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Stories of Success: Understanding Academic Achievement of Hispanic Students in Science

by

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Abstract

A review of the literature shows that there is much evidence to suggest the challenges facing Hispanic students in American public schools. Hispanic enrollment in K-12 public schools has increased from 6 to 19% in the last thirty years, yet schools have not made adequate adjustments to accommodate this changing population. Issues such as remedial tracking and cultural differences have led to low high school graduate rates for Hispanic students and inequities in schooling experiences (Gay, 2000). Particularly in the area of science, Hispanic students struggle with academic success (Cole & Espinoza, 2008). Despite these obstacles, some Hispanic students are academically successful (Rochin & Mello, 2007; Merisotis & Kee, 2006). This dissertation tells the stories of these Hispanic students who have been successful in science in secondary public schools. This study followed a grounded theory methodology and utilized individual interviews to collect data about Hispanics who have demonstrated achievement in the area of science. Through the analysis of these interviews, factors were identified which may have contributed to the success of these Hispanics in the field of science. Implications for future practice in public schools are also discussed.

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Chapter 1: Introduction

The education of minority students has become an important issue in the field of education. In 2010, the United States Census found that 43% of children in elementary through high school are students of color (U.S. Census). Students in the United States come from a wide variety of cultural and racial backgrounds, and teachers now must be prepared to educate a diverse group of students. Despite this increase in diversity in the United States, this country's educational system has not adequately dealt with the changes it has faced. I have observed that many teachers are unprepared for the diversity of students that they work with each year. In my experience, I have found that the achievement gap has now become a universally acknowledged (almost accepted) part of education. These struggles in secondary education carry over into the workplace, where Latinos face higher rates of unemployment and lower salaries than the majority group (Zambrana, 2011). In college degree programs in areas of science, technology, and engineering, where graduates are more likely to receive higher salaries, Hispanic[1] students are underrepresented (Pew Hispanic Center, 2009). Despite these challenges,

[1]Throughout this paper I will refer to "Hispanic" students, which has commonly encompassed numerous cultural groups, including those whose families originate in one of twenty Spanish-speaking countries. A survey from the Pew Hispanic center found that the majority of respondents from Spanish-speaking countries prefer the term "Hispanic," which will be used throughout this dissertation (Taylor, Lopez, Martinez, & Velasco, 2012).

some Hispanic students achieve academic success—3.3% of Hispanics receive a doctoral degree (Zamrana, 2011). This dissertation was written to focus on these individuals, who achieve success despite significant adversity.

Purpose of the Study

The purpose of this dissertation is to provide a description and analysis of the stories of Hispanic students who are academically successful. Because Hispanics are particularly underrepresented in the areas of science, and most of my career has centered around science education, I have focused my research on success in the area of science. These stories of success were collected and analyzed for themes, with the intent of making recommendations that may help schools better serve the needs of Hispanic students.

Overview. Chapter 1 will provide an introduction and a discussion of the educational significance of this topic. Chapter 2 will provide a literature review which will explore areas of the education system that impact the success of Hispanic students. In particular, factors which have impacted the success of Hispanic students in science will be reviewed. Stories of successful programs will be discussed. Chapter 3 will describe the grounded theory methodology which was used to describe and analyze the experiences of Hispanic men and women who have been academically successful in the field of science. Chapter 4 will present the data collected from interviewing ten men and women, grouped by themes including obstacles, common characteristics, and recommendations. Chapter 5 will present an analysis of the data collected, and a

discussion of factors which may contribute to the academic success of Hispanic students will be discussed. Areas for future research will be proposed.

Personal Interest. I became interested in the field of Hispanic education while I was working in my first teaching job in a southern California district impacted by severe poverty. After six months living in Mexico to learn Spanish, I was interested in trying out the field of education by working in an area that was primarily Hispanic. I arrived in California with no experience and no teaching license, but was quickly hired into a science classroom that had not had a permanent teacher for the first six months of the school year. Most of my students were Hispanic, with over ninety percent of the students receiving free or reduced lunch, and they were impacted by a number of challenges including poverty, a strong gang influence in the neighborhood, and inadequate school facilities. My students were a joy to teach, full of misconceptions, excited to participate in science labs, and to have a "real" teacher, instead of a string of substitutes. Even after I left California, several of my students kept in touch with me and reported on the progress of themselves and their former classmates. Many of my former students dropped out of high school, some were incarcerated, there were numerous teenage pregnancies and stories of gang involvement. However, occasionally a student contacted me who was successful academically. A few graduated from high school, others went on to attend community or four-year colleges. One former student even became a science teacher and accepted a job in his former school district. This led me to wonder why some students are able to achieve academic success despite significant obstacles. What factors

led to their success? Are these factors family based, school based, or individual qualities?

Educational Significance

The public school system in the United States has become significantly more diverse in the past few decades. In 2009, U.S. Department of Education found that 43% of public school students were members of a racial or ethnic minority group, compared to 22% in 1972 (www.census.gov). In particular, Hispanic enrollment has increased significantly—from 6% of the population of American public schools to 19% in the past thirty years. The 2010 Census found that eight million public school children speak Spanish at home (www.census.gov).

Despite the promises of equal access to education, minority students have not fared well in public schools. Statistically, minority students are less likely to graduate from high school and tend to have lower grade point averages (Orfield et al., 2004). When compared with their peers, Hispanic students are less likely to graduate from high school. A report from the Pew Research Center (2010) illustrates the variance in graduation rates between Hispanic and white students (Table 1).

Table 1: Graduation Rate of White and Hispanic Students

Race/ethnicity	**Graduation rate in 2009**
White students	86%
Hispanic students	59%

Data taken from Pew Research Center (2010).

Furthermore, the United States Department of Education found that the grade point averages of Hispanic students who do graduate tend to be significantly lower than members of majority groups (Table 2).

Table 2: Grade Point Averages of White and Hispanic Students

Race/ethnicity	**Grade point averages**
White	3.09
Hispanic	2.84

Data from 2009 High School Transcript study

Upon graduation, fewer Hispanics attend college than either their black, Asian, or white peers (Pew Hispanic Center, 2009). Of the 19.9 percent of the Hispanic population who complete some college, only 12.6 percent actually complete a college degree (Zambrana, 2011). This level of education translates into an occupational status that differs from the majority group, in which approximately one third of the population completes a college degree (U.S. Census, 2010). Hispanic workers are most likely to be employed in the service industries, and are underrepresented in the highest paid occupational categories (Zambrana, 2011).

Hispanic students are also culturally different from the majority group. Hispanic families are often larger—27.5% of Hispanic households consisted of five or more people in the 2010 Census (U.S. Census Bureau). Approximately one third of Hispanic families are impoverished, with 35 percent of Hispanic children under eighteen living in poverty

(U.S. Census, 2010). Hispanic students are more likely to speak Spanish in their homes, which raises the issue of language difficulties when students begin school. Valdes (1996) observed that parental practices and beliefs do not tend to correlate with the kind of practices that researchers have observed to lead to high academic achievement. Hispanic households are more likely to be headed by adults with lower levels of education. More than a quarter (27.3%) of Hispanics had less than a ninth grade education (Thierren & Ramirez, 2001), and only one in ten Hispanics who drop out of high school go on to obtain a General Educational Development (GED) credential (Fry, 2010).

Education is one method for Hispanic to achieve greater job opportunities, but Hispanic students continue to be impacted by inequities in education. The curriculum that Hispanic students are engaged in is different than that of white students. Hispanic students tend to complete advanced high school classes at a lower rate than their peers (Table 3). In 2009, Hispanic graduates were less likely than white graduates to have completed calculus or advanced science courses (High School Transcript study, US Dept. of Education). In fact, thirty-three percent of Hispanic students who were enrolled in high school had completed remedial classes (US Department of Education, 2009).

Table 3: Percentage of Students Completing Advanced Courses

Race/ethnicity	**Students completing advanced courses (%)**
White	14.2
Hispanic	8.1 (significantly different from white students)

Data from 2009 High School Transcript study

Science. In the area of science, Hispanic students are underrepresented in terms of numbers of students completing a college degree in science, technology, or engineering (Zambrana, 2011). Lack of academic rigor in schools with large numbers of Hispanic students has contributed to this underrepresentation (Margolis, 2008). Fewer Hispanic students enroll in advanced placement classes at the high schoool level, resulting in less preparation for college (Merisotis & Kee, 2006; Margolis, 2008). In both math and science, Hispanic students are less likely to achieve grade level proficiency (NAEP Report, 2011).

Achievement gap. In a 2005 report, the secretary of education acknowledged the need to focus on this achievement gap[2]. No Child Left Behind (NCLB) legislation brought issues of inequity to the forefront of educational discourse, and articles have appeared in everything from popular news sources to academic literature. Although there is an almost universal acknowledgement that the achievement gap needs to be a focus of educational reform, there has not been enough focus on how to create systemic change.

Gaps in the Literature

This dissertation will attempt to address some of the gaps in the literature. A review of the literature shows that there are studies of factors which impact the achievement of Hispanic students, however there are few studies that focus on

[2] Throughout this paper, the term "achievement gap" is used to refer to the gap in achievement in American public schools, which appears by income, race, and ethnicity (Johnson, 2002).

academically successful Hispanic students. Fordham (2004) argues that there is a need for researchers to explain the academic performance of successful minority students. In particular the area of science is neglected in the literature. In the few studies that have looked at Hispanic achievement in science, most of the focus is on the college level. This study will address the gap in the literature by focusing on stories of academically successful Hispanic students in the area of science.

Research Questions

The focus of this study will be on several questions:

- What are the stories, including obstacles and successes, of Hispanics who are academically successful in science?
- Do these successful Hispanics have common characteristics?
- Can this information help to create a model that can be used to propose specific changes that can be implemented in K-12 public schools to help students achieve academic success in science?

Overview of study. A grounded theory methodology will be used to provide information about successful Hispanic students. Semi-structured interviews will be conducted to find factors which influenced the success of Hispanic students. These interviews will be analyzed, and the analysis will be used to provide recommendations that may be used to increase the success Hispanic students in the area of science.

Conclusions

This chapter provided an overview of the significance and purpose of this study. From the statistics, it is clear that Hispanic students struggle to succeed in public schools,

particularly in the area of science. This study will address the gaps in the literature by telling the stories of Hispanics who have been successful in science. An analysis of these stories will help to identify factors which may help Hispanic students with academic achievement in science. Chapter 2 will present a review of the literature, including factors which impact Hispanic students in science education and a review of programs which have been successful in promoting Hispanic achievement.

Chapter 2: Literature Review

As stated previously, Hispanic students have historically struggled to be academically successful in public school in the United States. A review of the literature shows that there are several areas which have particularly affected their success. This chapter will focus on several of these issues, including structural arrangements, culture and language issues, and issues related to limited resources. Particular challenges Hispanic students face in the area of science will also be discussed. Despite these obstacles, some Hispanic students succeed, and literature will also be presented describing the successes of a variety of programs.

Structural Arrangements

The organization and structure of public schools in the United States is not designed to meet the needs of minority students. The current organization perpetuates class structures, helping the dominant culture succeed academically and doing little to address the achievement gap. Elmore (2002) suggests that the fundamental structure of schools is not conducive to student learning, which results in the existing achievement gap. This section will discuss the effects of academic tracking, standardized testing, and the lack of culturally responsive teaching.

The effects of academic tracking. Hispanic students are disproportionately represented in remedial classes at the secondary level. Placement in remedial classes affects the curricula to which these students are exposed. Remedial classes tend to emphasize rote learning in an effort to meet testing standards, rather than exposing students to challenging, high interest subject matter (Kozol, 2005). In addition, when

students are tracked into remedial classes, they are more likely to experience lowered standards. Gay (2000) noted that there is significant discrepancy in the quality of instruction that occurs in remedial and high curriculum tracks. The combination of lowered expectations and bland teaching techniques can result in a lowered standard of education for minority students.

Furthermore, once a student begins secondary school in a remedial track, it can be difficult to move into more advanced tracks. Paths that are set in middle school can perpetuate into high school. In fact, remedial tracks can have even further-reaching effects, affecting the college admission of minority students. According to Cooper (2005), school academic tracking policies are a form of racism, which takes students off the path that leads to adequate preparation for college.

Even in advanced classes, teachers may unintentionally discriminate against at-risk students by lowering their expectations of minority students and failing to push students to their full potentials (Conchas, 2006). In particular, minority students have been grossly underrepresented in the area of science. In their observations of science classrooms, Lee and Luykx (2006) found that schools fail to provide equitable learning opportunities for all students in science. The U.S. Department of Education found that minority groups were impacted by poor access to well-prepared teachers due to a national shortage of qualified science teachers and deficiencies in educational resources, such as curriculum standards and technological resources (Mendoza & Johnson, 2000).

Standardized testing. The current mandates of the federal government require states to use standardized testing to assess student learning, which can have a tremendous

impact on schools, affecting school ratings and even bringing about school closures. The results of these tests can have far-reaching effects, such as revising curriculum, placing students into tracks, and even restructuring schools. Educators who support the use of standardized tests cite reasons such as increased accountability and assistance in making curricular decisions. Although increased accountability is important, this current emphasis on standardized testing does not support the needs of minority students.

Historically, Hispanic students have not performed as well on standardized tests as their peer groups (Ladson-Billings, 2006; Contreras, 2005; Singleton & Linton, 2006). Therefore, schools with large populations of minority students are particularly affected by standardized testing policies. Schools with high minority populations have been found to abandon curriculum to emphasize standardized test preparation (Kozol, 2005). This practice can result in a focus on rote learning and an overuse of repetitive teaching techniques in an effort to produce higher scores on standardized state tests. An overemphasis on rote teaching techniques at the expense of curriculum can result in both student disengagement and lack of exposure to grade level curriculum.

According to McNeil (2005), testing is driving down the quality of public education through losses in curriculum and an overemphasis on test preparation. The quality of education is affected when test scores are used as the single indicator of academic success. Valenzuela (2005) asserts that high stakes testing "reduces children's worth to their test scores" (p.4). Although Texas scores on high stakes testing have increased, other indicators, such as college readiness tests and drop out rates, continue to

show a decrease in student performance (McNeil, 2005). These statistcs are alarming and should be considered carefully by both policy makers and by educators.

Culturally responsive teaching. Educators are not trained in affirming racial diversity or in meeting the needs of culturally different students. Howard (1999) documented the struggles of students of color learning in predominately white schools. In particular he noted the challenges students face when teachers are unable to understand minority culture. Conchas (2006) found that racial stereotypes had an influence on how teachers viewed different groups, and more importantly that teacher expectations influenced the students' own experiences of school. Teacher assumptions about intellectual potential affect how they treat their students and interact with them in instructional settings (Gay, 2000). Teacher assumptions about students of color may result in less instructional attention, which produces student disengagement.

Lack of multicultural training for teachers, administrators, and policy makers has significant effects on the curriculum of public school classrooms. The current educational system emphasizes the knowledge and experiences of the majority culture, almost completely excluding minority education from the curriculum (Howard, 1999).

