

FACTORS THAT INFLUENCE THE UNDERREPRESENTATION OF LATINO/A STUDENTS MAJORING IN MATHEMATICS IN THE STATE OF WASHINGTON

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ABSTRACT

This study examines factors that influence the under-representation of Latino/a students among mathematics majors in the state of Washington. A questionnaire was used to collect quantitative and qualitative data from Latinos/as regarding possible reasons for this under-representation. Surveys were administered to 140 Latino/a students and 12 Latino/a faculty/staff in 3 Community Colleges and 5 four-year public universities in the state of Washington. Several factors were identified that influence Latino/a students' choice to attend two-year versus four-year colleges as well as their choice of major. Areas for future research and action are identified including possible interventions to encourage Latinos/as to attend four-year colleges and to consider majoring in mathematics.

INTRODUCTION

In 2000, Latinos/as² comprised 12.5 percent of the total population of the United States, and accounted for 16 percent of all children in the U. S. aged 18 and under (U.S. Department of Education, National Center for Education and Statistics [NCES], 2003). These numbers take on added significance when we note that, in the last decade, the Latino/a population in the United States has increased rapidly and that this increase is likely to continue. According to the 2000 Census, Hispanics³ have the fastest demographic growth rate among minority populations. From 1990 to 2000, the Latino/a population increased from 22.4 to 32.5 million, or 57.9 percent (Guzman, 2001). By 2005, they are expected to be the largest U.S. minority (NCES, 2003). By the middle of this century, the population of Hispanics is expected to roughly triple. If these projections hold, they will account for almost one fourth of the total population in the United States.

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²The word Latino denotes a group of people with African, indigenous or Spanish heritage (Nieto, 2000).

³The word Hispanic denotes a group of people with Spanish heritage. Here it will be used more or less interchangeably with Latino/a to describe people who in general share the same language, similar customs, traditions, values, beliefs, and religion.

When examining the population growth of Latinos/as in the U. S., and noting their representation in higher education, several issues become apparent. First, although the last two decades have seen the number of Latinos/as entering higher education institutions increase by roughly 10 percent, the major portion of this growth was realized in two-year colleges (14 percent compared to seven percent in four-year colleges) (see NCES, 2003). In terms of enrollment, then, these numbers show that Latino/a students are overrepresented in community/technical colleges. However, less than half of these students earn their Associates in Arts (AA) degree (Women, Minorities, and Persons with Disabilities [WMPD], 1998). Second, in 2001, of all U. S. Latinos/as receiving bachelor's degrees less than one percent earned a degree in mathematics and statistics. Finally, only 72 Latinos/as obtained master degrees in mathematics and statistics, and only 15 earned a PhD in these fields (WMPD, 2004).

The Latino/a population in Washington State doubled from 1990 to 2000. In 2000, there were 442,059 Latinos/as living in the state of Washington. This represented a 105.8 percent increase (State of Washington Commission on Hispanic Affairs, 2001). Unfortunately, the number of Latinos/as in higher education in Washington follows the national trends. Latinos/as are under-represented in higher education and gravely under-represented in mathematics. The Higher Education Coordinating Board of Washington State (HECB, 2000) reported that in 2000, Latinos/as received 660 bachelor degrees. This represents only 3.6 percent of all degrees awarded at the five four-year public schools (HECB, 2001). Of the 660 bachelor degrees, only 36 were awarded in the sciences. Of the 111 masters degrees awarded only five were awarded to Latinos/as in sciences. Only seven PhDs were awarded in all disciplines (HECB, 2001). Clearly, Latinos/as are dramatically under-represented in higher education in the state of Washington.⁴

The under-representation of Latinos/as in higher education is in itself remarkable. However, their palpable under-representation in mathematics gives cause for concern at three levels: 1) Why there is little advancement of Latinos/as into four or five year universities in the U. S. and, in particular, into mathematics?; 2) what are the implications of this under-representation?; and, 3) why should we consider this under-representation problematic?

The answers to these questions may be bound to the political economy of the U. S. due to revolutionary innovations that increased productivity in jobs and industries. In the 21st century, the U. S. economy will need a qualified workforce with strong science, mathematics, engineering, and technology backgrounds.⁵ Projections by the 1996 Bureau Census (CEOSE, 2000) indicate that from 1995 to 2050, the percentage of white non-Hispanic workers will decline from 37 percent to 26 percent making it necessary for all minorities to take part in the workforce. CEOSE also predicts that Latino/a representation in the workforce will increase from 10 to 24 percent. The overall increase in minority workers could account for almost half of the traditionally dominated white-male SMET workforce compared to the current one-fourth (CEOSE, 2000). Since the Latino/a population has the fastest growth rate in the nation and the national economic progress is increasingly technology-oriented, the need to prepare talented Latino/a workers in the SMET disciplines should be considered a priority.

Another reason to consider the under-representation of Latinos/as in higher education and mathematics is the potential loss of new perspectives and interests that might expand the horizons of future research. The positivist approach in science and mathematics conveys protocols for both research and what is of interest. Although science is considered an objective field (Rosser, 1995), its protocols seemingly do not invite in-put from women and minorities whose experiences, methods, approaches, and perspectives may differ from mainstream Whites. Rosser (1995) argues that Latinos/as may actually elicit more innovative research of social value than that of their

⁴The HECB groups mathematics and science into one category so it is impossible to calculate how many were awarded for mathematics though obviously the numbers are small. Clearly, mathematics is white-male dominated, and women and minorities are dramatically under-represented (WMPD, 1998).

