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Exploring Latino Preservice Teachers' Attitudes and Beliefs about Learning and Teaching Science: What Are the Critical Factors?

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Abstract

This qualitative study explores the in- and out-of-school experiences that could have influenced elementary preservice teachers' beliefs and attitudes toward learning and teaching science. Participants were 126 Latina/o EC-6 preservice teachers in the context of a 16-week undergraduate level elementary methods course. Data sources consisted of written reflections and semi-structure interviews. Findings show that preservice Latino teachers' views about science can be determined by multiple factors, being the most important, their science teachers' attitudes and the type of instruction they received as students from elementary through high school. Participation in science activities with their families and media influence were other factors. Implications relate to creating more engaging science lessons and valuing in- and outside school students' everyday experiences. These findings add to a growing literature on educational attainment gaps in the STEM field.

Introduction

Latinos in STEM

The U.S. educational system is currently undergoing transformation and one emphasis is to create a generation of students who can think creatively, innovatively, and critically (U.S. Department of Education, 2016). One of the focuses on this reform is to increase teachers' and students' competencies in science, technology, engineering, and mathematics (STEM) and create learning opportunities that will prepare students to pursue careers in this field. The educational emphasis on STEM has emerged based on the U.S. economic growth and the skills needed for 21st century (Sahin, 2015). In the USA, this educational priority has mainly focused on underrepresented ethnic minority students, defined as students from African, Latino, and Native American heritages (Gándara & Maxwell-Jolly, 1999).

One ethnic minority that is evidently not well represented in the STEM field are the Hispanics[1]. Despite the amount of bachelor's degrees earned by Hispanics has doubled in the last two decades, the gap remains wide when compared with Asians and Whites (National Center for Science and Engineering Statistics, 2017). Also, Hispanics are not well represented in the current workforce (Nora & Crisp, 2012). Only two percent of the STEM workforce is Hispanic. This is a very low representation if we consider that almost 20 percent of the U.S. youth is Hispanic (U.S. Department of Education, 2016).

Studies that focus on underrepresented minorities demonstrated the existence of different factors that predict the students' aspirations to pursue a career in the STEM field (Engler, 2012). These factors are diverse, however, research highlights how earlier' students experiences affect their future career choices and success. In a study conducted by the Lemselson-MIT Invention Index in 2011, young U.S. students, ages 16-25, named at least one factor that prevented them from pursuing a further education or working in the STEM field. Twenty-eight percent said they were not well-prepared at school to seek further education in these areas (Engler). Also focusing on different racial/ethnic students, Wang (2013) reported that self-efficacy, a known positive impact on pursuing STEM careers, is influenced by lack of background knowledge in mathematics and science learning during high school, and this impact is more evident among underrepresented minority students than among White and Asian students. Nora and Crisp (2012), focusing on Latino students, found that their decisions to earn a STEM degree were influenced, among several other factors, by their academic experiences in mathematics and science course work at elementary and secondary levels.

Science Education in Elementary School

The developmental learning trajectory to do science is long and findings in science education and neuroscience support the introduction of science to young children as early as possible (Duschl, Schwingruber, & Shouse, 2007; Metz, 2009). Although some processes of science learning, e.g., curiosity, asking questions, and exploration, seem to develop spontaneously in young children, all science skills require support, scaffolding and instruction to mature into the complex process skills observed in scientifically literate adults (Jirout & Zimmerman, 2015). Young children are often described as skillful scientists: inquisitive, observant, open-minded, and persistent. Neuroscientists have found science stimulates brain development, allowing children to use their brain's capacity at a maximum level for learning (Yoon & Onchwari, 2006). When developmentally appropriate science experiences are provided in prekindergarten classrooms, basic skills in language, literacy, and math are integrated and reinforced (Gerde, Schachter, & Wasik, 2013), and understanding of science concepts later in life are strengthened (Brenneman, 2011).