In addition to issues with the curriculum, minority groups are also impacted by a cultural disconnect with teachers who are primarily white and middle class in the United States. The paucity of teachers with direct experience in minority cultures has led to misunderstanding and communication difficulties between educators and learners. Howard (1999) describes the need for teachers to "break out of their cultural isolation and ignorance" (p.14). Minority students need access to teachers who believe in their

abilities, use materials which incorporate multiculturalism, and provide students with rigorous engaging curricula--coupled with support to fully access the material. The aim of all teachers should be to "empower ethnically diverse students through academic success" (Gay, 2000, p.111).

Culture and Language Issues

Culture and language issues also have an impact on Hispanic students. Factors such as socioeconomic status, language issues, and cultural differences impact the achivement of Hispanic students.

Socioeconomic status and achievement. As noted earlier, Hispanic students are more likely to come from homes impacted by poverty. The link between socioeconomic status and student achievement has been discussed in many studies (Sirin, 2005; Valdes, 1996). This relationship has been found to exist in districts with a wide variety of characteristics from varying regions of the United States. In one meta-analysis of 128 school districts gathered from 74 independent samples taken over a decade, a relationship between socioeconomic status and achievement was noted (Sirin, 2005).

In a University of California study (1998), researchers compiled average Scholastic Achievement Test (SAT) scores (a test given to incoming freshman) by parental income level. Researchers found that SAT scores rose significantly as family income increased: scores were lowest when students came from families that earned less than $20,000 per year and were nearly 200 points higher on average when families earned more than $60,000. If SAT scores can be used as a predictor of achievement in

higher education, this suggests that the system of education perpetuates current socioeconomic groups.

It is important to note that the academic performance gap exists both in the inner city and in middle class suburban schools. Ogbu (1990) found that minority students in the inner city have similar academic struggles as students in affluent suburban schools. In a University of California study (1998) SAT scores were also broken down by race within varying income levels. Despite the increase in average SAT scores as family income increased, scores of Hispanic students still remained significantly lower than those of white or Asian students. This suggests that an interplay between socioeconomic status and cultural issues influences test scores.

According to Singleton and Linton (2006), socioeconomic status is a much broader term than merely income levels of families. These ethnographers believe a student's socioeconomic status must include a discussion of their cultural background and racial identity. This issue will be further explored in the following sections of this paper.

Language issues. Language issues have a significant impact on the education of minority students. Half of Hispanic kindergarten students entering public school in the United States speak English as a second language (Galindo & Reardon, 2006). Language issues can affect both comprehension of grade level material and ability to participate effectively in class. Much of the curriculum at the secondary level has advanced vocabulary, which can make the content less accessible to Spanish speakers. When teachers make assumptions about understanding of vocabulary, conceptual understanding

is also affected. In other words, students who are cognitively able to understand material may be hindered by vocabulary issues. There are programs to support English Language Learners (ELL) such as SIOP (Sheltered Instruction Observation Protocol), which uses teaching techniques such as visuals and direct instruction in vocabulary to promote conceptual understanding in content areas. However, most states do not require teachers to be trained in techniques to support ELL students (Short & Echevarria, 2005). Even when general education teachers receive basic training in ESL teaching methods or cross-cultural communication, these teachers rarely receive ongoing support in working with ESL students, which means that techniques they have learned may not become embedded in their instruction.

For Hispanic students who speak English as a second language, language differences can also have an impact on home-school interaction. Even if students are fluent in English, they may receive limited home support if parents are unable to understand academic English. Ethnographers have observed that Hispanic parents work to impart values of hard work and racial pride, but these values are not always carried over to success in the classroom (Caravantes, 2006). In many Hispanic families who have recently arrived in the United States, parents have received little formal education and lack the knowledge or confidence to help their children complete homework. Although researchers have found that Latino parents respect education, they may not understand the cultural expectation in the United States that encourages parent involvement in classrooms and schooling (Menard-Warwick, 2007).

In addition to difficulties in helping their children with academics, the language barrier may result in decreased communication between educators and parents. Some of the breakdown in communication comes from teachers, who may be unsure how to provide support for Latino families, particularly those who don't speak English fluently. At the same time, Latino parents may feel uncomfortable questioning teachers or becoming involved in their child's schooling (Valverde, 2012). When parents become involved, researchers have found that this can contribute to student success (Epstein, 2001; Henderson & Mapp, 2002; Valenzuela & Dornbusch, 1994).

Some studies have observed Latino parent groups, which have organized in order to promote involvement in their children's schooling (Menard-Warwick, 2007). Researchers have observed individual examples of strong links formed between home and school; however, these success stories are not the most common experience for Hispanic students in schools. There are few programs in place in public schools which explicitly work to encourage the interaction between school and home.

Curriculum and culture. In addition to language differences, it is important to consider the link between curriculum and culture. Historically, multicultural instruction has not been a part of the public school curriculum. Although researchers have found that using curriculum which incorporates multiculturalism into instruction increases the achievement of minority groups (Moore et al., 2002), many districts do not employ multicultural curriculum. It is difficult to ask all instructors to modify material to honor the cultural backgrounds of all students in the classroom if they are not given sufficient district support. Moore et al. (2002) noted that students are excluded from instruction by

not seeing their own cultures reflected in the curriculum. This may be evidenced by disengagement from instruction.

Even worse, some teachers feel frustrated by language and cultural differences and utilize rote learning to meet objectives. Kozol (2005) directly observed changes in curriculum in the schools which have a significant population of black and Hispanic children. In urban schools, teachers were "embracing a pedagogy of direct command and absolute control," with little opportunity for creative teaching techniques which might meet the needs of a wider variety of learners (Kozol, 2005, p.10). Hall (1976) notes that people learn better by teaching others and constructing their own knowledge, rather than passively receiving knowledge from a teacher or a professor. Education of at-risk students frequently focuses on rote learning techniques with little opportunity for collaboration or peer tutoring.

Culture and achievement. When the culture of students differs from both that of the majority culture and that of the teacher, educational problems can arise. In this paper, "culture" refers to the language, beliefs, values, and customs that a group shares. Because Latino culture differs from that of the majority group in American public schools, Hispanic students may face additional challenges in school. Ogbu and Simons (1998) assert that the treatment of minorities in both American schools and in general society has led to differences in school performance. Students of color grow up in a world in which they observe differential treatment based on ethnic and cultural differences. Fordham & Ogbu (1986) noted that minority students are cognizant of the white American control of schooling and the reality of job ceilings despite academic

accomplishments. This leads to a distrust of both the public school system and the intentions of educators.

Cultural differences may lead Hispanic students to face challenges in schools. Ethnographic studies have shown that Hispanic families have a high level of respect for education, but parents may not teach the individualistic values necessary for success in American schooling (Menard-Warwick, 2007). The Hispanic culture is a collectivist culture, which conflicts with individualistic values emphasized in classrooms in the United States. Whereas Latino culture emphasizes the success of the group, American classrooms frequently emphasize ranking and peer competition. This cultural difference can result in struggles in the classroom for members of collectivist cultures. In particular, first generation Hispanic students have been found to have high dropout rates (75.3%, Caravantes, 2006). Even with more time in the United States, this graduation rate did not improve significantly—only 49.4% of fourth generation Hispanic students received a high school diploma.

Finally, the cultural capital of Hispanic students may differ from that of students from the majority culture. When students have background experiences that differ from those of the majority culture, this can affect everything from problems with reading comprehension to difficulty understanding instruction. Teachers do not always effectively use techniques, such as visuals and hands-on activities, to help overcome differences in background knowledge. Thus, these cultural differences work as a barrier to the success of minority groups.

School culture. School culture has an important influence on student performance. Academic difficulties among the student population is often linked to cultural elements, such as unpleasant surroundings and low teacher expectations (Kozol, 1992). Schools which appear decrepit, with few resources, are unlikely to encourage scholastic achievement. When teachers embody lowered expectations, rather than challenging students and providing support when needed, the general school climate is not supportive of student achievement.

Furthermore, the culture of a school may promote the idea of academic success as the perogative of white Americans (Fordham & Ogbu, 1986). This can result in disengagement of minority students and a fear of striving for academic success. According to the oppositional social frame of reference, minority students may believe that adopting the frame of reference of the dominant culture (choosing school success in a white dominated society) forces them to give up their cultural identity. Therefore, these groups may choose failure in school in order to maintain cultural integrity (Fordham & Ogbu, 1986). Minority students may choose to diminish their own academic abilities and look for success in areas which are culturally acceptable. The culture of many schools creates educational barriers, in which schools differentiate the academic careers of minority and white students.

Limited Resources

Challenges in funding. In recent years, the federal government has called for greater school accountability through the passage of legislation such as NCLB (No Child Left Behind Act). The government has demanded that all schools show significant

progress and meet state standards. However, the federal government has provided inadequate support to address inequities in funding and resources. Nationwide, "the differential in per pupil spending between districts with the highest numbers of minority children and those with the fewest children of minorities amounts to more than $25,000 for a typical class in elementary school" (Kozol, 2005, p. 60).

In his work published in 2005, Kozol documented visits to sixty public schools over a five-year period. After viewing facilities, meeting teachers, and surveying students, his overall analysis was that the education of minorities in urban schools is inadequate. Kozol found that schools which have a significant population of minority children were lacking basic facilities. He observed classrooms which were not kept clean, textbooks that were out of date, and science labs without the basic equipment to perform experiments. The conditions of some schools were appalling: "lab stations in the science rooms had empty holes were pipes were once attached" and "foul odor filled much of the building because of an overflow of sewage" (Kozol, 2005, p. 7).

Many schools still maintain segregation, with black and Hispanic students isolated by their neighborhoods. Kozol (2005) observed many schools where more than 95 percent of students were black or Hispanic (p. 9). These segregated schools were places where the conditions were the most unacceptable. In a Bronx school, "physical conditions in some buildings had become so dangerous that a principal at one Bronx school…was forced to order that the building's windows not be cleaned because the frames were rotted and glass panes were falling in the street" (Kozol, 2005, p. 43). Spending per student at the time of publication, was $11,700 in New York City schools

as compared to $22,000 per pupil in a wealthy suburban New York district (Kozol, 2005, p. 45).

Schools, which are not adequately funded and not well-maintained, are disheartening at best, and at worst are inadequate for effective instruction. Students who are already at-risk due to ethnicity or socioeconomic status are further impacted by their school environment.

The role of teachers. The teacher provides the "single most important school based factor in student achievement" (Cooper, 2005, p. 27). However, school districts with a significant minority population have more teachers who are not credentialed and are inexperienced, which may lead to a lower quality education for minority students (Mendoza & Johnson, 2000). Mendoza and Johnson (2000) found that in schools where a high percentage of the students were minorities (over 50%), approximately 20% of science teachers were not certified.

In order for teachers to effectively work with minority students, they must provide curriculum that is simultaneously rigorous and accessible. In addition to teaching the curriculum, effective instructors must work to remove institutional barriers that impede success. These objectives can be very challenging for beginning teachers to achieve when they are struggling with management issues and developing new curriculum.

Researchers note that at-risk students are not given equal access to learning opportunities (Moore et al., 2002; Lee & Luykx, 2006). Underachieving students must have access not only to an excellent curriculum, including rigorous courses, and college prep classes, they should also be taught by the "best" teachers (Conchas, 2006). Gay

(2000) found that schools which have an overrepresentation of minority students are often defined by "intellectually dull" classrooms with little opportunity for dialogue or significant engagement. Teachers who are uncertified or inexperienced may struggle too much with discipline to create a learning environment which meets the needs of their diverse students.

One issue may be problems with teacher recruitment. Studies have found that school districts with a large minority population were unable to find adequately prepared teachers, which may impact the classroom experiences of minority students (Mendoza & Johnson, 2000). Experienced teachers have not been given incentives to work in schools which are heavily impacted by diverse groups of students. In his research on urban schools, Kozol (2005) found that a suburban teacher in New York is likely to be paid approximately $30,000 more than a teacher in the Bronx. The salary differential, coupled with challenging working conditions, provides little motivation for experienced teachers to move to urban schools. It is clear that underachieving students should be given access to the best and most experienced teachers, but districts have not taken steps to achieve this objective.

By not providing sufficient supports for diverse groups of students, current class structures are perpetuated. Teachers, parents, and community members will need to be involved for the systemic change to be effective. The federal government can support multicultural education by providing motivation for the "best" teachers to work at schools with the greatest needs.

Limited family resources. The entire upbringing of a middle class child often differs from that of a child with working class parents. For example, "…middle class parents engage in a process of *concerted cultivation*" whereby children are given a sense of entitlement, which encourages them to question adults, leading to an advantage in schools (Lareau, 2003). These children see themselves as equals to adults and are able to question and challenge them, thereby promoting their own learning. Working-class and poor families do not impart these same values to their children, which may have impacts on schooling. Lareau notes that working-class children emerge from childhood with a "sense of distance, distrust, and constraint in their institutional experiences" (Lareau, 2003, p.3).

Students who are members of a lower socioeconomic status (SES) are often not provided with cultural capital such as museum visits, encouragement in self-advocacy, and opportunities to engage in extracurricular experiences (Lareau, 2003). Ethnographers have found that working class children are more likely to engage in free play than in structured experiences (Sharp, 2012). Although this can have advantages, these experiences are not always connected with success in schools.

High quality early childhood education is not always feasible for working-class and poor families. Single parents who are working to support their families may not be able to provide high quality day care or preschool experiences. This can result in students beginning public school with learning deficits, which are often challenging to overcome. Once enrolled in school, attendance rates have been found to be lower for minority students. Families who are struggling financially may rely on older siblings to

act as caregivers to younger children, which may lead to issues surrounding school attendance.

Lack of parent involvement has also been cited as an obstacle to diverse students. Researchers have observed that teachers frequently see Latino families, particularly immigrant families, as being uninvolved in their children's education (Menard-Warwick, 2007). This may be due to lack of communication between schools and families. Ethnographers have found that parents verbally support education in the home, but this support often isn't effectively communicated with teachers (Valdes, 1996). Parents who are uneducated or come from a minority group may be intimidated by the prospect of questioning the professional judgment of teachers. Even when working-class parents want to become more involved in school activities, they may find it difficult to be involved in their children's education due to inflexible work schedules. There are clearly negative consequences for children when schools and families are unable to work collaboratively to promote the success of students.

Challenges in Science

In addition to facing challenges in school, Hispanic students particularly struggle in the area of science. Hispanic students are underrepresented in advanced science classes in secondary schools (Margolis, 2008; Merisotis & Kee, 2006). When Hispanic students attend college, they are both less likely to choose majors in one of the areas of science and less likely to graduate with a degree in science or engineering (Merisotis & Kee, 2006). Of the Bachelor's degrees awarded in science and engineering, 7.3% were

awarded to Latino students, compared to 65% to white non-Hispanic students (Cole & Espinoza, 2008).

