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Latino Youth's Out-of-School Math and Science Experiences: Impact on Teacher Candidates

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Abstract

This qualitative study examines the learning and interaction processes between Latino/a teacher candidates (TCs) and youth during a community service-learning program involving science and math. Knowing and affirming nondominant youth's strengths are essential from funds of knowledge and Third Space perspectives. Participants were 11 TCs and their tutees, 30 youth in first through tenth grades. The study took place in a Texas border colonia, or unincorporated settlement lacking basic services. Data sources were participant observations, youth's interviews and TCs' pre- and final reflections, rapport-building analyses, a focus group, and lesson plans. We found TCs incorporated the youth's funds to develop and implement authentic math and science lessons with them. Implications relate to how community service-learning projects can help TCs' future math and science teaching and can create a Third Space to explore math and science in culturally-relevant ways.

Introduction

Results from international and national studies indicate poor performance of U.S. school students in science and math (National Center for Educational Statistics, NCES, 2015). Deteriorating competitiveness reflects the status of education in the United States. While some students' interest in pursuing science, technology, engineering, and mathematics (STEM) degrees has increased, retention and graduation rates of students identifying themselves as STEM majors is discouraging, especially for non-White and non-Asian American students (Chang, Sharkness, Hurtado, & Newman, 2014).

One group less represented in the STEM fields are Hispanics[1]. Although this minority group may constitute approximately 24% of the total U.S. population by 2065 (Pew Research Center, 2015), Hispanics earning careers in STEM are scant (Nora & Crisp, 2012). Only 16% of Hispanic students who started college in 2004 as STEM majors completed a STEM degree by 2009, compared to 25% of White students. An analysis of these awarded degrees showed that Hispanic STEM graduates accounted for 8% of all graduates at the bachelor's level, 4% at the master's level, and 3% at the doctoral level (U.S. Department of Education, n.d.). Additionally, a gap exists between Hispanic skill performance in science and mathematics with other groups. According to recent National Assessment of Educational Progress (NAEP) results, eighth grade Hispanics scored 27 points lower in science and 20 points lower in mathematics, compared to their White peers (NCES, 2011a; 2011b).

Thus, why have so many Hispanics avoided pursuing STEM careers? Why do achievement gaps exist? This STEM field void and underachievement of Hispanics relate to many issues. One of the greatest contributing factors to the Hispanic achievement gap involves instruction (Cone, 2009). Many K-12 teachers are not qualified to teach mathematics and science (Banilower et al., 2012), feel unconfident in their ability to teach these content areas (Fulp, 2002), and rarely engage students in critical thinking skills (Barak & Dori, 2005). When science and mathematics are taught, instruction tends to focus on drill, rote practice, and standardized testing (Lee & Burxton, 2010), which is the opposite of best practices in STEM teaching (National Science Teachers Association, NSTA, 2012). Inadequate teacher preparation to teach STEM content areas is worse for minority students. In fact, most teacher candidates (TCs) are not ready to effectively teach Latino/a youth in mathematics and science (Téllez, 2004).

Furthermore, researchers have found that many teachers do not connect their students' in- and out-of-school experiences (Aikenhead, 2006) and are unfamiliar with diversity issues (Garmon, 2004). As a result, the culture shock experienced by many new teachers entering diverse school settings may lead to decreased confidence levels, lower student expectations, ineffective instructional practices, and consequently low student achievement

(Tschannen-Moram & Hoy, 2007). TCs can be more successful if they understand the cultural resources youth bring to their science and mathematics classrooms (Lee, 2005) and if they implement a culturally relevant curriculum (Lee & Burxton, 2010).