Despite the importance of introducing science since students enter school, this subject is almost neglected in the U.S. elementary schools. In most primary schools, classroom teachers are responsible for science instruction (U.S. Department of Education, n.d). However, science is not a priority and is poorly taught in many U.S. (Buss, 2010) and other countries' schools (Palmer, Dixon, & Archer, 2015; Petersen & Treagust, 2014). In addition, research in science education found that when science is taught, instruction tends to focus on drill, rote practice, and standardized testing (Lee & Buxton, 2010) and rarely engage students in critical thinking skills (Barak & Dori, 2005). These practices oppose best practices in STEM teaching (National Science Teachers Association, 2017) and the new vision of science education that promotes a swing from a text-centered curriculum to an inquiry-based approach (New Generation Science Standards, 2013).

The problem of science barely taught in elementary schools has been for long. Several authors have argued that many practicing elementary teachers had low confidence for teaching this subject and as a result, they taught as little science as possible (e.g., Bencze & Hodson, 1999). In a study conducted to examine preservice and teachers' efficacy to teach different subject areas in the elementary curriculum, Buss (2010) reported that the efficacy to teach science and mathematics were lower than for teaching other areas. According to Appleton (2008), the lack of self-confidence tends to result from the teachers' limited knowledge of science subject matter.

Research has also demonstrated that teachers' self-efficacy beliefs and teaching attitudes are crucial factors that influence K-12 students' learning. In a longitudinal study with 155 German secondary mathematics teachers and more than 3,000 ninth graders, Holzberger, Philipp, and Kunter (2013) described a positive relationship between teachers' self-efficacy beliefs and their instructional quality. Thus, understanding pre-service teachers' self-efficacy beliefs and teaching attitudes is important because it has been demonstrated to improve their instruction and in turn, to have an impact on K-12 students' outcomes and future life academic achievements (U.S. Department of Education, n.d.). Moreover, the quality of teachers' instruction can have a positive influence on students' STEM career pursuits (e.g., Wang, 2013), in particular for those underrepresented minorities such as Latinos (Nora & Crisp, 2012).

Purpose of This Study

Considerable research in teacher education has illustrated the influence of teachers' beliefs and attitudes about teaching and learning on classroom practices (e.g., Pajares, 1992; Richardson, 1996; Tschannen-Moran & Hoy, 2007). In particular, several studies have examined scientific learning and teaching in elementary school contexts to understand how teachers' attitudes and beliefs toward science affect their teaching behavior (e.g., Appleton, 2008; Pendergast, Lieberman-Betz, & Vall, 2017). Despite the existence of these studies, little has been reported on Latino preservice teachers' beliefs and attitudes toward teaching and learning this subject matter and the factors that could have influenced them.

The purpose of this study is to examine in- and out-of-school experiences that could have influenced participants' interest in science. Through written reflections and interviews, Latino elementary preservice teachers, who attended a science methods undergraduate course, shared narratives about their developing science identities. The research questions that guided this study were: a-Which are the beliefs and attitudes toward science of Latino preservice teachers? and b-Which are the factors that could have contributed to those beliefs and attitudes?

Conceptual Framework

This study is informed by the self-efficacy theory (Bandura, 1986; 1997) and the concept of Funds of Knowledge (FOK) (Vélez-Ibáñez, 1988). In order to understand Latino preservice teachers' attitudes and beliefs toward learning and teaching science, I drew on the self-efficacy theory (Bandura, 1986; 1997). Bandura defines self-efficacy as a person's faith in his or her ability ''to organize and execute courses of action required to attain designated types of performances'' (1986, p. 391). This theory can be useful to understand and predict individual and group behavior; identify ways in which behavior can be modified or changed; and serve as an intervention tool for psychological and sociological cases (Stone, 1998). According to Bandura (1986), what people think, believe, and feel affects how they behave. Self-efficacy influences a person's choices, actions, the amount of effort they give, how long they persevere when faced with obstacles, their resilience, their thought patterns and emotional reactions, and the level of achievement they ultimately attain (Bandura, 1986).