Academic rigor. According to the literature, there are a variety of reasons that students struggle in the areas of science. One major area of impact is a lack of rigorous curriculum at the secondary level. Margolis (2008) provided a case study of a magnet school for computer science, which targets Hispanic students. Although this school had access to technology and large number of computers, there was very little evidence of rigorous curriculum. Most of the assignments were rote, and Hispanic students were presented with very few problems requiring creative problem solving, which is necessary for success in computer science classes at the college level (Margolis, 2008). Academic rigor in the secondary level, particularly prior achievement in math has found to be an important indicator in selecting a science major in college (Crisp, Nora, & Taggart, 2009). When students are not exposed to engaging pedagogy at the secondary level, they are unlikely to choose a science or engineering major in college. When students do choose a science, technology, or engineering major, and are not adequately prepared in high school, remedial classes can limit the number of math courses (which are required to obtain a degree in science) students are able to complete during a four year degree (Crisp et al., 2009).

A study of Hispanic students who were successful in completing a degree in science or engineering found that successful graduates were more likely to have a highly rigorous high school curriculum (Rochin & Mello, 2007). High school grade point averages have also been shown to be an effective predictor of academic success in a

science major in college (Cole & Espinoza, 2008). In a similar study, Merisotis and Kee (2006) found that increasing the numbers of college graduates in science depended on elements of high school, such as high quality curricula in science and math and high quality education of secondary teachers. These studies show the importance of creating a high school environment which can help Hispanic students be successful in science classes.

The culture of a school has been found to be very important to the success of Hispanic students in science. Faculty support was listed as one of the most important elements in persisting in science majors in a survey of students who were successful in completing a college degree in science (Cole & Espinoza, 2008). In a survey of Hispanic students who left science majors, these students did not leave because of a lack of ability, but due to differential treatment by faculty and peers (Byars-Winston, Estrada, Howard, Davis, & Zalapa, 2010). Camacho & Lord (2011) support this belief through their research of science and engineering majors, who are found to be the most successful when enrolled in Hispanic Serving Institutions. These programs have high numbers of Hispanic students enrolled and tend to have the support of Hispanic leaders and role models, which has been shown to lead to the success of Hispanic students in science and engineering (Merisotis & Kee, 2006).

Importance of collaboration. Programs which create the opportunity for collaboration have been shown to be effective in promoting the success of Hispanic students in science. At the high school level, one group of researchers reviewed a program that was successful in increasing numbers of Hispanic students to apply to

college in a science major (Zimmerman, Johnson, Wambsgans, & Fuentes, 2011). The program, called Extreme Science, created a community of Hispanic learners engaged in science and engineering-based activities, such as rocketry, robotics, and electronics. Students were motivated to participate by field trips, guest speakers, and extreme science-based activities such as scuba diving. The culture created by this community motivated many of the program participants to select a college major in one of the areas of science (Zimmerman et al., 2011).

After selecting a major in science, Merisotis and Kee (2006) found that retention in science majors increased when collaboration is encouraged. Retention was found to increase through the use of collaborative technology, furniture in classrooms that encourage group work, and programs such as peer tutoring and a science support center.

Supportive programs. At the community college level, researchers found that providing structured support resulted in high retention of degree completion in science for Hispanic students (Kane, Beels, Valeau, & Johnson, 2010). Hispanic students were actively recruited into science programs and were provided with support such as free tutorials, study groups, career counseling, and internships. Scholarships were provided to deal with financial challenges faced by students (Kane et al., 2010).

At Yale, one informal group meets for weekly dinners to support Hipanic students majoring in math and science (Aguirre, 2009). The group named MAS (Math and Science Familias) provides support and regular meetings with Hispanic professionals in various fields of science. Although no formal data has been taken, the goal of the group is to decrease attrition from math and science majors (Aguirre, 2009).

In addition, collaborative classrooms can be effective in maintaining science retention for Hispanic students. Byars-Winston et al. (2010) found that persistence in science majors was correlated strongly with academic self-perception. Students persist in the sciences when they have confidence in their own abilities, which can be encouraged through interactions with other students, including interethnic interactions, which can be encouraged and supported by faculty (Byars-Winston et al., 2010).

It is clear that minority students face a wide variety of problems in public schools. Structurally, schools have not been set up to help students succeed. There is little support for multicultural education, and few opportunities for remediation. Historically, little has been done to address cultural differences between majority groups and Hispanic students. Curriculum tends to focus on the background knowledge and experiences of members of the majority culture, and language difficulties are not being adequately addressed. Finally, resources have not been effectively used to address the challenges faced by Hispanic students. The government does not adequately fund schools with an overrepresentation of minority groups. Schools which have the largest numbers of minority students also have the largest percentage of inexperienced and unlicensed teachers. Although parental support has been shown to be helpful in academic achievement, many families have limited resources to invest in their children's education. In the areas of science, Hispanic students are underrepresented in advanced classes and in college programs. Researchers have shown that this is due to issues such as academic tracking and lack of engaging pedagogy in remedial classes. The first section of this chapter enumerated the problems faced by Hispanic students; however, in my research I

found numerous examples of success stories, which can give hope for change in public education.

Success Stories

Throughout my research, I read a variety of success stories of secondary schools. These are case studies of high performing secondary schools and programs that are predominately Latino, many in areas also impacted by poverty, which are successful in helping Latino students become academically successful (Lucas et al., 1990; Gonzales & Huerta-Macias, 1998; Conchas, 2006; Reyes, Scribner, & Paredes-Scribner, 1999; Caravantes, 2006; Stanton-Salazar, 2001). Although the schools profiled here are in different parts of the United States, in reading the case studies, several themes emerge. The schools studied have commonalities, including a supportive school culture, supportive leadership, and parent and community involvement.

Supportive school culture. Researchers have noted that many of these high performing schools have a school culture that is supportive of the success of all students (Gonzalez & Huerta-Macias, 1998; Lucas et al., 1990; Valenzuela, 1999; Conchas, 2006; Reyes et al., 1999). Cultures of these effective schools place a value on diverse cultures, honor native languages, and encourage collaborative work. These successful schools place a value on both Latino culture and native language. In one case study of a successful Hispanic school, Gonzales and Huerta-Macias (1998) observed that Spanish was spoken by both staff and students throughout the buildings they studied. In classrooms, students were encouraged to participate in small group discussion in Spanish. This contrasts greatly with a more typical school where students are discouraged, or even

prohibited, from speaking languages other than English (Valenzuela, 1999). Likewise, Reyes et al. (1999) noted how linguistic diversity was celebrated in the high school they observed along the Texas-Mexico border. Native cultures and languages are honored through culturally relevant curriculum and a school culture which sees multilingualism as an asset.

The effective schools literature reiterates that both language and culture are valued in successful Latino schools (Lucas, Henze, & Donato, 1990). In fact, one case study profiled a school in which more than half the faculty were trained in ESL instruction (Gonzalez & Huerta-Macias, 1998). Teachers imbedded language instruction within curriculum rather than utilizing a pull-out model, which was effective for academic language acquisition in this high school. The validation of students' languages and cultures can increase student participation, involvement and achievement.

A school culture which encourages collaborative learning has also been shown to be effective in Latino education (Lucas et al., 1990; Conchas, 2006; Reyes et al., 1999.) Latino students at a Medical Academy public high school in California were more likely to be successful when teachers emphasized collaborative work (Conchas, 2006). Students interviewed discussed a school culture of teamwork, and teachers described communities of learners. This culture led to increased graduation rates, increased enrollment in Advanced Placement (AP) science courses, and students felt invested in a college bound culture (Conchas, 2006). When students engage in collaboration, they tended to be academically engaged in challenging work and supported each other through healthy competition (Lucas et al., 1990).

Supportive leadership. In a review of case studies of effective Latino schools, supportive leadership in a school has also been found to be an important element in promoting academic success. Leadership works to provide an environment of pleasant surroundings and excellent teaching. Principals in some of the effective schools studied worked to create equity in physical environments (Gonzalez & Huerta-Macias, 1998). Principals profiled in the study used discretionary funds and grant money to attempt to create a building that is a pleasing place to learn and has facilities to attract excellent teachers (Gonzales & Huerta-Macias, 1998). The principal at one high school gave priority to creating working conditions to attract excellent teachers, by providing sufficient collaborative plan time and perks such as financial assistance to attend conferences. (Gonzales & Huerta-Macias, 1998). Collaborative work between educators has been found to be an influential part of creating culture which supports student achievement (DuFour, 2003).

Teachers in the effective schools literature were found to have high expectations of their students (Lucas et al., 1990). In the eight effective schools profiled, Reyes et al. (1999) found that the teachers' instruction in the schools studied was characterized by interactive instruction, with students both participating actively in instruction and being held responsible for their own learning (Reyes et al., 1999).

Teacher leadership is vital in creating a school which promotes the success of students. Teachers can play a vital part in creating a school culture which provides supportive relationships between teachers and students, creates opportunities for adult learning, and facilitates student achievement (Fullan, 2007). According to Barth (2005)

"the nature of relationships among the adults within a school has a greater influence on the character and quality of that school and on student accomplishment than anything else" (p.8). A school culture that encourages a relationship of cooperation and trust between teachers is likely to carry over this same relationship to students. In schools which struggle with student achievement, reculturing should be at the core of the goals of educational leaders (Thompson, 2006).

In addition to relationships between teachers, school cultures that encourage meaningful connections between teachers and students, particularly relationships with supportive and caring adults, have been found to be important in achieving success in school (Knesting & Waldron, 2006). Teachers are central to the creation of this type of school culture which can support students in achieving success (York-Barr & Duke, 2004). Teachers take on a wide variety of roles, such as improving achievement, addressing assessment, dealing with diverse populations, and creating opportunities for professional development (Drago-Severson, 2007). This puts teachers in an optimal position to provide the catalyst to change a school culture by helping the entire school community work toward systemic change (Ackerman & Mackenzie, 2006).

Parent and community involvement. Finally, the effective schools literature emphasizes the importance of parent and community involvement in schools which support the academic achievement of Latino students (Lucas et al., 1990; Conchas, 2006; Caravantes, 2006; Gonzalez & Huerta-Macias, 1998; Reyes et al., 1999). Parent involvement in school has been found to be positively correlated to academic success in Hispanic students (Valenzuela and Dornbusch, 1994). Parent, community, and student

collaboration is crucial in helping students of all cultures feel accepted and validated. As discussed earlier in this paper, parents of Hispanic students face a variety of challenges in becoming involved in schools, including language barriers, schedules, and cultural barriers. Despite these obstacles, many successful schools profiled had counselor-run programs which encouraged parent involvement (Lucas et al., 1990). Several schools supported parent consultation with teachers by making interpreters readily available. Other schools encouraged parent participation through neighborhood meetings, nighttime ESL classes, and early morning or late afternoon conference times (Lucas et al., 1990). However, due to obstacles in forming groups, teacher or counselor guidance may be necessary to assist Latino parents in becoming involved in their children's education (Lucas et al., 1990; Menard-Warwick, 2007).

Gonzalez and Huerta-Macias (1998) noted the importance of parent involvement in one successful middle school along the U.S.-Mexico border. In this school, all teachers maintain weekly contact with parents in both English and Spanish. Parent volunteers are actively recruited and programs are being implemented to encourage parent involvement in curricular decisions.

Community resources have also been used effectively in some schools to promote the achievement of Hispanic students. One predominately Hispanic high school in California made extensive use of community mentors in their Medical Academy program (Conchas, 2006). Students were matched with mentors who were able to provide paid internships. Researchers found that the combination of rigorous science curriculum and a relevant internship help students with goal formation and increased student retention rates

(Conchas, 2006). Likewise, teachers at one middle school near the U.S.-Mexico border used field trips to provide Hispanic students with experiences that can help them see possibilities and create goals (Gonzalez & Huerta-Macias, 1998).

Connecting classrooms to outside resources can transform instruction by creating a cognitively more complex environment for learning (Moll & Greenberg, 1990). When both students and communities are engaged in learning, oppportunities to fight systemic oppression are created.

Conclusion

Despite the numerous challenges faced by Hispanic students in American public schools, stories of successful schools are encouraging. I entered the teaching profession because I believe that education is empowering and is the key to achieving social justice in our society. From my years in education, I have observed that most teachers are committed to the success of their students and are open to finding methods to help them achieve academically. The next steps are to find those elements which will help students be successful. In the words of Ronald Edmonds, “we can, whenever and wherever we choose, successfully teach all children whose education is of importance to us” (Cooper, 2005, p.27). The following chapter will describes the research that was conducted to help find factors which may promote the achievement of Hispanic students.

Chapter 3: Methodology

A review of the literature has outlined numerous ways that Hispanic students are underserved in K-12 American public schools. There is a significant body of work that points out the problems facing Hispanic students. The literature emphasizes achievement gaps, struggling students, and frustrated teachers. What is lacking in the literature, is research surrounding those students who have been successful; a change in research focus could contribute to long-term solutions.

U.S. Census data shows that there are minority students who are academically successful: sixteen percent of students who complete high school go on to complete a college degree by age 29 ("Educational Attainment," 2012). Despite the struggles they face, 2.7% of Hispanic adults complete a graduate program. (U.S. Census Bureau, 2012). Other individuals go on to be successful in business, industry, or other fields. Taking a proactive approach rather than continuing to focus on the challenges faced by racially diverse students, may provide more opportunities for systemic change. This study took such an approach by telling the stories of Hispanic students who are academically successful, particularly in the area of science.

Purpose of the Study

The purpose of this study was to identify factors which may have contributed to the success of Hispanic students in science in order to suggest changes that can be made to public schools to better serve the needs of this population. In the process of identifying these factors, this study also provided a forum for successful Hispanic students to tell their stories. This information was used to provide recommendations to policy makers.

Research Questions

The focus of this study was on several questions:

- What are the stories of these successful Hispanics and how do they compare?
- Do these successful Hispanics have common characteristics that may have contributed to their academic achievement in science?
- How can this information help to create a model that can be used to propose specific changes that can be implemented in K-12 public schools to help students achieve academic success in science?

Similar Research

There is literature that has looked at similar research questions, but there are significant gaps in the literature that this study attempted to address. Perry, Steele, and Hilliard (2003) present several examples of high schools which have promoted the success of diverse groups of students, however the focus of this study is on African American students, who face different challenges than Latino students. Likewise, Ladson-Billings (2009) provides a case study of teachers who have helped African American students to achieve in public schools. The focus of this study is on teacher qualities which have led to the success of diverse students. As discussed previously, there has also been some work focused on successful Latino students. Several studies have explored programs which have been effective in supporting Hispanic students (Conchas, 2006; Lucas et al., 1990; Reyes et al., 1999; Gonzales & Huerta-Macias, 1998). However, the literature is lacking in research that tells the individual stories of academically successful Latino students, particularly students who have been successful

in science. This study added to the body of knowledge and helped to identify factors that help students succeed in science.

Grounded Theory Research Design

Grounded theory was used to address these research questions. According to Creswell (2002), the use of this methodology can provide an in-depth understanding of an issue. This methodology was chosen because it is effective in telling the stories of Hispanic students, a marginalized group. This method gave a voice to students who are traditionally underserved in science and allowed the researcher to analyze themes that emerged from interviews, with the purpose of proposing changes to public schools.