⁵The Committee of Equal Opportunities in Science and Engineering often refers to these disciplines as SMET disciplines (CEOSE, 2000).

white-male counterparts. It is time, then, to investigate not only what causes the under-representation of Latinos/as in higher education but also to identify factors that influence them to choose majors other than mathematics. This present study was designed with this in mind. Here we investigate the reasons for the under-representation of Latinos/as in higher education and mathematics from the perspective of prospective Latino/a students.

A pilot study at Washington State University (WSU) identified the several factors as causing this under-representation. These include: parents' educational background; parents' involvement in their children education; socioeconomic status (SES); Latino/a culture --- gender roles in society, own expectations, family education---; lack of Latino/a role models; institutional barriers; lack of information on the work opportunities with a mathematics degree; and institutional racism. Identifying these factors may assist changing the underrepresentation of Latino/a mathematics majors and assuring greater opportunities for success in related fields. The present research, then, is guided by the following hypotheses:

1. Latinos/as or Hispanics are less likely to major in mathematics in the state of Washington due to culture, parents' educational background, stereotyping, lack of Latino/a role models, and discrimination and sexism.
2. Culture is the most influential factor preventing Latinos/as, particularly women, from majoring in mathematics.
3. Institutional barriers including the lack of Latino/a role models and mentors are common obstacles faced by minority students during undergraduate and graduate school that may prevent Latinos/as, particularly women, from majoring in mathematics.

METHODOLOGY

The Survey: This study is based on a survey of Latino/a students and faculty/staff. This survey included twenty questions. Of these, ten were multiple-choice questions and ten were open-ended. The qualitative questions provide the students' views on why Latinos/as do not major in mathematics rather than leading them with structured questions. However, since open-ended questions require a considerable amount of time to complete, I also chose to include 10 multiple-choice questions.

Whereas the open-ended questions allow classification of the salient factors preventing Latinos/as from entering into higher education, and influencing their decisions to not major in mathematics-related areas of study, the ten multiple-choice questions recorded similar empirical data, as well as basic demographic information. The questionnaire addressed the following:

- 1) The main factors that influence Latinos/as to choose majors other than mathematics (what discourages or encourages Latinos/as).
- 2) The impact of gender roles in the Latino/a culture (community).
- 3) The influence of peer pressure.
- 4) The existence institutional barriers.
- 5) The role of counselors in high school and college.
- 6) The information known about career opportunities for those with degrees in mathematics.
- 7) How important the amount of mathematics is when choosing a major.
- 8) The student's interest in ever majoring in mathematics.
- 9) Who serves as role models for Latinos/as?
- 10) The impact of the socioeconomic status on Latinos/as educational outcomes.

Data Collection: The survey was administered to students enrolled at five four-year public universities and three Community Colleges the state of Washington. The three Community Colleges were chosen because of the high percentage of Latinos/as enrolled, and the high percentage of Latinos/as living in the surrounding counties.

Participants: Participants were randomly selected around the different campus and universities. They were approached in a respectful manner and asked to identify themselves as Latinos/as or Hispanics. The majority of the participants from the Community Colleges were found in the library, computer labs, and cafeterias. In the four-year public schools, the majority of Latinos/as were found in Multicultural Student Centers, Ethnic and Cultural Center, CAMP program offices, Instructional Centers, McNair Achievement Program offices, and Chicano/a Latino/a Student Centers. In total, 70 Latina and 70 Latino students were surveyed. This included students from:

- The three Community College including: 24 Latinas (the age range is 18-24), 31 Latinos (90.3 percent ages 18-24; 6.4 percent ages 25-30; and, 3.2 percent ages 31-50)
- The five four-year public schools: 46 Latinas (95.6 percent ages 18-24, 4.3 percent ages 25-30), 39 Latinos (87.2 percent ages 18-24, 7.6 percent ages 25-30, 5.1 percent ages 31-50)

In addition, 12 Latino/a faculty and staff were surveyed in the Community Colleges and four-year public schools.

Data Analysis: Multiple-choice items were analyzed using the software, Excel. In most analyses, the questions were separated by sex and by type of institution. Open-ended questions were analyzed by looking for response patterns.⁶

RESULTS

Parents' educational background: Participants were asked to note the highest level of education their parents had attained. The results shown in Figure 1 reveal that only 10.3 percent of the Latinos/as surveyed are second-generation college students. Less than 15 out of the 140 Latinos/as surveyed had a parent who pursued a two-year or four-year degree though not all obtained a bachelor's or higher degree. Thus, most of the Latinos/as surveyed are effectively first-generation college students, that is, neither of their parents completed college. It is likely that the lack of direct academic knowledge of Latino/a parents creates an obstacle for their children.

Given the above, Latino/a parents' academic experience to guide and/or orient their children to choose a major or succeed in school is limited. As one participant stated, "Well Latinos/as do not have the [academic] support in the household. For example, if we have questions, we can't turn to our parents for help, and [we] are usually too embarrassed to ask the teacher...so we just drop math." Another student supports this view by saying, "I think Latinos/as are discouraged because...most of them come from a background where parents knew very little math." Latinos/as lack the encouragement and essential academic support from their parents to attend higher education institutions and pursue a degree in mathematics.

One consequence of the lack of academic experience of Latino/a parents is that many do not recognize the difference between two-year and four-year colleges. Thus, they may not guide their children in making decisions about pursuing a four-year degree or choosing a major. Further, since they may not know the difference between two-year and four-year degrees, Latino/a parents may expect their children to finish school faster. Thus, the students may find themselves

⁶At three community colleges and four universities, fifteen or more surveys were collected. At one university, five surveys were collected.