Yet, many assume Latino/a teachers know how to teach Latino/a youth in STEM areas. According to public domain documents, most educators and TCs in our area are Latinos/as. Despite an ethnic match between local teachers and students, Latino/a educators do not always recognize the everyday practices youth bring with them to school (Weisman, Flores, & Valenciana, 2007). Everyday practices relate to what youth know and do in their routine situations outside of formal classrooms (Lee, 2007). When TCs enter schools with theoretical, practical, and emotional grounding in community service learning (CSL) and youths' everyday practices, TCs can help bridge youth's home and school divide and can create meaningful learning opportunities (Mallya, Mensah, Contento, Koch, & Barton, 2012). Service-learning is a pedagogical approach in which those serving use their academic skills and knowledge to address community needs (National Youth Leadership Council, n.d.). However, not only TCs benefit from participating in CSL. The youth also gain when tutors connect instruction to youth cultural background. For example, Kisker et al. (2012) found that culturally-based lessons significantly improved Alaskan students' conceptual understanding of math. Additionally, in their research projects in a rural community in the Philippines, Handa and Tippins (2013) demonstrated how CSL helped prospective science teachers to move "beyond decontextualized science facts and concepts that have the potential to enclose rural communities, ecosystems, and people" (p. 261-262).

Although the U.S. government uses the term *Hispanic,* we prefer the term *Latino/a* when discussing our participants, who have more ties to Latin America rather than Spain. Thus, we present national data of the Hispanic population while we refer to our participants as Latinos/as.

In the light of these problems in science and mathematics education among Latino/a students, a critical need exists to focus on TCs, mainly on those who will work with recent immigrants. Several studies described the funds of knowledge (FOK) that students bring into a science or math classroom and how in-service teachers implemented the youth's FOK in their lessons (e.g., Aikenhead, 2006; Calabrese & Tan, 2009). However, little is known about how TCs incorporate the youth's FOK outside of school (González et al., 2001). Thus, the purpose of this study was to explore TCs' understanding of Latino/a youth's everyday practices in science and mathematics and how they incorporated these FOK in their lesson plans. Specifically, this study was guided by the following research questions:

1. What was the process of math and science interactions and learning between Latino/a TCs and youth in a Third Space?

2. How did TCs include community funds of knowledge into science and math lesson plans and how do they plan to continue doing so?

Conceptual Frameworks

Under a sociocultural conceptual umbrella (Vygotsky, 1978), we inform this study with Third Space perspectives (Gutiérrez, Rymes, & Larson, 1995) and FOK (Vélez-Ibáñez, 1988; Wolf, 1966). We combine both frameworks to focus on how TCs tapped into youth's FOK during a CSL project in the colonia of El Palmar (a group of Palm trees). All names are pseudonyms.

We define Third Space as a place where the integration of knowledge and discourses from home and school produce new forms of learning (Moje et al., 2004a). Moje (2010) stated we should uncover and teach how to produce and critique knowledge in a space that combines school and home knowledge. Third Space is "a transformative space where the potential for an expanded form of learning and the development of new knowledge are heightened" (Gutiérrrez, 2008, p. 152). During our study in an informal, unofficial space at a tutorial agency, TCs and their tutees created authentic learning interactions. Tutors incorporated the discourses and everyday experiences participating youth brought from home and connected the youth's experiences and discourses to science and mathematics curricula.

We also draw on the concept of FOK because the TCs learned about their tutees' everyday experiences; these tutors understood the importance of incorporating culturally relevant practices in their future classrooms (Nieto, 2007). The roots of "funds of knowledge" are anthropological and social. Wolf (1966) coined the term to define resources and knowledge that households manipulate to make ends meet in the household economy. Later, 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, are powerful ways educators can listen to youth and their parents. Likewise, these home experiences must be acknowledged and included in specific curriculum areas for the youth to succeed academically (Moje et al. 2004a). In our study, TCs assessed and affirmed the FOK of participating youth to counter a deficit model (Gorski, 2008) and to connect youth's FOK to disciplinary lessons (Moje et al. 2004a).

