IDENTIFICATION OF A POTENTIAL FACTOR AFFECTING GRADUATION RATES IN STEM FOR HISPANIC STUDENTS AT THE UNIVERSITY OF NORTH TEXAS VIA ANALYSIS OF NON-FICTION SCIENCE BOOKS IN SPANISH LANGUAGE FOR ELLs IN THE DALLAS ISD PRIMARY SCHOOLS

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Latinos are the largest minority group in the U.S.; however despite the continuous growth of the Hispanic population, Latinos are severely underrepresented in STEM fields. One of the reasons that might explain why Latinos do not major in STEM is the way they encounter science curriculum in primary school. Students' limited proficiency in English may constrain their science achievement when instruction is delivered exclusively in English. A quantitative analysis with graduation rates in STEM from 2009 to 2014 at the University of North Texas was conducted, finding that there is a significant difference ($p < 0.05$) in the number of bachelor's degrees in STEM between Hispanic, White, African American and other student populations. Interviews with teachers, librarians and publishing companies were performed to describe the limited science literature in Spanish at the Dallas ISD schools. Improving science literacy by teaching according to ELLs' linguistic skills and culture may lead to a better understanding of science curriculum throughout their education, which may translate into higher college graduation rates by Hispanic recipients in STEM.

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First and foremost I have to thank God for all the blessings received throughout my life. I also would like to thank my family and dearest friends for their motivation during this journey. A special thank you goes out to my professors for your knowledge, support and for sharing your passion for science with me.

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CHAPTER 1

INTRODUCTION

The commitment to science for all implies inclusion of those who traditionally have not received encouragement and opportunity to pursue science, women and girls, students of color, students with disabilities, and students with limited English proficiency.

National Research Council

1.1 Defining English Language Learner (ELL)

According to the US Federal Government, an English Language Learner (ELL), also called Limited English Proficiency (LEP), English as a Second Language (ESL), Non-English Language Background (NELB), or Second Language Learner (SLL) by some authors, refers to an individual between 3 and 21 years of age, enrolled or preparing to enroll in an elementary or secondary school in the U.S., born or not born in the US territory, and whose native language is other than English (NCTE, 2008).

1.2 Defining Hispanic or Latino

The U.S. Census Bureau defines the term Hispanic or Latino as a person whose origins come from Cuban, Mexican, Puerto Rican, South or Central American or other Spanish culture or origin, regardless of race, ancestry or ethnicity. The term Hispanic has also been used to refer to people of Latin America who speak indigenous dialects different than Spanish or English (Lee & Fradd, 1998). For this study the terms Hispanic and Latino are used interchangeably to identify populations of Spanish descent.

1.3 Defining STEM

According to the National Science Foundation (2008), the term STEM stands for the four primary discipline families of Science, Technology, Engineering and Mathematics. It is also an acronym referring to the academic disciplines including mathematics; natural sciences, including physical and biological sciences; engineering, engineering technologies, and computer information sciences (Chen, 2009).

1.4 Statement of the Problem

By 2050, it is projected that nearly one quarter of the U.S. population will be Hispanic (Genesee et al. 2005; Lawrence, 2012). Latinos now compose the largest ethnic minority group in the United States; however, despite the continuous growth of the Hispanic population, Latinos are severely underrepresented in higher education STEM programs and in STEM fields even though the STEM careers and professionals are highly revered in Latin America (Chapa & De La Rosa, 2006; Rochin & Mello, 2007; Cole & Espinoza, 2008; Flores, 2011). In Texas, a state with the highest number of Hispanic population after California, the majority of college degrees awarded to Hispanic students are not STEM related (Chapa & De La Rosa, 2006; Rochin & Mello, 2007). There is an obvious need to address the challenges and barriers faced by Latinos in entering STEM careers at the school level (Taningco et al., 2008, p.8). Latino pathways through U.S. education need to address complex cultural dimensions such as the experiences of ELLs (Cooper et al., 2005, p.314).

With the increase of the Hispanic student population in the U.S., there has been a growing interest in the influence that culture and language have on science instruction (Duran et al., 1997; Lee, 2003; Lee, 2005; Hampton & Rodriguez, 2001; Clark et al., 2012). According to Lee et al., (2001) ELLs' academic achievement is compromised by their English language skills. In a study performed with 226 fourth grade ELLs, it was found that their academic achievement in science was directly related to their English language proficiency (Lee et al., 2001). ELLs' academic performance in grades K-5 can be viewed as a process of developing literacy and English proficiency together with the learning of science (Lee et al., 2008). Research performed by Lee et al. (2007) showed that one possible solution is teaching academic subjects to ELLs in their native language while they acquire English proficiency (Lee et al., 2007). However English-only legislation in some states, such as California, prohibits teaching academic subjects in a language other than English, resulting in few studies showing the potential for success (Stoddart et al., 2002). According to Clark et al. (2012) there is a need for those students to learn science using their mother language in order to facilitate the understanding and assimilation of science content. Though there are other social, family-related, psychological and educational factors that come into play when talking about why Latino college students do not graduate in STEM, Flores (2011) claims that a better understanding of science by Hispanic students at the primary school level may lead to higher college graduation rates by Hispanic recipients in STEM field.

1.5 Bilingual Education and ELL Placement in Dallas ISD

The Texas Education Commissioner Rules, in Title 19 section 89, mandate that each school district that has an enrollment of at least 20 ELLs must offer a bilingual education (BE) program in grades PK-5 (Garcia-Rincon, 2013). Following federal, state, and local policies and mandates concerning the education of ELLs, the Dallas ISD has provided bilingual education (BE) and ESL programs for ELLs in grades PK-12, through the Multi-Language Enrichment Program (M-LEP), to meet their affective, linguistic and academic needs (Garcia-Rincon, 2013).

According to the Commissioner of Rules in the Texas Administrative Code, bilingual education at the Dallas ISD elementary schools mandates instruction for ELLs in grades PK-5 using two programs: a Dual Language program, with a one-way or two-way instructional model, and an ESL program (Garcia-Rincon, 2013). The Dual Language program is a one-way model involving one group of ELL students learning in two languages (English and Spanish). The two-way model works with students from two language groups (Spanish and English speakers) learning in both languages. The ESL program was intended for ELLs who spoke a language other than Spanish (Garcia-Rincon, 2013). Dual Language programs allow for the maintenance of the primary language and the associated culture, while providing the student with new knowledge of a second language and culture (Thomas & Collier, 1997). Research shows that the acquisition of a second language is more successful if students have a strong knowledge of their own language (Gomez & Gomez, 2007).

Dallas ISD, whose Hispanic population is 70% (61,169) at the elementary grades (PK-5) (Figure 1), 71% (22,414) in Middle school (grades 6-8) (Figure 2) and 70% (26,362) in High school (grades 9-12) (Figure 3), for the 2015-2016 academic year, has been using the Gomez and Gomez One-Way Dual Language Model since August 2006. This model requires the use of Spanish and English as languages for science instruction for ELLs in grades PK-5 (Gomez & Gomez, 2007).

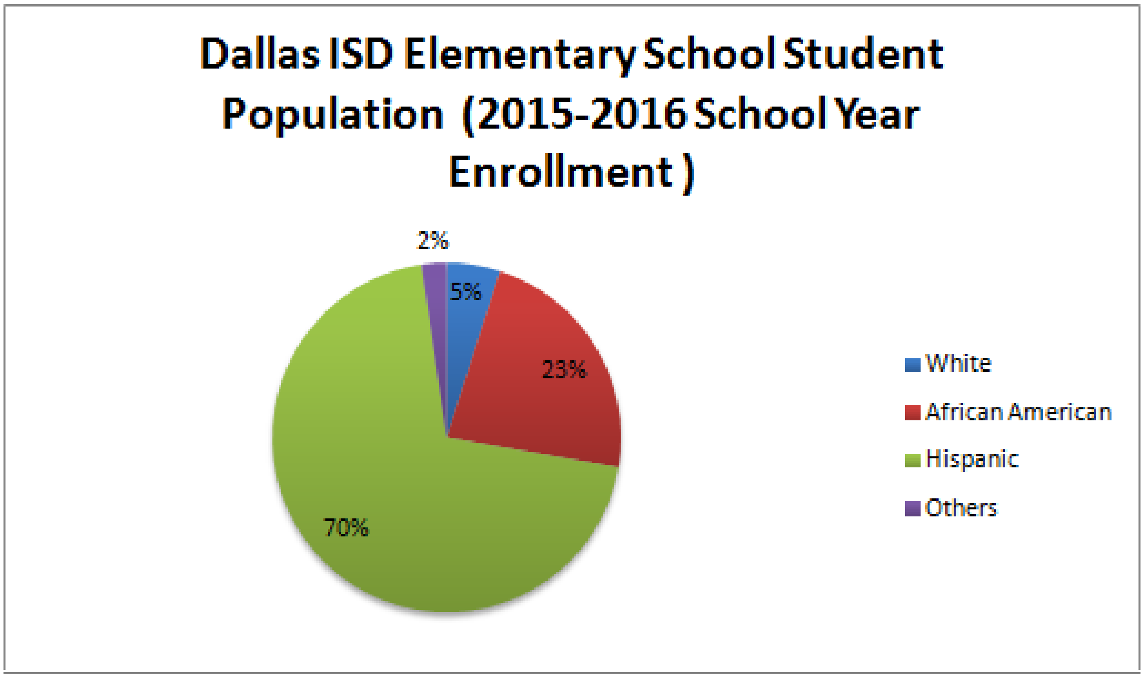


Figure 1. Dallas ISD 2015 Enrollment Statistics by ethnicity in PK-5 grades. *Source:* Data retrieved from https://mydata.dallasisd.org. Total enrollment: 87,384.

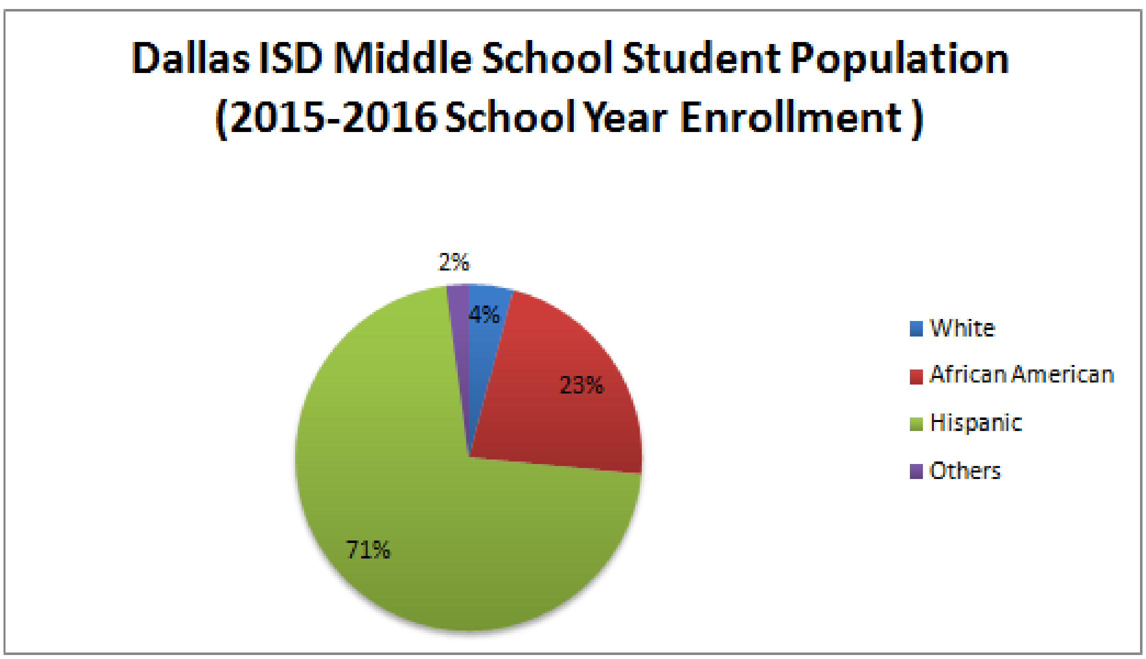


Figure 2. Dallas ISD 2015 Enrollment Statistics by ethnicity in 6-8 grades. *Source*: Data retrieved from https://mydata.dallasisd.org. Total enrollment: 31,570.

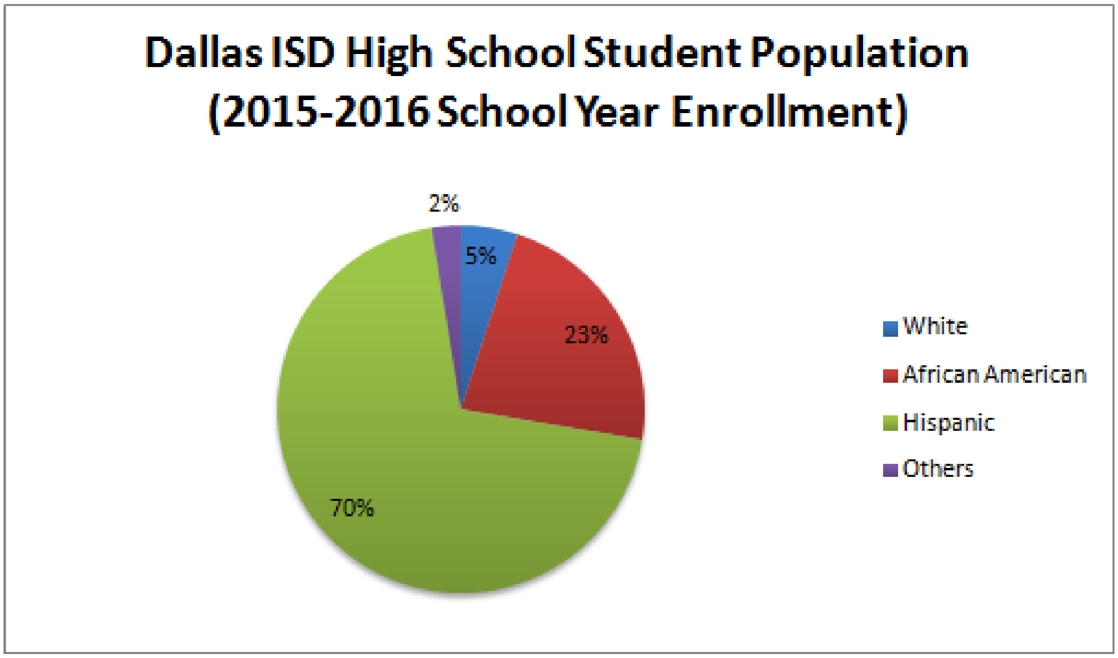


Figure 3. Dallas ISD 2015 Enrollment Statistics by ethnicity in 9-12 grades. *Source*: Data retrieved from https://mydata.dallasisd.org. Total enrollment: 37,661.

Each Dallas ISD Elementary campus should have a Language Proficiency Assessment Committee (LPAC) that determines matters related to student identification, placement, review, and reclassification. The identification and placement of ELLs process begins if languages other than English are recorded on a Home Language Survey. Parents or guardians of all the students who plan to attend a Dallas ISD primary school for the first time, are required to complete the Home Language Survey, regardless of their ethnicity and language or languages spoken (Garcia-Rincon, 2013).

Once ELLs are identified, they must complete the English Woodcock-Muñoz Language Survey (WMLS) (Garcia-Rincon, 2013). The results, based upon assessment of reading, writing, listening and language comprehension skills in English and Spanish, are used by the LPAC for appropriate program placement of the student. In addition to the WMLS results, the LPAC reviews ELLs' academic history, standardized test results, special needs, and previous instructional programs when determining instructional placement. Parental approval is required for the student's participation in the required ESL program until the student meets the exit criteria, graduates from high school, or the parent requests a change in program placement (Garcia-Rincon, 2013).

In Dallas ISD, ELLs enroll into grade levels with various levels of English language proficiency (Gómez & Gómez, 2007). In order to reach the English language progression and attainment standards established in federal and state mandates, all ELLs enrolled in Dual Language and ESL programs in the Dallas ISD schools are required to make adequate yearly progress in English proficiency (Garcia-Rincon, 2013).

