New York, NY: Cambridge University Press.

National Research Council (2009). Learning science in informal environments: People, places, and pursuits. P. Bell, B. Lewenstein, A. W. Shouse, & M. A. Feder (Eds.). Board on Science Education, Center for Education. Division of Behavioral and Social Sciences and Education. Washington, D.C.: The National Academies Press. Retrieved from http://www.nap.edu/catalog.php?record_id=12190

O'Neill, K., & Polman, J. L. (2004). Why educate little scientists? Examining the potential of practicebased scientific literacy. Journal of Research in Science Teaching, 41(3), 234–266.

Paulk, S. M., Martinez, J., & Lambeth, D. T. (2015). Effects of Culturally Relevant Teaching on Seventh Grade African American Students. MLET: The Journal of Middle Level Education in Texas, 1(1), 3.

Purnell, L. D., & Paulanka, B. J. (2003). Transcultural health care: A culturally competent approach. Philadelphia, PA: F.A. Davis.

Rideout, S., & Legg, M. H. (2000). Factors Limiting Minority Participation in Interpretive Programming: A Case Study. Journal of Interpretation Research,5(1), 53-56.

Rogoff, B. (2003). The cultural nature of human development. Oxford University Press.

Schaefer, R. T. (2013). Sociology: A brief introduction.

Sneider, C., & Burke, M. (2011). The legacy of YouthALIVE. Transformative Youth Programs Continue to Thrive in Science Centers.

Sorensen, E. K. (2007). A process for building the capacity of informal science education providers to engage Latinos (Doctoral dissertation, Colorado State University. Libraries).

Tharp, R. G., & Gallimore, R. (1988). Rousing minds to life: Teaching, learning, and schooling in social context. Cambridge, UK: Cambridge University Press.

Valenzuela, Angela. Subtractive schooling: Issues of caring in education of US-Mexican youth. State University of New York Press, 1999.

Wheatley, G. H. (1991). Constructivist perspectives on science and mathematics. Science Education, 75(1), 9-21.