Methods

Research Site

This study took place in an after-school tutorial agency in El Palmar colonia. This colonia, or unincorporated area lacking basic services, is one of the 2,300 located on the Texas-Mexico border (Texas Secretary of State, 2010). El Palmar, founded in 1962, is part of the Brownsville, Texas, metropolitan statistical area and has a total area of 0.6 square miles (1.6 km²) and a population of almost 7,000 (U.S. Census Bureau, 2010). El Palmar residents share many of the same socioeconomic and environmental challenges of other border colonias, including inaccessibility of health care, high public education drop-out rates, poor basic services, and extreme poverty (Esparza & Donelson, 2009). Based on average per-capita income, this colonia is one of the poorest of all U.S. communities; 56.4% of its population lives below the poverty line. Related to education, El Palmar residents have a high drop-out rate. Among those 25 years and over, 28.3% have a high-school diploma or equivalent. Nearly all El Palmar residents (99.3%) self-identified as Hispanic, 94.5% of Mexican origin, and 95.8% reported speaking Spanish at home (U.S. Census Bureau, 2010).

Project

Data gathering occurred during May 2013, when Bussert-Webb, using a classroom without walls model (Bemak & Chung, 2011), taught an English as a Second Language (ESL) literacy methods and CSL undergraduate course at the tutorial agency in El Palmar. During data gathering, science, math, and English TCs at the secondary level had to take this ESL literacy methods course, but others could enroll as a course substitution. TCs completed this course on campus during fall or spring or in the El Palmar tutorial agency during a May-intensive session. Over 85 TCs completed the course at the agency from 2006 to 2013, under our university's Institutional Review Board (IRB) and tutorial staff's approval and review. The service aspect of the course involved TCs assisting youth academically and planting native trees, flowers, and bushes with them. TCs tutor youth and created lesson plans related to gardening and the youth FOK. For instance, math lessons involved calculating areas and perimeters and science lessons incorporated ecology, botany, and entomology. After tutoring and lesson implementation, youth and their tutors planted native flora in the tutorial center garden. TCs aligned all lessons to the Texas Essential Knowledge Skills (TEKS) and youth participants' grade levels.

Participants

Participants included 11 TCs and 30 youth. Seven TCs were mathematics majors, two were science majors, one was a kinesiology major, and another was an English major. Their roles during the program were mentoring, tutoring, teaching, and helping the youth with gardening. Each preservice educator tutored one to three youth and designed and implemented lessons, combining math and science and our outdoor project. Before the TCs implemented lesson plans, they determined the youth's FOK through a rapport-building questionnaire.

Youth were native-Spanish speakers, 18 females and 12 males, ages six to 16 and in grades first through 10, in elementary, middle school, and high school. The youth were already attending the tutorial agency and we invited them to participate in the research. The tutorial director sent notes home with the youth, which they were to give to their parents. The notes (in Spanish and English) informed the parents that their youth would be invited to participate in a research study. All youth and adult participants were Latinos/as.

Data Sources

Each TC completed pre- and final reflections and two lesson plans (which they implemented with their tutees). Reflections allowed TCs to reflect upon their time with the youth and to make connections to course content. Another data source was a rapport- building questionnaire; the TCs informally met with the youth, introduced themselves, and asked the youth about their family FOK. The FOK information that the tutors gleaned for lesson plans came from their rapport-building analyses. Although we did not interview each TC, the latter participated in a tape-recorded, transcribed focus group discussion. A sample question for focus group discussion was, "Tell me about having a course outside of university walls."

A bilingual research assistant interviewed the youth in pairs; interviews consisted of semi-structured questions that focused on FOK and the outdoor project. A sample question was, "What did your tutor do with you for the two lessons?" Most of the 25 to 30- minute audio-taped and transcribed interviews were Spanish and English combinations, depending on respondents' language preferences. Last, Bussert-Webb engaged in participant observation every day from 3:30 to 9 pm; she took field notes, writing the date, time, event, and her interpretations. These observations focused on the youth-tutor interactions. This participant observation allowed us to cross-reference youth and tutor reports.