1.6 Methodology

This study used two forms of analysis in order to identify a potential factor affecting college graduation rates in STEM by Hispanic students: first, a quantitative analysis of the number of college STEM degrees awarded by Hispanic students at the University of North Texas; and second, a qualitative analysis of ELLs' science instruction in elementary schools within Dallas ISD.

For the quantitative analysis, a one-way analysis of variance (ANOVA) was performed to determine whether or not there is a statistically significant difference between ethnicity groups on the number of bachelor's degrees attained in STEM. A chi square test of independence was also performed to determine whether or not the variables, ethnicity and type of degree, are independent variables. Graduation rates in STEM were obtained from a University of North Texas data base. The number of bachelor's degrees was obtained for the years 2009 to 2014, instead of only one year, in order to avoid the addition of potential variables that could affect graduation in STEM during a specific year.

For the qualitative analysis, a knowledge of the textbook used to teach science to ELLs in Dallas ISD elementary schools was required, as well as nonfiction science reading books available in the schools' libraries to enable ELLs to complement their science learning. A first interview was created for elementary teachers who teach science to ELLs in Dallas ISD schools; a second interview was created for librarians from the surveyed schools; a third interview was created for publishing companies, whose nonfiction science reading books are present in the surveyed schools, to ask why they do or do not publish in a language other than English. A chi square goodness of fit was performed, with the qualitative data obtained from the questionnaires, in order to determine how well the observed distribution of counts from the 5-point Likert scale questions fits the distribution of expected counts from a theoretical prediction.

The importance of this study was premised upon an urgency to address the challenges and barriers faced by Latinos at the K-12 level in entering STEM careers. A knowledge of how ELLs are learning science in primary schools may contribute to identifying potential factors affecting STEM university degree attainment by Hispanic students. In addition, though this study was conducted in Dallas Texas, the results can be of use in other states, cities and/or school districts that also have significant Hispanic populations. A potential statistically significant difference in graduation rates in STEM between the Hispanic, White, African American and other student populations at the University of North Texas can also help to inform other large diverse universities who have similar student populations.

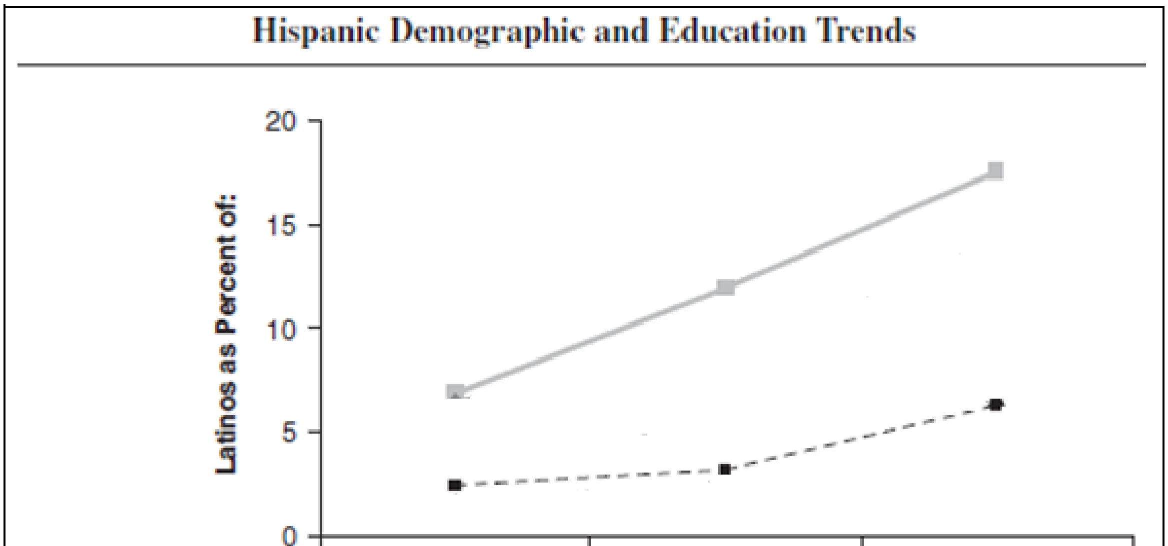
CHAPTER 2

LITERATURE REVIEW

2.1 Underrepresentation of Latinos in STEM

The research articles about Hispanic demographics and participation in STEM consulted for this study used the term Latino to refer to this population's ethnicity. The Latino population has continued to grow very rapidly in the last decades (Cole & Espinoza, 2008). About half of the growth is due to international migration and half is due to natural increases (Chapa & Valencia, 1993; U.S. Census Bureau, 2003; Chapa & De La Rosa, 2004). By the year 2050, researchers Colby & Ortman, (2015) predict there will be more than 20 million Latinos between the ages of 5 and 17 living in the US. The number of college-age Latinos will also increase from 3 million to more than 8 million by 2040; unfortunately, these numbers are not likely to translate into a significant increase in college graduation rates (Cole & Espinoza 2008). According to Flores (2011), despite the growth of the Latino college-age population in the U.S., Latinos are not equally represented in science careers; they continue to have low enrollments in higher education and even lower graduation rates in STEM fields.

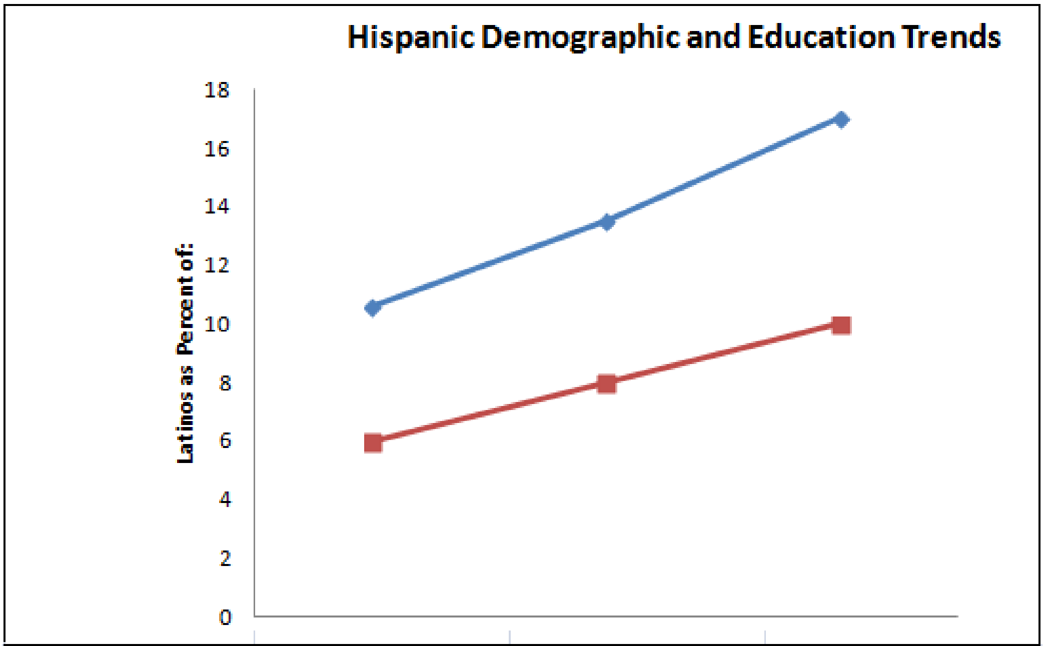
According to Chapa & De La Rosa (2006), there has been a growing gap between the Latino college-age population and the proportion of Latino individuals obtaining STEM degrees starting in 1980 to present. According to statistical data published by the National Science Foundation (1998), as early as 1977, out of 303,798 bachelor's degrees related to STEM, only 2.9% (8,810) were awarded to Latinos; later, in 1990, this number increased to 4.14% (13,624) out of 329,094 cases. Further, Chapa & De La Rosa (2006) compared the percentage of degrees in STEM awarded by Latinos with the percentage of Hispanic population ages 18 to 24 in the U.S. for years 1980, 1990 and 2000, finding that the number of STEM degrees awarded to Latinos did not correspond to the continuous growth of the Hispanic college age population (Figure 4).



	1980	1990	2000
% Pop 19-24	6.8	11.9	17.5
% Bachelor's in Science	2.4	3.2	6.3

Figure 4. Hispanic Demographic and Educational Trends in 1980, 1990 and 2000 (Chapa & De La Rosa, 2006, p.205).

Moreover, data from the U.S. Census Bureau (2015) and National Center for Education Statistics (2015) showed that for the 2001-2002 academic year, out of 441,087 bachelor’s degrees in STEM, 6% (26,465) were awarded to Latinos; for the 2009-2010 academic year, out of 253,650 bachelor’s level in STEM, 8% (35,286) were earned by Latinos, and for the 2013-2014 academic year out of 573,911 bachelor’s level in STEM, 10% (44,108) were attained by Latinos. Even though there was an increase in the number of bachelor’s degrees in STEM awarded to Latinos during these years, this increase is not proportional to the increase in the Hispanic college age population in the US (Figure 5).



	2002	2010	2014
% Pop 18-24	10.57	13.5	17
%BA in STEM	6	8	10

Figure 5. Hispanic Demographic and Educational Trends during 2002, 2010 and 2014. *Source*: Data retrieved from http://www.census.gov, and https://nces.ed.gov.

Regarding college enrollment, the percentage of Hispanic students enrolled in STEM fields in U.S. universities increased by 33% from 1996 to 2004, representing nearly 10% of the total students enrolled in STEM fields in 2004 (United States Government Accountability Office, 2005). Although Hispanic students have been shown to be equally as likely as White students to major in STEM subjects, they are significantly less likely to earn a degree in a STEM field (Chen & Weko, 2009). According to data from the Higher Education Research Institute (2010), only 16% of Hispanic students who began college in 2004 with STEM majors completed a STEM degree by 2009 (Figure 6) (Herrera & Hurtado, 2011).

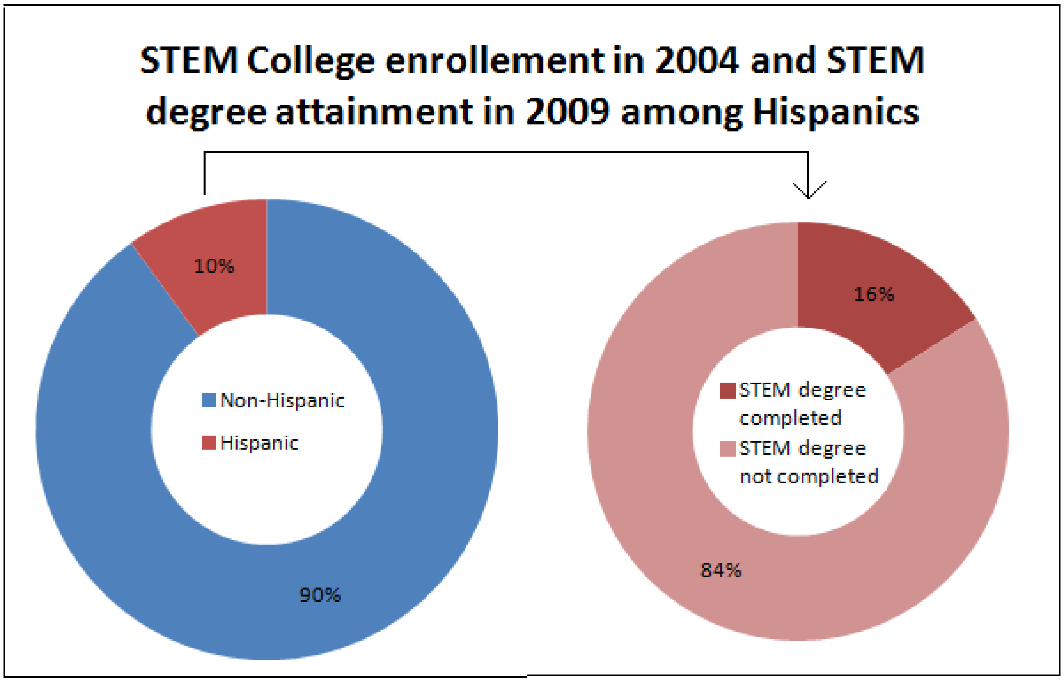


Figure 6. STEM college enrollment in 2004 and STEM degree attainment in 2009 by Hispanic students. Source: U.S. Department of Education (2015).

In similar proportion, data from the University of North Texas showed that out of 505 students enrolling into college with a STEM major in fall 2005 at this University, 15% (79) were Hispanic; when looking at degree attainment of those Hispanic students in years 2009 and 2010, out of those 79 students, only 17% (12) earned a STEM bachelor's degree during those years (Figure 7).

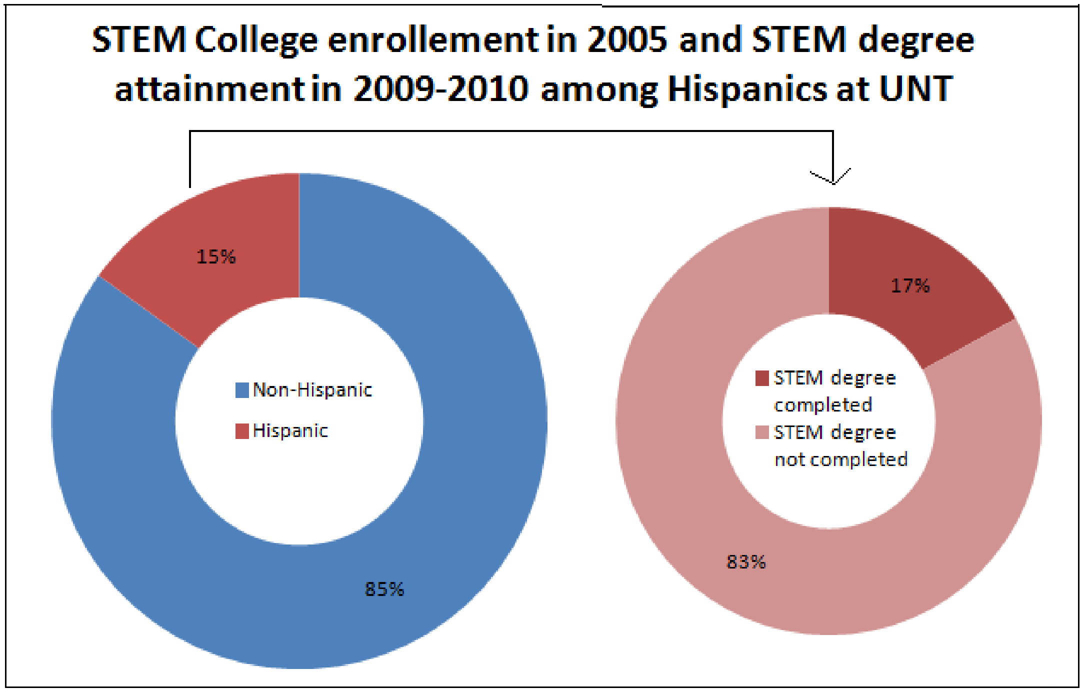


Figure 7. STEM college enrollment in fall 2005 and STEM degree attainment by Hispanic students during years 2009 and 2010 at the University of North Texas. N = 505, N for Hispanics = 79.

A myriad of reasons that may explain why Latino college students do not enter and/or succeed in STEM careers have been documented by several authors (Gandara, 2006; Taningco et al., 2008), however, most tend to be related to school curriculum and cultural factors (Flores, 2011). Research by Gonzalez et al., 2005 supports that school curriculum in the U.S. is generally designed for white middle class students and is not culturally relevant for Latinos.

Moreover, researchers Cooper et al., (2005) and Flores, (2011) claim that Hispanic college students who try to enter STEM careers face educational barriers that have to do with their experiences at early school grades. According to Clark (2012), one big impediment might be the ELLs' lack of high level English proficiency during primary school. Research shows that having noncompetent English language skills during early school years, has a strong negative impact on academic performance and STEM success in college (Tornatzky et al., 2006; Dreher & Letcher, 2009). This is explained because ELLs are usually focused on mastering English literacy skills, leaving behind important math and science concepts and skills that need to be learned early to succeed in STEM careers (Flores, 2011).