Teacher efficacy is important because it is a powerful predictor of instructional behavior and how well knowledge and skills are learned (Bandura, 1986) and low self-efficacy tend to be rooted in the teachers' limited knowledge of the subject matter (Bandura, 1997). Tshannen-Moran, Hoy, and Hoy (1998) found that teachers with high efficacy are more likely to try new instructional approaches in an effort to improve their teaching, and are eager to work with students who show learning difficulties. Related to self-efficacy are teachers' attitudes and beliefs. Attitude can be defined as a "general positive or negative feeling toward something" and beliefs as "information that a person accepts as true" (Koballa & Crawley, 1985, p. 225). Previous research showed that attitudes and beliefs drive classroom actions and influence the teacher change process and their teaching efficacy (Guskey & Passaro, 1994; Pajares, 1992). Thus, teacher attitudes and beliefs are important concepts in understanding classroom practices and teachers' thinking processes (Richardson, 1996). According to Pajares (1992), beliefs are based on evaluation and judgment, while knowledge is based on objective fact. Palmer (1998) asserted that teachers knowledge of students and content depends heavily on self-knowledge. This knowledge, and all knowledge, is filtered through beliefs to be interpreted. Once beliefs are set, they are very hard to change (Pajares).

I also drew on the concept of FOK because the preservice teachers in this study shared their out-of-school experiences with science. In his study of economically disadvantaged communities in Mexico and USA, Vélez-Ibáñez (1988) tapped into residents' FOK. Vélez-Ibánez described FOK as "…information and formulas containing the mathematics, architecture, chemistry, physics, biology, and engineering for construction and repair of homes, the repair of most mechanical devices including autos, appliances and machines as well as methods for planting and gardening, butchering, cooking, hunting, and of 'making things' in general" (p. 38). According to Moll, Amanti, Neff, and González (1992) these everyday experiences, usually untapped, constitute important cultural resources that educators should incorporate in their classrooms.

Methods

Site

Institutional Review Board approval was obtained prior to the study. This study took place in a university located in a south Texas border city with 93% of Latino population. The high school graduation rate for adults over 24 years of age in this city was 63% and the per capita income was $14,000; 36% of residents live in poverty (U.S. Census Bureau, 2010). The racial/ethnic demographic composition of teachers and their students in most of the school districts in this border city is different from that nationwide. In the 2011-12 school year, while almost 24 % of the students nationwide were Hispanic, only 8 % of the K-12 teachers were Hispanic (U.S. Department of Education, 2016). On the contrary, in the local school district the demographics in the student-teacher population it is quite similar. In the 2016-17 school year, Hispanic students were 98.4 % and Hispanic teachers 89.3 % (The Texas Tribune, n.d.). The university is one of the largest Hispanic-serving institutions in the U.S. with a Hispanic enrollment of about 90%.

Participants

Participants were 126 EC- 6th elementary preservice teachers. I collected data while participants were enrolled in a 16-week undergraduate level course taught by the researcher and over five different semesters. This course focuses on teaching science methods for EC- 6th elementary preservice teachers and university students take it in their junior year. One hundred sixteen (92%) participants were females and ten (8%) males. Participants were

majority Latinos (98%), and three were White (2%). The majority of participants were fluent in English and Spanish.

Data Sources and Analysis

I gathered data through retrospective written reflections and semi-structured interviews. All participants (126) completed a reflection but only eight were interviewed. Written reflections were a required course assignment designed to encourage preservice teachers think reflectively about their attitudes and beliefs toward science and to help them develop their expertise in their practice (Loughran, 2007). Students reflected about their past experiences with science in- and out-of-school, and responded to the following guiding questions: 1- What do you think has influenced you to like, or dislike, science? 2-Describe a particular experience (with this subject) when you were an elementary, middle-, or high-school student that influenced you to like or dislike science. 3- Which experiences with science do you recall having out-of-school (e.g., at home, summer camp, etc.); describe the type of activity, with whom, where, etc. 4-Do you feel ready to teach science? (see Appendix).

A smaller sample of participants volunteered to be interviewed. I asked all participants if they were interested in being interviewed for the study; 20% of all participants did. From this group, I purposely sampled (Patton, 2002) eight students. I contacted selected participants to be interviewed via email. The intention of the interviews was to further understand the participants' in- and out-school experiences with science. I tape recorded and transcribed interviews; interviews lasted one to two hours, depending on depth of response, and occurred in my office or at the university library. A sample interview questions were: a-When you look back at your science education, what do you see?; b- Did you like science? Dislike it? Did you ever think about that?; c- What do you recall about your science classes in elementary, middle, and high school?; d- Do you have any role model as a scientist or science teacher?; and e- As a child, did you have any activity related to science at home (e.g., games, TV programs, etc.)? (see Appendix).