Grounded theory in other research. Grounded theory has been used to answer similar questions in other research. In the work of Ceballo (2004), the grounded theory methodology was used to study high performing Hispanic students. In this study, the researcher conducted interviews of ten successful first-generations college students who attended a highly competitive university. In this study, the focus was on identifying parental factors which may have influenced the success of the participants. Grounded theory allowed the researcher to use the voices of the participants to identify themes which led to the success of these Hispanic students. Hendricks, Smith, Caplow, and Donaldson (1996) also used grounded theory to look at factors which may have contributed to the success of Hispanic students in higher education. Through the analysis of interviews, the researchers were able to identify themes that may have led Hispanic students to persist in completing undergraduate programs. These studies posed similar research questions to the ones investigated in this study.

Participants. In order to be selected for this study, participants were required to meet a variety of criteria. All participants defined themselves as Hispanic. The Pew Hispanic Center (www.pewhispanic.org), suggests that individuals are defined as Hispanic if they trace their family roots from any one of twenty Spanish-speaking countries, including Latin America and Spain. The U.S. Census Bureau (www.census.gov) uses a more liberal definition and categorizes individuals as Hispanic if they define themselves as such. For purposes of this study, participants self-defined their ethnicity as Hispanic.

All participants were adults who attained a minimum of a bachelor's degree in science and were working or attending graduate school in a field of science. Although I strongly believe that individuals can be successful in a variety of areas, including small business ownership, family life, or other areas, I intended for the focus of this study to be on individuals who have been successful academically in the area of science. All participants also had experiences attending school in the United States.

Recruitment. Participants were recruited from a variety of sources, including membership in the Society of Hispanic Professional Engineers (SHPE), contacts through science curriculum specialists at several local school districts, the Centro Cultural community center in Forest Grove, the Louis Stokes Alliance for Minority Participation (LSAMP) at Portland State University, and contacts established through participants. I attended several events to seek personal introductions to potential participants, and also phoned or emailed contacts. During these personal meetings, I described the purpose of the project and offered participants the opportunity to participate. From these brief

meetings, ten individuals were selected to participate in the interview process. These individuals were selected based on willingness to participate in a thirty-minute interview and meeting the criteria for participation (stated previously). Both men and women were selected for the interview process.

Interview. The interview was designed to provide detailed information about the stories of each participant. This study used a semi-structured interview for data collection, which has been defined as an interview in which the researcher asks a series of predetermined questions in order to explore a theme (Creswell, 2002). Because one goal of this study was to provide a forum for successful students to tell their stories, the use of semi-structured interviews allowed participants to provide detailed personal information.

The work of Conchas (2006) shows the efficacy of the interview technique in gaining knowledge of personal details and in telling the stories of participants. Conchas (2006) studied a population of Hispanic students who were academically successful in an urban California magnet school. Although the researcher used both quantitative and qualitative techniques in his research, he found that student "voices" were vital to his analysis. Thus, the data gathered from one-on-one interviews provided him with more in-depth information about the schooling experiences of study participants (Conchas, 2006).

All interviews were conducted one-on-one in person in order to provide an informal setting and encourage participants to tell their stories. A series of questions was asked of all participants and was used to guide the conversation (see Appendix). This semistructured format was useful in opening a conversation while providing participants

the opportunity to contribute to the discussion. The use of several open-ended questions was designed to provide consistency between the interviews. However, the main emphasis of the interview was to allow participants to have a voice in the study. The questions were specifically designed to be open ended to encourage participants to actively participate in guiding the course of the conversation. A transcript of the interview was provided to each participant, and a follow-up was conducted via phone or email, depending on the preference of the participant, in order to ensure that the participant had an opportunity to add additional information or reflect upon the interview.

Interview Design. Each question is based on a review of the literature that suggests themes that might emerge during the interviews. The appendix provides a full description of the interview instrument. The introductory questions ("Tell me about yourself." and "Tell me about some of your academic successes") were designed to find out details about each participant, including information about jobs, family of origin, and significant academic experiences.

The literature review suggests that there are several main factors that have led to the success of Hispanic students in science. After the introductory questions, the remainder of the questions were designed to explore these topics suggested in a review of the literature including involvement of family members or other significant adults, the role of school culture, and the influence of peers. There were also open-ended questions which allow each participant to add themes or ideas that have not been explored in the literature review.

The literature review showed the importance of the support of family or other adults in achieving success. Following the introductory questions, the next questions in the interview ("Was your family supportive of your academic successes?" and "Were there other adults who encouraged you to be successful at school?") were designed to elicit information about the involvement of family members or other adults. Participants were encouraged to provide detailed information about the involvment of family members or other adults by asking for specific details about role models, relationships with teachers, involvement in school functions, and the role of family members in homework and school projects.

As discussed previously in the literature review, school culture has been found to influence the success of Hispanic students. The next questions ("Do you feel like your school had a culture that supported the success of all students?" and "Were there programs or classes, such as IB, AP or academic support classes, that supported your success?" and "How did your school motivate students?") were designed to find out about the culture of the school the participant attended. Information about school programs and curriclum were used to look for a link between success and the culture of a school.

The next section of interview questions ("Were your friends supportive of your success?" and "Did you often work on homework or school projects with friends?)" focused on the influence of peers, which the literature review suggests may be a significant factor in promoting Hispanic student success. This series of questions was designed to provide information about the role that friends or peer groups play in

individual success, including the role of peers in homework, in the selection of advanced classes, and in the participation in college track classes.

Finally, the last section of the interview provides open-ended questions ("What were the major obstacles you faced during your schooling?" and "What would you tell teachers and school administrators about things that can help Hispanic students succeed?"). These questions were designed to provide participants an opportunity to comment on any aspect of their schooling that was significant, which allowed participants to add information to what was found in the literature review.

Each interview lasted approximately thirty minutes, and all interviews were audio taped and transcribed. The interviewer also took brief notes after all interviews to record impressions or note important body language. The interviews continued until saturation of data occured, which was the point at which new data no longer contributed new information to the problem studied (Glaser & Strauss, 1967).

Analysis of data. Interviews were transcribed and analyzed immediately after each interview to allow for the development of categories during the research process. Each participant was assigned a pseudonym which was used throughout the research process. Open coding was used for the initial data analysis, with codes applied to each sentence (Gibbs, 2012).

Memos were written after coding each interview to identify important themes (categories) that emerged from the data (Strauss & Corbin, 1990). Interviews were listened to a minimum of three times and were transcribed by the researcher. During the listening and transcription process, notes were written to observe voice inflection, to

observe patterns in the codes, and to find major themes which emerged. All notes and codes were analyzed to find categories (Strauss & Corbin, 1990).

The categories were used in two ways. Several major categories served to discuss the obstacles faced by the participants. The remaining categories were used to create a theory to explain factors which may have contributed to the academic success of the participants. Quotes taken from the interviews served to support the development of this theory. This theory led to a discussion of recommendations for schools which can be used to inform future practice.

Reliability and Validity. The development of the interview instrument (see Appendix) was vital in increasing the validity of this study. All questions were developed with the intention of exploring themes which emerged during the literature review. Questions were designed to encourage participants to talk about each of these areas, but were open-ended enough to allow interviewees to introduce new ideas.

This study follows the strategy of Krefting (1991), which suggests the use of dense descriptions of both the context and participants so that readers may determine applicability of the study. The results section includes extensive excerpts from the interviews to allow the reader to directly observe the data.

Internal consistency reliability was used in this study to increase reliability (Creswell, 2002). The questions were designed to discuss the same topic at different times within the interview to establish consistency of response (Krefting, 1991). Furthermore, participants were sent a transcript of the interview and given the opportunity to add to or further reflect upon answers, which created more reliability in

this study. Finally, interviews were conducted until a pattern of response was observed to assure that major themes were identified in this study.

Bias. According to Creswell (2002), many researchers both recognize their own biases and use them as an asset in their research. Since I have been a classroom teacher for twelve years, with about half of those working with impoverished Hispanic students, I have clear biases and opinions. This study will look at the stories of academically successful Hispanic students through the eyes of a teacher who has been personally and professionally involved with this population for most of my career. Through my work as a teacher, and my work as a part of several professional learning communities, I have been a continual advocate for institutional change that will benefit the needs of Hispanic students. Thus, this inherent bias was beneficial in creating a study which identified a theory that may lead to change.

Conclusion

This chapter summarized the methodology that was used to add to the knowledge about Hispanic achievement in science and to fill in some gaps in the current literature. The interviews of academically successful Hispanics provided both a forum for these students to tell their stories and provided data which was analyzed to create recommendations for schools. The following chapter will present the results of the interviews, grouped by major themes. Both obstacles to achievement and commonalities of successful Hispanics will be discussed.

Chapter 4: Results

The purpose of this study was to collect the stories of Hispanics who have been successful in science and to see how they compare. An additional goal of the study was to look for common characteristics between participants to find patterns in disposition or environment that may have contributed to their success. Finally, the study aimed to propose specific changes that can be implemented in K-12 public schools to help students achieve academic success in science. Grounded theory was used in this study—interviews were coded and codes were grouped to find common themes. The results in this section are grouped by the themes that emerged from the coding process.

This section will begin with a brief introduction to the participants, followed by a discussion of the obstacles they faced during their academic careers. The next section will look at common characteristics between participants that may have contributed to their academic success. The final section will include a description of participants' recommendations to other Hispanic students, including their own children, and to school systems.

The participants

In this study, four women and six men were interviewed. The participants were all working in or were graduate students in a field of STEM. Two worked in computer science, three in biological sciences, three in science education (with a major in science), and one in statistics. The participants ranged in age from mid twenties to mid fifties. All participants currently live in the Portland Metropolitan area, and attended secondary school in Oregon, California or in their country of origin. Five of the participants,

Isabella, Matias, José, Martin, and Santiago were born in Mexico. Four of the participants, Daniel, Gabriela, Valentina, and David were born in the United States, with family of origin from Mexico, Puerto Rico, or El Salvador, and one participant, Olga, was born in South America. Four of the participants had at least one parent who attended some college. Of the remaining six participants, parents only completed part of elementary school. Characteristics of participants are summarized in Table 4 below.

Table 4: Characteristics of Participants

Participant	Country of origin	Education level
Olga	Venezuela	Master's degree
Valentina	Mexico	Bachelor's degree
Gabriela	El Salvador	Bachelor's degree (two)
Daniel	Puerto Rico	Master's degree
Isabella	Mexico	Master's degree
David	Mexico	Doctoral candidate
José	Mexico	Master's degree (two)
Martin	Mexico	Bachelor's degree
Santiago	Guatemala	Bachelor's degree
Matias	Mexico	Master's degree

Olga is originally from Venezuela, but has been living in the United States since she was in her late teens, when her family left their home country for political reasons. Olga was one of five girls, and she described her family as poor, although her father was

college educated as an engineer. Olga received her degree in engineering and is married with adult children. Valentina's family originated from Michoacan, Mexico—her parents are both migrant workers, who never finished elementary school. She has three children of her own, and has completed a degree in biology with aspirations of attending dental school. Gabriela has degrees in both speech and hearing science and computer science and is the only member of her family to attend college. Her parents left El Salvador because of the civil war, leaving Gabriela's two brothers behind with family. Both her parents currently work in factories in eastern Oregon and speak very little English. Daniel's family came from Puerto Rico and discouraged him from speaking Spanish at home because his father wanted him to be a "full blooded American." Daniel has a degree in environmental science and has also worked as a pilot and a science teacher at a school with a large number of Hispanic students. He has raised his own daughter to be bilingual.

Isabella moved to the United States from a large city in northern Mexico. After completing school she briefly moved back to Mexico to work as a biologist, but returned to the U.S. after facing many obstacles as a woman doing field work. Although her parents never completed elementary school, they pushed all of their children toward academic success, and all of Isabella's eight siblings have completed at least some college. David's family originiated in Mexico, although he grew up in southern California. His mother only completed third grade but encouraged David to attend college. He is currently pursuing his doctorate at University of Washington in molecular biology.

José's mother moved from Mexico to Oregon alone with her two sons when José was twelve. No one in the family spoke English when they arrived. José is currently finishing his second masters degree and also works at a center that supports minority students majoring in an area of STEM. Martin has already finished a degree in science, but he has aspirations of applying to medical school. He is currently working at a research lab and at his family's restaurant while he waits for his younger brother to be old enough to take over the family business.

Santiago's family moved from Guatemala to Miami and then took a Greyhound bus to Portland. His father abandoned the family after their arrival and his mother had to work long hours. Santiago had only attended school for two years in Guatemala, and he was placed in a third grade class even though he was twelve. Outside of school, he taught himself independently by reading encyclopedias in a local library. His skills as a placekicker got him a spot at a university and he pursued a degree in computer science. Matias attended high school close to the U.S.-Mexico border, where many of his classmates crossed the border daily from Tijuana to attend school. A recommendation from a teacher led him to attend Gonzaga University and pursue a degree in science.

The participants had many differences, including varying countries of origin and widely varying educational experiences. Despite the differences in the background stories of these individuals, some common themes emerged. These common themes, including obstacles, common characteristics, and recommendations from participants are summarized in Table 5 below and will be discuss in the following section.

Table 5: Major Themes that Emerged in the Interviews

Main themes	Subthemes
Obstacles	Family responsibilities Parent involvement Language Lack of school support
Common characteristics	Supportive adult relationship Family support Significant event Persistence Peer support
Recommendations	Engagement in science Supportive schools Connections Family involvement

Experiences of the participants: Success despite obstacles

The literature emphasizes the struggles that Hispanic students face to succeed in school. The participants in this study also faced significant obstacles in completing a degree, but they succeeded despite these challenges. In some cases, the challenges they faced were what motivated them to succeed. José talked about a 3000 mile trip from a small town near Guanajuato, Mexico to Hermiston Oregon. His mother traveled alone with two children, and this experience served to motivate him. In his words, "we put our lives at risk--I had to make it worth it." Most of the participants had parents who spoke no (or little) English, some parents had not completed elementary school, and most were not able to help with homework or school assignments. Many of the families were impoverished and some participants had responsibilities for helping with siblings, maintaining the house, or helping with the family business. One focus of this study was to tell the stories of the participants—an important part of their stories is the obstacles

they faced. The following section will focus on some of the challenges the participants struggled with, including family responsibilities, less parent involvement in school, language difficulties, and lack of school supports.

Family responsibilities. Participants talked about the importance of family in Hispanic culture. Although many participants found the support of their family played a role in helping them to be successful, family responsibilities were an obstacle to success for some. Martin talked about cultural differences: "my culture is collective. You know—family. Family. We're always thinking that way…" This emphasis on family created some challenges for Martin due to responsibilities at home. Martin was helping to run a family business—a restaurant into which the family had invested all of its resources. He worked at the restaurant after school until closing and then started homework, often working until one or two in the morning. He elected to take a number of advanced placement classes, which involved numerous hours of homework outside of school. By the end of sophomore year, he was so exhausted that he often slept through his early morning classes and began learning the material on his own at home and only attending on quiz or test days. Non-attendance led to Saturday school, which was a further impact on his time. His family encouraged him to cut back on work, but

> " it's the family business, we invested everything we had. I can't cut back. My family is my number one no matter what. If they go down, I go down. They are my priority and my brothers depended on me and my parents did, and we all depended on each other."

The balance between family responsibilites and time spent on school was a constant struggle for Martin.