An additional impediment may be the lack of science background knowledge from primary and secondary education (Rochin & Mello, 2007). The preparation in K-12 courses in English, math and science has an impact on admission into post-secondary schools and selection of major in college (Taningco et al., 2008). Another reason, no less important, is the alarming high school dropout rates among Hispanic students, which in 2014 was 12% for Hispanic, and was higher compared to White (5%) and African American (7%) (NCES, 2015). As a result, Hispanic students are rarely exposed to science curriculum that would foster interest in STEM professions (Chapa and De La Rosa, 2006; Taningco et al, 2008).

Latinos must be fully able to participate in the sciences "to improve the quality and quantity of human resources of a country" (Rochin & Mello, 2007, p.344). There is a need to address the challenges and barriers faced by Latinos entering STEM careers, especially at the early education level with the experiences of ELLs (Cooper et al., 2005; Rochin & Mello, 2007; Taningco et al., 2008; Halle et al., 2012).

2.2 The Use of Home Language to Teach ELLs

The largest number of students in U.S. schools who are learning English as their second language are students from Spanish-speaking homes (Lee & Fradd, 1998; Hickman et al., 2004; Johnson, 2011). To ELLs, it may take as long as 7 years to acquire a level of language proficiency comparable to native speakers (Collier, 1989; Hakuta, 2000; Thomas & Collier, 2002; Halle et al., 2012). Because of this, much debate has centered on which language should be used as the primary language of science instruction for ELLs in the US; English or the child's home language (Amaral et al., 2002).

According to Latham (1998), Genesee et al., (2005) and Dreher & Letcher (2009), the students' mother language can play an important role in their science learning, whether or not the teacher speaks these languages; when ELLs are allowed to use their home language in the classroom, their academic performance as well as their English-language development often improves (Dreher & Letcher, 2009, Working Group on EEL Policy, 2010).

Specifically, according to Nakmoto et al., (2008) and Clark et al., (2012), having access to both Spanish and English versions of texts can improve ELLs' text comprehension. Research performed with high school Hispanic students demonstrated that Spanish speakers make use of their first-language knowledge to apply and adapt strategies (Garcia, 1996). Research performed by Jimenez in 1996 showed that middle school Hispanic students make sense of text by translating segments from Spanish to English and applying Spanish word knowledge to make sense of English words, showing how useful the use of the mother language can be.

In addition, according to Handsfield & Jimenez, (2009), ELLs ought to make use of their mother language in order to make meaning of subject content, especially in science. According to Lee et al., (2008) and Gunes & Gunes (2005), being literate in science involves abilities well beyond being able to speak, read and write; it involves learning to observe, predict, analyze, summarize, present information in a variety of formats and interpret tables and graphs. Moreover, formulating hypotheses, proposing alternative solutions, using time and spatial relations, interpreting data, predicting, generalizing, and communicating findings are language functions which are fundamental to the process of science inquiry (NSTA, 1996, p.7).

Students should have flexibility to negotiate meaning, and discourse practices and resources in science, using their linguistic skills in both languages (Handsfield & Jimenez, 2009); this can enable them to build a foundation of science concepts before entering higher school grades where language becomes more “decontextualized and cognitively demanding” (Cummins, 1992, p. 99).

2.3 Science Learning of ELLs in Elementary School

According to Hampton and Rodriguez (2001), despite race and ethnicity, children are natural scientists; they want to know more about the world by bringing information into their minds, gathering data through their senses, emotions and conversations with others (p. 462). Moreover, kids show a liking for science, especially at young ages (Sutman et al, 1993; Hampton & Rodriguez, 2001; Dijkstra et al., 2011). A research study performed with 62 Hispanic elementary children from 3 schools in El Paso, Texas, and in which science was taught with bilingual support, showed that Science was clearly one of the favorite subjects of the third graders in comparison to Reading, Social Sciences, Math and Language Arts (Hampton & Rodriguez, 2001).

When talking about ELLs’ science learning, literacy development plays an important role (Lee, 2005). Students who are still in the process of developing basic literacy skills may have difficulty comprehending science language, especially if this is happening in a different language from the one used at home (Lee et al., 2008). ELLs may experience difficulty comprehending symbolic representations and associating them with real, three-dimensional objects; they may not distinguish explanations from descriptions and may substitute precise science terms for gestures and non-specific terms (Lee et al., 1995; Wetsby 1995).

2.4 Science Instruction for ELLs in Elementary School

Science instruction at the elementary level within the U.S. has remained traditional in most cases (Raizen & Michelsohn, 1994; Koster et al., 2012). In 2011, Johnson defined traditional instruction as the one that is mainly textbook-based, relying on lectures, without a strong tie to the real world and with a lack of resources. Despite traditional instruction, ELLs bring a wealth of cultural and linguistic knowledge with them to school, that may help them with learning science (Lee et al., 2008; Ciechanowski, 2009; Geva & Massey-Garrison, 2013). However, research has shown that ELLs tend to lag behind their monolingual English-speaking peers in terms of academic achievement, especially in science, due to their low English language skills (Lee et al., 2008; Dreher & Letcher, 2009).

According to Lee et al. (2013), having low English proficiency is a barrier for a full inquiry experience when science instruction is solely delivered in English. When science class is in English, ELLs' science learning is directly related to their level of English proficiency (Lee, 2005). Moreover, teaching science to ELLs is a challenge for many teachers; it often requires extracurricular effort and frequently demands bilingual instruction (Vang, 2006).

According to Lee et al., (2008), Feinstein, (2011) and Dong (2013), one possible solution is to teach ELLs in their native language while they acquire English language proficiency. However, school language policies are a principal factor in determining how school subjects are taught to ELLs (Lee et al., 2008). In states that support bilingual education, such as Texas, science instruction can build on ELLs' prior knowledge while students develop English proficiency (Garcia-Rincon, 2013). Nonetheless, states such as California, Arizona and Massachusetts have restricted or virtually eliminated bilingual and ESL programs; programs which may meet the diverse and complex needs of ELLs (Clark, 2012). In those cases, ELLs may even be removed from their regular classrooms during science class into classes to improve their English proficiency (Lee et al., 2008; Clark, 2012).

In order to improve science learning among ELLs during primary school, it is necessary to understand the complexity of learning science and the importance that the mother language and culture have on ELLs' minds (Genesse et al., 2005; Lee et al., 2013; Medina & Campbell, 2015).

2.5 The Teacher's Cultural Background in ELLs' Science Classrooms

PK-5th graders use their prior knowledge to make sense of scientific text; this knowledge is built from family experiences, trips, previous encounters with magazines and books, and popular culture (Ciechanowski, 2009). In making science accessible for all students, the National Science Foundation (1998) emphasizes the use of "culturally relevant curriculum materials that recognize cultural perspectives of all ethnic groups to science" (p. 29). However, often ELLs' cultural and ethnic background goes unnoticed despite the increasing number of ELLs in US urban schools (Nevarez-La Torre, 2010).

Specifically, there is a gap in science achievement between mainstream and ELLs, potentially due to the lack of connection between what it is taught and the students' cultural background, (Rodriguez, 1997; Krajcik, 2013; Geva & Massey-Garrison, 2013).

In 1998, Lee & Fradd defined 'cultural congruence' as the understanding that teachers and students share on a set of rules for interacting and communicating. "The less English-proficient the students are, the more cultural congruence plays part in the instructional process" (Lee & Fradd, 1998, p.18). Without teachers' support for new ways to approach learning, including knowing, doing and talking science, ELLs may fail to relate science and even resist learning it (Au, & Kawakimi, 1994: Feinstein 2011). For teachers who share the mother language and culture of ELLs, having the same background knowledge may improve the students' science learning (Trueba & Wright, 1992; Hart & Lee, 2003; Medina & Campbell, 2015).

Further, Sutman et al. (1993) suggested the use of examples relevant to ELLs' culture to illustrate science content; teachers should point out the role science plays in their everyday lives (p.4). According to Lasdson-Billings (1995), science teaching requires teachers to relate concepts to the student's culture since it can be used as a "vehicle for learning" (p.161). A research study performed with fourth grade ELLs from four urban district schools, showed that in classrooms where teachers shared their students' languages and cultures, ELLs reached higher scores in science, compared to their mainstream peers (Lee et al., 2001).

2.6 The importance of a textbook and nonfiction reading books for science instruction

Despite the rapid growth in technology for educational purposes, having a science textbook is still crucial given the fact that it is one of the most useful tools for science instruction (Gladstone, 2003). According to Fathman et al., (1992), Dimopoulos et al., (2005) and Sharma & Buxton, (2015), science textbooks are a major source for selecting concepts and are used as the basis for demonstration, group and individual activities, especially in science. Students are expected to read and acquire information independently from texts (Seifert & Espin, 2012).

However, the National Research Council mentioned in 1999 that science understanding should also coincide with the practice of literacy skills. The purposes of reading science according to the National Science Education Standards (NSES) are first, an understanding of science in a way that brings personal fulfillment and excitement, and second, to provide answers to daily life questions for informed decision making (NRC, 1999, pp. 11-12). Specifically, reading nonfiction science books may help students learn new science concepts, see how those concepts can be applied in their lives, and practice their literacy skills (Rice, 2002; Seifert & Espin, 2012).

While most elementary science textbooks have a structure configured by pre-reading activities, organizers, and chapter activities that help students apply and evaluate their knowledge (Farris et al., 1988), nonfiction science reading books encourage students practice reading informational text and implementing reading strategies and comprehension skills (Ambruster, 1992). Both the use of a science textbook and the practice of literacy skills with nonfiction science reading books are crucial for the students' success in science (NRC, 1999).

Despite the need for ELLs to approach science using their home language at the early school years, the amount of nonfiction science textbooks and reading books available in a language other than English is minimal compared to the ones offered in English (Duran et al., 1998; Feinstein, 2011). This lack of alternative linguistic resources to teach science to ELLs may make teachers scale down their academic expectations and substitute less demanding content goals (Duran et al., 1998; Seifert & Espin, 2012). ELLs should be able to have a complete understanding of science content that meets the academic aims set by the teacher, without losing their interest in science (Amaral et al., 2002; Feinstein, 2011).

2.7 Science Learning of ELLs in Middle School and High School

According to Cummins, (2007) ELLs cannot afford to postpone learning science content while they acquire proficiency in English. Science instruction with bilingual support is typically not offered in middle and high school, as it is in elementary school, which might affect their academic performance (Longo, 2016). In secondary schools, ELLs may not be prepared for science curriculum and their native language resources might be either ignored or treated as impediments (Revees, 2006; Caswell et al., 2016).

For the last two decades, there has been evidence showing that Hispanic ELLs lag behind their English-speaking counterparts in terms of science achievement. In 1996, the National Assessment of Education Progress (NAEP) revealed that out of 618,280 eighth graders in Texas, 67% (414,248) were below the basic level in science achievement (Hampton & Rodriguez, 2001). The Texas Education Agency showed that for the Biology STAAR assessment performed during the spring of 2015, out of 166,637 Hispanic eighth grade students, 8% (13,374) did not pass the test.

Research reveals that high school students whose home language is not English are also challenged by a high volume of terminology and specialized use of language to construct meaning in science (Lemke & Sutton, 1994; Cho, & McDonnough, 2009). Language minority students arrive in the classroom underprepared for learning high school science; they appear to have weak scientific previous knowledge and a lack of linguistic tools to construct advanced science concepts (Duran et al., 1998; Cho, & McDonnough, 2009).

None of this is to suggest that Hispanic high school students are not interested in the sciences. In 1998, Duran et al. studied how 10 Hispanic high school students, coming from a low-income urban school in the Midwest part of the U.S. constructed understanding of Biology concepts based upon their competence in English. In an initial survey, the students expressed their interest in science class, mentioning why science was important and how it was pertinent in their everyday lives. However, if they performed poorly on science tests, primarily due to their poor skills in English, they felt frustrated, disengaged and discouraged with science education. According to Vang (2006) and Cho, & McDonnough, (2009), language minority students are just as capable to succeed in science courses as any other student; all they may need from teachers is encouragement, empowerment and culturally as well as linguistically relevant instruction (p. 41).

Research Objectives

1 Determine whether or not there is significant difference in the number of bachelor's degrees attained in STEM, from the Fall 2007 to Spring 2015 at UNT, between Hispanic, White, African American and other student populations through a One-way Analysis of Variance (ANOVA) test in SPSS.

2 Determine whether or not the variables ethnicity and type of degree are independent variables for a cohort of college students at UNT during that time period through a chi square test of independence in SPSS.

3 List the textbook used to teach science to Hispanic students in the Dallas ISD surveyed schools for grades K-5.

4 List the nonfiction reading books and digital media in Spanish language in the Dallas ISD surveyed schools' libraries.

5 Interview science teachers of ELLs in the Dallas ISD schools about their science class.

6 Organize the teacher's interview responses into histograms for each question asked.

7 Interview librarians from the Dallas ISD surveyed schools about the nonfiction science reading books in Spanish.

8 Organize the librarians' interview responses into histograms for each question asked.

9 Contact via email the publishing companies in the U.S. that publish the nonfiction science reading books present in the Dallas ISD surveyed schools about the factors determining the publication of these books in Spanish.

10 Organize the publishing companies' responses into histograms for each question asked.

11 Determine how well the observed distribution of counts in categories from the Likert scale questions fits the distribution of expected counts from a theoretical prediction through a chi square goodness of fit in SPSS.

Research Questions

1 Is there a significant difference between ethnic groups in the number of bachelor's degrees attained in STEM at the University of North Texas?

2 Is there an association between the variables: type of degree (STEM and Non-STEM) and ethnicity (Hispanic and Non-Hispanic), at the University of North Texas?

3 Does the observed distribution of counts in categories from the Likert scale questions fit the distribution of expected counts from a theoretical prediction?

4 Are there nonfiction science reading books in Spanish for ELLs in the Dallas ISD schools?

CHAPTER 3

METHODOLOGY

Dallas ISD has tracked the college enrollment and completion status of its graduates with data from the National Student Clearinghouse (NSC) since 2006. NSC data indicate that the majority of Dallas ISD graduates who go on to college enroll in public institutions located in the state of Texas (Hall, 2015). For example, among the class of 2014 graduating from Dallas ISD high schools, nearly 90% of the students who entered higher education enrolled in a public, in-state institution.

Moreover, most Dallas ISD graduates stay “close to home” when enrolling in college. Among four-year universities, the University of North Texas enrolled the most Dallas ISD graduates, followed by the University of Texas at Arlington, Texas Woman’s University, and the University of Texas in Austin for the graduating classes of 2007-2014 (Hall, 2015). In the same sense, UNT appears to be the four-year university with the highest number of Dallas ISD graduates awarding a college degree (Table 1).

Based on enrollment statistics and the fact that UNT offers pioneering programs and innovative initiatives in STEM in order to address the U.S. workforce shortages in STEM fields, UNT was chosen as the location for as the site for quantitative analysis of graduation rates among ethnic groups.

College or University	Degrees granted N	%
University of North Texas	966	11.0
University of Texas, Austin	614	7.0
University of Texas, Arlington	539	6.1
Texas Woman's University	361	4.1
University of Texas, Dallas	353	4.0
Texas A&M University	303	3.5
Southern Methodist University	292	3.3
Sanford Brown College, Dallas	268	3.1
Everest College, Dallas	241	2.7
Texas A&M University, Commerce	236	2.7
Eastfield College, DCCCD	218	2.5
Prairie View A&M University	196	2.2
Stephen F. Austin State University	182	2.1
El Centro College, DCCCD	169	1.9
Mountain View College, DCCCD	165	1.9
Total	5,103	58.1

Table 1. Colleges granting the most Dallas ISD graduates for class 2007-2013. *Source:* Data retrieved from http://dallasisd.org.

3.1 Quantitative Analysis

3.1.1 Participants

The data used for the one-way ANOVA and chi square test of independence came from cohorts who were designated as First-time in College (FTIC), enrolled full-time their first term (starting in the Fall terms of 2005, 2006, 2007, 2008, and 2009), with a declared STEM major at the University of North Texas. The selected data included the cases in which Hispanic, White, African American and other students were awarded a STEM or Non STEM degree during the period of Fall 2007 to Spring 2015. The degrees considered STEM related for this particular study were:

Applied Technology and Performance Improvement
Biochemistry
Biology
Chemistry
Computer Engineering

Computer Science
Construction Engineering Technology
Electrical Engineering
Electrical Engineering Technology
Engineering Physics
Geography
Information Science
Information Technology
Manufacturing Engineering Technology
Materials Science and Engineering
Mathematics
Mechanical and Energy Engineering Energy
Mechanical Engineering Technology
Physics

For this particular research study Asian, Pacific-Islander, American-Indian and two or more ethnic populations were grouped as “Other”. The data used for the chi square goodness of fit came from a cohort of teachers and librarians from the Dallas ISD schools during the 2015-2016 school year.