I analyzed the data collected from both written reflections and interviews with the grounded theory method; I looked for patterns across data (Corbin & Strauss, 2008). I began by reading all data and jotting down initial thoughts; after rereading the data and initial ideas, I then began to identify themes vis-à-vis this study research questions and conceptual framework (Miles, Huberman, & Saldana, 2013). I also looked for similar and dissimilar (anomalous) data to ensure I considered all perspectives from participants.

Findings

After the data analysis, I identified several in- and out- of school factors that have affected participants' attitudes toward science. In-school factors were mainly related to their former teachers' attitudes and the type of instruction they received in elementary, middle- and high-school; and the difficulty with the content and lack of resources. Out-of-school experiences were linked to parental involvement and media influence.

In-School Factors

Former Teachers' Attitudes toward Science and Type of Instruction

In response to the question, "do you like or dislike science?", only a small percentage (18%) of those participants who completed the written reflections stated that they did like science and also few expressed feeling confident to teach this subject. When I further asked about the factors that could have led them like or dislike this subject, all participants connected those responses to their former teachers' attitude toward science and the type of instruction they received in elementary, middle, and high school.

The following table (Table 1) provides with participants' quotes that demonstrate the influence that former teachers, and their type of instruction, had on the participants' attitude toward science. This table includes participants' positive, negative, and mixed experiences with science. The analysis demonstrated that those participants who had good experiences with science in their previous schooling years, usually have a positive attitude toward the subject and consequently they feel more confident to teach it. On the contrary, participants with negative experiences do not like science and are reluctant to teach it. Participants who had positive experiences recalled doing hands-on activities (rather than traditional lecturing) and having enthusiastic and

knowledgeable teachers. Also, positive comments mainly refer to middle- and high-school years, while negative experiences predominantly relate to elementary school.

Table 1. Participants' former experiences with science

Positive Experiences
"… the science teachers that have taught me during the elementary and junior years have highly impacted my interest in science. I recall several teachers in elementary that would explain every topic with high enthusiasm and I think this is a very important step to begin a great lesson..."
"She [the teacher] was amazing; she always tried to avoid doing lectures and using the book all class period. She would find new ways to teach us things and tried to incorporate as many experiments as she could in class"
"…my freshman science teacher was nice, funny; he was always ready to teach, his attitude to teach was incredible and it made everyone want to learn and stayed interested on science"
"My science classes consisted of a lot of activities and experiments which was beneficial to me because it made it easier to master and understand the difficult concepts"
"…what influenced me to like science were the teachers…they did a great job trying to make the subject fun teaching. I remember how much my science teachers loved the subject they were teaching and how excited they were to give their lesson… the subject was difficult but they tried to do more hands-on activities so we could better understand what they were teaching"
"I have always loved science and it has always been my favorite subject... all of the science experiments and activities we did in class had a lot to do with me liking the subject. I'm more of a hands-on person so I really enjoyed doing the lab activities"
Negative Experiences
"What have influenced me to dislike science have been mostly negative experiences, boring, or hard science teachers who did not build the right foundation to learn science, and who were not able to fully let us experience the subject with experiments and exploration"
"My 3rd grade science teacher didn't really teach us anything at all, she would only have us write down terms with their definitions and draw a picture that would relate to the word…we never did any experiments. My 4th grade teacher would just make us read the book in class… and at the end of the week she would give us a test that related to the readings from the book. My 5th grade teacher tried to teach us the subject with exciting ways but at this point my classmates and I hated the subject because of our previous teachers, so we would just mess around in class and the teacher gave up on us"
"I think what has influenced me to kind of dislike science is because when I was in elementary school, our teachers never really made it exciting or exposed us to much of it. Throughout my early childhood (pre-kindergarten through 2nd grade), my teachers never took much time to teach science"
"In elementary I don't remember learning science except when we were in 5th grade. My teacher had concentrated in other subjects all year until the moment we had the science benchmarks"
"… science was the only subject that kept me from being "A" Honor Roll, so I started disliking it. This is also tied to the fact that my teachers didn't try to change the way of giving the lesson so in my mind, I was the one with the problem and thus making me dislike the subject even more since it made me feel dumb"
"The teacher would tell 'study the booklet, study the booklet' so, yeah it's horrible, it was like boring."
"…my science teachers would rarely teach the subject; when the subject was actually taught there was not much effort to promote engagement… it was taught straight from the book and with no actual hands-on activities that allowed us to apply the new knowledge that we had acquired …."
"I really did not like science. I truly believe that it had to do with my teachers, and their teaching and assessment methods. I am the type of person that learns better on my own, without pressure"

