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How Autobiographies of Latinx Preservice Teachers Build Culturally Relevant Instruction for the Nature of Science

Noushin Nouri, Jair J. Aguilar, Patricia Ramirez-Biondolillo

Introduction

One aim of science education is to develop more equitable undergraduate science learning, including making science more accessible for diverse learners. Since Latinx students are underrepresented in science (Riegle-Crumb, Moore & Ramos-Wada, 2011), there is an immediate need to consider differentiated instructional approaches in order to increase their engagement in it, especially in Hispanic-Serving Institutions (HSIs). To do this, we argue that preparing teachers to teach science in a culturally relevant context by developing their understanding of how sociocultural factors shape both their own and their students' learning is a powerful place to begin. Latinx preservice teachers (LPSTs) come into education programs as learners with existing cultural understandings and experiences. These can be drawn from and made explicit to produce more culturally responsive teachers, one way to build a strong foundation of culturally responsive instruction, is to collect and examine LPSTs' autobiographies about their own science education. In this chapter, we, therefore, present and analyze the results of Latinx preservice teachers' autobiographical descriptions of their experience with science from early childhood into adulthood, paying specific attention to how their cultures shaped those experiences. This study took place at a four-year HSI with the highest Hispanic undergraduate student enrollment in the State of Texas (Excelencia in Education, 2018). The fact that the majority of our students (almost 92%) are Latinx makes it crucial for us, as STEM educators, to hear their voices and integrate them into our educational programs as a Hispanic-Serving College of Education (HSCOE).

Literature Review

The need to develop more equitable undergraduate science education by making science relevant to all students led to the National Science Foundation (NSF) (1996; 2017) to call on communities of scientists and science educators for assistance. According to Santiago, Calderón, and Taylor (2015), the Latinx population is the largest growing ethnic group in the US, and is projected to become approximately thirty percent of the entire population by 2050. If a group this large is not effectively exposed to a high-quality education, fostering skill and interest in science and technology, the U.S. will have a shortage of individuals working in STEM careers. Currently, 66% of all Latinx undergraduate students are served at HSIs (*Excelencia* in Education, 2018); thus, HSIs have the potential to be leaders in developing curricula that can increase Latinx participation in and contributions to science on a national level. To increase the number of Latinx students in STEM, we argue teachers must be better prepared to engage these students in science and related fields beginning in or before elementary school, by implementing teaching and learning techniques and approaches that are more relevant to the students' backgrounds, experiences, and cultural orientations (Kelly-Jackson & Jackson, 2011). Research suggests teachers, particularly those in early education, are reluctant to implement high quality science lessons due to poor preparation in teaching science, lack of knowledge of or experience regarding science, or simply because of mistaken beliefs and attitudes towards the nature of science (Greenfield et al., 2009). Consequently, there is an urgent need to identify and understand culturally shaped beliefs, as well as the strengths and barriers that foster or hinder interest in and engagement with science within Latinx communities.

Culturally Relevant Pedagogy

Culturally relevant pedagogy (CRP) is a method of teaching in a cross- or multi-cultural setting that encourages students to relate course content to their cultural background. Often, course material is presented in a mainstream idiom, or with underlying mainstream assumptions, that hamper learning. CRP proposes a theory in which students develop both their critical skills and cultural competencies at the same time, thus attaining better academic success (Ladson-Billings, 1995). Ladson-Billings states that to achieve this, teachers who advocate for CRP must have a clear conception of self and others, as well as how understanding social relationships impact their relationship with others. In this regard, Lee and Luykx (2007) conclude that teachers who promote, use, and advocate for CRPs must see themselves as part of a larger learning community in which (a) they have a necessity to give back, (b) believe all their students can achieve their goals, and (c) their instruction is always evolving.