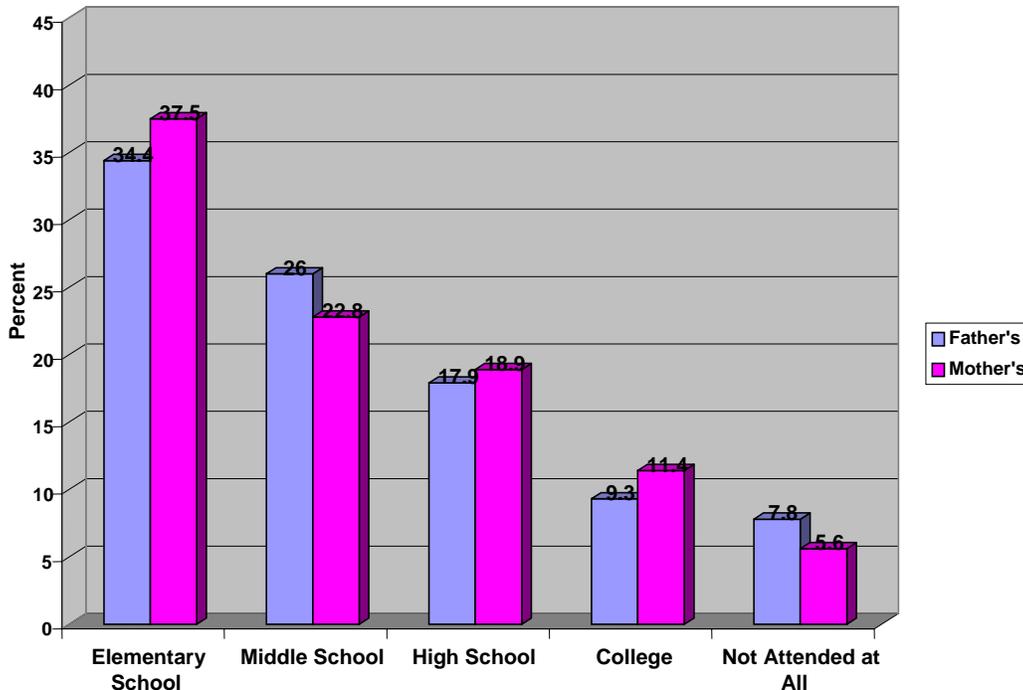


Figure 1. Highest Level of Educational Attainment by Latino/a Parents

compelled to decide on their own between two-year and four-year degree. As one Latina stated: “My family doesn’t really know the difference [between a two-year and four-year college], so they expect me to graduate quickly.” Another participant noted, “College is expensive and Latino families feel it is so expensive as to be unattainable. They are unaware of the availability [of] scholarships.” Further, since Latino/a parents are unschooled, Latino/a students are unlikely to have their parents' guidance on the availability of financial aid and filling out application forms for financial aid and admissions.

The socioeconomic status (SES) of Latinos/as may also play a role in their educational prospects. Because Latino/a parents do not have college degrees, they are more likely to earn lower incomes than people who do. For instance, according to the Postsecondary Education Opportunity report (2003), in 2003 the median earnings for a person who had less than a high school education was \$22,584; high school graduates earned \$29,800; and, those with a Bachelor's degree earned \$48,896. It is clear, then, that education matters and makes a difference in earnings. Because 90 percent of Latino/a parents have completed high school or less, their median average earnings is likely to be roughly \$26,000. When compared to the median earnings of someone holding a bachelor's degree, the difference is almost half making it difficult for their children to attend four-year institutions. For example, the tuition for a student taking 36 to 54 credits at WWCC for the 2004-2005 varied from \$2,311 to \$2,602 (Office of Admissions and Registration, Walla Walla Community College, 2004). At WSU the tuition cost for two 10-18 credits semester was \$5,154 plus \$474 in mandatory fees or \$5,628 for the 2004-2005 school year (Office of Student Financial Aid, 2004). Thus the SES of unschooled Latino/a parents may be the key for Latino/a students deciding whether to attend two-year or four-year colleges.

In summary, parents' educational background is likely to influence Latinos/as choice of attending a two-year or a four-year college. Some of the reasons given by participants in the study to attend two-year colleges include: two-year colleges are more affordable, closer to home (to help family with rent), and faster to graduate from and start working. One Latino wrote, “I think that we as Latinos/as (not everyone but most) because of our socioeconomic status and

responsibilities with the family, we just pursue a two-year degree.” Likewise, a Latina stated, “I think...if they [Latinos/as] lack the [financial] resources to attend higher education they won’t [attend at all]. I came from a poor family and because we lack money [financial resources], my educational opportunity has had to be limited.”

Lack of Latino/a role models: Latinos/as from the sample repeatedly noted the low number of Latino/a instructor or professors in higher education, especially in mathematics. Question number three asked, “Statistics show that mathematics is a field predominantly and traditionally dominated by white men. Why do you think this is?” Their responses are summarized in Figure 2.