"I was always interested in the subject, but never really had a good teacher that was involved or made the class captivated"

Mixed Experiences

"My teachers have influenced me to like and dislike this subject depending on the lesson or the way he/she has taught the lesson. If the lesson was interesting and hands-on I would like the subject and be excited for class; however, if the lesson was not hands-on and it was not interesting I wouldn't want to go to class or be interested in the subject"

"I really never enjoyed going to my chemistry class because I didn't really understand and they put me with kids that didn't try in school. That really put a damper in my mind for science but I gained it back during my senior year when I took anatomy. My professor was really insightful and put a lot of effort into trying to make learning fun"

"Science in elementary and middle school was really hands on mainly involving several experiments and group projects, allowing the entire class to interact with each other allowing everyone to learn from one another by bouncing ideas in class discussions lead by the teacher… High school on the other hand was dull. Science mainly dealt with lectures and little to no interaction among classmates"

Difficulty with Science Content and Lack of Resources

Participants also shared other in-school factors that could have influenced their attitude toward science. For instance, the following respondent highlighted the lack of resources and the emphasis on standardized testing preparation: "I surely do not blame everything on the teacher because there are other factors that contributed to my lack of interest in science… it might be the timing, lack of resources, stress over state exams material… who knows?"

Several participants mentioned their difficulties with the subject, in particular with the scientific terminology: "I have always disliked science very much. I feel that science is a very difficult subject… it is a difficult subject because I do not understand the terminology;" "I honestly did not like science and the reason behind that is that some of the terminology was extremely difficult to comprehend and my teacher was not that supportive when it came to asking for help;" and "the terminology is hard for me to understand. When I understand concepts and key terms I like the subject, but I think that has to also do with the way it had been taught."

Others found science difficult because of the integration of mathematics in the lessons: "One factor that made me dislike this subject was that it involved a lot of math. Math has always been my weakest subject in school and noticed that I wasn't as engaged or interested in science lessons that involved doing any type of math;" "Once equations and math become involved I immediately lost almost all interest because I usually have a hard time understanding it."

For the following participant, the difficulties that she encountered with this subject prevented her to be a veterinarian, her dream career: "Science is a very difficult subject … very boring and it causes me to day dream and not pay attention...I've always wanted to become a veterinarian, but because I would have to take all science classes I decided not to proceed with my childhood dream job. Science is just not for me."

Out-of- School Factors

Participants shared out-of-school factors that impacted their attitude toward science. In particular, several preservice teachers focused on their family influence. They also commented on the positive effect of media.

Family Involvement in Science Activities

In response to the question, "what do you recall about out-of-school experiences with science?" several pointed out their family members' involvement. Table 2 depicts participants' comments that mainly reflect good memories with science at home.