Family responsibilities also took away from time spent on school for some of the other participants. Santiago's parents divorced while he was still young, and he was "pretty much left to be the man of the house. I had to learn to be a plumber. I had to learn to remodel. I had a lot of responsibilities." School wasn't seen as important in his family. "Where we grew up school just wasn't important. In Guatemala, if you got done with 6th grade it was time to go to work." Olga teaches science at a school with a large number of Hispanic students, which gives her a unique insight into the academic struggles of Hispanics. She described many of her students falling asleep in class because they worked until two o'clock in the morning to help financially support their families. They missed tutoring sessions because they are responsible for picking up younger siblings after school. Martin had "two younger brothers and I had to watch them…they always asked for help with homework and I always wanted to help."

Although family responsibility was an obstacle for many participants, in some cases, it provided a motivation for the participants to succeed in school. Gabriela talked about the family responsibility of gaining a career—"I know everyone's looking at me to provide." For Gabriela, a career means the ability to support not only herself, but her parents and her brothers and their families too. José, too, saw the importance of providing for his family. Even while attending graduate school away from home, José uses a portion of his monthly scholarships to send home money to his mother. He sees education as the key to providing for his family: "…if there's a way to lift my family out of these circumstances, it's through education. Really there's no other way." Family responsibility was both an impediment and an asset to the participants of this study.

Parent involvement. Another obstacle cited by eight of the partcipants was that their parents were less likely to be involved in their schooling. Matias observed that his parents were not as involved in academics, such as helping with homework. He felt that the language issue was a challenge for them as well as cultural differences—he noted that his parents would not have felt comfortable questioning a teacher. Daniel agreed: "culturally there was a big importance on education, but there is this…kind of philosophy that the teacher knows all, and listen to your teacher…" Isabella, a high school teacher, tries to explain why Hispanic parents do not always attend school conferences:

> "in my culture, we respect teachers, and we trust what teachers do. It's very hard for a parent to come and ask or argue because you know what you're doing…they feel intimidated…it's not easy to go to a system that you don't understand and you don't know anything about."

Six of the participants' parents did not complete elementary school, and school is an institution with which they are not familiar. Even if they felt comfortable attending school events, they were often unable to help their children with school work, due to a combination of language barriers and lack of knowledge. Referring to homework help, participants said things such as "there was no way my mom and dad could help me" and "I don't know how much she remembered," and "they didn't do too much schooling themselves."

Valentina discussed the differences in parent involvement in the home. "Kids in our culture, in my home, kids have their world and adults have their world. We're not like, oh babe, come look and see what I'm doing. It wasn't like we got to learn from our parents. We were very kid-ish until we went to school. I think we lacked a lot of exposure." Valentina observed that Hispanics are not encouraged to ask questions of

adults, which led to some challenges in school. Finding lab partners, joining study groups and asking questions of instructors was challenging for her.

Martin talked about completing homework alone because his family couldn't help: "there's no one that knows anything about the science I'm going into, so it was all by myself. It was my own thing." Daniel agreed that many of the Hispanic families he worked with were unable to help with homework: "they really want to support their kids, but they're working so hard to put food on the table… they really don't know how to help their kids with math."

Four of the participants noted that their parents attempted to attend extracurricular events or school functions, but others observed that their parents were intimidated by the language differences. The support of interpreters varied depending on the age and geographic location of the participants—those who attended school in southern California had interpreters available at conferences. Older participants never had interpreters available, and those who went to school in the Pacific Northwest reported mixed availability of interpreters. Only a few of the participants participated in extracurricular activities--several of the participants played sports, one was in band, and all reported at least some parent attendance at these after school activities.

One participant, Santiago, had a different experience than the other participants when it came to school. Santiago's family felt that work was more important than school: "school just wasn't that important—in Guatemala if you got done with sixth grade, it was time to go to work." School was always seen as secondary to work--his mother did not attend his graduation because she was working. In his culture,

> "people who go to college, they are just lucky. They are rich—as long as you have enough money to survive, that's good. My parents took every opportunity to work. To make money. They would take two or three jobs because the work is there."

Many parents of the participants were unable to help their children with school due to language differences or lack of academic knowledge, but they still found other ways to support their children to achieve academically. Support from families will be discussed in a later section of this paper.

Language. Language was a significant obstacle for eight of the participants. The parents of many of the participants spoke little or no English, so the majority of participants primarily spoke Spanish at home. Several participants noted that they continued to learn English long after high school— José says he is "still learning words every day" and Santiago did not consider himself fluent until he took speech classes in college.

Santiago came to the United States in the 1970's and spoke Spanish exclusively when he arrived here at age twelve. The school system did not offer language support classes, and he did not consider himself to be fluent until college. Language was frequently an obstacle for him in completing assignments. Likewise, Isabella talked about her struggles completing assignments in English: "I hated it because it took me an hour and a half to read a stupid chapter, which in Spanish it would have taken me half an hour and I would have been done." Likewise, Valentina was "slowed down…already the class is going fast" and the language made it much more difficult. She found that the language differences required her to read chapters two or three times to understand them.

Olga says "it was hard to study, it took hours." Time spent on school assignments and homework was a frequent theme in the interviews.

In addition to the language struggles, two of the participants discussed the difficulty in missing instruction in secondary school to attend ESL classes. Martin says "it almost felt like a segregation of sorts…you would skip your normal classes for ESL and then you had to make up for it." José was transported from his normal middle school for half the school day to attend English classes at a high school, because his middle school did not offer any ESL support programs. Missed instruction added to the difficulty of completing assignments in another language.

Lack of school support. For six of the participants, school systems were not supportive of their success, particularly when it came to pursuing higher education and in providing academic rigor. Martin, in particular, really struggled with a system which wasn't supportive to him. As described earlier, Martin worked long hours at his family's restaurant leaving little time for sleep. Martin felt like there was no leniency in the school's policies—"I just had to fit the cookie cutter model of a student."

Valentina felt unsupported by her school when it came time to apply to college: "They just kept telling me graduate. They made it seem like it was the end of the road." She never had a counselor meet with her, and none of her friends were college bound. Neither of her parents finished more than elementary school, so they were unaware of how to go about applying to college. She talked about receiving her college acceptance and scholarship offer: "I remember when I got my award letter and we were

confused…that was hard for us to read the letter and understand what was happening," and the school counseling department provided no assistance.

Gabriela also felt unsupported by her counselor, who was involved in college planning with her until she made the decision to attend community college. After making this decision, she felt that her counselor was no longer supportive and did not provide any help with the application process. David barely knew his counselor, and met with him when he was close to graduation: "he was like, 'oh wow you're actually gonna graduate.'" David is now a doctoral candidate in molecular biology at the University of Washington; he felt like this interaction may be typical of the treatment of Hispanics in high schools, regardless of their abilities. He noted that education related to college applications "was kind of an elitist thing;" there was more support in the advanced classes. David took a mix of advanced and more basic classes and noticed that "the lower end classes had teachers who didn't want to be there." Likewise, at Santiago's high school there was differential treatment of students, "I never heard anybody talk about college. If you were a really good student they would focus on you. If you weren't a good student, you're on your own."

The level of support was different for two of the participants who attended some high school outside of the United States. Both Isabella and Olga, who attended some high school in Mexico and Venezuela, respectively, felt supported by their schools in being prepared for college. They noted that in their countries, high schools are used as preparation for college, so all of their peers were college-bound. In this type of setting both women said that it was expected that they attend college—in Isabella's words,

"Everyone I knew had a plan to go to college. It wasn't like you were doing something different. That's what everybody does."

José also experienced some support from his school. He received little education about colleges from his high school counselors, "it was definitely me taking the initiative," but there was an academic support class that gave him support in filling out applications, applying for scholarships, and revising college essays. While attending community college, one college program involved transporting students to visit university campuses, which is what ultimately led him to Portland State University. Matias had similar programs at his school, in which students were selected to attend presentations from various college representatives. Counselors met with students regularly and university visits were also set up for students. He felt that the school set up a culture "where there was a big emphasis on where you are going to college." And this system seemed to work, because most students were college-bound. However, he noted that he attended a private Catholic high school, and it was common for Catholic universities to recruit actively from these types of schools and for students to be encouraged to attend college.

Four of the participants observed discrimination in schools. Olga, a high school teacher, observed differential treatment of Hispanic students by security officers in her building: "for instance, they say Ms. L., I neeed to go to the bathroom. I say, take a pass. An American says I need to go. I say take a pass, they say I don't need a pass beause they never stop me. But they stop the Latinos." Olga was also surprised by the

differences in curriculum when she was transferred from a school with a small minority population to a school with a greater number of Hispanics.

> "When I came over here, the first thing that shocked me was—oh don't worry about it with this population. Because I was worried I needed to teach this before they learn that. And they go, oh, they don't need to know that. This population. And I go, what do you mean this population? This population needs to be taught. They need the people that push them. I told them you're going to hate me, but I don't care. I don't come over here for love. I have love in my house. I come over here to teach you. Maybe one day you're going to realize the reason I'm pushing you is that I want you to at least have the chance and the choice to go to college if you want to. You don't have to, but you have the choice."

Olga noted that many teachers developed strong relationships with their Hispanic students, but many of her students still talked with her about a sense of exclusion and discrimination. Valentina observed the differential treatment of Hispanics in her school district. She described the setting of the district boundaries so that all children of migrant workers, who were predominately Hispanic, attended one middle school and the children of the farmers attended a different middle school. Valentina observed that differences in middle school curriculum became clear when the students all attended the same high school, and the Hispanic students were much less prepared. David also described a feeling of discrimination when he met with his counselor who expressed surprise that he was going to graduate despite the fact that he was a strong student.

Isabella, another science educator, felt this same sense of discrimination in her school, both from the students and as a staff member. She "was the science teacher with an accent." A colleague once asked her "'Do you know math?' He said, 'I mean in English.' I was like, what? After a while, I was like it reflects on you, not on me."

Santiago described his lack of preparedness for standardized testing as one barrier to college admission. “It was unfair. Some of the stories I couldn’t relate to. I’d be reading the stories, and I wouldn’t even know what I’d be reading about.”

The participants experienced a number of common obstacles, including family responsiblities, language obstacles, and lack of school support. However, they also had some common characterisitics, which may have contributed to their academic success.

Common characteristics that led to success

A number of themes emerged from the interviews, showing that the participants had some common characteristics that may have contributed to their success. Most of the participants had several commonalities, including a relationship with an adult who helped them to succeed, the support of their families, and a significant event that pushed them toward academic success. Participants also demonstrated persistence and resilience; most overcame significant challenges to succeed academically. Participants varied in support from peers: many of them worked on school and homework independently, while others relied on peers for translation help and motivation to succeed.

Significant adult relationship. One significant experience that was prevalent throughout the interviews, was an interaction with an adult who helped with academic success. Every participant named an adult who was helpful in pushing them toward success, including teachers and relatives.

Two of the participants described a connection with an elementary teacher, who motivated them to succeed. Santiago described his fifth grade teacher:

> “…my favorite teacher. He was the one that motivated me…just a very good teacher. Listened. Would take the time even after school, when the kids would

> leave, he would sit and be in no hurry to go home. Felt like somebody was interested in my learning…he would come to me and say there is a book club thing, or a competition, I'd like you to join that."

Martin also made a connection with his fifth grade teacher: "I signed a contract with her to keep her updated. I told her I was going to graduate and go into the medical field…"

One of David's high school teachers pushed him to choose a four year univeristy. He was considering attending a community college and then his literature teacher encouraged him to consider University of California at Santa Cruz. David credits this teacher as the main influence on him choosing to attend college there. One of the reasons Matias was pushed toward science because of his physics teacher, who was also his golf coach. In addition to his teacher, Matias was supported by various family members in trying careers in the sciences. An uncle was a doctor, who introduced him to lab skills

Each of the four women cited one of their parents as an adult who had a significant influence on her academic success. For three of the women, their father was their main influence on them attending college. In Olga's words,

> "my dad said if you don't want to go clean toilets, you go to school. If you don't want to be dependent on a man, you need to go to school…we were five girls and the five of us went to college. It was not an option."

Olga says she learned from early on that the way out of poverty was through education. Isabella's father was also a significant influence on her.

> "I was raised to be tough…my dad was like, especially you, the females, you have to have an education. You have to learn how to support yourself because you don't want to depend on a guy. And when your dad tells you that, it's like you really hear it."

Valentina's father saw the importance of school, even though he had not finished elementary school. "My parents are some of the smartest people…even though they

didn't go to school." She noted that her father saw the importance of education and worked harder so that she could have the time to devote to homework and studying. School work came before family responsibilities. Her father helped her to access outside help with aspects of school with which she was not familiar. Her father wanted to support her desire to attend college and found a work colleague to help the family fill out college and scholarship applications.

For Gabriela, the main influence was on her success was her mother. She discussed the influence of her mother, who were "really adamant that I was going to go to college. Particularly because she saw what was happening in their country because of the main population's lack of education. So she said our children, particularly our daughter, is not going to be like that." She also described some significant relationships with "phenomenal" teachers, who counseled her on which courses might be helpful for college. Their advice replaced help from the counselor, "who wasn't fantastic in almost any sense of the word." In particular one high school teacher helped her join a program to take college courses during high school. The experience of taking a college class, even one that was mostly online, helped push her to consider college.

Like Gabriela, José was influenced by his parents, particularly his mother. He felt that his mother was the driving influence that pushed him to succeed. Her tenacity in crossing the border and traveling with two children alone to Oregon motivated him to improve his situation through education. Furthermore, his mother's help with math fundamentals, while she simultaneously managed a store, helped him to build the foundation he needed to succeed.

Family support. Nine of the participants received significant support from their families that helped them to succeed. Isabella's parents worked hard to allow her to focus solely on school, despite the fact that her family was impoverished: " it was just that's your job…you don't do anything else but taking care of school…I had my first job when I was twenty something." David's family provided the same kind of financial support so that he could focus on school: "I did have a few jobs, but nothing that contributed too much. My job was to study a lot and basically do well." Valentina talked about how "open-minded" her parents were by giving her the time to focus on education rather than pushing her to work or to meet family responsibilities such as helping with siblings.

Not all of the families were able to provide financial or academic support, but many of the participants received significant emotional encouragement from their families to achieve academically. Gabriela's family was unable to help with academics or to support her financially to attend college, but her family provided her with emotional support and encouragement and became a "really good support system" that encouraged her to pursue higher education. They were "always really adamant about school…the moral support was gonna be there which was very important." Likewise, Valentina's parents had little formal education, but they encouraged Valentina to find other places to seek assistance with academic work. Her father was a migrant recruiter for a local school district and asked work colleagues for help until he found someone to assist his daughter with college applications.

Her family provided logistical support by helping to take care of her young children while she attended classes. Both Olga and Daniel had parents who talked to them extensively about the importance of academic success. José and Martin both discussed the importance of their parents as role models, who taught them the value of hard work.

Only Santiago felt unsupported by his family—his family valued work over education and had a difficult time seeing the link between education and success. Santiago observed that this was a common attitude in Guatemalan culture in his generation.

Significant event. Half of the participants had a significant event that pushed them in the direction of academic success. These events ranged from large life changes, such as the death of a parent to a simple event such as a teacher or adult giving advice. The participants noted that these events changed their trajectory and motivated them to succeed academically.