Data Analysis

We read many times the data collected from each of the participating TCs and their respective tutees. Data analysis consisted of looking for patterns of these data following a systematic qualitative method, grounded theory (Corbin & Strauss, 2008). As this was a qualitative study, instead of establishing inter-rater reliability, we met several times to discuss our findings and to challenge each other to ensure trustworthiness of the results.

First, in the open coding process, we read all data and then reread them several times, jotting down insights based on our conceptual frameworks and research questions. Next, we identified and categorized initial themes by making comparisons and looking for similarities and dissimilarities across all data sources from the TCs and youth (Bogdan & Biklen, 2007). Initially, over 10 themes emerged, but we saw how they were related to other themes and collapsed them into larger themes or categories (Corbin & Strauss, 2008). Thus, we sifted through the themes again with an emphasis on how the tutors used their realizations of the youth's community-based practices to improve their teaching. This process allowed us to understand the data more deeply, as qualitative research focuses on a deeper level of understanding. We illustrate each theme by using key quotes from participants.

Findings and Discussion

In this section, we focus on the themes that emerged from data analysis. First, we describe the role of quality time in youth and TCs sharing. Second, we focus on how the process of tapping into youth's gardening and home-based practices increased TCs' learning experiences and helped TCs to create lessons that were significant. Finally, we discuss the connections that TCs established between their CSL experience and their future teaching.

The Process of Understanding Youth's FOK: Building Trust through Quality Time

The process of interactions related to TCs and children building *confianza* [trust] and spending time. The quality time shared by TCs and their tutees during the CSL program helped the TCs to understand their tutees' FOK and strengthened their relationship with the youth and TCs' contextualized lesson plans. According to Florencia, 11, "Here they have more time to explain because there is [sic] less people than at school. At school there are, like, 27 students. It is better here." Zulma, 16, agreed that during the CLS program they receive more attention, "… they teach and are interested in what I have to say… I really like my tutor because I can trust her with anything and because I can ask her for help and she won't make fun of me." Zulma's quote highlighted the role that trust plays in the learning process. Armando, 12, added, "they conversate [sic] with me and not like teachers that just want to teach." Trust remains an essential element in the mutual exchange of goods and services between community and leads to long-term relationships (Vélez-Ibáñez, 1988). Teacher-child trust proves essential in a FOK approach as well. "The notion that teachers need to earn students' respect and trust is often an implicit understanding at the heart of what all educators do" (González et al., 2005, p. 218).

Because of this trust-building process and quality time, the TCs discovered the youth lacked exposure to hands-on academic activities. Although Yolanda's tutees had skimmed over the concepts of perimeter and area in school, they were uninvolved in real-life geometry exploration at school; thus, many did not learn the concepts deeply. Yolanda, a math major, said her tutees were so excited to discover mathematics in their everyday environment with her that "they kept measuring other things in the room we were in." Thus, Yolanda realized providing time to share and explore could motivate the youth to extend their knowledge.

What surprised us most was a statement from Bob, a kinesiology major, during the focus group. Bob had served as a full-time teacher's assistant for several years in a local elementary, where he taught physical education. He shared his experience during the CSL project, "I learned a lot in regard to teaching diverse students. I have never got that deep into a student's life." Bob went on to explain that he did not have enough time, even in physical education, which escapes much of the high-stakes testing emphasis, to get to know his students. Thus, this process of making time is significant because it demonstrates the importance of out-of-school experiences and slowing down to learn about youth and to explore with them. Conversely, it is difficult for school-based teachers to take the time to learn about their students' FOK if the teachers face pressure to teach to the test. Time for the latter must be for test preparation.

Tapping into Youth's Interests and Community Funds of Knowledge

Through building-rapport questionnaires and informal conversations, TCs could tap into their tutees FOKs in this liminal space, not quite school, not quite home (Moje et al., 2004a). An important FOK we found was the youth's gardening knowledge, which they reported learning from their parents. In their responses, youth shared much gardening knowledge from home. For instance, Florencia, shared, "I knew how to plant because my dad would plant a lot," and Zulma said, "I almost knew everything; I have always gardened with my grandparents because they have a ranch." Many youth taught their tutors how to garden. Yolanda, a math major, said, "I was amazed to hear tutees instruct us on how to dig holes, estimate how deep they needed to be, how to soften the dirt to dig better."