Table 2. Participants' science activities with their family

"Throughout my education, I had educators who would show little to no interest in science … I did a lot of science museums, zoo, and aquarium trips with my family… but not really anything with school"
"…my love for science came as the result of being allowed by my parents to experiment with nature… science was not introduced as a subject bombarded with facts and equations but rather through playing with flying objects, magnifying glasses, etc.…"
"I had always enjoyed science and I was just- since I was growing up, my parents always kind of had me outside-, observing things and seeing how everything worked… I was just always very interesting…once I started learning about that in school I wanted to keep on doing that…even when I was little, my dad would have me in his shop and I would use scrap parts to build like little imaginary cities and stuff like that"
"The most memorable out of school activity relating to science in my childhood was going to the zoo with my family… My favorite part of this experience was when my mom would read the description of the animals in their habitats to explain their name and where they were originally from"
"My father is not very educated, but we did have encyclopedias to go back as references to and that's how we did it projects together… he had a bunch of tools… so I guess he wanted me to pursue an education and that was how I started being curious about science"
"Also growing up my parents liked being involved in my school work so any time I had a project to do, they would help me out."
"My parents would buy us school supplies and school books at the stores that would include science experiments"

Media Influence on Science Attitudes

Some participants also mentioned how media, in particular television programs and internet games, played an important role in their attitude toward science. For the following preservice teacher, this was an activity that also involved his father:

> My dad and I really had a passion for *The Discovery Channel*… he [his dad] used to watch a lot of those Discovery shows…back in those days it wasn't all about reality shows, it was a lot of science, I used to watch a lot of it on Discovery Channel where it had the planets and it had the, you know mountains and uh, the animals and all that stuff so I think Dad is the big influence on me…

Similarly, other participants expressed that they had been exposed to science, through television programs and video games, even before they were taught science at school. For instance: "I remember well that I watched on T.V. several documentaries… it was a lot of *National Geographic* and I liked everything…but actually it was even before I had science in my classrooms… I always liked science" and "I grew up with the subject [science]…I watched a lot of programs and video games that involved animals and other science stuff and they gave me the answers to the 'whys' I had in my childhood…"

Conclusions

This qualitative study pinpoints different in- and out- of- school factors that could influence Latino preservice elementary teachers' attitudes toward learning and teaching science. Participants in this study generally connected their feelings toward science to their past schooling experiences, which seem to play an important role (Banks, 1999; Edwards & Loveridge, 2011). Most participants agreed that school factors, such as their former teachers' attitudes and type of instruction, played a significant role on how they perceive science and, on their confidence to teach this subject to their future students.

The majority of participants (more than 80 %) expressed that they do not like science and consequently, they are not ready to teach this subject. Studies that also focused on elementary preservice teachers found that some teacher candidates experience 'sciencephobia' (Moscovici & Osisioma, 2008) and are reluctant and fearful to

teach science (Appleton, 2008; Pendergast, Lieberman-Betz, & Vall, 2017). This issue has largely been attributed to the teachers' low self-confidence in teaching science which stems from unsuccessful science learning in the past (Appleton, 2008; Bandura, 1997).

Some of the participants related the lack of confidence to teach science to their limited knowledge of science subject matter. Also, most reported having almost never been exposed to effective, inquiry-based instruction and thus, they felt not having this type of instruction models on which to draw for their own students. Instead, they stated having received instruction mainly based on lecturing. Conversely, those few participants who stated they were exposed to an inquiry-based instruction that involved hands-on activities asserted that this type of instruction certainly helped them to understand complex scientific concepts. Gaining un understanding of these concepts is important when attempting to improve preservice teaching practices (Pajares, 1992) and it also plays a role in shaping one's self-efficacy in science teaching (Bandura, 1986).

Participants also shared that the lack of inquiry-based instruction mainly occurred during their elementary school years. Several studies have demonstrated the effectiveness of inquiry-based science teaching in elementary schools (e.g., Alake-Tuenter, Biemans, Tobi, et al., 2012) and how they have a positive effect on their attitudes toward science (Asim, 2018; Hubbard & Abell, 2005). By comparing the beliefs toward science teaching of students who had experience inquired-based physics courses with other who had not, Hubbard and Abell concluded that students exposed to an inquiry approach understand what is to be an active learner in science and challenge their pedagogical skills. Similarly, Asim found a positive effect of a student-centered constructivist approach on the elementary preservice teachers' beliefs during a university level science methods course.