Santiago recounted an event that pushed him toward success:

> "I think one thing that really stuck in my mind, that probably changed a lot of where I've gotten today…my uncle would come over…to visit my mom. And he asked how's your family, and when it came to my name, he said 'I don't think he's going to turn out to do anything.' I was just in the kitchen, he was in the living room. That just burned me. It got to me. It kind of drove me. To prove that. And you know how it is. Somebody says something and you know it's not right, you feel like you can disprove it."

Isabella had a similar experience. She was working as an assistant at the welcome center, and she was thinking about getting a masters in science. Talking this over with her boss, her boss said "'Are you sure? It's going to be hard.' And between the lines she

was saying it's going to be too hard for you. So, I said watch me. And a month later, I had a scholarship to Pacific and one to PSU." Isabella felt that this interaction pushed her in the direction of academic success.

David said that he was not a great student in high school; he described himself as "lazy" and "didn't want to do anything." His family did not have the money to pay for college, so he was considering a local community college. However, toward the end of his senior year, his father passed away and his family collected the life insurance. His mother and brother decided to use the life insurance money to cover David's education. Suddenly resources were available that could support him in attending college. This investment in his education gave him the resources and the motivation to apply to a highly competitive four year university.

Valentina was motivated to major in science by an episode that happened when she was a young child. She remembers her mom being sick:

> "She had a toothache. And when my mom got sick it affected the whole family. I remember I would tell her, mom just go to the dentist…and she's like 'I can't. There's nowhere I can go. And we don't have money.' And since then I was like, I'm gonna be a dentist. And I'm going to see whoever needs me."

Valentina chose a biology major in college as a path to apply to dental school. In listening to the interviews, participants described these experiences vividly and with emotion; each experience had obviously been an important life event.

Persistence. All of the participants faced significant challenges, including speaking English as a second language, many of them coming from impoverished families, and some having parents who never completed elementary school. The

participants were persistent in pursuing academic success even when faced with significant obstacles. As one participant put it, success is "about persevering…getting back up when you hit the ground."

Seven of the participants categorized themselves as average students. Santiago insisted repeatedly that he was an average student, who simply took advantage of every opportunity that presented itself. When he started working he wanted to be in charge of administering all of the department's computers, but he lacked the appropriate certification. His company was unwilling to pay for him to take the necessary exams, so he paid seven hundred dollars of his own money to take the certification tests and studied all year independently. He recounted how his persistence led to the job he currently has, once he finished his certification: "I was in this room, with really important people from Microsoft and I thinking I can't believe I'm sitting here in front of all these important people. And it's because I'm sticking my neck out. Working hard."

Gabriela summarized her experience in school eloquently, "It's not about being a smart student or being a particularly strong student…if you want it and if you can take the punches, that's all it is." When she was not initally accepted to the graduate program she wanted, she found a different program and enrolled in classes immediately. Likewise, Olga and David both described themselves as average students, who were successful in school because they persevered. Matias noted that he had to work harder than other students because he was still learning English.

Isabella categorized herself as a strong student while attending school in Mexico, but she struggled more here due to language differences. It took her significantly more

time to complete reading in English, which meant that she spent far more time studying. Persistence kept her in school despite her difficulties.

When Valentina arrived at college, she realized that her high school had not adequately prepared her for college level work, despite finishing high school with a high GPA.

> "They tested me and I tested below high school. So I had to start all over. I gave up my scholarship before I even lost it. I knew I was going to lose it. I don't have the skills, I don't have the ability. I'm wasting their money, my time. So I went to [a community college] and slowly started building my skills to the college level."

Despite testing so low, Valentina persisted in finding a way to reach her goals, even though college took her much more time to complete than an average student.

Martin struggled with attendance at school due to working late at night at his family's restaurant. When it finally became clear that he would struggle to graduate, he looked for another path: "I started to seek alternatives…I didn't feel like they were going to support me." Through his own research he found a way to finish high school while taking classes through his local community college. He took the maximum credits allowed and was able to finish high school and his associates degree simultaneously. Rather than giving up, Martin persisted in finding a way to meet his family's need to have his help with their business while still achieving his academic goals.

Nine of the participants cited the need to use education to improve their circumstances as the reason to persist in school despite significant challenges. In most cases, they thought of education as a way out of poverty, although some participants felt like education led to independence. In Olga's words, "my family was poor, the only way

out of poverty was through education." José had the same experience: "if there's a way to lift my family out of these circumstances, it's through education. Really there's no other way." Gabriela cited the pressure she feels to use her education to help her whole family, including her parents and brothers: "…it's a bit of pressure, because I know everyone's looking at me to provide."

Santiago was also motivated by the desire to improve his circumstances. He was highly motivated to take advantage of all the opportunities provided to him by public school. When he arrived in the United States, he had spent the previous two years out of school, so he saw school as an opportunity to improve his circumstances: "I remember the struggles that everyone was having [in Guatemala]. I used every opportunity, because when you grow up poor, you get any opportunity, you make the best of it."

As mentioned earlier, Olga and Isabella were both motivated by the desire to be independent women. Both of their fathers pushed them both to become educated so that they would never have to be "dependent on a man" For Isabella, her father pushed his daughters more than his sons, telling them "especially you, the females you have to have an education." This need for independence motivated both of them to be successful in school.

Peer support. Most of the participants did not receive significant academic support from their peers, but many were supported through translation help. Most of the participants talked about working on homework and class work independently, although they did receive translation help from peers. José "was one of those students who did stuff on my own," but his peers gave him translation support. José attended a school

where there were a significant number of Hispanic students, and he relied on them to translate assignments or directions from teachers. Matias came to high school in the United States speaking very little English, and his private school did not offer any classes in English as a second language. Getting translation help from peers, many of whom crossed the border daily from Tijuana, helped him to complete high school assignments. Matias said "that's how I got through high school…if I didn't understand something I would always have someone better at the English-Spanish thing." Futhermore, most of his friends were college bound, which also pushed him in that direction. José's middle school had a significant number of Hispanic students, and "the nice thing is, at that age, when you're 12-13 years old some students—from the heart—they're there to translate for you." José remembers getting translation help so that he was able to complete his above grade level assignments in math.

For Isabella and Olga, friends supported them in making plans to pursue higher education. Isabella said, "in the neighborhood I could see everyone I knew…had a plan to go to college." This expectation that everyone she knew attended college, pushed her onto the college path. Olga also got support from peers: "in my school, everyone had the vision to go to college. We had two in the medical field, I was in engineering, and one in architecture. In my group, we worked together for years. We always met for lunch. All of my friends in high school went on to college." David also noted that all of his closest friends went on to college, several of them to prestigious Ivy League schools.

Three of the participants did not feel supported in academic achievement by their friends. Martin always "felt a little bit different. I felt like they had a different

focus…different priorities. I always felt I had more value in the class than some other people were taking from it." Santiago felt the same—he felt like many students wasted the opportunities given to them, and he usually worked on school work alone. For Martin, family responsibility after school also made it impossible for him to join study groups. Working made it hard for him to form relationships with peers. "For the most part, I was by myself. Nobody wants to do homework with you if you're doing it at midnight." Likewise, Valentina was the only one of her friends who was going to college—it was a part of her life that she had to pursue independently.

Recommendations of participants

All of the participants had insight into improving education to help Hispanic students succeed. Some of them had even participated in programs, such as outreach programs or panel discussions that were aimed at exposing Hispanic students to science or at providing information on colleges. The participants observed that several things would help Hispanics to succed academically, particularly in the area of science, including hands-on experiences, supportive school programs, personal connections, family support, and education about the path to college. In addition, participants who are also parents, discussed the things they have done differently with their own children to prepare them for academic success.

Engagment in science. One theme that surfaced repeatedly was the need to get Hispanic students more engaged with science. Olga observed that "in their country there are a lot of people who choose science. It doesn't matter what language you speak. Anyone can do science." Olga felt that more exposure to science, starting in elementary

school would help more students feel confident in choosing science as a major: "I tell them science is everywhere."

Like Olga, Matias thought teachers need to "provide them with memorable experiences…that is what would serve as an inspiration for them to take those courses in college." David agreed: "More hands-on activities…just excite kids about science!" David discussed the shift he experienced when he took an advanced placement biology class:

> "you actually got to do some experiments…[before] there was this disconnect between something you read in a book and something you actually did. When I would look at bacteria and see glowing colonies, I was like, wow this actually exists. This is a really powerful tool to understand the world."

David felt that this engagement with "real science" helped to lead him to choose a science major in college. David also noted the importance of having teachers who are highly motivated and really care about science. He felt that these types of teachers could provide an engaging experience for students. Matias noted that the relationship with engaging teachers was a very important factor in his choice to pursue a degree in science.

José felt that engagement through hands-on experiences was vital, particularly incorporating research experiences into science curriculum: "…if you're not doing hands-on, to them all there is is books. It's boring. It's two dimensions. I want something that I can feel and then I can remember it." José observed that the opportunity to engage in research in his early college years was motivating to him and pushed him to choose a career in the sciences. Likewise, Olga noted that hands-on activities in high school were pivotal in leading her to choose a major in geology. Many of the

recommendations of participants, including hands-on activities, engaging curriculum, and relationships with teachers, mirrored the reasons they chose to enter the science field.

Supportive schools. Seven of the participants thought that schools could be more supportive in helping Hispanic students to succeed by preparing students adequately for college. Isabella felt that schools can help students succeed by pushing them academically. She has observed that some teachers allow Hispanic students to underperform:

> "That's one story, the pobrecita syndrome…you know, poor kid…you need to be nice to him or her because they need so much and you're going to make their life easy. Their lives are going to be hard no matter what and they have to be prepared for that. You have to push them, you have to force them to learn what they need to learn."

Isabella refers to "pobrecita syndrome, " when teachers express excessive empathy for students, resulting in low expectations. She believes the role of the school is to prepare students for the future, rather than excusing them for any challenges they face. Olga agreed—she felt that Hipanic students need the best teachers and a rigorous college preparatory curriculum so that they have options. Even if they do not choose to attend college, the option should be there—as she tells her students "at least you have the weapons—you know the means to go." Martin felt that segregating Hispanic students into English language classes is a form of tracking—students ultimately miss instruction time in their core subjects which makes learning more challenging. He felt that English language learners would be better served by placing them "into that ocean of English…they would not sacrifice class time with English speakers."

Valentina felt like more school programs should be implemented to help Hispanic students find information about college admission and requirements. When she went to high school, she was not sure what a degree was, and was not familiar with the path to follow to complete higher education:

> "it wasn't like I really planned for it or anything…they just kept telling me graduate. They made it seem like it was the end of the road. I didn't really have any idea what a degree was—a masters or an associates. No idea at all."

In addition to teaching the pathway to college, Gabriela felt that schools need to work harder to help all students see that they have potential, since Hispanics "get the image of that perfect student…it's the student that gets straight A's and is in sports and is creative and so on and so forth.. and it's not particularly Hispanic and it's not particularly African American." Santiago agreed that schools can work to provide the message: "don't ever let anyone tell you you can't do it, because all it takes is work." Olga noted that many of her students see scientists as people who are smart—she tries to convince her students that everyone is a scientist who has curiosity and engages in observation. She hopes that this encourages some of them to have the confidence to engage in science curriculum, even when it is challenging.

Connections. Many of the participants described the importance of their relationships with significant adults, as discussed earlier. The participants made some recommendations of how to establish these relationships. Several of them discussed the importance of establishing relationships with Hispanic students as individuals, rather than thinking of them as a group. Isabella discussed the need to avoid labels:

> "I hate labels. I didn't know that I was Hispanic, Latina, Mexican, a woman of color, and all these things before I came to this country. I learned that when I came here. Look at the kids, don't look at the labels."

Isabella felt that some teachers automatically label their students: "I label you as the one that isn't interested, the one that is apathetic, you don't care about school, your family doesn't care about school, your parents don't come." She quoted the words of her father: "he said, 'we are all the same and everybody cries and loves and poops, we just come in different colors and sizes and speak different languages'." Isabella felt that teachers need to work to see their students as individuals rather than stereotyping them.

Likewise, Martin felt that educators should be open to recognizing each student as an individual and be open to providing students with unique opportunities to help them succeed. In addition to seeing students as individuals, Matias felt that educators need to recognize the importance of relationship. He felt like a connection with teachers is vital in helping Hispanic student succeed academically.

Santiago felt that in addition to teachers, connection with role models is also important for the success of Hispanics. "Latinos need to see Latinos who are successful. Educators. Doctors. Nurses. They need to see them and what made them successful. They need to see other examples." Gabriela also felt that role models could be successful in conveying the message that hard work leads to success. Hispanic students need someone telling them: "if you can take the punches, that's all it is. So you flunk a class your first term or something. Too bad. Take it again."

Adults can also be effective in helping students see the relationship between education and careers. Gabriela remembers many of her Hispanic classmates who left

school because they needed to provide for their families. She thought that students need to hear the message that "of course you want to provide for your family, but if you think in the long run, you'll provide so much more effectively for them if you get a good stable career. Particularly in something you love." David observed the importance of having teachers who work to develop relationships with students--"not just some person who is there to make a living, but a person who really cares about students."

Family. Many of the participants cited family as a very important element in helping Hispanic students succeed. Daniel talked about the need to employ a full time social worker who can act as a family liaison, starting at the elementary level. He felt that parents need to be provided with books and encouraged to read to their children. Parents need to be taught how to create an expectation of academic success by emphasizing talking about school and supporting students in homework: "when you get to school, if that students continues to struggle, then you get somebody in that house to mentor and support that student." Daniel felt that this can be accomplished by transforming the school into a community center, where cohorts of parents can meet and provide support to each other: "you come back to school once a week, you talk to other parents about what challenges you faced, you foster that community."

Valentina talked about the importance of involving parents in the educational process:

> "I think a lot of it has to do with parents. Because if you go to the kid and try to teach them, if the support is not at home or the parents don't know how important it is…they're not going to…it would totally have to be a family thing."

Isabella noted that many of the Hispanic parents she works with feel intimidated by schools and school staff should look for ways to involve them: “it’s not easy to go into a system that you don’t understand.”

Five of the participants are parents, and one participant is very involved in raising his younger siblings. Two of the women noted that Hispanic culture can emphasize the role of women as a mother, rather than as a provider. Olga has worked hard to teach her children the value of financial independence: “I always tell them you don’t want to depend on a man. Don’t expect you’re going to find a rich man that’s going to support you—that’s only in telenovellas.”

Valentina talked about the cultural norm of having kids in a separate world from their parents, which she felt led to a lack of exposure to concepts of science and math. With her own children, she tries to involve them in discussions of science concepts, particularly talking to them about what she’s learning in graduate school. She believes it is important to have parent education to help parents prepare their children for school. Likewise, Santiago supplied his own children with the knowledge and resources to attend college. Daniel’s father wanted him to become “a full blooded American” and discouraged him from using Spanish at home. With his own daughter, he has encouraged her to become bilingual by enrolling her at a Spanish immersion preschool. Daniel feels that encouraging literacy in both Spanish and English would be helpful to student success.