These ideas are synthesized into the three main characteristics of CRPs (Morrison, Robbins, & Rose, 2008) as follows: academic success, cultural competence, and critical consciousness. Morrison et al., define the first as teachers maintaining high expectations for their students' success, without compromising or losing cultural identity. The second requires teachers to provide encouragement and support to their students so that they maintain their cultural identity while achieving academic success. They do this by reshaping the prescribed curriculum, building on students' prior experiences and knowledge, and encouraging relationships between schools and communities. Finally, Johnson (2011) defines critical consciousness as students' ability to "identify, understand, and critique societal issues and inequities" (p.173). Unfortunately, according to Buxton (2009), this last is often the least addressed aspect of CRPs, especially in high-poverty low-performing schools, where students lack access to high-quality teachers, teaching, and resources.

The Nature of Science

The nature of science (NOS) is “a rich description of what science is, how it works, how scientists operate as a social group, and how society itself both directs and reacts to scientific endeavors” (McComas, Clough, & Almazroa, 1998, p. 4). When teaching about NOS, several important aspects should be included: scientific knowledge is tentative (subject to change), empirically based, and subjectively shaped (i.e., involves personal background, biases, and/or is theory-laden). The subjective aspect involves human inference, imagination, and creativity, which includes the invention of explanations that are socially and culturally embedded. Additionally, the distinction between observations and inferences, and the functions of and the relationship between scientific theories and laws should also be considered (Lederman, 2007).

There are many reasons for including NOS in school curriculums and, therefore, in teacher preparation programs. Bravo, Merce, and Anna (2001) believe that understanding what science is, how it has progressed through history, and its relationship with society and culture are essential to be an educated citizen of the twenty-first century. The lack of deep understanding of NOS leads teachers to present science as a collection of facts instead of as a discipline (Abd-El-Khalick, & Lederman, 2000). Meyer and Crawford (2011) highlight that “viewing science as culture creates the space for examining science learning, and inquiry, as a borderland of cultural interaction” (p.531). Specifically, communicating the culture of science helps populations whose cultural understanding or interpretation of science is not aligned with the cultural attitudes and practices of the scientific community (Lee, 2003). In this regard, Meyer and Crawford (2011) state that when NOS is included in the instruction, students come to see how their cultural views about science differ from the “values of schools-based science” (p. 544). Meyer and Crawford argue further that this strategy explicitly helps diverse learners reach a better understanding and ownership of scientific concepts that don’t align with their cultural backgrounds.

Unfortunately, despite the importance of NOS and its effective role in implementing a culturally relevant pedagogy, only 3% of research about NOS is related to ethnic groups other than whites (Walls, 2012). In one study of bilingual 5th graders of mostly Puerto Rican backgrounds, Meyer and Crawford (2011) combined inquiry instruction and NOS to show that, while students acknowledged science as a way of knowing, they distinguished it from their families' views about it. Similarly, the limited research specifically investigating Spanish preservice teachers' knowledge of NOS has concluded that these populations have misconceptions about science (Vázquez-Alonso, García-Carmona, Manassero-Mas, & Bennàssar-Roig, 2013), but does not offer correctives of this problem. To help Latinx populations create stronger connections to and develop an interest in science, it is critical to link their cultures with the culture of science and NOS.

Theoretical framework

The research we present here considers and adopts a framework developed by Lee and Fradd (1998) that argues for modifying instruction to fit students' existing conceptions of science. Lee and Fradd introduced the concept of "instructional congruence to indicate the process of mediating the nature of academic content with students' language and cultural experiences [so as] to make such content (e.g., science) accessible, meaningful, and relevant for diverse students" (p. 13). Further, they emphasize that instructional congruency is impossible to achieve in science unless teachers understand NOS as an integral part of knowing how to guide students in developing an understanding of science. In other words, teachers need to know "what the nature of science is and what kinds of language and cultural experiences the students bring to the learning process" (p.14). Lee (2003) further explains that cultural congruency, i.e. compatibility between students' culture and the culture of science, is also needed for integrating science with students' cultural experiences in order to encourage and enable better levels of achievement and interest in science. Following these ideas of cultural and instructional congruency, we begin our present research examining LPSTs' cultural experiences and combining them with teaching NOS.