3.1.2 Data Analysis

A one-way analysis of variance (ANOVA) was conducted using SPSS to determine whether or not there is a statistically significant difference between the number of bachelor’s degree attained in STEM by Hispanic, White, African Americans and other groups. An analysis of variance ANOVA determines the proportion of variability attributed to each of several components; it is considered one of the most useful and adaptable statistical techniques for social studies (Cronk, 2012, p. 57). The hypotheses stated for this analysis were:

H0: The number of bachelor’s degree in STEM between ethnicity groups (Hispanic, White, African America and other) is not significantly different.

H1: The number of bachelor's degree in STEM between ethnicity groups (Hispanic, White, African America and other) is significantly different.

A chi square test of independence was conducted using SPSS to determine whether or not type of degree (STEM and Non-STEM) and ethnicity (Hispanic and Non-Hispanic) are independent variables. The chi square (x^2) test is a nonparametric statistical analysis method often used to assess the probability of association or independence of facts; where the data consist in frequencies or counts (Zibran, 2007, p.33). The hypotheses stated for this analysis were:

H0: Type of degree (STEM and Non-STEM) and ethnicity (Hispanic and Non-Hispanic) are independent variables.

H1: Type of degree (STEM and Non-STEM) and ethnicity (Hispanic and Non-Hispanic) are dependent variables.

A chi square goodness of fit was conducted using SPSS to determine if the observed distribution of counts in categories of the Likert scale questions from the teacher's and librarian's questionnaires matches the distribution of expected counts from a theoretical prediction (Wu, 2007). A chi square goodness of fit is concerned with the distribution of categorical values and is used in assessing surveys, among other things (Hinkin, 1998). The hypotheses stated for this analysis were:

H0: The observed counts in categories of the Likert scale questions equal the expected counts.

H1: The observed counts in categories ok the Likert scale questions do not equal the expected counts.

3.2 Qualitative Analysis

3.2.1 Participants

Personal communication was conducted with teachers and librarians from the Dallas ISD schools during Spring and Fall 2015. Thirty six Dallas ISD K-5 teachers who taught science were interviewed during the 2015-2016 school year (Table 2).

Grade	Number of Teachers	Elementary schools
K	6	Stemmons, Ireland, Kramer
1	5	Kramer, Rosemont, Williams
2	4	Turner, Mills, Kiest, Carr
3	11	Russell, Stemmons, Cabell, Bethune, Jones, Williams
4	4	Mills, Cabell, Ireland
5	6	Bethune, Jones, Mills, Cabell
Total	36	

Table 2. Dallas ISD interviewed teachers listed by grade N=36.

Publishing companies, whose nonfiction science reading books were present in the visited schools during Spring and Fall 2015, were contacted by email during Fall 2015. The publishing companies presented in Table 3 are the respondents.

Publishing Company	Location	Grade/ Level	Language in which they publish
ABDO	Edina, MN	PK-12	English/Spanish
Barron Educational Books	Hauppauge, NY	PK-Adults	English only
Beaport Publishing	New York, NY	K-8	English/Spanish
Capstone	Mankato, MN	K-5	English/Spanish/Bilingual
Charlesbridge	Watertown, MA	PK-12	English only
Crabtree Publishing Company	New York, NY	K-8	English/Spanish
DK Readers	New York, NY	1--8	English only
Enslow Publishing	Berkeley Heights, NJ	PK-12	English/Bilingual
Gareth Stevens Publishing	Milwaukee, WI	K-12	English/Spanish/Bilingual
Heinemann	Portsmouth, NH	PK-12	English only

Houghton Mifflin Harcourt	Boston, MA	K-12	English/Spanish
Lerner	Minneapolis, MN	PK-12	English only
Mitchell Lane Publishers Inc.	Hockessin, DE	PK-10	English only
Mondo Publishing	New York, NY	K-5	English/Spanish
Norwood House Press	Chicago, IL	K-8	English only
Penguin Random House	London, UK	K-5	English only
Rosen Publishing	New York, NY	PK-12	English/Bilingual
Rourke Publishing Group	Vero Beach, FL	PK-12	English/Spanish/Bilingual
Scholastic Corporation	New York, NY	K-7	English only
The Creative Company	Mankato, MN	K-5	English only

Table 3. Publishing Companies who answered the interview N=20.

3.2.2 Description of Interviews

Schools surveyed in Dallas ISD were selected randomly based upon the opportunity to accompany a university-based team teaching water conservation and recycling lessons to elementary students. The teacher's interview questionnaire (see full survey in Appendix A.1) was created based upon a beta interview with elementary teachers in the Dallas ISD schools during Spring 2015 (following questions):

Question 1 is related to the science textbook used for in-class science instruction.
Questions 2-4 use a Likert scale and refer to the content, vocabulary and teacher's reactions of students' attitude towards the science textbook (Wu, 2007).
Questions 5, 6 and 7 are related to other materials and resources used for science instruction.
Question 8 refers to the teachers' preparation for science instruction.
Question 9 refers to the instructional time spent for science class.
Question 10 is an open question for teachers to express their opinion about the literature available to teach science to ELL in Spanish.

The Likert (Wu, 2007) style used for this questionnaire is a 5-point scale ranging from Strongly Disagree to Strongly Agree. The Likert survey style is one of the most frequently used instruments in the social sciences (Wu, 2007).

A librarian's interview questionnaire (see full survey in Appendix A.2) was also created based upon a beta interview with librarians in elementary schools in Dallas ISD during the Spring 2015:

Questions 1 and 2 refer to the amount of nonfiction Science reading books in Spanish available in the surveyed school's library.
Question 3 uses a Likert scale and it is intended for librarians to express their opinion about the nonfiction science books available to ELLs in Spanish.

A third interview (see full survey in Appendix A.3) was created for publishing companies whose nonfiction science reading books were present in the surveyed schools; the purpose of the interview was to determine why they do, or do not publish in a language other than English. The publishing companies were contacted via email during Fall 2015.

Question 1 is related to the language in which they publish nonfiction science books currently.
Question 2 relates to the "reason" that determines if a book is published in a language other than English.
Question 3 refers to the existing demand for publishing nonfiction science books in Spanish.
Question 4 refers to the opinion of the companies about the need of literature in Spanish for ELLs.

3.2.3 Data Analysis

Responses from each question in the teacher's, librarian's and publishing company's interviews were grouped and presented graphically as frequency histograms. The hypotheses stated for this analysis were:

H0: There are not nonfiction science reading books in Spanish for ELLs in the Dallas ISD surveyed schools.

H1: There are nonfiction science reading books in Spanish for ELLs in the Dallas ISD surveyed schools.

CHAPTER 4

RESULTS

4.1 Quantitative Analysis

4.1.1 One-way ANOVA

A one-way analysis of variance was conducted to determine if there was significant difference in the number of bachelor's degrees in STEM between Hispanic, White, African American and other ethnic groups for the years 2009 to 2014. A statistically significant result between groups was observed (F=9.350, df=3, p<0.05), therefore the null hypothesis was rejected, meaning that there was a statistically significant difference in the number of bachelor's degrees awarded in STEM between ethnicity groups for the years 2009 to 2014 (Table 4).

	Sum of Squares	df	Mean Square	F	p value
Between Groups	9697.500	3	3232.500	9.350	.000
Within Groups	9680.000	28	345.714		
Total	19377.500	31			

Table 4. One-way ANOVA of the number of bachelor's degrees awarded in STEM for the years 2009-2015. N for Hispanic = 94, N for White = 422, N for African American = 110, N for Other = 98.

Results from the Post Hoc test of multiple comparisons showed that there was a statistically significant difference (p<0.05) when comparing number of degrees awarded in STEM between Hispanic with White, White with African American and White with Other ethnicities (highlighted in bold in Table 5). On the other hand, when comparing Hispanic with African American, Hispanic with Other and African American with Other ethnicities, the difference was not statistically significant (p>0.05).

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	p value
Hispanic	White	-41.00000*	9.29670	**.001**
	African American	-2.00000	9.29670	.996
	Other	-.50000	9.29670	1.000
White	Hispanic	41.00000*	9.29670	**.001**
	African American	39.00000*	9.29670	**.001**
	Other	40.50000*	9.29670	**.001**
African American	Hispanic	2.00000	9.29670	.996
	White	-39.00000*	9.29670	**.001**
	Other	1.50000	9.29670	.998
Other	Hispanic	.50000	9.29670	1.000
	White	-40.50000*	9.29670	**.001**
	African American	-1.50000	9.29670	.998

Table 5. One-way ANOVA Post Hoc Test (Tukey) for multiple comparisons. N for Hispanic = 94, N for White = 422, N for African American = 110, N for Other = 98.

4.1.2 Chi-Square Test of Independence

A chi square test of independence was conducted to determine whether or not type of degree and ethnicity are independent variables. A statistically significant relationship was observed (x^2 = 20.408, df=3, p<0.05, phi=0.121) with a weak effect size, therefore the null hypothesis that the variables type of degree and ethnicity are independent was rejected, meaning that students from a particular ethnicity were associated with graduating within a particular degree (Table 6).

	Value	df	p value
Pearson Chi-Square	20.408	3	.000
Likelihood Ratio	20.548	3	.000
Linear-by-Linear Association	3.102	1	.078
N of Valid Cases	1398		

			Type of degree		Total
			STEM	NON STEM	
Ethnicity	Hispanic	Count	94	112	206
		Expected Count	106.7	99.3	206.0
		Residual	-12.7	12.7	
	White	Count	422	362	784
		Expected Count	406.0	378.0	784.0
		Residual	16.0	-16.0	
	African American	Count	110	144	254
		Expected Count	131.5	122.5	254.0
		Residual	-21.5	21.5	
	Other	Count	98	56	154
		Expected Count	79.8	74.2	154.0
		Residual	18.2	-18.2	
Total		Count	724	674	1398
		Expected Count	724.0	674.0	1398.0

		Value	p value
Nominal by Nominal	Phi	.121	.000
	Cramer's V	.121	.000
N of Valid Cases		1398	

Table 6. Chi square test of independence of the number of bachelor’s degrees awarded in STEM and Non STEM. N for Hispanic = 206, N for White = 784, N for African American = 254, N for Other = 154, Total N = 1398.

The qualitative data obtained from the Likert scale questions of the interviews conducted with teachers and librarians were evaluated using a chi square goodness fit.

4.1.3 Chi-Square Goodness of Fit

A chi square goodness of fit test was conducted to determine if the observed distribution of counts in categories of the Likert scale questions fits the distribution of expected counts from a theoretical prediction. A statistically significant difference was observed (x^2 = 39.325, df=4, p<0.05, Cohen's w=0.23) with a weak effect size, therefore the null hypothesis that the observed counts equal the expected counts was rejected, meaning that the distribution of observed counts in the responses of teachers and librarians did not match the expected one (Table 7).

	Observed N	Expected N	Residual
Strongly disagree	1	5.0	-4.0
Disagree	14	5.0	9.0
Undecided	2	5.0	-3.0
Agree	27	16.0	11.0
Strongly agree	3	16.0	-13.0
Total	47		

	Responses
Chi Square	39.325[a]
Df	4
p value	.000

Table 7. Chi square goodness of fit of Likert scale questions from teacher's and librarian's interview. N teachers=36, N librarians=11. N total=47

4.2 Qualitative Analysis

4.2.1 Ethnicity of Interviewed Teachers

According to Trueba & Wright, (1992), Au & Kawakimi, (1994) and Hart & Lee, (2003) when teachers share the mother language of ELLs, the students' science learning might improve. For this study it was important to know how many interviewed teachers shared the same Hispanic background as their students. Of the 36 teachers interviewed, 97% (34) were Hispanic (Figure 8).

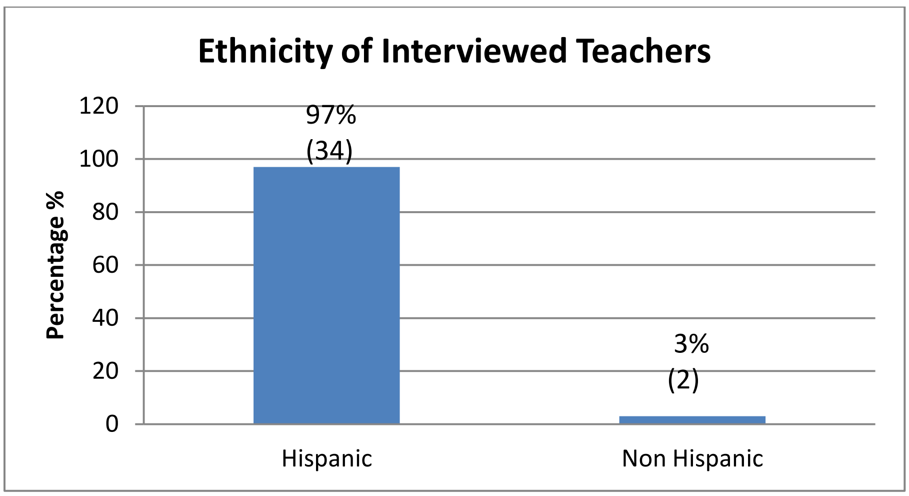


Figure 8. Ethnicity of Dallas ISD interviewed teachers. N=36

4.2.2 Response from Teachers

Of the teachers interviewed, 83% (29) used the book FUSION to teach science; 17% (7) did not (Figure 9).

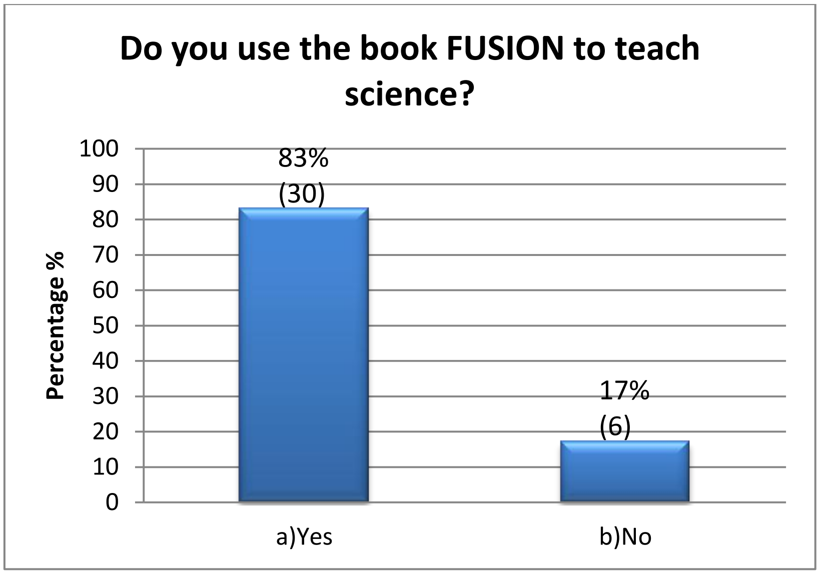


Figure 9. 1) Do you use the book FUSION to teach science? N=36

Of the teachers interviewed, 72% (25) agreed that the book FUSION is aligned to the Science TEKS they are required to cover, however 25% (9) disagreed with it, and 3% (2) were in strong disagreement (Figure 10).