Based on youth's gardening schemata, the TCs developed math or science lessons. Ana, a math major, asked her tutee how math was involved in the gardening project; the youth explained, "We count the number of plants…and make sure there is enough distance between each plant and tree that currently exist in the garden …with this we can avoid the development of pests and diseases." Given her tutee's understanding of gardening and math connections, Ana attempted to scaffold instruction, an important component in constructing meaning (González, Andrade, Civil, & Moll, 2001). Ana stated, "I would like to challenge her to more advanced concepts in mathematics, such as the distance formula." Ana's statement demonstrates motivation to teach the youth more difficult math concepts, and this motivation may relate to her work with youth in a community setting. Cone (2009) found that TCs who participated in a CSL project with youth made higher gains in self-efficacy beliefs about equitable science teaching and learning and diversity knowledge than TCs who taught each other only.

The TCs also developed lessons based on their tutees' inquiries and gardening-related interests. For example, Jovana's tutee wondered "how many buckets filled with water would it take to water all the plants that we had planted." Jovana, a math major, and her tutee thus calculated the volume of water in buckets. This type of inquiry is an important higher-level thinking skill in science (Bianchini & Colburn, 2000). Additionally, this inquiry is essential in a FOK approach because it positions the child as an active disciplinary, or subject-area, learner (Calabrese & Tan, 2009). Similarly, Vicky, a science major, developed a nature-walk lesson based on her tutee's interests. Vicky stated, "I used *identifying different types of leaves* as a theme for this lesson because, as we were outside working on the walking path, I noticed that my tutee was playing with the leaves" (original emphasis). Jovana and Vicky incorporated assessments and activities related to the youth's everyday lives. These types of activities "engage learners in scientific habits of thinking while learning about natural phenomena help students become apprentices in science" (McConachie & Petrosky, 2010, p. 105).

In other instances, the TCs learned how to use math and science tools to connect the youth's gardening knowledge to academics. According to González, Moll, and Amanti (2005), disciplinary tools create "… the bridge between our students' knowledge, background experiences, and ways of viewing the world and the academic domain" (p. 8). For example, Ana used a scientific calculator to challenge her tutee in gardening-based geometry; Noe, a math major, used a measuring wheel to calculate the perimeter of the walking path; and Alberto, a science major, developed an integrated math and science lesson and used a protractor and a measuring tape to estimate the height of trees. These candidates demonstrated that mathematics does not imply only sophisticated formulas, but the use of disciplinary tools applied to our everyday lives (Ojose, 2011).

Tapping into Home-based Practices

Besides using the gardening knowledge, TCs developed lessons based on other math and science practices that the youth brought from home. These TCs acknowledged the diverse FOK grounded in nondominant youth's home experiences (González et al., 2001). We found Third Space theory permeated these home-school connections, not just because of liminality, or the tutorial agency being between home and school, but also because of ways the tutors integrated and transformed home and school experiences (Gutiérrez, 2008). As an example, Alberto's lesson on the *food chain* related to Juan's and Julio's FOK in hunting and cooking animals for family feasts. Alberto, a science major, wrote, "They were excited to learn that there were food webs and energy relationships all around them … and surprised to discover that they were part of a food web." In other words, Alberto helped his young charges to see that science was around them and that they were part of it.