Methods

As a method of inquiry, an autobiography is a narrative form that provides stories as data, wherein each person shares his or her experience as a kind of a story that can be analyzed (Merriam, 2002). Autobiography shows a person's perspective in a precise and specific context, with precise and specific connections to the situations they describe (Cullum-Swan and Manning, 1994).

Gathering learners' autobiographies can help educators take learners' culture and experience into account when designing curriculum or methods of instruction. When students are not part of mainstream culture, their stories are significant because they highlight the differences between how non-mainstream students learn. Meyer and Crawford (2011) emphasize the role of these experiences in science learning, connecting their neglect to underrepresentation:

> Without directing greater attention to students' actual experiences in school, science and how science may or may not align with students' diverse racial, cultural, and linguistic backgrounds and understandings, these student groups will likely remain underrepresented in the sciences. (p.530)

Therefore, autobiographies were chosen as a methodological strategy and used to collect student's experiences in science.

Participants

Participants were recruited from our current preservice population. Ten Latinx preservice

All these 10 preservice teachers were Latinx female preservice teachers who were between the ages of 19-22.

Data Collection and Analysis

The participants were asked to write their “science-life story” reflecting on experiences that impacted their attitudes towards science as well as their understanding of the nature of science. To help guide their autobiographies, participants were provided a set of guiding questions (Table 1) that were adopted and modified from Krause, & Maldonado, (2019). Participants were free to expand beyond the topics within the guiding questions.

Table 1. list of guiding questions for the autobiographies

Number	List of Questions
1	What do you remember most about learning science in elementary or middle school?
2	How do you feel about science? How have your feelings changed over time?
3	How do you think your school science experiences impacted your understanding of science? What experiences made it easier/harder for you to learn science?
4	What did your teachers do or not do to connect science to you r home/cultural/community experiences? How do you think this impacted your experience?
5	How was your science learning supported at home and in your community? Did your parents or other family members engage in activities involving science? Did you do any activities that involved or applied science outside of school (e.g., sports, hobbies, games)?
6	If you received science instruction in a language other than your home language, what was your experience like? What did teachers do or not do to support your learning?
7	Do you remember any memory from your science teacher that made you interested/hated on science?
8	Are there any elements in your culture that can be considered as a barrier to learn science or pursue a career in science?
9	Are there any elements in your culture that can be considered as a benefit to learn science or pursue a career in science?
10	To what extent did your science teachers go beyond the content and to help you to know how science generally works?

Because many preservice teachers are not familiar with the term Nature of Science, we did not mention the phrase directly and instead we asked questions such as question 10.

Researchers coded the date using two coding methods: In vivo and domain and taxonomic coding (Saldaña, 2015). The rationale for using in vivo coding was because it considers the use of words or short phrases "from the participant's own language in the data record as code" (Saldaña, 2015, p. 294) and it reflected our desire to emphasize the actual words used by the participants. As we were also interested in extracting cultural aspects, we used domain and taxonomic coding based on its usefulness for "discovering the cultural knowledge people use to organize their behavior and interpret their experiences" (Saldaña, 2015, p. 292). At the beginning researchers independently coded the data. In analyzing these narratives, we - sought to uncover both strengths and barriers that facilitated or hindered science learning.

After coding all the data independently, researchers convened to determine percent of agreement (85%) and engaged in discussion to reach consensus on final coding.

Results

The topics that emerged from the students' autobiographies were categorized around eight major themes: family involvement, linguistic barriers, cultural relevance, conflicts between science and religion, gender stereotypes, early experiences with science education, the impact of teachers' attitudes and methods, and standardized tests. Following, we provide more details, with direct student quotations and examples of each theme.

Family involvement

One of the positive aspects of Latinx culture is a deep loyalty to family (Quintos, 2008), and this was revealed to be a powerful motivation for science learning for many LPST students.