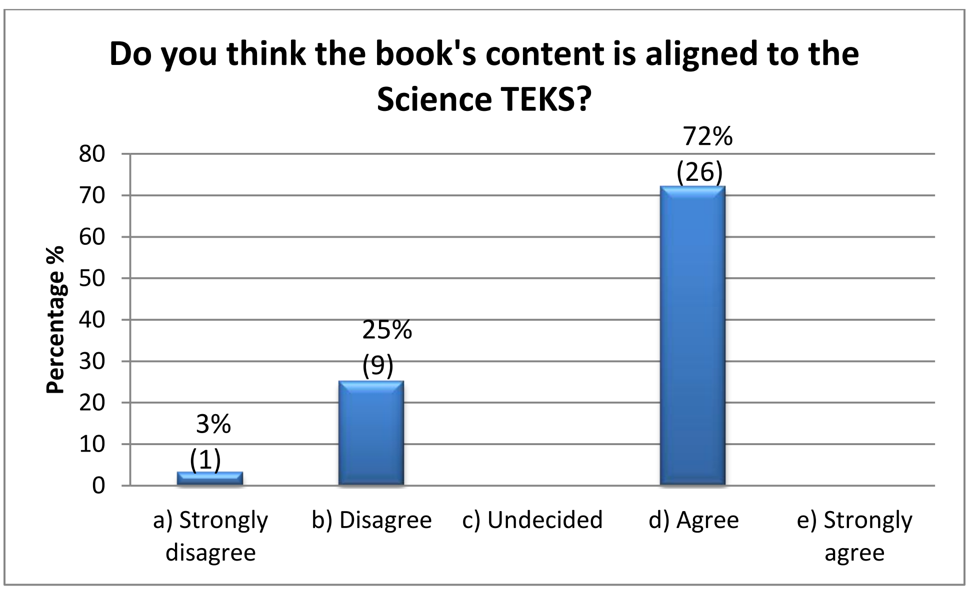


Figure 10. 2) Do you think the book’s content is aligned to the Science TEKS? N=36

Of the teachers interviewed, 52% (18) disagreed that the book FUSION was good in terms of the vocabulary. They mentioned that the vocabulary used in the book was either too easy or too complicated for the students. This question showed the greatest amount of disparity in answers, and requires further investigation to determine why this occurred. On the other hand 36% (11) agreed, and 8% (3) strongly agreed that the book's vocabulary was good (Figure 11).

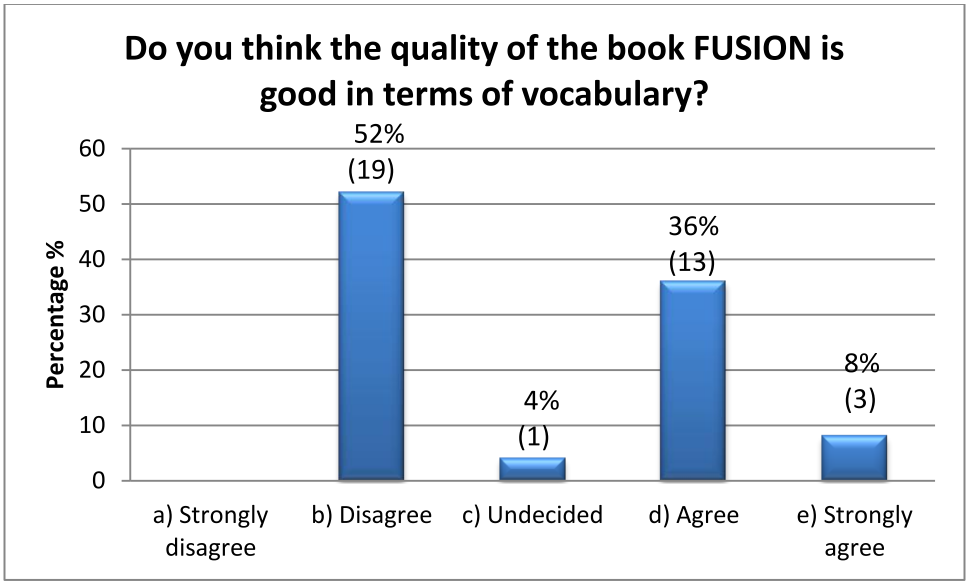


Figure11. 3) Do you think the quality of the book FUSION is good in terms of vocabulary? N=36.

Of the teachers interviewed, 58% (19) agreed, and 5% (4) strongly agreed that students felt confident in the use of the book FUSION. However 33% (10) of the teachers disagreed with the question and 4% (3) claimed to be undecided when answering the question (Figure 12). The results demonstrate that although the book FUSION appears to teachers to be too easy or too complicated for students, the majority of students felt confident in the use of the book; perhaps helping to facilitate their science learning.

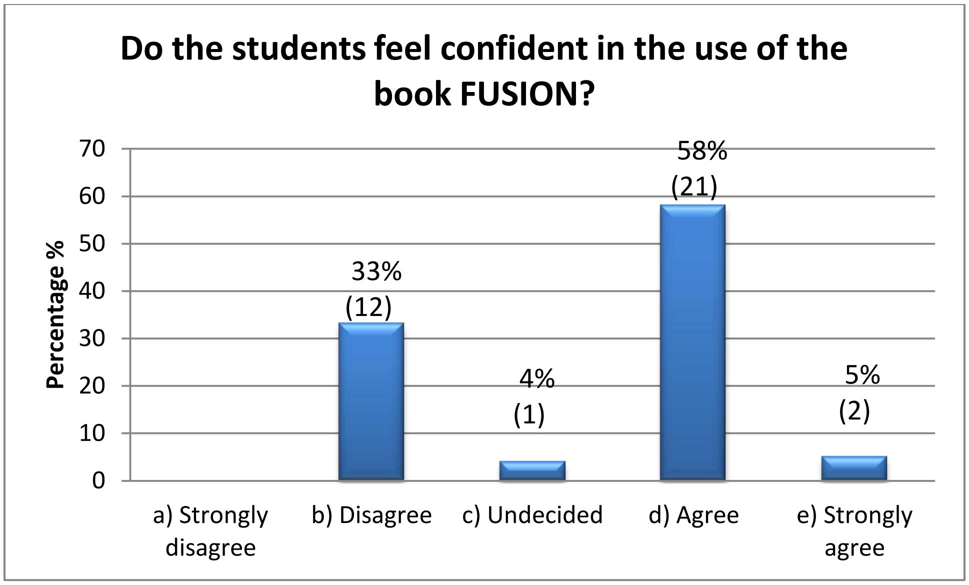


Figure 12. 4) Do the students feel confident in the use of the book FUSION? N=36

Of the teachers interviewed, 69% (24) did not use another science textbook to teach science, however 31% (12) mentioned that they used nonfiction science reading books from the library or their own collection to complement their science lesson (Figure 13). According to the National Research Council (1999), both the use of a textbook and nonfiction reading books for science learning are crucial for the all students to succeed in science. The results of this question suggest that teachers were making use of various literacy resources to improve the ELLs' academic achievement in science.

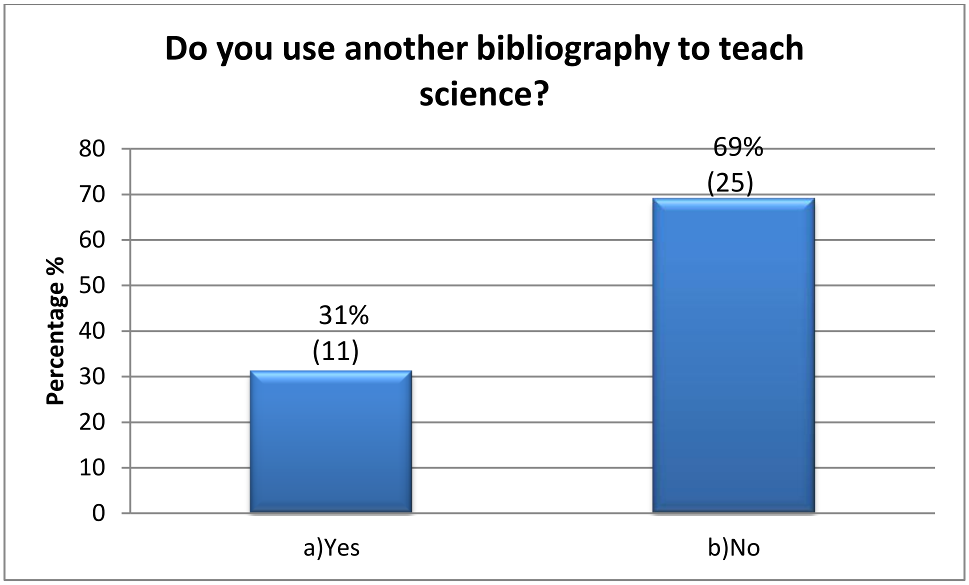


Figure 13. 5) Do you use another bibliography to teach science? N=36

The majority 91% (33) of interviewed teachers used other resources to teach science while only 9% (3) relied solely on the FUSION science textbook (Figure 14). This result suggests that teachers considered that the science textbook FUSION, though in Spanish language, did not adequately provide the necessary content for ELLs' science class.

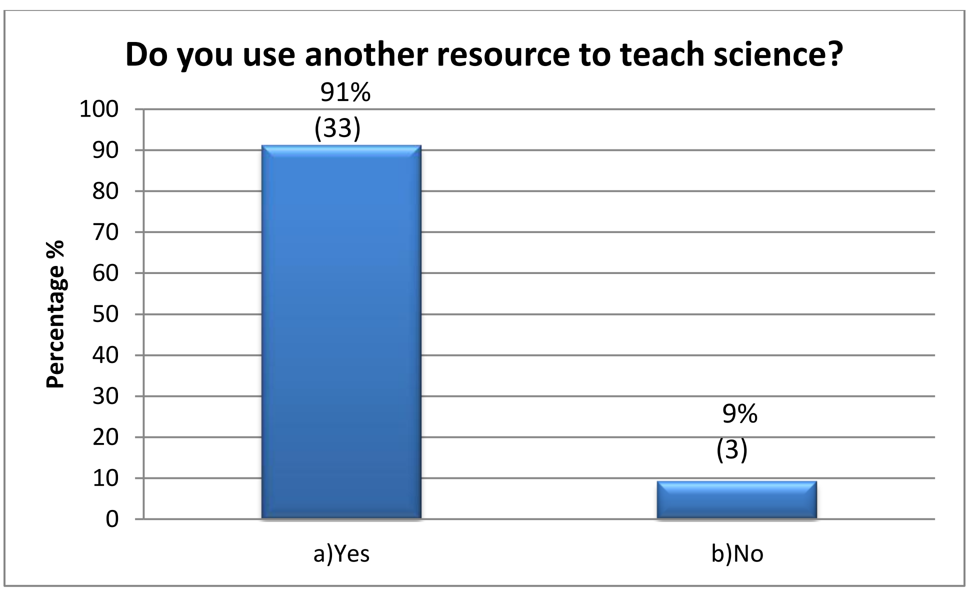


Figure 14. 6) Do you use another resource to teach science? N=36

Out of 33 teachers who responded to this question, 24% (9) of the teachers used *STEM scopes*, a K-5 online science resource that provides hands-on inquiry activities, assessments, problem-based problems and teacher support resources in English (NGSS, n.d.); 22% (7) used *teacherspayteachers.com*, an online site that provides teaching resources created by teachers in English, 18% (6) used *YouTube®* science videos in Spanish (see Appendix A.6), 15% (4) used *Brainpop.com* (see Appendix A.6), 6% (2) used *National Geographic®* resources, 6% (2) used *Thinkcentral.com*, an online learning site that provides access to digital books and activities in English, 6% (2) used *Google®* and 3% (1) used *Gizmos,* an online program to do math and science simulations in English (Figure 15).

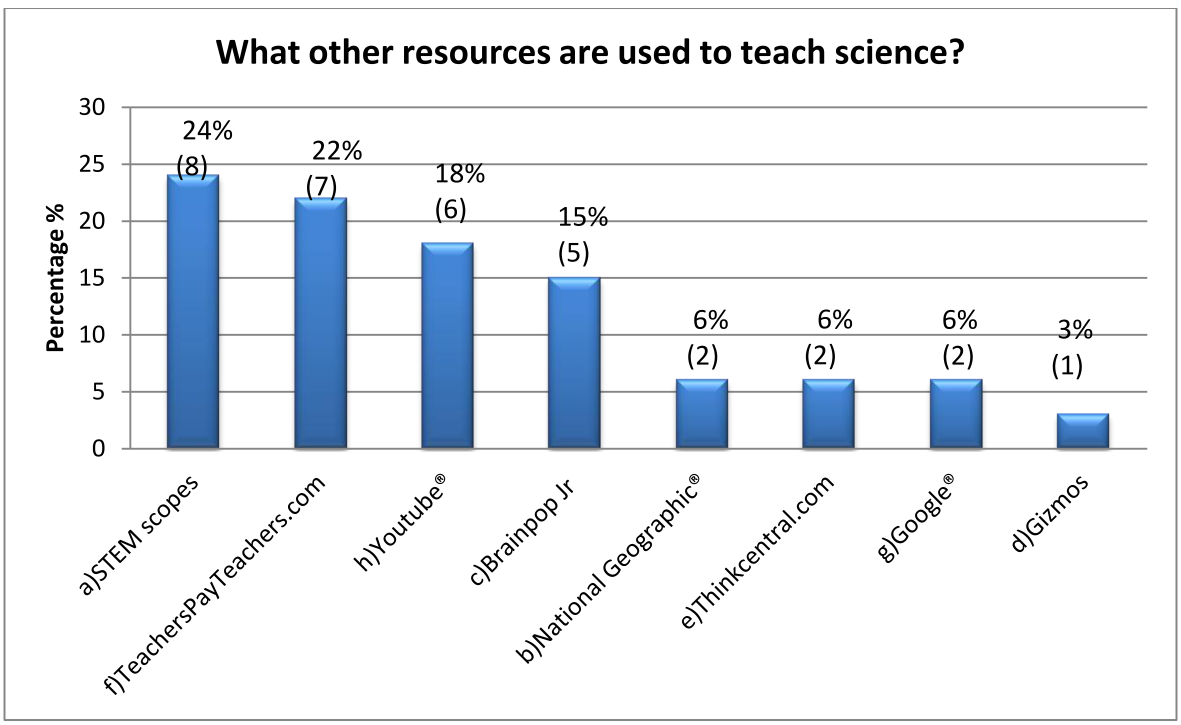


Figure 15. 7) What other resources are used to teach science? N=33

Of the teachers interviewed, 80% (28) responded that they felt prepared and confident to teach science to their bilingual classes; however 20% (8) did not (Figure

16). This ratio is similar to English speaking teachers who teach science in non-bilingual classes. According to Knaggs & Sondergeld (2015), many elementary teachers lack of confidence regarding teaching science due to a weak science content background and negative experiences as students of science. However, this response suggests that the lack of confidence in ELLs' teachers regarding science teaching is not a potential factor that might affect ELLs' science learning and achievement exclusively.

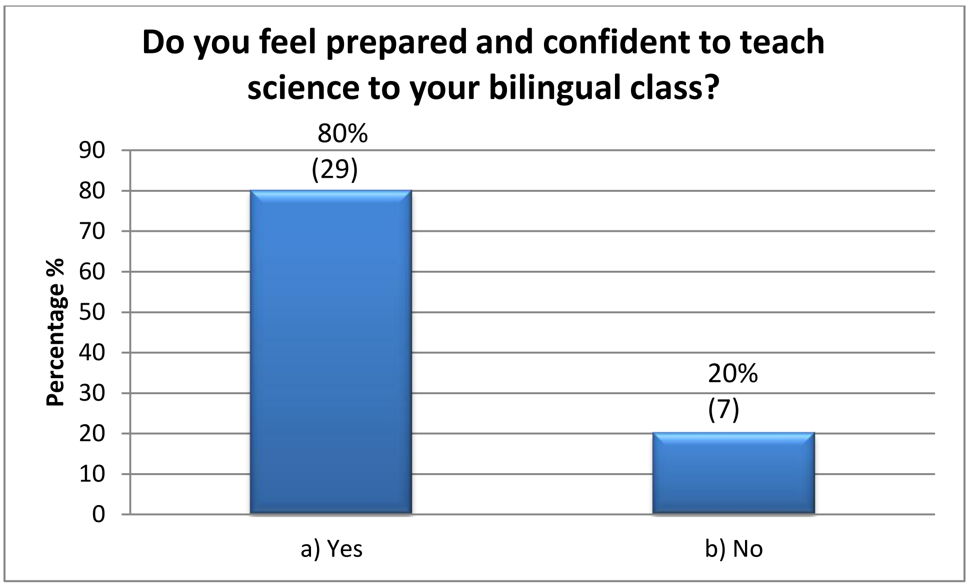


Figure 16. 8) Do you feel prepared and confident to teach science to your bilingual class? N=36

Of the teachers interviewed, 72% (25) spend more than 1 hour a week to teach science, 22% (7) teach for approximately 1 hour a week, and 6% (4) less than 1 hour a week (Figure 17). In 2009, Cervetti et al., conducted research to study the time devoted to science by elementary teachers. In this study, out of 233 English speaking teachers, 80% (186) reported allocating 1 hour a week, 16% (37) reported half an hour and 4% (19) reported less than half an hour. National trend data show a decline in instructional time in the elementary grades on science instruction over the past two decades (Blank, 2013). This suggests that similar to English-speaking students, ELLs also receive science instruction for a limited amount of time. Even though this might be a potential factor affecting ELLs' science achievement at primary school, it does not affect ELLs exclusively.