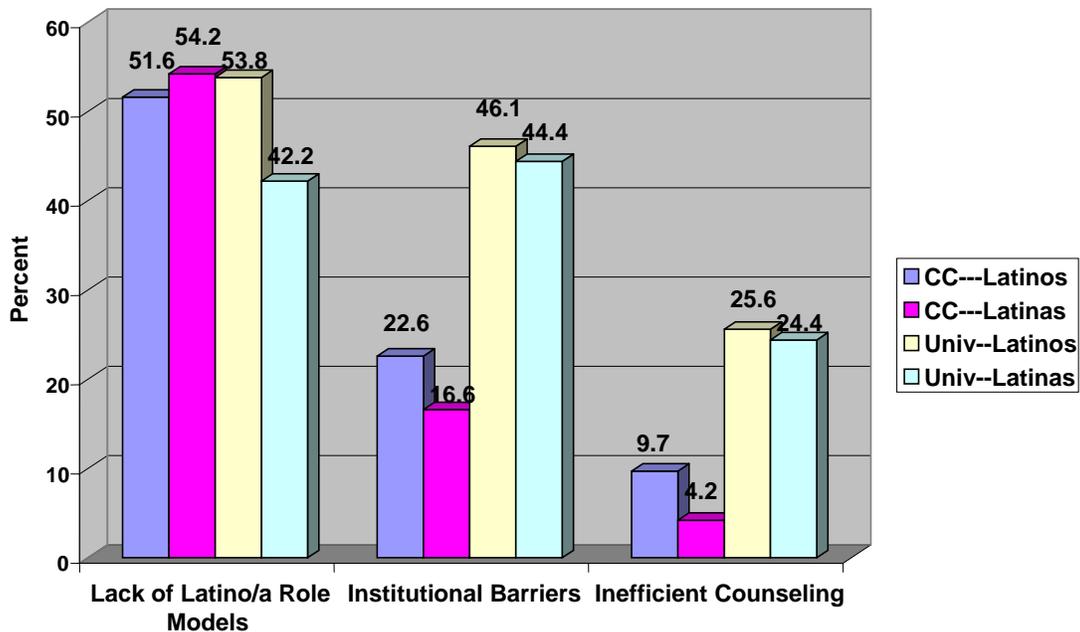


Figure 2. Reasons Given for Why Mathematics is White-Male Dominated Discipline

As illustrated in Figure 2, approximately half of the Latinos/as surveyed agree that the lack of Latino/a role models is a major reason why mathematics is white-male dominated. This is consistent with nation-wide statistics showing the under-representation of minorities, especially Latinos/as, in faculty positions. In 1999, according to the National Center of Education Statistics (2003), Hispanics accounted for only 2.9 percent of all full-time instructional faculty.⁷ Further, only 1.8 percent were professors in two-year and four-year colleges. Since the number of Latino/a faculty is considerably low, the number of Latino/a mathematics faculty may be even lower. In other words, the Latinos/as’ notion that there are few Latino/a faculty role models is a reality in higher education and mathematics.

In addition, Latinos/as in universities are more likely than Latinos/as attending Community Colleges to face institutional barriers that influence the white-male dominance of mathematics. For example, Latinos/as attending universities are more likely than Latinos/as attending Community Colleges to think that inefficient counseling influences the under-representation of Latinos/as in mathematics and other minorities. This, then, contributes to their perception that mathematics is likely to remain a white-male dominated field.

⁷Full-time instructional faculty includes professors, associate professors, assistant professors, instructors, lecturers, and adjunct faculty.

Two questions in the survey were designed to determine how institutional barriers and inefficient counseling influence Latinos/as who go to higher education institutions choose majors other than mathematics. Question numbers eight and nine asked: “Do you think that there are institutional barriers preventing Latinos/as from majoring in mathematics?” and, “In your opinion, do you think that counselors in high school and in college encourage students to pursue academic or vocational careers?” The findings are summarized in Table 1.

These results show that Latinos/as enrolled in universities are more likely than Latinos/as who attend Community Colleges to see institutional barriers as an obstacle to majoring in mathematics. Latinos/as attending universities are more likely than Latinos/as enrolled in Community College to highlight the role of counselors in encouraging them to choose academic over vocational careers. Ironically, Latinos/as attending Community Colleges are more likely than Latinos/as who attend universities to think that counselors encourage academics. Latinos/as in the universities are more likely to see the impact of inefficient counseling when choosing majors. This suggests that Latinos/as are encouraged to enroll in four-year colleges, but they decide not to due to other factors such as culture, SES, lack of information, and so on.

Interests other than mathematics: Latinos/as, tend to major in more "traditional" or "popular" disciplines than mathematics. Participants repeatedly expressed the feeling that mathematics is not a "traditional" or "popular" major, but did not define what these words meant. In order to decipher this, the participants were asked to identify their majors. The most "popular" majors are displayed in Table 2 below.

Clearly, business, education, and psychology are the primary choices for Latinos/as to pursue a bachelor's degree. As one Latina pointed out, "I know Latinos/as who are math teachers . . . [If other] Latinos/as don't go into mathematics it's because they are not interested in math." Another Latina remarked, "It's all the different majors that one can decide upon and there are a limited number of Latinos/as who actually pursue a major. Therefore, other majors may seem appropriate (attractive) or it's more interesting to the [Latino/a] student." Latinos/as tend to pursue degrees in fields more popular than mathematics. As a Latina wrote, "people do not encourage children to major in math; they mention other more popular traditional majors."

The notion of popular majors for Latinos/as is supported by the related literature. For instance, according to the NCES (2003), in the 1999-2000 academic year, Hispanics' the "most popular fields of study" in which to obtain a bachelor's degree were business, social science/history, psychology, education, and engineering/engineering related technologies. The pattern continues in graduate school. For the masters' degrees, the most popular fields of study for Hispanics were education, business, health professions and related sciences, public administration and services, psychology, and engineering/engineering related technologies. For PhD's degrees, Hispanics' most popular fields include education, psychology, biological sciences and life sciences, social science/history, and engineering/engineering related technologies, (NCES, 2003).