For example, Alondra[1] explained that being good in science and math while her sibling and cousins struggled continually encouraged her to learn more in order to help them. Similarly, Emma, who enjoys science a great deal, discussed how her family always encouraged her to pursue science, how her parents were actively involved in her science fair projects, and how her brother studying science were important motivating factors for her. Opportunities to help siblings, positive parental encouragement, and important role models within the family setting were highlighted in many of the LPST autobiographies.

Yet, while many LPSTs acknowledged that their families strongly encouraged their continued engagement in science education, some also revealed that it was difficult for their families to provide support in learning science due to language barriers (e.g., parents who were monolingual Spanish-speakers), lack of resources, and parents' educational background. These LPSTs identified a lack of role models and a lack of familiarity with science-related careers as primary reasons why they were not interested in pursuing a career in science. Some narratives described a generational impact wherein the parents' level of formal education acted as a barrier for an LPST's own aspirations, curtailed access to educational resources, and prevented access to benefits conferred by higher socioeconomic standing, as explained by Erica:

> In my culture, I do feel there are barriers to pursuing a degree or career in science. A lot of times, students in our culture are not able to go to college because of family. Some are expected to start working straight out of high school to help out with family bills and the household. I know there are a lot of careers that we can pursue that involve science. I think, in order to help our students, we need to be able to tell our life story at

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1 All names are pseudonyms

> the beginning of the year, so they know it is possible [for them] to become anything they want.

Linguistic Barriers

Participants in this study all came from Latinx families who speak Spanish at home. Since Spanish was their first language, participants revealed that the English language was often a linguistic barrier for learning the scientific language, as well as other subjects. Some participants stated that although they were placed in bilingual programs, these often did not provide enough support to help them build cognitive academic language proficiency in English. Bilingual programs often offer the instruction both in English and students' native language (in this case Spanish) while ESL classes help students with improving their English skills. In both cases, students may need specific support for making necessary connections between scientific academic language and conversational English. Due to the lack of resources and support specific to science, many students struggled with science terminology and this affected their attitude toward science. Julia called science terminology "a nightmare." Mira expressed concern about lack of supportive bilingual programs in the upper levels:

> Even though the district had a high Spanish speaking population, they only offered bilingual education at the elementary level and the upper levels had ESL programs. It was evident that some of my peers struggled with language barriers.

From these perspectives, ESL classes are not successful in scaffolding students' linguistic needs in science. Mira complained, "when I was struggling with difficult science terminology, my bilingual class was teaching me colors in English." In some cases, although the students were willing to learn and build their scientific literacy, their respective schools did not offer enough support or resources for them to refine their academic scientific language and conceptual understanding of science.

Cultural Relevance

The integration of culturally relevant instruction in the classroom allows students to use experiences and concepts to build on their schema. Some LPSTs stated that culturally relevant lessons helped them understand the content being taught. Similarly, some LPSTs claimed that the lack of cultural relevance is the reason they did not understand science and thus began to dislike it. For example, Julia explained, "The only teacher I had [that I] really learned from was a physics teacher because of her incorporating a lot of culturally relevant examples."

In addition, some LPSTs wrote about lack of experiences connecting science to their actual life and their community and this makes the importance of including this experience in teacher preparation programs more critical. Consider this quote from Karen:

> I can't really think of ways my teachers connected science to my everyday life. Maybe, when we got to bring something from home and do a show-and-tell, some people would bring animals. Again, I don't recall science being supported, promoted or further touched upon outside the classroom. I used to be a part of the Boys and Girls club and we would do some activities in there, but for the most part, I do not remember any science.

In addition, while some LPSTs appreciated teachers who connected their lessons to the community, Sarah criticized her teachers for not including any activity related to the community in their lesson plans:

> I don't remember any of my teachers throughout my school years who even tried to connect science to my community, school, or culture. If I had had some connections between science and my personal life, I think I would have definitely been more

interested in the subject.