In a study conducted by DiBiase and McDonald (2015) with 275 middle and secondary science teachers from several districts in North Carolina, the authors discussed different reasons (e.g., class size, accountability and curricular demands) that prevent from using inquiry-based teaching. In Texas, where this study took place, the reasons are similar. Nichols, Glass, and Berliner (2012) found that Texas is one of the states with the highest Accountability Pressure Index (APR) for performance on standardized testing. Nichols, et al. also revealed that the pressure to perform on high-stakes tests it has been felt most evidently by teachers and students living in poverty.

Several participants in the present study shared their difficulty of learning science because they could not understand the scientific terminology. It is important to point that the setting of this study, a predominantly Latino community in a U.S.-Mexico border city, has a high percentage of English Language Learners (ELLs) in its schools (The Texas Tribune, n.d.). Research has demonstrated that the implementation of hands-on and inquiry-based activities in a science classroom benefit in particular the ELLs. According to Lee and Fradd (1998) these activities promote scientific understanding, inquiry, and discourse. Even though the academic language used in science can be a burden for all students (Snow, 2010), it is even more complex for ELLs because they must develop literacy skills for science in their second language as they simultaneously learn and comprehend scientific concepts.

Teachers' attitudes and beliefs toward science are as complex as they are diverse and are not limited to their schooling experiences. Participants in this study made clear that their attitudes toward science have also been positively influenced by outside of school factors, in particular their shared time with family members in activities that encompass science. Thus, the science practices in the classroom cannot be detached from social context and the experiences that students bring from home and the community (González, Moll, & Amanti, 2005).

Evidence indicates that the family plays an important role in helping to shape students' engagement, aspirations, and achievement in science (e.g., Archer, DeWitt, Osborne, et al., 2012; Aschbacher, Li, & Roth, 2010). Participants in this study emphasized the importance of their family members involvement, specifically of their parents, with science activities. This active parental involvement reinforces the idea that Latino parents have high expectations for their children's education and want to participate in their children's academic success (Fuller & García Coll, 2010; Gándara & Contreras, 2009). Parents' involvement in their children's education correlates positively with their children's academic success (Jeynes, 2016). In a meta-analysis of 42 studies of pre-kindergarten to college youth, Jeynes found a significant correlation between parental engagement, overall child outcomes, and child academic achievement. Furthermore, Park and Holloway (2013) concluded, based on an analysis of 3,248 national surveys completed by parents, that Latino parents are more involved in home-based academic activities (e.g., homework) than Anglo parents.

Furthermore, participants' linking to their experiences in school and the wider community (e.g., home) can help them build their science identity (Appleton, 2008). Participants' comments indicated that connecting this new knowledge to concepts that were familiar to them through their culture opened up a space for them to develop a science-related identity. Outcomes such as this are valuable in fostering student science-related identities (Appleton) that are grounded in school and home at least in part because they expand student understanding of the range of people who are knowledge holders.

Studies on funds of knowledge indicate that the lived experiences of all students, independently of the home and community backgrounds, can serve as intellectual resources for academic learning. In science classrooms, effective teachers use cultural and community resources in ways that are academically meaningful and culturally relevant (González, Moll, and Amanti, 2005). These cultural connections can be of great help, in particular for ELLs (Rodriguez & Berryman, 2002), as these students strive academically in science (Lee & Buxton, 2013).

This study contributes to the literature on the preparedness of future science elementary teachers, in particular of those preservice teachers who eventually would be teaching science to racial/ethnic minorities. Understanding the different factors that influence the attitude and self-efficacy of Latino preservice teachers, inform valid modes of preparing this preservice teacher population. Several studies show that teachers' self-efficacy positively impacts both student learning (Holzberger, Philipp, & Kunter, 2013) and student interest in these subjects (Sjaastad, 2012), and in turn, their future career choices and success (Riegle-Crumb, King, Grodsky, & Muller, 2012; Wang, 2013). Thus, cultivating students' positive attitudes toward science from early on is crucial, in particular among underrepresented minorities. A higher representation of minorities in the field could narrow conjectures about who is able of learning science in a field historically dominated by white middle-class males (and recently Asian males) sometimes referred as the "culture of power" (Barton, 2003).