Finally, Martin has been very involved in raising his (much) younger siblings who were both born in the United States. He noticed that one brother was automatically

enrolled in ESL when he entered kindergarten, and he remained there until fifth grade, even though "he's actually not very good at speaking Spanish. But just because we put a checkmark on Hispanic, 'yes,' they automatically put him into ESL." Martin felt like his brother missed out on instruction by being enrolled in ESL, so when he enrolled his youngest sibling in school, he "avoided putting any Hispanic information on any of his forms and the thing that is curious is that….he has never taken ESL." Martin considers his brothers to be equal in their abilities to speak English, but the "Hispanic" label automatically categorized one of his brothers. Martin suggests that the identification process for placement into ESL needs to be reconsidered, and that ESL classes should not provide a lower level of instruction.

Conclusion

This chapter provided the stories of the participants, including obstacles they faced, some common characteristics, and a description of participants' recommendations for helping Hispanic students succeed in science. The following chapter will draw some conclusions found from the results. An analysis of these results will be used to discuss common characteristics of the participants. Recommendations will be proposed, and limitations and areas for further research will be discussed.

Chapter 5: Conclusions and Recommendations

Introduction

The purpose of this study was to tell the stories of Hispanics who are academically successful in science, look for common characteristics, and recommend changes that can be made to public schools to support their achievement. This section will provide an analysis of the data collected in the interviews, including the obstacles faced by participants, some of their common characteristics, and recommendations to educational policy makers, including limitations of the study. Reflections on the study from the researcher will be included, including surprises and experiences during the study. Finally, areas of further study will be suggested.

The participants

This study had a wide variety of participants, including men and women of varying ages, employed in varying careers. Some were in their early twenties, recently out of school and just beginning a career. Others were in the last few years of their careers, and were approaching retirement. This range allowed for the comparison of experiences over a period of time, as well in different types of careers. The experiences of men and women were also different, regardless of their career choice, as will be discussed.

Stories of participants: Success despite obstacles

The experiences of these men and women showed that their path to academic success was definitely not straightforward. The literature review suggested that Hispanics face a wide variety of obstacles to achieve academic success, including

academic tracking, lack of culturally responsive teaching, poverty, and language issues. The data showed that the participants experienced many of these same obstacles that other Hispanics experience. One goal of this study was to tell the stories of the participants, and the obstacles they faced are an important part of these stories. The following section will provide a summary of some of the main challenges the participants faced. These challenges have been grouped into themes, including culture, language, and school systems.

Cultural differences. One theme that was prevalent throughout the interviews was cultural differences. Some participants described the incongruity of Hispanic culture and some academic behaviors needed to succeed in predominately white schools. Participants described the need to assert themselves by asking questions of the teacher or selecting lab partners—behaviors which felt uncomfortable to them. A few participants described coming to school with less background knowledge because parents were not formally educated. In one case this translated to difficulties with standardized tests, in which the reading comprehension questions did not make sense to the participant.

It is clear from this study that family is a central part of Hispanic culture--the focus on family was a common theme throughout all of the interviews. The cultural focus on family was an obstacle in some cases due to the need to meet family responsibilities, including helping with a family business or providing child care for younger siblings. The two men who were raised by a single mother, cited the need to provide for their mother either by helping with household repairs or by helping financially. This took time and focus away from schoolwork. It was interesting to note

that none of the women in the study cited family responsibilities as an obstacle. In fact, in three of the cases, the women noted that their parents took on extra responsiblities so that school could be their main focus. These women noted that this is not the common experience for Hispanic women.

The Hispanic culture is a collective one, which may suggest that peers would be an influence on the success of students. However, most participants cited that peers were not a significant influence on their academic success, although they did help with English language development by acting as translators in some cases. In contrast, two of the women cited the importance of having a peer group that was college bound, and two of the men discussed the cultural expectation at their high school that all students would attend college.

Language. Language was an obstacle for the majority of the participants, many of whom arrived in the United States speaking Spanish exclusively, and struggled with the combination of cultural differences plus the need to learn a second language. In some cases, participants were assisted by classmates who were bilingual. Participants discussed the need to put more time into reading assignments—sometimes double or triple the time needed to complete the same reading in Spanish. This presented a struggle even for some participants who were born in the United States but did not speak Spanish at home. For some, the model of leaving the classroom for discrete instruction in English proved to be a challenge bcause they missed content instruction. Many were unable to receive help at home because their parents proficiency in English and had less formal education. One

participant discussed the difficulties in taking standardized tests in his non-native language.

Lack of school support. A major obstacle discussed by the participants was the lack of support from their schools. Several participants, noted a lack of academic rigor at the secondary schools they attended or at which they taught, which had a high percentage of Hispanic students. Several participants observed that they were not adequately prepared for college level work upon the completion of high school due to lack of rigor in their high school classes.

One participant, who attended a rural high school where many of the students were children of migrant workers, found that her preparation for college was so inadequate that she was unable to complete freshman level classes, despite receiving high grades in high school. Another participant referred to the "pobrecito syndrome," in which teachers fail to challenge their students out of sympathy for their students' challenging circumstances.

Several participants discussed the lack of support given by their secondary schools when planning for college. They were not educated about the college application process: counselors didn't meet with them and they were not taught about types of degrees and college options. Several participants observed that counselors assumed that they were not college bound and that counselors were only available to help students with college applications if they were in the "higher level" academic tracks. In one situation, a family friend stepped in to help with college applications, without whom the participant may not have applied to post-high school education.

In contrast, one participant who attended a private school for part of his high school was more supported in the path to college. His private high school brought in college recruiters and set the expectation that all students would attend college, an experience that parents are willing to pay for in tuition expenses. Two of the women, who attended high school in their home countries had the same experience. Both women observed that all of their peers were college bound, which created an atmosphere of academic achievement in their high school.

Two Hispanic women, both educators, discussed the discrimination they have observed in schools. They observed both institutional discrimination, such as less emphasis on challenging curriculum, and personal discrimination, from teachers and their own colleagues. The participants noted that some Hispanic students feel that teachers treat them differently that members of the majority group.

In conclusion, it is important to note that the experiences of the participants were not without obstacles. In fact, most of the participants faced many of the same obstacles described by the large body of research showing reasons why Hispanics struggle with academic success. However, this group of individuals was able to succeed academically—the following section will discuss some of the common attributes that may explain what led to this success.

Common characteristics of participants

The second goal of this study was to look at patterns in the data to find characteristics that the participants had in common. Although the participants came from very different backgrounds and experiences, there were several common characteristics

that appeared throughout the interviews, includng a relationship with a supportive adult, family support, and persistence despite challenges. In addition, many of the participants described a significant event which pushed them toward success. This section will discuss these commonalities that may have contributed to the success of the participants.

Supportive adults. Every participant described a significant relationship with an adult, which helped push them toward academic success. These included relationships with family members or teachers. All four women cited the importance of a parent in providing them with the encouragement to achieve academic success, with two of them focusing on the influence of their fathers. One of the men described his relationship with his mother, who pushed him to academic success. The remaining participants described a significant relationship with a teacher. In some cases, the teacher was one from elementary school who took a particular interest in the participant or helped them to take advantage of opportunities. In other cases, the teachers were secondary teachers who recommended colleges or showed them the path to college enrollment.

Family support. As discussed earlier, parents were not able to provide much formal support with academic work. However, relationships with parents were vital in providing emotional support and encouragement. Both men and women described this importance. In some cases parents acted mainly as a support system, offering emotional support or encouragement. In other cases, parents provided support with child care or in giving the participants freedom from family responsibilites so that they could focus on academics. Many of the participants noted that their peers did not have these same types of freedoms and had to sacrifice time on academics for time to provide child care for

siblings or help with household duties. Even in the case of one participant who did not feel that his parents were interested in his academic achievements, his family did support him financially so that he did not have to work. This support allowed him to spend time on school and sports, which ultimately led to an athletic scholarship to college.

Persistence. As described previously, the participants experienced numerous obstacles to achieve academic success. Many of them described themselves as average students who were willing to persevere despite difficulties. Participants also demonstrated resilience in continuing on the pathway to academic success despite experiences with failure. Some of them encountered minor challenges, such as failing a college class—they demonstrated persistence by taking the class again. Others encountered more major challenges, such as arriving at college unprepared or failing to be admitted to graduate school the first time. Several attended community colleges first after acknowledging their need to build their skills before attempting to apply to a university.

Significant event. Half of the participants interviewed had a significant event that they felt pushed them toward success. Not every experience was a positive one—in many situations participants described a negative interaction that drove them to succeed. Some of the experiences involved a single interaction with a family member or colleague, while others were life changing events, such as the death of a parent in one case. When questioned about their experiences, participants told their stories with vivid detail, obviously remembering the significance of the experience.

In conclusion, this study was able to identify some common characteristics of successful Hispanic students. Relationships with supportive adults, family support, and demonstration of persistence were present in all of the interviews. Many of the participants also described a significant event which pushed them in the direction of success. Based on the results found here, there are a number of recommendations that should be considered by educational leaders.

Recommendations for educational leaders and policy makers:

An analysis of the data led to a number of recommendations that should be disseminated to educational leaders and policy makers. These recommendations are important to educational leaders at various levels, ranging from higher education to classroom teachers. In higher education, teacher preparation programs should be aware of changes that need to be made in teacher training. School district leaders should be made aware of systemic changes that can be implemented at schools. Finally, administrators, teachers, and school counselors need to be familiar with changes that can be made at the school level. Many of the changes suggested here do not require additional funding, but rather a change in mind set or a commitment to create a particular program. The following section will discuss some of the recommendations made by participants, including some additional information from the literature. Figure 1 presents four areas that may contribute to the success of Hispanic students, including academic engagement, a supportive school culture, connections with supportive adults, and family partnerships.

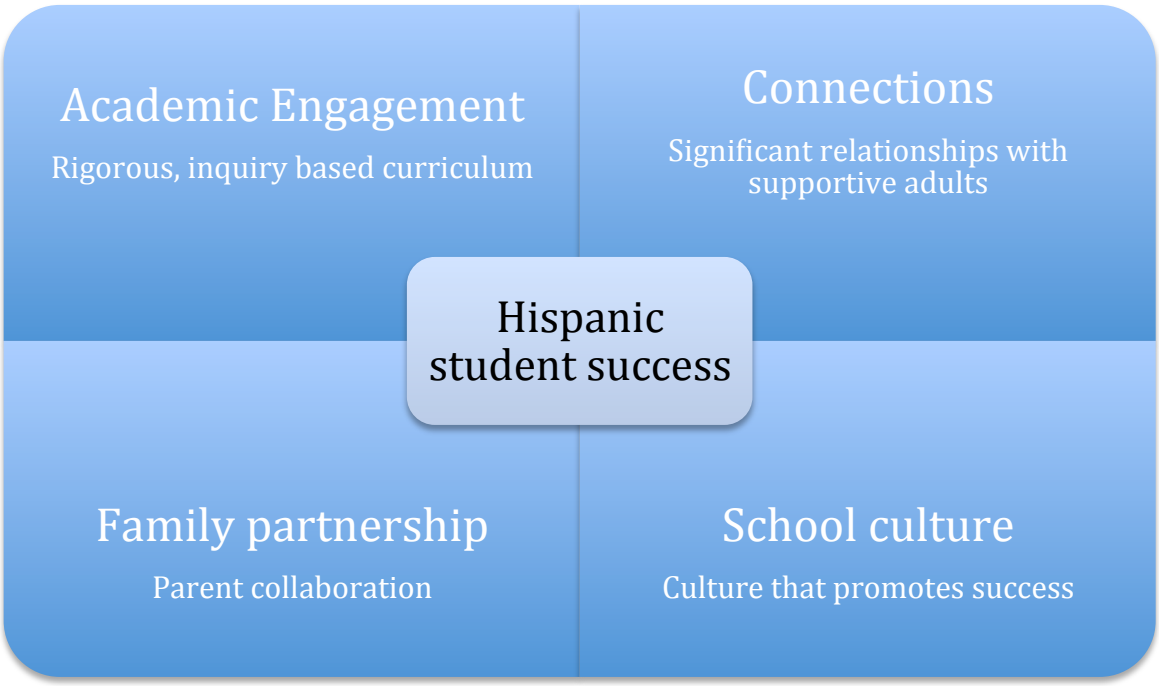

Figure 1: Factors that Contribute to the Success of Hispanic Students

Academic engagement. From the interviews, it was clear that all of the participants were passionate about science. Participants described how their interest in science began because of engaging activities in science class or from opportunities to engage in research. Many of the participants recommended that educators provide hands-on opportunities including lab activities, dissection, and scientific research.

One factor that is important in helping Hispanics achieve academic success in science is involving students in engaging, rigorous academic experiences. Inquiry experiences have been found to increase both engagement and achievement of at-risk students (Geier, Blumenfeld, Marx, Krajcik, Fishman, Soloway, & Clay-Chambers, 2008; Smith & Wilhelm, 2002). It is important for teachers to provide these types of inquiry experiences. The Next Generation Science Standards, which are in the process of being adopted by numerous states, describe the necessity for all students, including Hispanics,

to actively engage in science through modeling and problem solving (www.nextgenscience.org). This focus on modeling and problem solving can be provided by teachers when they provide students with real world problems, which allow students to actively engage in high interest activities that encourage higher level thinking. Likewise, hands-on experiences, which allow students to ask a solvable question, design an experiment, and collect data to answer the question are vital for students to engage in scientific thinking (National Research Council, 2007). An emphasis on conceptual understanding of big ideas can help Hispanics to be successful in science classrooms (Geier et al., 2008). For Hispanic students, this type of experience is particularly important because it deemphasizes areas in which some Hispanic students struggle, including memorization of vocabulary and a heavy emphasis on reading text for information. To change common practices in science classrooms requires changes at all levels of education, including teacher preparation, school organization, and teachers attitude and knowledge.

Supportive school culture. In order to support Hispanic students, schools must have a culture that supports everyone to succeed. It is important for schools to have a school culture that promotes the success of all students, a curriculum that is rigorous enough to prepare students for higher education, as well as a program in place that provides information about college options and the college application process.

Schools which are successful in supporting Hispanic students have both an emphasis on strong academic programs and a cultural expectation that all students have the potential to attend college (Conchas, 2006; Knesting & Waldron, 2006). A cohort

model, whereby students support each other to achieve success, has been found to create a culture of achievement (Conchas, 2006). Individual teachers can also work to create a classroom where academic success is the norm, rather than the exception. Rose (1995) describes successful classrooms as ones in which teachers create a climate of high expectations. Having a classroom climate that is supportive of success is powerful for Hispanic students.

Several participants described lack of academic readiness for attending college. One was so poorly prepared for college that she had to abandon her university program and enter community college to build her skills. Two of the participants, both educators, discussed the importance of providing students with the tools they need to choose a path in higher education. One participant felt that her school, with a high proportion of minority students, neglected to adequately prepare many of her students for post high school education, assuming that they are unlikely to attend college.