Lack of information about the career opportunities with a degree in mathematics: From the survey results, Latinos/as persistently declared that all a mathematician can do is teach. As one Latino stated, "Latinos/as are more into fast and easier careers that do not involve teaching." Another wrote, "I think that most of the Latinos/as are more like[ly to go] into business and engineering, not in teaching." This illustrates the notion that Latinos/as do not know the career opportunities available in mathematics other than teaching. There are different options within mathematics degrees including actuary, statistics, operational research analyst, as well as applied and theoretical mathematics.⁸

⁸For more information about the definition, work nature of mathematics graduates, and related occupations with a degree in mathematics, please consult the book *Great Jobs for Math Majors*, by Stephen Lambert and Ruth J. DeCotis, or the interested reader may visit the Bureau of Labor Statistics website at <http://www.bls.gov/oco/ocos043.htm>.

Table 1. Perceived Institutional Barriers and Quality of Counseling in Community Colleges and Public Four-year Universities

		Community Colleges					
		Latinas			Latinos		
Perceived Institutional Barriers		Yes	No	Undecided	Yes	No	Undecided
N		2	11	7	13	7	4
%		8.3	45.8	41.7	22.6	51.6	19.4
Perceived Inefficient Counseling		Academic	Vocational	Undecided	Academic	Vocational	Undecided
N		9	1	12	10	6	15
%		37.5	4.2	50	32.3	19.3	48.4
		Four-year Universities					
		Latinas			Latinos		
Perceived Institutional Barriers		Yes	No	Undecided	Yes	No	Undecided
N		22	5	18	24	9	4
%		39.1	30.4	28.3	43.6	30.8	23.1
Perceived Inefficient Counseling		Academic	Vocational	Undecided	Academic	Vocational	Undecided
N		9	16	19	6	10	22
%		19.5	34.8	41.3	15.4	25.6	56.4

Table 2. Majors reported by Latinos/as in Community Colleges and Universities

Majors	Latinas				Latinos				Total Combined	
	CC		Univ		CC		Univ		N	%
	N	%	N	%	N	%	N	%		
Business	6	25.0	8	17.4	4	12.9	4	10.3	22	15.7
Education	3	12.5	10	21.7	6	19.4	1	2.5	20	14.3
Psychology	1	4.1	6	13.0	0	0.0	3	7.7	10	7.1
Engineering	0	0.0	3	6.5	4	12.9	3	7.7	10	7.1
Management	0	0.0	1	2.2	0	0.0	4	10.3	5	3.6
Info. System										
Spanish	1	4.1	4	8.7	0	0.0	1	2.5	6	4.3
Nursing	4	16.7	0	0.0	1	0.0	0	0	5	3.6
Mathematics	0	0.0	1	2.2	0	0.0	0	0	1	0.7

Latinos/as in universities were more likely than Latinos/as from the Community Colleges to know the careers available with a degree in mathematics. Even though Latinos/as in the universities thought they knew what mathematicians could do, they only asserted at two careers for mathematicians: teaching and statistics. The significance of these findings is that, in

Washington, Latinos/as are not aware of the large number of possible career opportunities for those with a degree in mathematics and therefore are not likely to be attracted to mathematics as a viable major.

The assumption that mathematics is extremely complicated and “hard:” Latino/a Students acknowledged that mathematics was not their strongest academic subject by indicating that mathematics concepts are difficult to grasp, the terminology is overwhelming, and rules are too extensive. Some of the responses from participants related to mathematics include, “It’s hard to pass the classes,” “math is too hard of a subject,” “most Latinos/as dislike or have a hard time learning mathematics,” and “math is usually very difficult to excel in.” Thus, the following question emerges: In general, how do they view mathematics? The responses are reported in Figure 3.

The findings reveal that Latinos/as in the Community Colleges are more likely than Latinos/as at the university level to dislike mathematics. In general, Latinas are more likely than Latinos to dislike mathematics. More than one fourth of Latinos/as from the Community Colleges and universities expressed the feeling that mathematics has too many concepts. Additionally, with the exception of Latinas in universities, more than one fourth of Latinos/as in the two-year and four-year colleges are likely to see mathematics having too many rules. Latinas are less likely than Latinos to find mathematics confusing. However, the greatest disparity appears with Latinas in universities; more than forty percent found mathematics to be “confusing.”

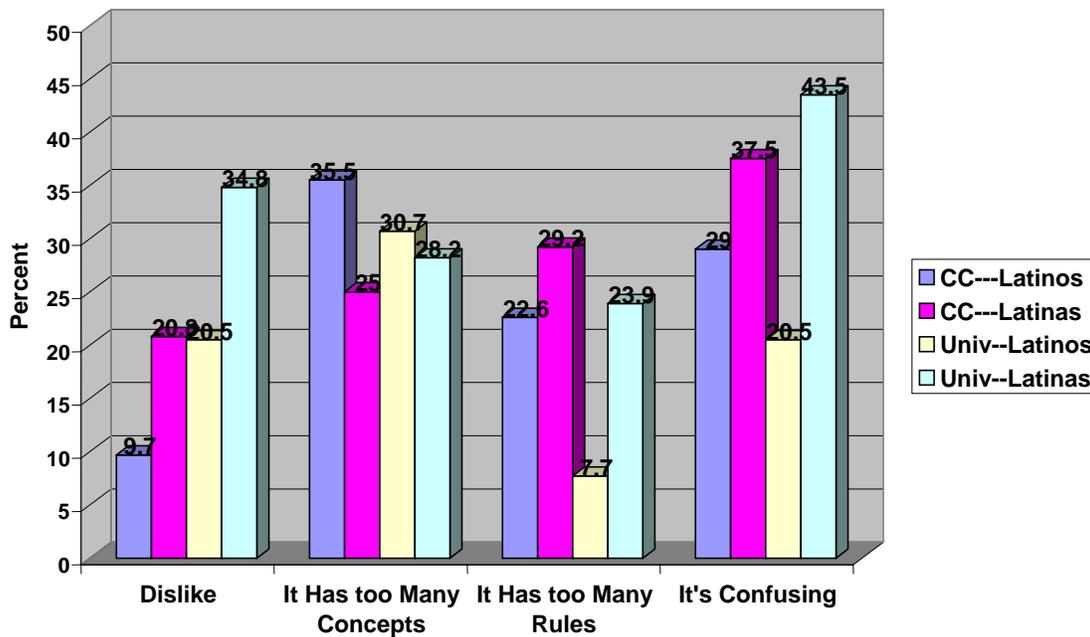


Figure 3. Students’ Views of Mathematics

While Latinos/as recognized that mathematics is not that easy to learn, they also recognized that mathematics is useful and interesting (see Figure 4).