It is important for HSIs to recognize the need to incorporate culturally relevant instructional approaches to foster an environment that inspires students to take ownership of their learning and growth. These narratives imply that the shift for incorporating more culturally responsive pedagogy into the classroom must occur if we want to bridge the gaps in science education.

Conflicts between Science and Religion

Some LPSTs mentioned that scientific principles often conflicted with the religious traditions of their culture, claiming this was a challenge for them and a reason for being apprehensive toward-science. The families of these LPSTs' feared that the knowledge of science would interfere with their child's religious faith. For example, Jessi mentioned:

> Hispanic culture traditionally stems from cornerstone ideas of religious dedication, machismo attitudes, and dedication to the family above anything. I was told by many of my own family to abandon ideas in conflict with my religion if I wanted to support my family.

In addition, many LPSTs shared several examples of conflicts between theological perspectives and scientific principles in their autobiographies—it should be highlighted that occasionally LPTs had misconceptions about scientific principles. For example, Nicole wrote:

> I was challenging what I was taught at home with what I was learning at school. In school, I was learning that science is part of everything, from our creation to evolution, to health and wellness. This created a conflict with my Hispanic heritage because, according to my parents, I was created by a greater being. Yet, according to my textbook I was created by organisms.

After sharing her own experience that “my mom used to say science is against my faith,” Nicole offered her idea about teacher preparation programs’ responsibilities:

> I think it is important that an educator establishes an understanding with parents who feel that science instruction goes against religious beliefs to reassure that what is being taught is to help develop their child’s understanding when it comes to science.

Gender Stereotypes

Science is often depicted as a male-dominated field. These stereotypes have a negative effect on young girls who are subsequently dissuaded from taking an interest in science. For example, Sarah stated that “I think science is not for girls.” Stereotypes informed by socio-cultural factors associated with ethnicity, socio-economic status, and age, directly influence how people feel about their own identities and gender roles. Some participants stated that they felt gender played a latent role in their desire to pursue science or not. Monica wrote in her narrative: “As a Hispanic female, I feel that careers in scientific fields are not always encouraged.” In addition to this perspective, in some of LPSTs’ minds, the social environment discriminated against them in accordance with this mindset, as in this quote from Jessi: “along the way, throughout high school, I met other people who would bring me down because I was a girl, and girls weren’t as involved in scientific fields”

Early Experiences with Science Education

While some of our LPSTs mentioned the positive impact of early exposure to science on their later science success, in some narratives LPSTs indicated not being exposed to science prior to 5th grade. In Texas science isn’t assessed by a state-mandated standardized test until 5th grade. We found multiple narratives that contained statements along the lines of: “I cannot recall any science in elementary.”

Conversely, some of the narratives described some of the science experiences in elementary or middle school as enjoyable. Emma who was, in fact, exposed to science during those years recalls it fondly.

> My elementary and middle school experiences had a positive impact on my attitude towards science because I used to enjoy science classes. But once I started high school, the pressure of getting a good grade and the language barrier made it hard for me to understand the science classes and I stopped enjoying them.

Lack of exposure to science in early education also led to a lack of foundation for learning more advanced science in the higher grades, turning science into a "difficult" subject. In some autobiographies, we noticed LPSTs starting to dislike science beginning in middle school, which, among other factors, was rooted in the lack of foundation from early childhood as exemplified by the comment, "in middle school, the science began getting tougher for me, the words grew more complex and it took me longer to process the information that was being given to me, so I began to dislike the subject."

The Impact of Teachers' Attitudes & Methods

Many of the LPST narratives reveal that both teachers' attitudes and methods can significantly affect a student's interest in science. As an example of the first, Alondra wrote: "My teacher seemed like she was someone who loved teaching the subject. Things changed after that. I started to like science." By contrast, Erica criticized her teacher's attitude saying, "It was clear my teacher did not enjoy what she did." As a result, Erica showed a more negative attitude toward science, which she sought to correct, or at least mask, in her own teaching. "I would try a different way. I would not want my negative attitude toward the subject to come across to the students."