Juan, 12, also mentioned to Alberto that Juan's brother possessed much expertise in fixing cars. Based on Juan's FOK, Alberto created a lesson on simple machines that could be used in the gardening project: "I used garden tools to engage my tutee because of his experience in helping his brother with tools. This activated his prior knowledge and helped him make a connection." Examples of simple machines Alberto used were his tutees' arms as levers, part of a flag pole as a pulley, and the agency's bike ramp as an inclined plane. According to Vélez-Ibáñez (1988), FOK include: "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). Also, fingers and hands are mathematical tools used in many Latino communities for measurements and calculations when store-bought tools are not available, e.g., estimating how many strawberries could fit in a pint container by using one's fingers as measuring tools (Ríos, 2006).

Furthermore, the hands-on, inquiry based lessons that Alberto conducted with his tutees relate to NSTA (2012) standards. According to these standards, students should learn scientific behaviors, such as asking questions, gathering data, and considering evidence through applied activities (Hampton & Rodríguez, 2001). These types of activities benefit youth and help them to learn to think like scientists (Moje et al., 2004b). Sinatra, Heddy, and Lombardi (2015) found that youth's engagement in scientific practices has positive learning outcomes both in and out of school. Similarly, based on the eighth grade NAEP report, students who are involved in hands-on projects scored higher in science (NCES, 2011b).

Connection of FOK to Future Teaching

Based on data collected through reflections and focus groups, TCs shared how they would implement what they learned during this CLS experience in their future teaching. Data analysis demonstrated that no TC participant had heard or read about FOK before the CSL course began. However, from this CSL experience, they realized the importance of tapping into students' FOK to increase student learning. The candidates discussed implications for their future disciplinary teaching in and out of school. For instance, Ana, a math major, said:

I need to keep my students' families' FOK in mind as I design my lessons… The more they are engaged, the learning will be more accessible…Knowing the strengths, weaknesses, and skills of my students' families will provide me with the ability to design and implement appropriate lessons that will surely help my students succeed.

Jovana, a math major, planned to use a FOK approach and to have students share their out-of-school practices, which runs counter to a test-centric pedagogy (Palmer & Rangel, 2011):

I will have a better understanding of my students' background, culture, and family traditions and hobbies.... I will make sure to have students converse with each other and share with me what they like to do outside of school and when they are with their relatives.

In addition, our CSL project helped the candidates to move away from the "preconstructive lenses of homework and school" (Clark, 2002, p. 296) and to seek a FOK approach instead. NSTA (2012) supports this move beyond the school day; NSTA recommends that science educators engage youth in informal learning to encourage their students to pursue STEM careers. After participating in this project, Yolanda, a math major, wanted to create a CSL math club involving real-life activities and students' FOK:

I would like to get them involved in remodeling buildings where they will be painting, cutting grass, and setting up a fence... For painting, this will help them understand how volume takes effect, how many buckets will be needed to paint a specific area. When cutting the grass, they will use ratio expressions to define how long it will take two people to cut grass…Building a fence will help them apply their measuring skills and it will involve perimeter.

Yolanda's quote was not an anomaly. Other TCs expressed motivation to continue incorporating youth's FOK with science and mathematics problem-solving. Jovana, a math major, wrote in her final reflection:

Some of the concepts that I will incorporate in my future classroom will be the funds of knowledge. This will allow me to have a better understanding of my students' background, culture, and most importantly family traditions and their hobbies … If the students are able to relate to the material and find it engaging, they will most likely pay attention to the lesson and learn without realizing it. At the beginning of the school year I will make sure to have students converse with each other and share with me what they like to do outside of school and when they are with their relatives.

Finally, Angel, a science major, reflected on his experience in the CSL project:

This experience with my tutee helped me realize that most youth see science as a subject in school and nothing more. They think that science starts in the classroom and stays in there. It is important to help students make connections between science and the real world… As a future teacher, I would benefit greatly when students make real world connections to a classroom lesson…this connection helps students understand lessons and their meaning because it activates their background knowledge.

Limitations

Data collection presented several limitations. For example, we did not interview TCs, which may have yielded richer data. Next, due to the limited amount of time to conduct this project, and the considerably large sample (30 youth), participants were interviewed in pairs. Interviewing by pairs may have influenced the youth's responses. Participating youth may have copied information or agreed with the other interviewee so as not to appear as strange or different and may said things to please the research assistant. TCs may have also said or written things to please the second author or to get higher grades. Finally, due to the small number of TC participants (11), we do not intend to generalize our findings to all TCs.