At schools with a large number of minority students, including a significant population of Hispanic students, the curriculum is often different than that at schools with fewer minority students (Brayboy, Castagno, & Maughan., 2007; Kozol, 2010). Lack of academic rigor is discriminatory—lack of preparation for higher education creates an obstacle for students who plan to attend college. In some cases, well-meaning teachers might attempt to create easier curriculum for their students in an effort to facilitate their success. However, this “assistance” does not facilitate success in the long run, as students are not adequately prepared for higher education.

In addition to changes in curriculum and practices, schools also need to support students in their pathway to higher education if they elect to attend college. Direct instruction and information about the pathway to college is important for helping Hispanics achieve success. Many participants described having no knowledge of how to complete a college or scholarship application and felt unsupported by their school counselors. Some were not familiar with degrees or academic requirements to meet their goals and several chose to attend a college that a teacher recommended because they were not familiar with any other options.

Valverde (2012) describes the need to educate Hispanic students in the steps for college admission, noting that many Hispanic parents are not familiar with steps for college admission. Having direct instruction and support in the college admission process would increase the possibilities for many Hispanics. A small minority of the participants were involved in programs which helped them prepare for college, including visits by college recruiters or transportation to visit college campuses, or panel discussions with students attending college. These types of programs can familiarize Hispanics with the college application process to effectively prepare them for post-high school education.

In my experience, a school culture that emphasizes the success of all students is vital to student achievement. Changing school culture does not have to require extensive expense or I have observed that leadership that is commited to schoolwide change, both from administrators and teachers, can help to focus a school on success. Strategies such as creating time for staff collaboration, structuring school schedules to allow

teachers to plan curriculum in grade level groups, implementing learning teams to focus on data driven decisions, and looking for opportunities to celebrate successes can change the culture of a school. Many of these strategies require very little in the way of funding, but can have a trememendous impact on the atmosphere and climate of a school.

Connections. Many of the participants discussed the importance of relationships in providing support to Hispanic students. In particular some of the participants discussed the need for connections with teachers, noting that teachers can provide motivation and help students see connections between education and their career goals. In some cases, suggestions by teachers resulted in them choosing a particular college or major. In other cases, a relationship with a supportive adult allowed the participants to feel that they had the capability to succeed. Some participants suggested that Hispanic role models would be helpful in bringing about change, and helping create connections between students and these role models would be motivating.

The education system in many Latin American countries does not expect all children to attend school, thus some Hispanic adults do not see education as a method to improve their standard of living (Valdes, 1996). It is important to help students see the connection between education and life improvements. Panel discussions and relationships with role models could show Hispanic students some possibilities.

Valverde (2012) discusses the importance of Hispanics seeing the success stories of other Hispanics. Some successful high schools have established mentorship programs to create formal opportunities for Hispanics to connect with adults who can support their academic success (Conchas, 2006). Numerous colleges utilize Hispanic student

organizations to provide mentorship to their students—similar programs could be created in secondary schools, utilizing either Hispanic adults or Hispanic college students. The experience of seeing real people who have achieved success is a powerful one, and could be a significant experience for Hispanic students interested in college.

A relationship with a significant adult has been shown to be important in helping Hispanics achieve academic success (Alfaro, Umaña-Taylor, & Bámaca, 2006; Martinez, DeGarmo, & Eddy, 2004; Knesting & Waldron, 2006). A supportive adult can develop relationships that communicate high expectations and help students see their own value (Knesting & Waldron, 2006). A relationship with a supportive adult can also help to develop character attributes, such as academic persistence, that may lead to academic success (Caravantes, 2006). There was significant evidence from the interviews that showed the importance of persistence in helping the participants achieve academic success. Tough (2012) suggests that these character traits represent a skill set that can be taught, and schools are an effective place to learn these skills.

I feel like creating connections with the students we serve is one of the simplest ways to effect real change. An initial step in creating these connection is to know the demographics of our students. In this paper, I referred to "Hispanic" students, which encompasses a large diversity of students from many different countries. It is important to know which students we serve and to understand the cultural diversity within the Hispanic community. It is also vital to understand individual differences between students. Many of the participants in this study discussed the importance of knowing students as individuals, rather than labeling them as part of a group. From my personal

experience, I have observed that developing connections with students as individuals can be immensely beneficial in increasing motivation and participation in class. As teachers, we must look for opportunities to create these connections with our students. Developing cultural competence and understanding our students as both members of a cultural group and as individuals as an important first step.

Family partnership. One connection that was particularly important for the participants was the relationship with family. Some participants recommended helping parents to become involved in their child's education to facilitate academic success, while noting that there are obstacles for parent involvement in school.

Despite the importance of family in the Hispanic culture, the literature shows that Hispanic parents are less likely to be formally involved in schooling (Golan & Petersen, 2002). There is a significant body of research that shows the relationship between parent involvement and academic achievement (Chavkin & Gonzalez, 1995; Dickson, Zamora, Gonzalez, Chun, and Callaghan Leon, 2011; Valenzuela & Dornbusch, 1994). One participant, an educator, spoke at length about his thoughts on supporting families to become involved in schools, beginning when children are very young.

Participants observed that their parents were less involved in academics, often due to an inability to help with homework. Some participants had parents who were involved when they participated in extracurricular activities, such as band concerts or sporting events, but many noted that their parents did not attend school events. Many of the reasons cited by the participants for lack of parent involvement, such as language barriers and unwillingness to question the teacher are confirmed in the literature (Valdes, 1996;

Valverde, 2006; Golan & Petersen, 2002). Research shows that this is common in Hispanic culture—there is an emphasis on respect for the knowledge and authority of teachers and Hispanic culture is not congruous with questioning teachers (Valdes, 1996; Tinkler, 2002).

The literature also discusses logistical barriers to involving parents in schools, such as lack of transportation, lack of child care, language difficulties, and lack of confidence in school settings (Valdes, 1996; Valverde, 2006). Particpants noted the significance of language difficulties in parent communication with schools, with varying support from interpreters.

Valdes (1996) also raises the question of what constitutes school involvement. Teachers in schools in the United States often define involvement as attending conferences, questioning grades, and assisting students with homework. This model may conflict with the Hispanic perception of involvement. Valdes (1996) suggests that Hispanics tend to consider school involvement in a less formal way by teaching their children to respect their teachers and instructing them in moral values.

Baquedano-López, Alexander, and Hernandez (2013) suggest that current school practices of encouraging parent involvement focus on involving middle class members of the majority group—practices need to change to include all parents. Valverde (2006) promotes a partnership model in which family inclusion is a vital part of the the learning process. He proposes the model of a school as a learning community in which teachers and parents both represent a vital component.

Making interpreters available and sending home all written communication in both Spanish and English is a first step. Several participants discussed the fact that parents were able to participate in student conferences because interpreters were available. Beyond increasing communication between home and school, schools can be created as community centers that provide support to parents, including Hispanic parents. Schools can offer internet access, workshops and trainings on topics that support Hispanic parents, and provide a bilingual contact staff member to support them at school events. By welcoming parents into schools, staff may be able to assist Hispanic parents in developing relationships with teachers in support of their child's education.

I feel that the importance of developing relationships between parents and educators is often neglected. As teachers, we have often failed to recognize that the Hispanic culture is very supportive of education. We have neglected to utilize parents as a resource to promote student success. Creating opportunities for home-school collaboration can be challenging and will almost certainly involve the use of additional resources. Schools that successfully collaborate with parents often have additional staff, such as a community liaison, that create programs to involve parents. In order to create successful programs, schools need to prioritize parent involvement by devoting both time and financial resources to create opportunities for home-school connections.

Stakeholders and allocation of resources

There are a number of groups who should be aware of the information found in this study. There are many groups who are involved in the education of Hispanic students, some of them directly and others indirectly. Teacher training programs can have

a significant influence on developing educators who are aware of cultural differences and who create programs that support the success of all students, including Hispanics. Likewise, school districts can choose to focus on the development of programs that can support Hispanics. District leaders can create policies that facilitate the success of students, administrators can guide teachers in instructional practices that will support Hispanic success, and programs can be created that encourage home-school connections. Some of these programs, such as staff development, support from interpreters, or school-run programs that promote parent involvement, require additional funding for implementation. But this additional funding can result in an incredible payoff. By neglecting to fund programs which support the success of Hispanics, we are losing human capital—participants of the workforce who are able to offer significant contributions to careers in areas of science.

Another important stakeholder that should be aware of the information presented here is teachers. One important outcome of this study was to show the incredible difference teachers can make in the lives of their students. Participants cited the influence of teachers repeatedly throughout the interviews. Teacher need to be aware that their words and attitudes have a significant influence on their students. They also need to realize that they have the power to create curriculum and experiences that are incredibly influential in students' lives. Teacher preparation programs can help to prepare teachers to cultivate these relationships and ongoing staff development can support teachers in this work.

Because there are a variety of stakeholders who would benefit from the information found in this study, it is important to disseminate this information through several avenues. One way to make this information public is by publishing journal articles. An article written in a peer reviewed journal is more likely to be read by those in higher education, while teachers may be more likely to read an article in a popular magazine. In addition, teacher training events at the district level are another way to disseminate this information. Some districts, including the one in which I teach, have a diversity representative at the district level. This individual is frequently in charge of designing staff development sessions and can be provided with information that might be useful to staff. Finally, conferences, particularly events that are widely attended by K-12 educators or those working in teacher education preparation programs, would be an effective venue for sharing this information.

Limitations

There are a number of limitations to this study. These results cannot be generalized to include every Hispanic student in public school in the United States. The participants varied greatly in age, and were approximately half female. The data suggests that there may be patterns of response in areas such as age or gender. However, because this study was not focused on age groups or gender differences, there is not sufficient data to draw conclusions about either topic.

In addition, there are likely to be regional differences in the experiences of Hispanics. Every participant from this study currently lives in the Pacific Northwest, and most attended high school in either Oregon or California. It is likely that the experiences

of a Hispanic growing up in an area with many other Hispanic students is different than the experiences of those attending school in the Pacific Northwest, where the percentage of Hispanics is lower. Some of the particpants attended school in rural areas, while others were from larger cities, which resulted in varied experiences. The results of this study need to be considered with these limitations in mind.

Further research

The interviews suggested a number of areas that could lead to further research. This study showed that there is a clear difference in the experiences of Hispanic men and women, which could lead to further investigation of gender differences. These interviews suggested that men and women had different experiences in schools, different types of relationships with peers, and played different roles in their families. Age also seemed to play a part. The older participants seemed less likely to have the support of parents in pursuing academic interests—one of them stated that his mother did not attend his graduation because work was seen as more important. A study of age and gender differences might lead to some interesting conclusions.

Another area for further research centers around the country where Hispanic students were educated. Two of the participants in this study attended secondary school in their home countries before pursuing higher education in the United States. These participants had very different experiences than those participants who attended secondary school solely in the United States. In addition, most of the participants stayed at one school for high school. It is possible that less stability may have led to different outcomes for the participants. A study that looks at issues related to mobility and

experiences with immigration might suggest some changes that could be made to programs to support Hispanics.

Finally, this study suggested some personality traits, such as persistence, that may have contributed to the success of these individuals. Some interesting studies could be developed looking at some of these traits and investigating how these traits developed in individuals. A larger sample size focused solely on traits possessed by successful Hispanic students could lead to different results than those found here.

Reflections

When I began creating a literature review for this study four years ago, I had some ideas of what might help Hispanic students succeed academically. At that time, I had taught for more than a decade, with about half of that time working with at-risk Hispanic students in southern California. I had a number of preconceived ideas about which school programs would be most beneficial to students. There were a number of surprises in my results. I was surprised to see how many of the participants described themselves as average students. I expected that individuals who chose a science major would frequently be those who were excellent students in secondary school. However, more important than making high grades seemed to be the ability to persist despite significant adversity.

I also expected peers to have a significant impact on the success of the participants. However, the majority of them cited peers as helping with translation, but rarely with actually helping them to achieve academic success. Two of the women did mention that peers had been important in their development in high school, so there may

be gender differences in this area. It is also possible that this independence is a trait of individuals who choose science as a major. It would be interesting to look at Hispanics who are successful in other fields to see if they are similarly unreliant on peers.

I was also surprised to hear about the discrimination two of the teachers felt. I expected that students would feel a sense of discrimination—I have witnessed differential treatment at my school. Many of my Hispanic students (particularly the males) have talked about feeling a sense of exclusion or a difficulty in making relationships with some of their teachers. However, I had not considered the discrimination that Hispanic staff members might feel in a school. Both Latina educators discussed interactions in which they experienced differential treatment. One of them described feelings of exclusion while in her teacher preparation program. She observed that she never realized she was a "woman of color" until she came to the United States. This is definitely an area in which I will be more aware in the future.

The final surprise was the excitement I felt after each interview. I was so nervous about meeting a new person before each interview, that I did not expect to enjoy the interview process. However, the interviews turned out to be the most engaging part of this entire project. I truly enjoyed meeting each of the ten people who had incredible stories to tell. These people overcame incredible odds and perservered to accomplish amazing things. It was an absolute privilege to spend time with each one of them.

Early on in this study, one of the participants expressed frustration with the lack of changes in schools--she felt like there is not enough effort to implement real changes in school systems. My hope is that this study, and others like it which focus on

successful students, can be a first step in the process of helping schools, communities, and families work together to create sustainable change.

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Appendix

Interview Instrument

Begin with introductions:

- Brief introduction of myself and my background.
- Assurance of complete confidentiality and the use of pseudonyms throughout my dissertation.
- Offer to forward my dissertation when it is complete.

Prompt	Possible Probes (Clarifying and elaborating)
Tell me about yourself.	Age/Level of education Ethnic identity/country of origin Places lived Current job or college major Schools attended Family of origin Education level of parents
Tell me about some of your academic successes.	Were there classes/subjects in which you were particularly successful? Were there events (science fairs, projects, academic contests, scholarship opportunities) that stand out? Were there other experiences outside of school that helped you succeed (internships, jobs, volunteer experiences)?
Was your family supportive of your academic successes? How?	How did they help you/not help you? Were they involved in your schooling? Did they attend school functions? Were they involved in school assignments/projects/homework?
Were there other adults who encouraged you to be successful at school?	Were teachers helpful? Were there particular teachers that stand out? School counselors/administrators? Other relatives? Other members of the community? Did you have any role models? Anyone who provided an example or encouraged you?

Think back to your experiences at middle and high school. Do you feel like your school had a culture that supported success of all students? How?	Did you have any programs or classes (such as IB, AP, academic support classes) that supported your success? Did your school use "tracking"? How did your school motivate students?
Think about your friends in middle and high school. Were they supportive of your success?	Were most of your friends in the same classes as you? Were most of your friends academically successful? Did you often work on homework or school projects with friends? Did most of your closest friends go on to college?
Describe an episode that strikes you as particularly important in your development.	How was this episode significant? Did it lead to any significant changes in your academic goals?
What were the major obstacles you faced during your schooling?	Language issues? Culture issues? Family responsibilities? Teachers? Curriculum?
I will use this research to help inform teachers and school administrators about things that can help Hispanic students succeed. What would you tell them?	What might your ideal school look like? Can you think of things that would help kids be successful? Particular programs, types of classes?
Is there anything else you want to tell me about? Thank you for participating.	Anything else you want to add?