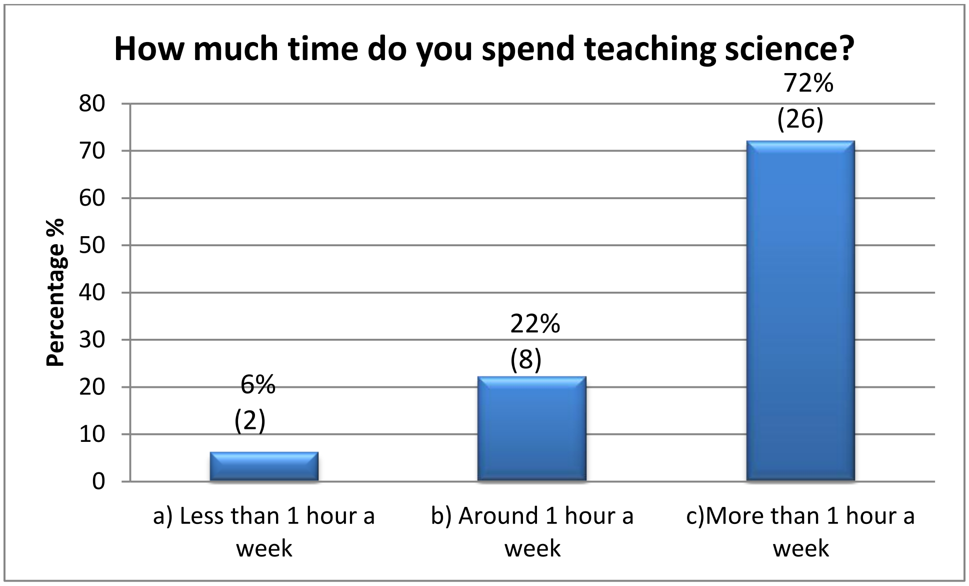


Figure 17. 9) How much time do you spend teaching science? N=36

Of the teachers interviewed, 69% (24) said that they thought there was not enough science literature available in Spanish to teach ELLs, 14% (5) mentioned that they had to spend time translating science materials from English into Spanish, 11% (3) mentioned that they had to bring science books from their home countries and 6% (2) mentioned that bilingual books were more expensive than the ones in English (Figure 18).

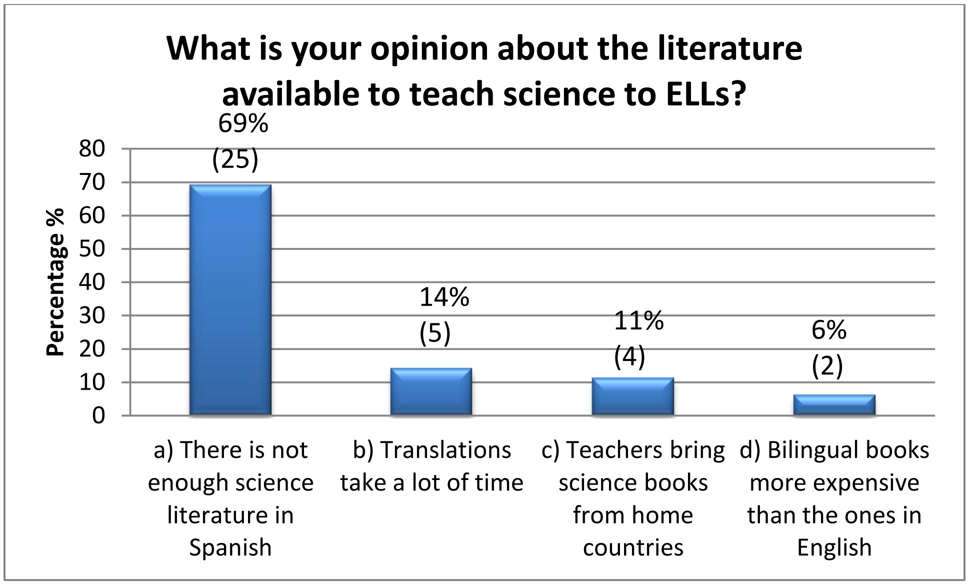


Figure 18.10) What is your opinion about the literature available to teach science to ELLs? N=36

Researchers Lo, et al., (2014) claimed that nowadays they are not merely managers of the school libraries, they are also expected to serve as administrators, teaching consultants and information specialists Research by Montiel-Overall & Jones, (2011), and Lo, et al., (2014) states that librarians should work along with teachers to ensure that learners are equipped with the skills and knowledge they need to succeed in the society of the 21st century. For this study, it was important to understand school librarian's opinion regarding science literature available in Spanish for ELLs in Dallas ISD. The librarians that were interviewed were responsible for the school library at each of the surveyed schools.

4.2.3 Responses from Librarians

Responses from question 1 and 2 of the librarian's interview (see full survey in Appendix A.2) showed that out of the 11 Dallas ISD school libraries visited, in 64% (7)

the number of nonfiction science reading books in Spanish did not equal the number of Hispanic students (highlighted in bold), and in 36% (4) there was an equal number of books for students (Table 8) (Figure 19). This shows that there was a limited amount of science literacy resources in Spanish for ELLs in the majority of the schools surveyed. This may also be considered as a potential factor affecting ELLs' science learning.

Elementary School	Total student Pop	Hispanic student Pop	Number of nonfiction science books in Spanish	Number of nonfiction science books in English
Leslie Stemmons	**828**	**92% (767)**	**325**	**975**
Clinton Russell	**754**	**86% (648)**	**330**	**670**
Mary Mcleod Bethune	**738**	**97% (717)**	**679**	**1505**
Anson Jones	**675**	**76% (513)**	**364**	**906**
William Cabell	**624**	**90% (561)**	**229**	**1121**
John Ireland	**584**	**81% (474)**	**250**	**750**
Arthur Kramer	559	69% (386)	480	1020
Martha Turner	**518**	**79% (409)**	**264**	**536**
Roger Mills	504	56% (280)	450	1050
C. F. Carr	415	62% (258)	300	1200
Sudie Williams	315	93% (293)	396	804

Table 8. Demographics and number of reading books in Spanish for the school libraries visited. N=11 *Source:* Data retrieved from http://tea.texas.gov/

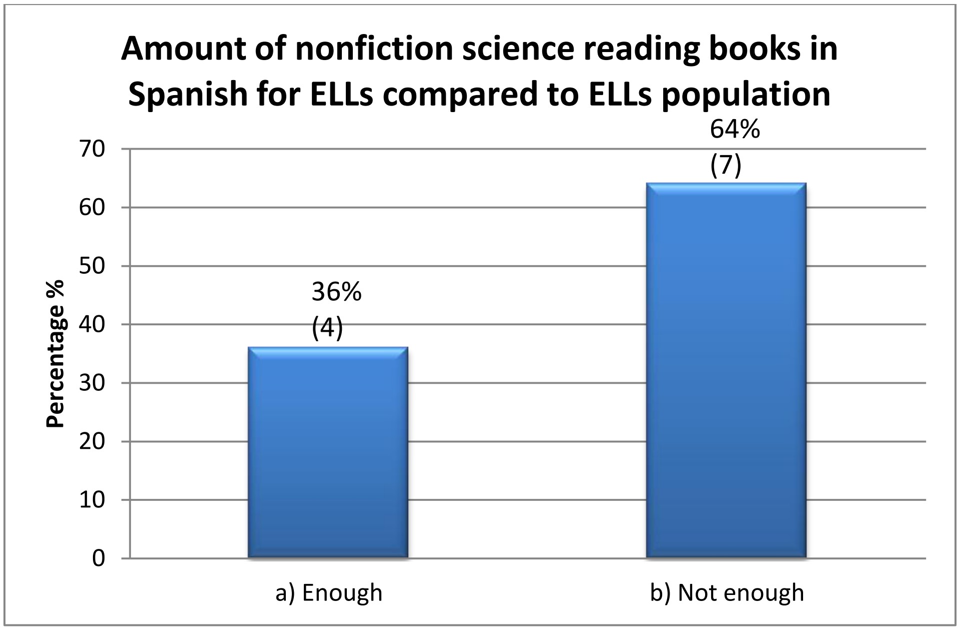


Figure 19. Amount of nonfiction science reading books in Spanish for ELLs compared to ELLs population in the schools surveyed. N=11

Of the librarians interviewed, 80% (8) agreed that it was important to have science books in Spanish available for ELLs, and 20% (3) strongly agreed (Figure 20). This response clearly shows that even though 100% of the librarians interviewed were aware of the importance of having science literature in Spanish for ELLs, the number of nonfiction science books in Spanish for ELLs was limited compared to the high Hispanic student population in the schools surveyed.

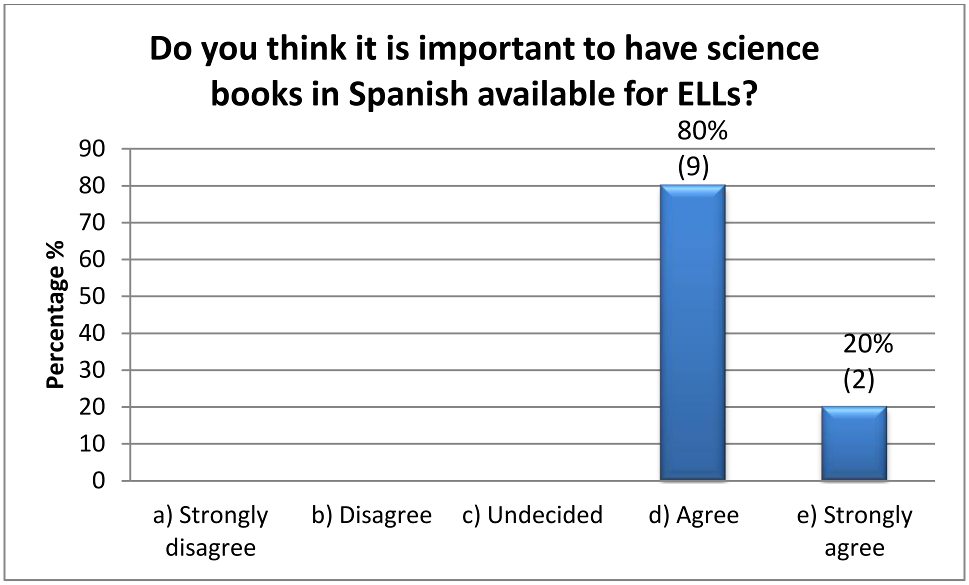


Figure 20. 4) Do you think it is important to have science books in Spanish available for ELLs? N=11

Nonfiction science reading books in Spanish identified in the Dallas ISD school libraries during this study were published by different publishing companies in the U.S. and Europe. Following the teachers' responses from Question 10 of the teacher's interview (see full survey in Appendix A.1), where they mentioned that there was insufficient science literature in Spanish in the U.S., publishing companies were contacted concerning their reasons to publish, or not publish in Spanish, considering the high Hispanic student population in the U.S. The results below are based on responses to questions asked via email.

4.2.4 Responses from Publishing Companies

Of the publishing companies interviewed, 65% (13) do publish nonfiction science books in Spanish language currently, 35% (7) does not (Figure 21).

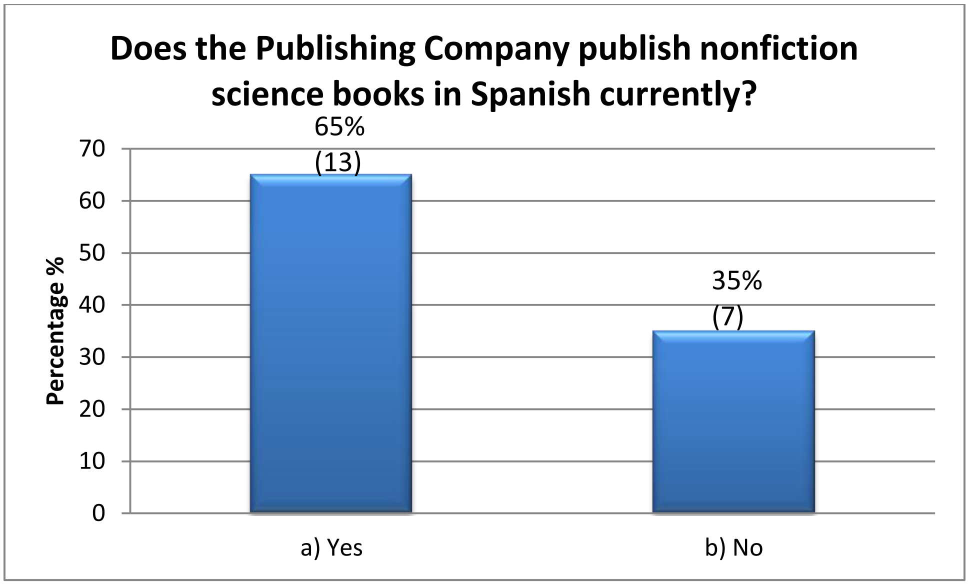


Figure 21. 1) Does the Publishing Company publish nonfiction science books in Spanish currently? N=20

Of the publishing companies interviewed, 40% (8) mentioned the reason that determines if a book is printed in a language other than English is a high demand for publishing in a certain language, 35% (7) mentioned that it depends on the financial resources of the publishing company and 25% (5) mentioned that it relied on the author's decision (Figure 22). The response suggests us that the major reason driving the publication of a science book in Spanish in the U.S. is the demand for that book.

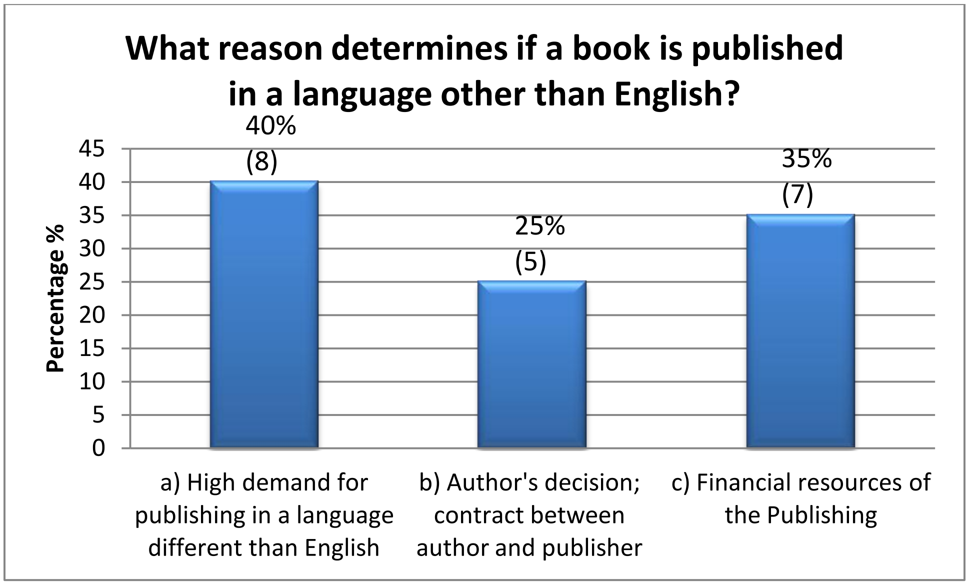


Figure 22. 2) What reason determines if a book is published in a language other than English? N=20

Of the publishing companies interviewed, 75% (15) mentioned that there was not sufficient demand for publishing nonfiction science books in Spanish, and 25% (5) said there was (Figure 23). The possible conclusion from this response is that even though there is a Hispanic population of 55 million in the U.S., 10.4 million in Texas as of July 1, 2014 (U.S. Census Bureau) and 87,384 Hispanic PK-5 students in the Dallas ISD as of June 1, 2016, a high Hispanic population does not necessarily translate into a high demand for nonfiction science books in Spanish.