Implications

How can our findings help teachers to engage nondominant students in academic science and math at school? First, teachers can learn about students' everyday experiences. For instance, youth can keep logs about how they use a particular subject throughout a 24-hour period, from getting ready for school to playing outside; they can discuss their observations with the class. The next step is to connect youth FOK to academic processes and practices. Lee (2007) developed the Cultural Modeling concept in which educators examine what youth know from everyday settings; the lessons TCs developed in the present study related to Lee's Cultural Modeling. Similarly, Moje et al. (2001) stated that to construct congruent Third Spaces in the classrooms, teachers need to deconstruct the boundaries that could exist between classrooms and communities.

Yet, our findings point to something larger than filling gaps between school and home and using youth's funds to build academic knowledge and skills in math and science. When we see connections between what youth know and practice in their everyday lives to what it expected in school, we begin to eradicate low expectations of culturally diverse youth of poverty (Gutiérrez, Morales, & Martínez, 2009). The achievement of nondominant and poor youth relates partly to teacher expectations (Gershenson, Holt, & Papageorge, 2016; Gorski, 2013; Sorhagen, 2013). Thus, teachers need to know youth's FOK because deficit perspectives on low SES youth abound in some schools (Biles, Mphande-Finn, & Stroud, 2012; Gorski, 2008). We ponder whether engaging in CSL projects like ours could help educators to teach math and science with a strengths-based perspective; this is worth further study. We do know that positive, early interventions in math and science can develop Latinos/s' interest in STEM fields (Nora & Crisp, 2012) and can improve their science achievement (Romance & Vitale, 2012).

Thus, sites such as El Palmar, can be places for TCs to experience the opposite of test-driven essentialist curricula plaguing some low SES schools (Bussert-Webb, 2009; McNeil et al., 2008). Hopefully, TCs' experiences in out-of-school sites can help them to create contextualized curricula based on youth's FOK (González et al. 2005). If novice teachers encounter teach-to-the-test curricula in schools serving predominately low SES youth, they may remember the ways they tapped into the youth's FOK after these CSL courses. At the least, TCs can experience contextualized teaching and culturally-relevant pedagogy as a foundation. Perhaps more teacher preparation classes can be taught in community centers away from college campuses so that communities can help to improve math and science education in schools serving predominantly nondominant youth in poverty (Banerjee, 2016).

Instruction in science and mathematics classes consists usually of a combination of reading textbooks, completing worksheets, memorizing vocabulary, and listening to lectures (Fulp, 2002). In another national study, about 40% of science teachers at the K-12 levels agreed "teachers should explain an idea to students before having them consider evidence for that idea" and more than 50% believed labs exist to reinforce ideas students already learned versus focusing on labs for learning science (Banilower et al., 2013, p. 21); the most recent lessons of elementary, middle, and high school teacher participants consisted of whole-class discussions and lectures. Conversely, during our out-of-school program, tutors exposed their tutees to real-world activities that seldom take place in the classroom. We want to emphasize that this is not the teachers' fault. Instead, this phenomenon has much to do with testing pressures (Nichols, Glass, & Berliner, 2012). Our findings demonstrate the potential to develop and implement lesson plans that included inquiry-based activities in a place without the organizational constrains of formal schooling. Moreover, by accessing tutees' FOK, TCs could build zones of practice (González et al., 2001) in which youth became motivated as they integrated their everyday knowledge with academics. The quality of a student's teacher is the single most influential in-school factor in academic achievement and future life outcomes (U.S. Department of Education, n.d.).