Participants' narratives also reflected both positive and negative experiences about instructional approaches. These narratives describe how "authentic" approaches like hands on activities and similar methods made science engaging, and how a lack of same made the classes difficult and boring. For example, Nicole wrote, "I loved hands-on activities but hated lectures and worksheets." Or, "I loved her classes. Her lesson plans used engaging ways to incorporate science [in]to our daily life. We even had a part called 'science in the kitchen'".

By contrast, Karen explained:

> What made it harder for me was …. going through a long chapter in the science textbook every class period…[it] made me dread going to that class.

Other narratives depicted how rote memorization and the lack of authentic, engaging experiences affected how the LPSTs felt about learning science. They described feeling discouraged due to didactic learning and a lack of active participation in their classes. As Sarah stated, "most of the time it was lectures and non-sense [sic] worksheets." Further many described an emphasis on formulas rather than the concept of science in their classroom.

While lack of "authentic" approaches suggests a disconnect between science and its pragmatic uses in everyday life, the LPSTs' teachers failure to contextualize the whys and wherefores of science—i.e., the nature of science—hindered students' comprehension of the concept of scientific facts, theories, and laws. Rebeca wrote, "I enjoyed experimenting and things like dissecting, but I dreaded going to science class to learn about laws and equations simply because I couldn't understand them or make sense of them." When students do not understand the reason why something is a law and why something else is a theory, everything can seem like nonsense.

In the excerpts above we can ascertain that teachers play an important role in helping shape the science identity of students. Teachers who incorporated hands-on activities made a strong positive impact on their students' attitude toward science.

Standardized Tests

The narratives also described how high-stakes testing affected the quality of instruction students received. The LPSTs reported that teachers were focused on teaching to the test and did not engage in inquiry-based learning. Thus, LPSTs revealed how they started to become more disengaged from science by associating it with high-stakes testing. According to Rebeca:

> "I feel as though many students during my time in elementary through high school can agree on the fact that during this time is when state exams became the focal point of all instruction. Therefore, we were not being taught how to think but more of what to think."

The last sentence of this narrative alone is telling as to the extent to which emphasizing the test can go against the nature of science, which encourages critical thinking and provokes asking questions.

Discussion

Often, working in an HSCOE/HSI means focusing on enrollment (Garcia, 2017). In order to think beyond this narrow scope, we examined LPSTs' experiences in their own science education to provide a better picture of LPSTs needs to create a culturally relevant teacher preparation program. The culturally relevant pedagogy has proven to be an effective teaching approach, particularly to many of the science and mathematics (Kelly-Jackson, & Jackson, 2011; Jackson & Boutte, 2009) subjects students tend to avoid in their STEM pipeline.

The results presented in this project highlight some of the factors that can interfere in the learning and teaching of science from the perspective, background, and experience of LPSTs through a process of self-narratives captured as autobiography (Merriam, 2002; Cullum-Swan & Manning, 1994). The experiences of LPSTs who participated in this project show that exposure to science instruction in early elementary years can promote interest in science later in life. In the state of Texas, elementary students do not take standardized tests in science until 5th grade (Texas Education Agency, 2012). This, according to our students, led to many teachers in early education to be reluctant to teach science. However, students must learn from childhood the basics and fundamentals of science in order to reach the level of scientific knowledge needed for a good quality science education that lasts a lifetime (Lederman & Abd-El-Khalick,1998).

Moreover, the LPSTs revealed in their autobiographies how their science teachers were unable to connect science instruction with the LPSTs' own cultural contexts, backgrounds, and experiences. When teachers use culturally relevant pedagogies (Kelly-Jackson, & Jackson, 2011), they are not only considering the students' backgrounds and experiences in their instruction, but also connecting, engaging, and motivating students by referencing a culture they know and understand (Williams, & Rudge, 2016). As a result, students are less reluctant to engage in classroom activities, responding with a more positive attitude and an interest in the learning process. In addition, when teachers connect their instruction culturally, they can address and include social and religious aspects that help students from different cultures and conditions feel they belong to a science community (Hernandez, 2001).