Implications

An important implication of this study is the understanding of Latino elementary teachers' beliefs and attitudes about science. Negative attitudes toward this subject, as well as low self-efficacy and lack of self-confidence tend to be rooted in the teachers' limited knowledge of the subject matter (Bandura, 1997; Pajares, 1992). Science educators need to continue to identify those beliefs and practices that undergird desirable and equitable science instruction. As stated by Banks (1999), "Teachers cannot transform schools until they transform themselves" (p.xi). Thus, I suggest that science educators assist preservice teachers in understanding their beliefs, and in helping them make clear those reasons that have shaped the way they respond to learning and teaching science.

According to public domain documents, most students and educators in the region where this study took place are Latinos. Despite an ethnic match between local teachers and students, Latino educators do not always recognize the everyday practices youth bring with them to school (Weisman, Flores, & Valenciana, 2007). Based on the findings, I recommend that science teachers develop clear goals to tap into their students' everyday experiences in- and outside school (Barton, 2003). Valuing diverse science experiences as important resources portrays preservice teachers as rightful experts of certain knowledges related to these content areas (Barton & Tan, 2009).

Another implication relates to Latino parents' involvement in science activities. This involvement could have a positive impact on the future of those youth living in regions where most of the population is Latino and poverty percentage is high (U.S. Census Bureau, 2010). Several studies have demonstrated the underrepresentation of minorities, such as Latinos, in the STEM field. For instance, in a national study using Institute of Education Sciences (IES) longitudinal data sets, Chen and Weko (2009) found that the percentage of students entering STEM fields was higher among male students and students with more advantaged family background and stronger academic preparation than their counterparts. Parents promoting their children STEM interest may have great impacts on their self-efficacy beliefs and attitudes toward science.

Thus, I recommend discovering families' needs through surveys and involve parents by inviting them to workshops and other events in which educators and students' families share different science activities. González, Moll, and Amanti (2005) suggested that teachers visit children's families through an approach that reexamines home contexts and incorporates families' strengths and everyday practices into the classroom where they are not usually valued. These home daily experiences, usually untapped, are powerful ways educators can listen to Latino youth and their parents (Moll, Amanti, Neff, & González, 1992). Likewise, these experiences must be acknowledged and included in specific science curriculum areas for the youth to succeed academically

(Moje, Ciechanowski, Kramer, et al., 2004). One limitation of this study was that participants were from a specific region in the southern United States. Therefore, results of the current study cannot be generalized to other Latino preservice teachers living in other states or regions of the country.

Notes

Although the U.S. government uses the term *Hispanic,* I prefer the term *Latino* when discussing our participants, who have more ties to Latin America rather than Spain. Thus, I refer to Hispanics (federal term) when I present national data from government agencies while I refer to our participants as Latinos.

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Appendix

Reflection Essay

With a minimum of 850 words, write about your beliefs and attitudes toward science.

Following is a list of guiding questions: 1- What do you think has influenced you to like, or dislike, science? 2- Describe a particular experience (with this subject) when you were an elementary, middle-, or high-school student that influenced you to like or dislike science. 3- Which experiences with science do you recall having out-of-school (e.g., at home, summer camp, etc.); describe the type of activity, with whom, where, etc. 4-Do you feel ready to teach science? (Justify your answer)

Interview Questionnaire

Which is your major? Which is your program of study?

When did you realize you wanted to be a teacher?

Why did you want to become a teacher? What led you to make this decision?

When you look back at your science education, what do you see?

Did you like science? Dislike it? Did you ever think about that?

What do you recall about your science classes in elementary, middle- and high-school?

Do you have any role model as a scientist?

Do recall a particular science teacher who inspired you?

Do you feel ready to teach science? Which are your strengths and weaknesses to teach this subject?

As a child, did you have any activity related to science at home (e.g., games, programs, etc.)?

Did your parents (or other family members) had any influence on your decision of becoming a science teacher?

Did your parents (or other family members)

Do you have kids at home? Ages?

If so, do you have any activities/practices with your kids at home that involve science?

Do you help them with any science homework or science projects?

Do you get involved in your children school activities that are particularly related to science (e.g., science projects)?

Do you promote your children inquiry-based skills? If so, how?