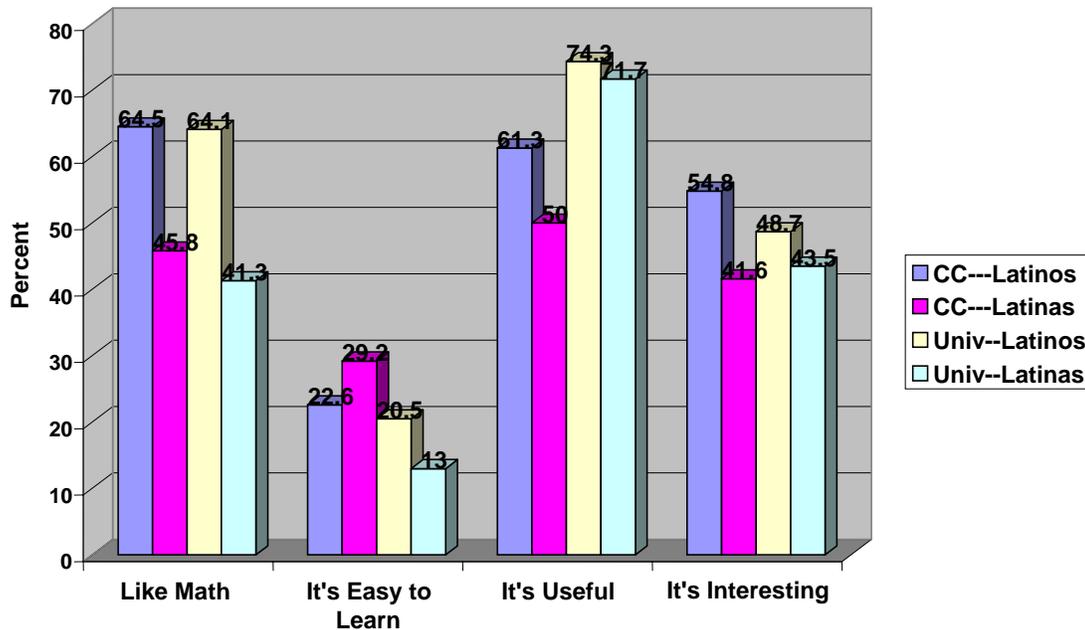


Figure 4. Latinos/as views of mathematics as a field of study

Latinos/as in Community Colleges are more likely than Latinos/as from universities to like mathematics. More than one fifth of the Latinos/as in the Community College sees mathematics as being easy to learn. Interestingly, Latinas from the Community Colleges are twice as likely as Latinas attending four-year public schools to view mathematics as easy to learn. Latinos/as in universities are more likely than Latinos/as in Community Colleges to see mathematics as being useful. More than 40 percent of Latinos/as in Community Colleges and universities describe mathematics as being interesting. In general, then, Latinos/as are likely to have a positive view of mathematics. Nevertheless, they are still likely to choose majors other than mathematics.

Mathematics is time-consuming: Latinos/as stated that mathematics is time-consuming ---It takes a long time to do a mathematics assignment and in order to work as a mathematician. However, engineering is a field of study that requires time, high-quality study habits, and an extensive application of mathematics. Engineering is a very challenging major and that requires an average of four and half to five years to earn a bachelor's degree. In sum, an engineering degree is a time-consuming discipline. Surprisingly in 2001, Latinos/as received 4,016 bachelor's degrees in engineering⁹ compared to 625 degrees in mathematics (NCES, 2003). The difference appears to be, then, that Latinos/as assume that the only occupation for mathematicians is teaching and teachers earn a low salary.

The difference between mathematics and engineering, then, largely lies in salaries. Engineers have higher salaries than mathematicians (teaching) with a bachelor's degree. According to the Salary Survey report by Koncz from the National Association of Colleges and Employers (2004), average starting salaries in the U. S. are \$51,297 for computer engineers, \$52,539 for chemical engineers and \$48,578 for mechanical engineers. In contrast, the 2002-03 average starting salary for teachers was \$29,564 (American Federation of Teachers, 2004).

Latinos/as see mathematics leading to a career in teaching, which usually requires a degree higher than a bachelor's degree to earn a decent amount of money. Second, Latinos/as see mathematics as a time-consuming choice. Even though engineering may be a more time-

⁹Engineering: includes aerospace, chemical, civil, electrical, mechanical, and so on

consuming discipline, Latinos/as still major in it because they know that they will earn more money with a bachelor's degree in engineering than with a master's degree in mathematics.