Conclusions

This study contributes to Latinos' mathematical and scientific achievement by exposing TCs to the everyday practices of youth who participated in a CLS program at the after-school tutorial agency in El Palmar colonia. By tapping youth's FOK, the participating TCs were able not only to counterpart the disconnection between students' everyday experiences and what is taught in school but to develop students' interest in mathematics and science that were implemented in lesson plans.

During this CLS program, TCs and youth had more time to interact, which allowed youth to share their FOK and to open up to their tutors. According to Gutiérrez (2008) the transfer of FOK is favorable in an educational Third Space where outside school experiences are practiced, learning is encouraged, and a transition to the school curriculum is made. Integrating school and community knowledge, or merging students' everyday worlds, is particularly important in those communities that are marginalized (Moje, Collazo, Carrillo, & Marx, 2001) like El Palmar, where most residents are recent immigrants of low socio-economic status (SES) (U.S. Census Bureau, 2010). These recent-immigrant students come to school with their own home and community cultural values, most of them from Mexico. Thus, it is educators' challenge to discover how to incorporate youth values into the curriculum (Moll et al., 1992).

This challenge is exacerbated with cultural mismatches between educators and students (Bell, Horn, & Roxas, 2007; Santoro & Allard, 2005). One might think that in the present study, in which all the participants were Latinos/as, the tutors and tutees would share many cultural values and that the tutors' understanding of FOK would be possible. However, many differences existed between the tutors and tutees in term of SES, immigration and neighborhood status (Bussert-Webb, 2013) and despite an ethnic match among our participants, most of the TCs were impressed with the cultural resources that youth brought and shared during the program. Several tutors reflected that they even learned from their tutees' everyday experiences; for instance, Yolanda, a math major, said, "I was amazed to hear tutees instruct us on how to dig holes…" and Osvaldo, and English major, "Today I learned something new from my tutee… she told me something on technology that I did not know before."

Capitalizing on youth's learning in the content areas (Lee, 2007), which TCs did with her tutees in this study, constitutes another challenge. This difficulty is notorious in Texas schools, where the focus on No Child Left

Behind (NCLB) legislation has turned attention to student test scores (Palmer & Rangel, 2011). Nichols, Glass, & Berliner (2012) found that Texas, where our study took place, had the highest Accountability Pressure Index (APR) among the 25 states they studied. 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. From a Third Space perspective, the partitioning of time and space is especially pronounced in schools serving predominately low socio-economic status youth (McNeil, Coppola, Radigan, & Vasquez- Heilig, 2008).

Even if test score gains from teaching to the test could measure student progress, test scores do not reveal youth's motivation or what they learn in the content areas as a cultural practice (Carlone, 2004). For example, chemists skim and scan recursively through diverse scientific texts to understand transformations (Shanahan & Shanahan, 2008). Scientists make a claim, provide evidence, and write in accurate, precise, scientific language (Moje et al., 2004b). And scientists, such as Einstein, believe that imagination is fundamental in inquiry. However, imagination cannot be tested on high-stakes basic skills tests.

In our project, youth actively participated in the outdoor activities, creating a constructivist-learning environment that is coherent with Third Space theory and FOK (Gutiérrez, 2008). To understand youth FOK, the participation and interaction between preservice or in-service teachers and students must be more symmetrical (Gutiérrez, Baquedano-López, & Tejeda, 1999). In a reciprocal context, an instructional Third Space could be compared as Vygotsky's Zone of Proximal Development (Gutiérrez, 2008) in which participants interact and learn from each other (Meira & Lerman, 2009). As stated by Cook (2005), the outcome of this learner–teacher interaction, during which both have contributing influences, will be authentic, not the commonly observed in the classrooms, in which the teachers tend to create inflexible roles and patterns of interactions usually dominated by teachers.

Finally, we envision this program, not only as a Third Space between home and school (Gutiérrez, 2008), but also as a site of transformation and empowerment. This study demonstrates that future teachers could have authentic, science and math interactions with their students, which could consequently help bridge the dichotomy between in-school and outside school disciplinary practices and lead to a pedagogical change in the social organization of learning.

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