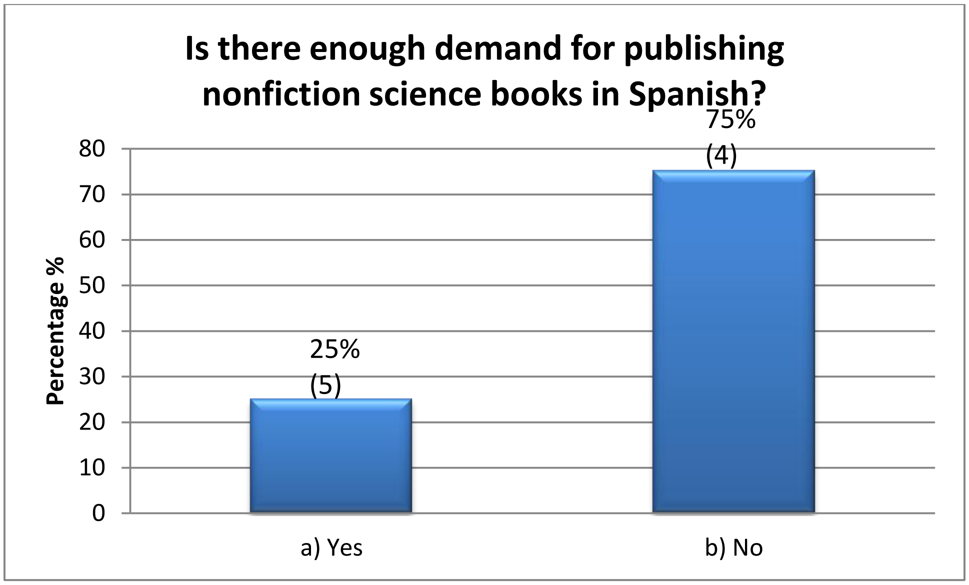


Figure 23. 3) Is there enough demand for publishing nonfiction Science books in Spanish? N=20

Of the publishing companies interviewed, 75% (15) were aware of the growing Spanish speaking population in the U.S. and the need for literature in Spanish, five percent (1 respondent) was not aware of the population, and 20% (4) did not answer the question (Figure 24). Even though the majority of the publishing companies interviewed were aware of the high Hispanic population in the U.S. and the need for literature in Spanish, awareness did not necessarily translate into a high demand of books in Spanish, and thus their publication.

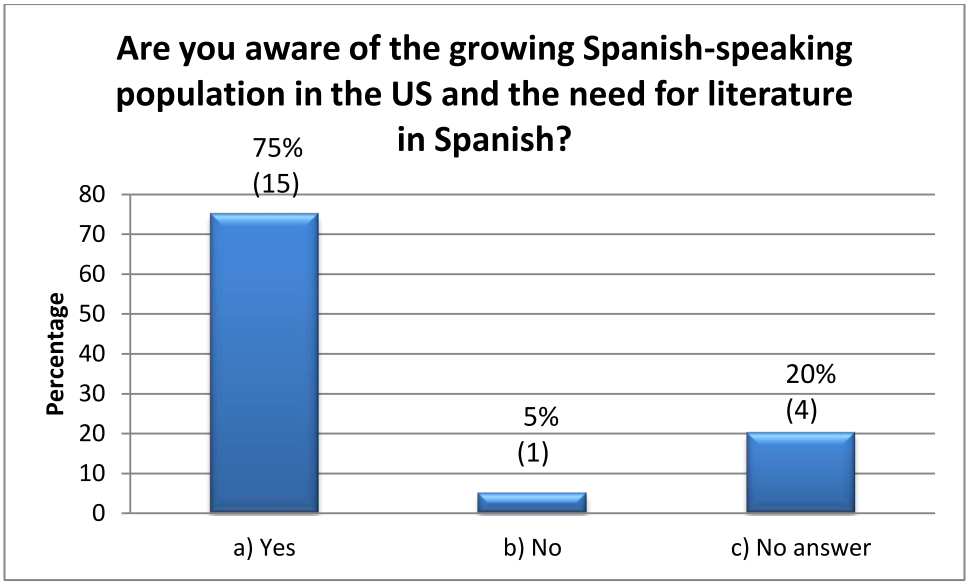


Figure 24. 4) Are you aware of the growing Spanish speaking population in the US and the need for literature in Spanish? N=20

CHAPTER 5

DISCUSSION

With the goal of examining one of the potential factors that might explain why Latino college students are not graduating with STEM degrees in the same proportion as they are with Non STEM degrees, a series of quantitative and qualitative tests were conducted with University of North Texas graduation data and teacher and librarian interviews in elementary schools in the Dallas Independent School district. The university and DISD were considered representative of national Hispanic demographics at both college and elementary levels.

5.1 Quantitative Analysis

The statistically significant difference ($p<0.05$) observed in the number of bachelor's degrees in STEM between Hispanic, White, African American and other student ethnicity groups (one-way ANOVA) revealed that for UNT, students from White and Other ethnic groups tend to graduate with a STEM college degree in greater proportion than students from Hispanic and African American ethnic groups. When comparing ethnicities separately, this test also showed that there was a statistically significantly difference in the number of STEM degrees between the ethnicities: Hispanic and White ($p=0.001$), African American and White ($p=0.001$), and White and other ($p=0.001$).

In the same instance, the statistically significant difference ($p<0.05$) observed with the chi square test of independence, revealed that for UNT, ethnicity was related with type of degree; in other words, students of a particular ethnicity tended to graduate with a particular type of degree. The results also showed that in particular, Hispanic and

African American ethnic groups tended to graduate in greater numbers with Non STEM degrees in comparison to White and Other ethnic groups, who tend to graduate in greater numbers with STEM degrees. These results supports research conducted at other universities in the U.S., where Latinos were also not graduating with STEM bachelor's degrees and consequently, continue to be underrepresented in science careers and professions (Chapa & De La Rosa, 2006; Hernandez et al., 2013; Toven-Lindsey et al., 2015).

Another potential factor affecting ELLs' science learning in U.S. schools is the K-5 science curriculum (Cooper et al., 2005; Rochin & Mello, 2007; Taningco et al., 2008). School curriculum is generally designed for white middle-class students and is often not culturally relevant for Latinos (González et al, 2005). Hispanic ELLs must master basic English and Math skills, having less opportunity for development of skills that are crucial for science understanding (Flores, 2011). Besides this, when science is delivered solely in English, ELLs' academic achievement in science might be at risk (Lee et al., 2008).

Research, preformed by Cole & Espinoza (2008) with 146 Latino college students in STEM majors, showed that for both Latinos and other minority students, their selection and persistence in STEM majors correlated with their academic preparation in high school (p.289), suggesting that Latino high school students might be underprepared to take science curriculum in college. A possible solution to this might be to target Hispanic high schools students who have interest in STEM field, and promote their curiosity and self-esteem with regard to science and math in order to enhance their knowledge and skills in science (Cole & Espinoza, 2008).

The quantitative analysis of the interviews performed with teachers and librarians, resulted in a statistically significant difference ($p<0.05$), using a chi square goodness of fit, that the observed responses from teachers and librarians regarding the Likert scale categories (questions 2, 3 and 4 in the teacher's interview Appendix A.1) and question 3 in the librarian's interview (Appendix A.2); did not match the expected ones. However, results showed that the majority of teachers (30 out of 36) agreed with the use of the textbook FUSION in terms of TEKS alignment, science vocabulary and acceptance from the ELLs. The majority of the librarians (9 out 11) agreed that it was important to have science books available in Spanish for ELLs.

5.2 Qualitative Analysis

5.2.1Responses from Teachers

In the teacher's interview (Appendix A.1) it was determined that 17% (6) of the teachers did not use the textbook FUSION. Given the facts that science textbooks are still the major source for presenting science concepts and are used as the basis for a science lesson (Sharma & Buxton, 2015), this negative response suggests a follow up to find if the science textbook FUSION fully addresses the linguistic needs of the ELLs.

For question 5, 91% (32) of them used outside resources in English to teach science, including the websites *TeachersPayTeachers.com* and *Brainpop.com* as well as the learning sites *STEM scopes* and *Gizmos*; however, 20% (7) of them did not feel prepared and confident to teach science. The lack of preparation and confidence to teach science is also common among elementary teachers that teach science of non-bilingual classes (Knaggs & Sondergeld, 2015), and is not a potential factor affecting ELLs' science learning exclusively.

Regarding the length of time spent teaching science, 22% (7) of the teachers interviewed spent around 1 hour a week and 6% (4) less than an hour. Even though science learning requires time for the development of higher cognitive skills (NSTA, 1996; Lee, 2005), the limited amount of time devoted to science also happens in non-bilingual classes (Cervetti et al., 2009; Blank, 2013) and is not a potential factor affecting ELLs' science learning exclusively.

5.2.2 Responses from Librarians

As to the librarian's interview (see full survey in Appendix A.2) it was interesting to find that in the majority of the school libraries surveyed (7 out of 11), the number of nonfiction science reading books does not equal the number of Hispanic students at each school. Knowing that reading nonfiction science in primary school improves ELLs' literacy skills and science learning (Ambruster, 1992; NRC, 1999; Rice, 2002), and that the Hispanic PK-5 student population in Dallas ISD represents 70% (87,384) of the total student population, the disparity between the number of nonfiction science books and the number of Hispanic students might be a potential factor affecting ELLs' science learning.

5.2.3 Responses from Publishing Companies

For the purposes of this study, publishing companies were contacted concerning their reasons to publish or not publish in Spanish, considering the high student population in U.S. primary schools. It was interesting to find that 35% (7) of them do not publish nonfiction science books in Spanish anymore.

When asking the publishing companies about the reasons that determine the publication of a book in a language other than English, the demand of the book in a particular language appears to be the biggest reason. Results also showed that 75% (15) of them mentioned being aware of the growing Spanish speaking population in the U.S. and need for literature in Spanish; the same proportion mentioned having no demand for nonfiction science books in Spanish. These results suggest that awareness of a high Hispanic student population in the U.S. by the publishing companies does not necessarily translate into a high demand for nonfiction science books in Spanish and thus their publication.

5.3 Limitations

Two limitations might constrain the generalizations made in this study. First, the sample used for the one-way ANOVA and chi square test of independence although obtained from a large diverse university database, is not representative of all Latino college students in the U.S. Second, the sample size used for the teachers' and librarians' interview, although sufficient for the chi square goodness of fit, was modest. A larger number of teachers and librarians would have allowed for a more complex qualitative analysis.

5.4 Implication for Future Research

The analysis of how ELLs are learning science in the Dallas ISD primary schools was performed in order to identify potential factors affecting STEM degree attainment by Hispanic students. This research can be built upon by continuing research on ELLs' learning, to see if these same factors affect students at higher education levels such as middle school and high school throughout 6-12 science curriculum.

Though research is plentiful about the disparity between the number of Hispanic students and the number of their White counterparts awarding degrees in STEM, it is interesting to note that this study is one of few related to the identification of potential factors affecting graduation rates in STEM with a focus on how Hispanic ELLs learn science during primary school.

CHAPTER 6

CONCLUSION

Latinos are the largest ethnic minority group in the U.S. (U.S. Census Bureau, 2015), and despite the continuous growth of the Hispanic population, Latinos are severely underrepresented in higher education STEM programs and field, even though the STEM careers and professionals are highly revered in Latin America. One of the reasons that may explain why Latinos do not major in STEM, is the way ELLs encounter science curriculum at the K-5 level (Rochin & Mello, 2007; Taningco et al., 2008; Flores, 2011).

The identification of the literacy resources ELLs have for science learning at their schools was performed due to previous studies that relate the language barriers faced by ELLs when learning science at the K-5 level, and the underrepresentation of Latinos in STEM (Cooper et al., 2005; Rochin & Mello, 2007; Taningco et al., 2008; Flores, 2011). However, other social, family, psychological and educational factors come into play when talking about why Latinos do not graduate with STEM bachelor's degree.

This research study was conducted for the purpose of identifying a potential factor affecting graduation rates in STEM at UNT by Hispanic students, via analysis of ELLs' science instruction in elementary schools in Dallas ISD where a great proportion of UNT students come from. The statistically significant difference ($p<0.05$) in graduation rates in STEM of Hispanic students in comparison to White students at UNT, and the description of how ELLs are learning science in the Dallas ISD primary schools, does not assume that there is a cause-effect relationship between those premises.

The description of how ELLs learn K-5 science curriculum might encourage stakeholders in education to plan and select literacy resources according to ELLs' linguistic skills and needs. Understanding the influence that culture and language have on ELLs' science instruction might also lead elementary teachers who teach science in bilingual classes to make science more relevant to the students' culture and use the students' native language as a learning vehicle. According to Chapa & De La Rosa (2006) and Flores (2011), without effective intervention at the primary and secondary education levels, a small number of Latinos with STEM college degree will continue.

APPENDIX A

TEACHER'S INTERVIEW

School's name:______________________________________

Teacher's name: _____________________________________ Grade:__________

1) Do you use the book FUSION to teach science?

   a) Yes b) No

2) Do you think the book's content is aligned to the science TEKS?

   a) Strongly disagree
   b) Disagree
   c) Undecided
   d) Agree
   e) Strongly agree

3) Do you think the quality of the book FUSION is good in terms of *vocabulary*?

   a) Strongly disagree
   b) Disagree
   c) Undecided
   d) Agree
   e) Strongly agree

4) Do the students feel confident to use the book FUSION?

   a) Strongly disagree
   b) Disagree
   c) Undecided
   d) Agree
   e) Strongly agree

5) Do you use another bibliography to teach science?

a) Yes b) No

6) Do you use another resource to teach science?

b) Yes b) No

7) What other resources are used to teach science?

____

8) Do you feel prepared and confident to teach science to your bilingual class?

a) Yes b) No

9) How much time do you spend teaching science?

a) Less than 1 hour a week b) Around 1 hour a week c) More that 1 hour a week

10) What is your opinion about the literature available to teach science to ELL (English Language Learners)?

____

____

____

____

____

APPENDIX B

LIBRARIAN'S INTERVIEW

School's name:____

Librarian's name: ______________________________________

1) How many nonfiction science reading books are there in the library?

____

2) How much of your nonfiction science reading book collection is in Spanish?

____

3) Do you think is important to have science books in Spanish for ELL (English Language Learners?

a) Strongly disagree

b) Disagree

c) Undecided

d) Agree

e) Strongly agree

APPENNDIX C

PUBLISHING COMPANY’S INTERVIEW

Publisher's name: ____

1) Does the Publishing Company publish nonfiction science books in Spanish currently?

   a) Yes b) No

2) What reason determines if a book is published in a language other than English?

   ____

   ____

   ____

3) Is there enough demand for publishing nonfiction science books in Spanish?