For example, the LPSTs explained that religion played a major role in their academic scientific growth—negatively—by preferring faith-based explanations that rendered real-life events, easily clarified by science, "unexplainable" (Taber, 2017). Therefore, teachers must find cultural opportunities (e.g., in Latinx culture) to make connections that could be highlighted in a science class, which in the end would help students overcome some of the misunderstandings and barriers they may have toward the learning of science (Billingsley, Brock, Taber, & Riga, 2016).

Another aspect that the LPSTs externalized in their narratives was how gender stereotypes are prominent in their families and community. This played a significant role that either weakened or completely hampered any desire to pursue a career in a science-related field. Students should be exposed to the experience and expertise of science professionals, particularly women, with the aim of breaking the false stigma that science is a single-gender profession and showing that anyone can pursue a career in any STEM-related field (Stout, Dasgupta, Hunsinger, & McManus, 2011).

Teacher preparation programs, in particular, those rooted in HSIs, should include examples of culturally relevant pedagogy, community involvement projects, authentic science, and the nature of science (McComas, Clough, & Almazroa, 1998) in their programs of study.

Implications for Hispanic-Serving Colleges of Education

In answering the call for HSIs to examine the ways in which they serve their Latinx students (Garcia, 2017), we provide a list of suggestions based on the outcomes of our project. 1) It is important to expose LPSTs to culturally relevant science instruction, so they may utilize these concepts in their own teaching. This helps increase best practices in early childhood education that can promote interest and skills in science that can be used later in life. Elementary students in Texas not being assessed in science until upper grades (Texas Education Agency, 2012) which has impacted the extent to which science education is addressed in the early grades; however, students must learn from early childhood the fundamentals of science required to foster scientific knowledge (Lederman & Abd-El-Khalick,1998).

2) Students in our study reported that most of their science instruction, especially in high school,

was boring lectures, resulting in students not enjoying their teachers' attitude. Despite the strong emphasis on the importance of inquiry-based science teaching and nature of science, according to our subjects, most teachers still prefer to lecture in their classrooms. Conceptual learning, science and engineering practice, science process skills, and the nature of science should be emphasized in teacher preparation science courses.

3) Culturally relevant science education and community connections are necessary to help students from each culture and background feel they belong to a science community. Latinx students' cultures have many aspects that can be highlighted in science classes.

4) In an HSCOE, most students come from religious families (Gonzalez, 2008). The discussion should be held in science methods courses about the differences between science and religion which is a component of NOS.

5) All classrooms in the community should address gender disparities by inviting Latinx women who work in different scientific fields to discuss career opportunities.

6) NOS should be an important part of science classes along with science content. Understanding NOS would allow students to recognize why they are doing science and why learning about it is meaningful. In addition, learning about science process skills provides lifelong lessons for students, and recalling and associating science as a context that helped them to learn these skills increases positive feelings about science in society.

As final words, In the discipline of science, the answer to what it means to be an HSCOE is the importance of teaching science in a way that emphasizes culturally sustaining practices with implementing culturally relevant pedagogy, community involvement projects, authentic science, and the nature of science in degree programs. Furthermore, education programs should utilize specific strategies to communicate science terminology with bilingual students. Finally, science and education departments should work together to make sure teachers have a proper pedagogical content knowledge to teach science. This collaboration should be expanded to involve some of our teachers in scientific research, providing them with authentic experiences in doing science, specifically when research is related to their cultural community and environment. “Having a Latinx-serving identity is based on both outcomes and culture” (Garcia, 2017, p.128). Let us aim for the best outcome for our students by preparing them with respect to their culture.

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