Latino/a cultural¹⁰ influence in their educational choices: Latinos/as are likely to attend higher education institutions located close to home ---usually Community Colleges. Due to the location of the four-year public schools in the state of Washington when Latinos/as decide to stay close to home they limit their academic opportunity to two-year degrees. Likewise, there are cultural gender roles that influence the decisions of Latinos/as to major in a "white-male dominated field" such as mathematics. Latino/a patriarchal culture reinforces gender roles in the community. Participants indicated that these stereotypical gender roles are slowly diminishing, but are still present and affect more heavily the decision Latinas make for educational and career choices. Cultural influences on gendered roles and the perception that mathematics is a white-male profession create barriers for Latinas (see Figure 5).

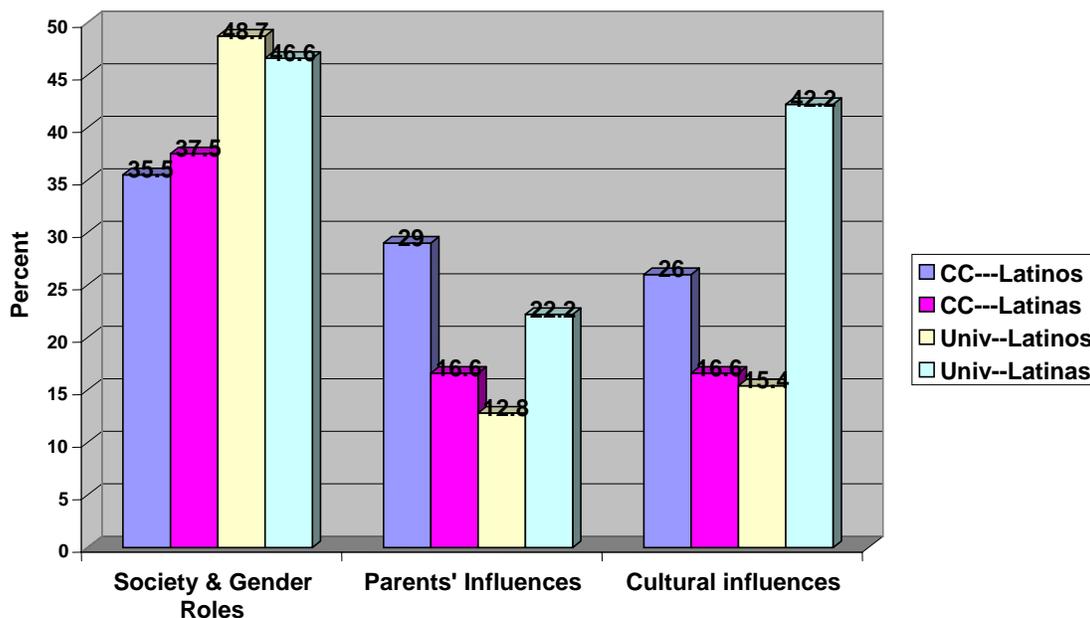


Figure 5. Reasons given for why mathematics is white-male dominated

As the data illustrate, Latinos/as in the universities are more likely than Latinos/as enrolled in Community Colleges to see society and gender roles as an influential reason why mathematics is white-male dominated. Latino/a parents' influences weighed more heavily on Latinos attending a Community College than a university. This may be related to the fact that Latinos in a Community College may have to help their parents with rent. On the other hand, Latinas enrolled in the universities are more likely than Latinas attending a Community College to see parents as an influential factor in their academic choices. In Community Colleges, Latinos are more likely than Latinas to see cultural influences as a factor. Additionally, Latinas in universities are more likely than Latinas in Community Colleges to see cultural influences as a factor influencing mathematics to be white-male dominated. This suggests that further research be conducted to identify factors that allow Latinos/as to break from the cultural influences to attend four-year institutions.

¹⁰In this paper, Latino/a culture refers to Mexican culture because most of the Latinos/as surveyed (more than 90 percent) reported their nationality as Mexican.

Finally, parent involvement may be related to their children's academic attainments. Parents' involvement in school activities is directly linked and crucial to Latinos/as academic attainments (Tinkler, 2002). For instance, Latino/a students "showed greater self-esteem" when parents monitored them and "helped out" with their homework (Tinkler, 2002). However, the definition of parent involvement sometimes differs between teachers and Latino/a parents. For example, a 1999 study by Scribner, Young, and Pedroza in high-performing Hispanic schools in Texas found that teachers identified parent involvement as participating in school events, meetings and tutoring (Tinkler, 2002). Latino/a parents, on the other hand, refer to parent involvement as assisting students with their homework, monitoring their advances in school, providing them with a tutor, and feeding them before going to school. Nevertheless, another more radical definition for parents involvement is suggested by Gerardo Lopez (Tinkler, 2002). In 2001, Lopez observed that the colloquial definition of parent involvement meant to take their children to work in the fields to show them the importance of being educated and having more employment opportunities than an unschooled individual (Tinkler, 2002).

As acknowledged before the definitions of parent involvement may differ from professional and cultural perspectives. Sadly, some teachers fail to distinguish the different definitions of parent involvement and assume that Latino/a parents who do not participate directly or actively in the academic progress of their children do not care for their children's education. The truth is Latino/a parents' value education but often express it differently.

The mainstream educational system: Latinos/as refer to institutional barriers as the lack of academic support by their teachers and the school. One example is that the schools do not provide tutoring program for Latinos/as taking mathematics related classes. In addition, the low expectations of teachers due to the lack of experience and cultural understanding to positively interact with Latinos/as are present. A Latino best describes this by stating: "Many professors don't understand Mexican culture, much less how to teach Chicano students [Latinos/as]."