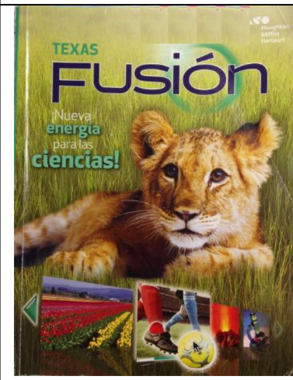
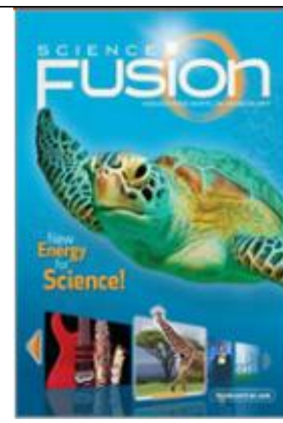
   a) Yes b) No

4) Are you aware about the growing Spanish-speaking population in the US and the need for literature in Spanish?

   a) Yes b) No

APPENDIX D

SCIENCE TEXTBOOKS

Name	Publishing	Grade	Language	Cover	Picture of the book
Science Fusion	Houghton Mifflin Harcourt	K	Spanish	Paper cover	
Science Fusion	Houghton Mifflin Harcourt	1	Spanish	Paper cover	
Science Fusion	Houghton Mifflin Harcourt	2	Spanish	Paper cover	
Science Fusion	Houghton Mifflin Harcourt	3	Spanish	Paper cover	

Science Fusion	Houghton Mifflin Harcourt	4	Spanish	Paper cover	
Science Fusion	Houghton Mifflin Harcourt	5	Spanish	Paper cover	

APPENDIX E

NONFICTION SCIENCE READING BOOKS

School	Title	Author	Publishing
Leslie Stemmons	El ciclo del agua	Cristina Quental	Everest
	¿Qué aspecto tiene?	Bobbie Kalman	Crabtree
	Porqué debo proteger la naturaleza	J. Green and M. Gordon	Anaya
	Combustiones fósiles	N. Saunders and S. Chapman	Heinemann
	Rocas sedimentarias	Chris Oxlade	Heinemann
	Un paseo por el bosque lluvioso	Kristin Joy Pratt	Dawn
	¿Qué son los biomas?	Bobbie Kalman	Crabtree
	¿Qué son los seres vivos?	Bobbie Kalman	Crabtree
	Un hábitat de bosque tropical	Bobbie Kalman	Crabtree
	¿Cómo se adaptan los animales?	Bobbie Kalman	Crabtree
	¿Cómo se mueve?	Bobbie Kalman	Crabtree
	Animales llamados mamíferos	Bobbie Kalman	Crabtree
	¿Qué le da forma a la tierra?	Bobbie Kalman	Crabtree
	Insectos útiles y dañinos	Bobbie Kalman	Crabtree
	Nieve, relámpago	Edison	Capstone
	El libro de las nubes	Tomie de Paola	Harcourt
	Energía Nuclear	Tea Benduhn	Scholastic
	Poleas	Michael Dahl	Capstone
	El calor	Sally Walker	Lerner
	Fuerza y movimiento	Aliki Brandenberg	Laorusse
	Las burbujas explotan	Mark Weakland	Capstone
John Ireland	El ciclo del agua	Bobbie Kalman	Crabtree
	Es agua	Ralley Cole	Mondo
	Los hábitats de agua dulce	Diane Snowball	Mondo
	Exploremos los hábitats de la tierra	Margaret Phinney	Mondo
	Los insectos	B. Bird and J. Short	Mondo
	¿Qué animales viven aquí?	M. Woolley and K. Pigdon	Mondo
	¿Debe exixstir la exploración espacial?	Susan Harvey	Mondo
	¿Qué son las plantas?	Bobbie Kalman	Crabtree
	El ciclo de la vida de la mariposa	Bobbie Kalman	Crabtree
	¿Qué es el tiempo?	Bobbie Kalman	Crabtree
	La tierra	Van Rose	DK Publishing

	Despacio, empujar, jalar	Sarah Shannon	Heinemann
	El Sol	Guillain	Heinemann
	La Luna	Guillain	Heinemann
	Las estrellas	Guillain	Heinemann
	Estaciones del año	Steffora	Heinemann
	Las estaciones y el tiempo	Mary Berendes	The Child's World
	La Tierra y el Sol	Bobbie Kalman	Crabtree
	¿Cómo se siente al tocarlo?	Bobbie Kalman	Crabtree
	Aprende y descubre la ciencia	Daniel Santa Cruz	Harper Collins
	Mis cinco sentidos	Margaret Miller	Harper Collins
Anson Jones	El agua potable	Mary Schuch	Capstone
	Con mi lengua	Mariana Pellegrino	Progreso
	Con mis manos	Mariana Pellegrino	Progreso
	Con mis oídos	Mariana Pellegrino	Progreso
	Gigantes de hierro	Karen Wallace	DK Publishing
	Astronautas	Charlotte Guillain	Heinemann
	El poder de la energía	Rebecca Weber	Capstone
	Cómo crece un renacuajo	Pam Zollman	Scholastic
	El oso pardo	P. Whitehouse	Heinemann
	El elefante	P. Whitehouse	Heinemann
	La jirafa	P. Whitehouse	Heinemann
	El león marino	P. Whitehouse	Heinemann
	La cabra montés	P. Whitehouse	Heinemann
	Jirafas	John Bonnett	Wildlife Education
	¿Qué es un insecto?	Trumbauer	Capstone
	Insectos increibles	John Townsend	Capstone
	La catarina	David Scwartz	Scholastic
	La mariposa monarca	David Scwartz	Scholastic
	Saltamontes	Jason Cooper	Rourke
	Mariposas	Jason Cooper	Rourke
Martha Turner	Libélulas	Jason Cooper	Rourke
	Mariquitas	Jason Cooper	Rourke
	Hormigas	Jason Cooper	Rourke
	Insectos	Jennifer Dussling	DK Publishing
	Las plantas son seres vivos	Bobbie Kalman	Crabtree
	¿Cómo se mueve?	Bobbie Kalman	Crabtree

	El ciclo de la vida de un árbol?	Bobbie Kalman	Crabtree
	Semillas se plantan, semillas crecen	Mark Weakland	Capstone
	Verde como una rana	Molly Dingles Vélez	Gumdrop
	Amarillo como un limón	Molly Dingles Vélez	Gumdrop
	Gris como un delfín	Molly Dingles Vélez	Gumdrop
	Enfriar	Patricia Whitehouse	Heinemann
	El magnetismo	Walter Ring	Lerner
	Gases	Mezzanotte	Scholastic
	Pintas, Cuartos, Galones	Molly Karapetkova	Rourke
	Lagos y estanques	Cassie Mayer	Heinemann
	Ríos y arroyos	Cassie Mayer	Heinemann
	El ciclo del agua	Bobbie Kalman	Crabtree
	El Sol	Anita Ganeri	Scholastic
	Lagos. Geografía del mundo	Max Stevens	Scholastic
	Lagunas. Geografía del mundo	Max Stevens	Scholastic
Clinton Russel	El techo del mundo	Laurence Quentin	Heinemann
	Vivo en las montañas	Gini Holland	Gareth Stevens
	El hábitat de la antártida	Bobbie Kalman	Crabtree
	Un hábitat de desierto	Bobbie Kalman	Crabtree
	Un hábitat de pantano	Bobbie Kalman	Crabtree
	Las cadenas alimentarias en charcos	Katie Kawa	Power Kids Press
	Las cadenas alimentarias del desierto	Katie Kawa	Power Kids Press
	Hábitats acuáticos	Bobbie Kalman	Crabtree
	Un hábitat en el bosque tropical	Bobbie Kalman	Crabtree
	Los seres vivios necesitan agua	Bobbie Kalman	Crabtree
	¿Esto es un ser vivo?	Bobbie Kalman	Crabtree
	Las plantas son seres vivos	Bobbie Kalman	Crabtree
	Las plantas de distintos hábitats	Bobbie Kalman	Crabtree
	Las cadenas alimentarias en madera	Katie Kawa	Power Kids Press

	Las cadenas alimentarias en pradera	Katie Kawa	Power Kids Press
	Las cadenas alimentarias en el jardín	Katie Kawa	Power Kids Press
	Es igual o diferente	Bobbie Kalman	Crabtree
	Los animales crecen y cambian	Bobbie Kalman	Crabtree
	Cómo usan los animales sus ojos	Annie Everall	Rourke
	Hogares de los seres vivos	Vic Parker	Rourke
Mary McLeod Bethune	El ciclo de vida de una araña	Bobbie Kalman	Crabtree
	¿Sabes algo de los anfibios?	Buffy Silverman	Rourke
	Explorar ecosistemas con Max Axiom	Emily Sohn	Capstone
	Iluminante mundo de la luz con Max Axiom	Emily Sohn	Capstone
	Materia: mira, toca, prueba y huele	Darlene Stille	Perma-Bound
	Luz y sonido	Mike Goldsmith	Lectorum
	La luz: sombras, espejos y arcoiris	Natalie Rosinsky	Perma-Bound
	Conoces la Tierra. Geografía del mundo	Max Stevens	Scholastic
	Las montañas	Alison Adams	Benchmark
	El ciclo de vida de las plantas	Julie Lundgren	Rourke
	Continentes: Asia	Leila Mevrell Foster	Heinemann
	El ciclo del agua	Robin Nelson	Lerner
	Los imanes	Robin Nelson	Lerner
	Mi cuerpo	Lola Schaefer	Benchmark
	Araña	Esther Cullen	Mondo
	¿Qué es?	David Drew	Elsevier
	En el bosque	Ermanno Cristini	Scholastic
	Las plantas y los animales	Natalie Lunis	Benchmark
	Las hormigas	Mickey Daronco	Benchmark
	Cómo se mueven las cosas	Robin Nelson	Lerner
	Agua	Dona Herweck Rice	Harcourt
Arthur Kramer	La vida de una rana	Dona Herweck Rice	Harcourt
	Las máquinas simples	Lola Schaefer	Benchmark
	Hecho de metal	Patty Whitehouse	Rourke
	Los fósiles	June Edelstein	Benchmark

	La montaña Santa Helena	Rachel Kranz	Benchmark
	Insectos y arañas	Dona Herweck Rice	Harcourt
	Mis cinco sentidos	Aliki Brandenberg	Harper Collins
	El poder del imán	Buffy Silverman	Rourke
	La mariposa monarca	Bruce Golstone	McGrawHill
	¿Qué es la materia?	Lola Schaefer	Benchmark
	Desierto	Cassie Mayer	Heinemann
	Oceáno	Cassie Mayer	Heinemann
	Bosque Tropical	Cassie Mayer	Heinemann
	Un hábitat de sabana	Bobbie Kalman	Crabtree
	Un bosque tropical	Bobbie Kalman	Crabtree
	Un hábitat de desierto	Bobbie Kalman	Crabtree
	Hábitats acuáticos	Bobbie Kalman	Crabtree
	El bioma Marino	Bobbie Kalman	Crabtree
	Dentro de la selva tropical	Diane Willow	Charlesbridge
	Usar el aire	Katz Cooper	Heinemann
	Usar el agua	Katz Cooper	Heinemann
Sudie Williams	Usar el carbón, el petróleo y el gas	Katz Cooper	Heinemann
	Usar las rocas	Katz Cooper	Heinemann
	Nubes	Cassie Mayer	Heinemann
	Lluvia	Cassie Mayer	Heinemann
	Nieve y relámpagos	Cassie Mayer	Heinemann
	Viento	Cassie Mayer	Heinemann
	Soy el agua	J. Marzollo and J. Moffat	Scholastic
	El viento	Anita Ganeri	Gareth Stevens
	El Sol	Anita Ganeri	Gareth Stevens
	Los fósiles nos hablan del pasado	Aliki Brandenberg	Harper Collins
	Aprender de los fósiles	Katz Cooper	Heinemann
	Los dinosaurios más pequeños	Don Lessen	Lerner
	Dinosaourios cornudos	Don Lessen	Lerner
	Carnívoros gigantes	Don Lessen	Lerner
	Dinosaurios pico de pato	Don Lessen	Lerner
	Reptiles todo tipo	Bobbie Kalman	Crabtree
	Los pequeños murciélagos	Joyce Markovics	Beaport
	Las ranas de la madera	Joyce Markovics	Beaport
	Las serpientes de cascabel de bandas	Clark Sawyer	Beaport

	Está nevando	Alex Appleby	Gareth Stevens
	Es una tormenta	Alex Appleby	Gareth Stevens
Roger Mills	Está granizando	Alex Appleby	Gareth Stevens
	Huracán	Jessica Rudolph	Gareth Stevens
	Tormenta de nieve	Joyce Markovics	Beaport
	Terremoto	Joyce Markovics	Beaport
	Inundación	Jean Greenlaw	Beaport
	Tsunami	Joyce Markovics	Beaport
	La primavera	Thayer	Lerner
	Cuatro estaciones estupendas	Alex Appleby	Gareth Stevens
	Todo es materia	Martin Elena	Capstone
	Sobre la energía	N. Saunders and S. Chapman	Capstone
	100 Experimentos Científicos	G. Andrews and K. Knighton	Usborne
	Animales acorazados	Lola Schaefer	Heinemann
	Animales resbalosos	Lola Schaefer	Heinemann
	¿Qué forma tiene?	Bobbie Kalman	Crabtree
	Pirámides	Nathan Olson	Capstone
	Estrellas y galaxias	Miguel Pérez	Barrons
	El Sistema Solar	Miguel Pérez	Barrons
	El ciclo de la vida de la rana	Bobbie Kalman	Crabtree
	Transferencias de energía	N. Saunders and S. Chapman	Capstone
	Fuerzas y movimiento	Angela Royston	Heinemann
	El ciclo del agua	Bobbie Kalman	Crabtree
C. F. Carr	Oceános y mares	Cassie Mayer	Heinemann
	Desiertos	Joan Early Macken	Gareth Stevens
	Llanuras	Joan Early Macken	Gareth Stevens
	Mares	Joan Early Macken	Gareth Stevens
	Los volcanes de la Tierra	Bobbie Kalman	Crabtree
	¿Qué le da forma a la Tierra?	Bobbie Kalman	Crabtree
	Imanes	Angela Royston	Heinemann
	La electricidad	Sally Walker	Lerner
	El calor	Sally Walker	Lerner
	El Magnetismo	Sally Walker	Lerner
	El sonido	Sally Walker	Lerner
	La luz	Sally Walker	Lerner
	La materia	Sally Walker	Lerner

	¿De qué color es?	Bobbie Kalman	Crabtree
	Flotar y hundirse	Robin Nelson	Lerner
	Dime como flotan los barcos	Shirley Willis	Grolier
	Dime que tan rápidamente va	Shirley Willis	Grolier
	¿Qué son las plantas?	Bobbie Kalman	Crabtree
	Las plantas son seres vivos	Bobbie Kalman	Crabtree
	El ciclo de vida del árbol	Bobbie Kalman	Crabtree
	Abecedario de los animales	Alma Flor Ada	Planeta
William Cabell	Es igual o diferente	Bobbie Kalman	Crabtree
	Los seres vivios necesitan agua	Bobbie Kalman	Crabtree
	Serpientes y lagartos	Ellen Catala	Capstone
	Mi primera visita al zoo	José María Parramon	Barrons
	Dentro de la Amazonia salvaje	Jeff Corwin	Thompson Gate
	Dentro de Luisiana salvaje	Jeff Corwin	Thompson Gate
	Dentro del Brasil salvaje	Jeff Corwin	Thompson Gate
	Dentro de Borneo salvaje	Jeff Corwin	Thompson Gate
	El mundo marino	Jeff Corwin	Thompson Gate
	El mundo Australia	Jeff Corwin	Thompson Gate
	Los camellos tiene joroba	Eric Carle	DK Publishing
	Animales bebés	Eric Carle	DK Publishing
	Adivina qué está creciendo	Eric Carle	DK Publishing
	Soy una hoja	J. Marzollo and J. Moffat	Scholastic
	Usar las plantas	Katz Cooper	Heinemann
	El ábitat de la Antártida	Bobbie Kalman	Crabtree
	El hábitat del Ártico	Bobbie Kalman	Crabtree
	El desierto del Sahara	Lisa Trumbauer	Harcourt
	¿Sólido o no?	J. Scieber and C. Swain	Benchmark
	¿De dónde viene el papel?	Susan Ring	Harcourt

APPENDIX F

DIGITAL MEDIA

Dallas ISD provides librarians and teachers with an online catalog where they can access educational science videos in Spanish that can be streamed or purchased on a campus by campus basis. Some of these resources are:

Name	Description
Britannica Escolar Online	Provides a Spanish Elementary Encyclopedia with 2,000 articles, images, Spanish-language videos, and Spanish Learning Materials specifically designed for elementary students.
Brainpop	Access educational animated movies in Spanish for grades K-5 to explain concepts in a voice and visual style that is accessible and entertaining to both children and adults. Also includes interactive quizzes and games, comic strips and experiments.
Sid, el niño científico	YouTube® offers the award-winning educational animated television series in Spanish that uses comedy and music to promote exploration, discovery and science readiness.

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