Another drawback of the mainstream education system is that teachers often ignore the difference between their teaching style and Latino/a learning style. For example, in the U. S. education system, classes and curriculum are generally designed with an individualistic orientation (Nieto, 2000). A Latino remarked, "Professors do not understand that Latinos/as need some extra help due to ESL factors...professors and institutions are not culturally sensitive to these needs." Latinos/as share a cooperative learning style, which is reinforced in the Latino/a culture. As Barri Tinkler (2002) says, "One of the greatest differences between the school culture and Latino home culture is the idea of working cooperatively versus competitively." Tinkler refers to the disconnection of teaching-learning approaches of teacher-student relation versus the Latino/a parents-Latinos/as relation. It is logical to think that Latinos/as should adopt the individualistic oriented learning style because, after all, Latinos/as live and will work in a competitive economic market. The problem is not that teachers use an individualistic or competitive approach to teach Latinos/as; the problem is that this approach is the only one used in the classroom when both individualistic and cooperative styles should be used (Nieto, 2000).

Some Latinos/as mentioned that they had negative experiences at early age and this is why they grew away from mathematics. For instance, one Latina wrote, "well, I know with me all started in elementary school. I was placed in a 'special' mathematics class. It was only me and another girl (both Mexicans), we were separated from our class and were taught simple math --- adding, subtracting etc. After that I hated math. I haven't liked it since. That's why I wouldn't want to major in it." This is not an isolated case. Some Latino/a students expressed that the lack of academic support from their teachers influenced their choice in not majoring in mathematics. Since unschooled Latino/a parents do not know how to encourage their children and in what way they can be helpful in their children's education, then it is up to the education system and teachers to provide the support needed for them to achieve academically.

Tracking is another deterrent in the U. S. educational system that discourages Latinos/as from enrolling in four-year colleges and majoring in mathematics. Three types of tracking were

described by the participants. First, Latinos/as indicated that their peers were tracked into certain classes. These classes were more often vocational classes rather than academic. According to the NCES (2003), in 1998 the distribution of highest level of middle academic¹¹ mathematics courses taken by Latinos/as was 59.1 percent. In contrast, the distribution of highest level of advanced academic¹² mathematics courses taken by Latinos/as was 26.2 percent. Apparently Latinos/as are not encouraged to take advanced mathematics courses, but rather to take the minimum mathematics requirements. Second, many Latinos/as felt that teachers and schools overemphasize language in the curriculum. As a result, teachers focused less on mathematics and more on learning “proper” English. In some schools, Latinos/as are tracked in classes with lower academic curricula, which often do not meet the established standard thus forcing some to drop out of school (Nieto, 2000). Finally, participants noted the practice of teachers and counselors showing favoritism to academic achievers or "college candidates." Latino/as expressed the feeling that counselors and teachers only encourage the more eager academic achievers to pursue a four-year degree. Those Latinos/as who were not academic achievers, were not encourage them to pursue a bachelor's degree, but to take vocational classes and enroll in a Community College. These factors and others from mainstream education influence Latinos/as choice to not majoring in mathematics (see Figure 6).

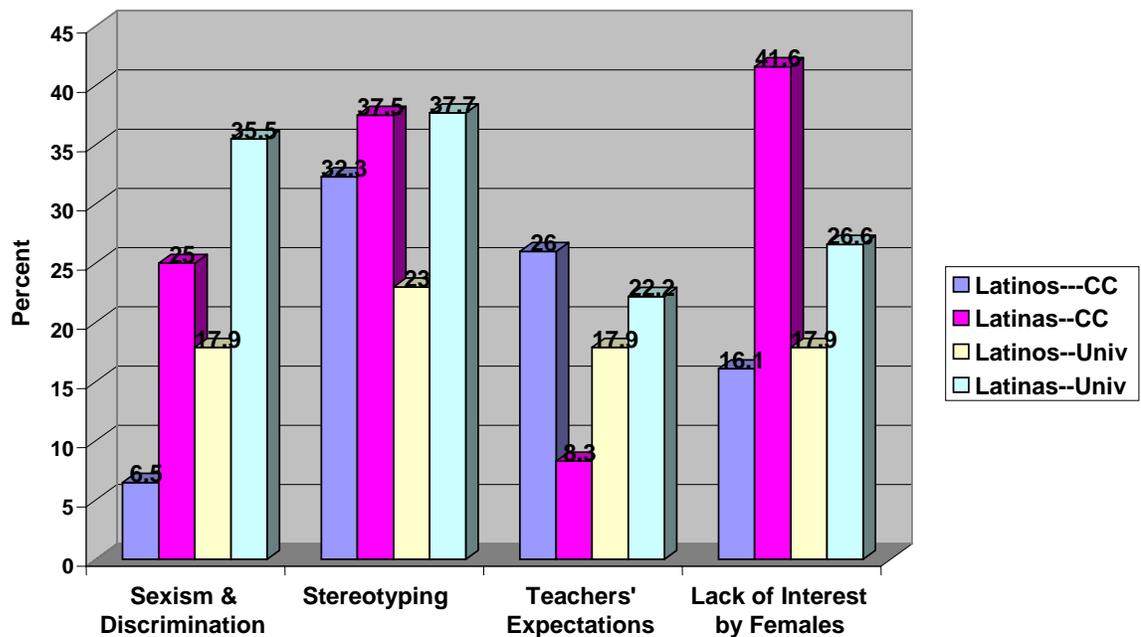


Figure 6. Additional reasons given for why mathematics is white- male dominated

As shown in Figure 6, Latinos/as attending universities are more likely than Latinos in Community Colleges to perceive sexism and discrimination. This is parallel to the feeling Latinos/as have about institutional barriers. Latinas are more likely than Latinos to consider mathematics as a white-male field due to sexism and discrimination. Similarly, Latinas are more likely to suffer from stereotyping than males regardless of the type of institution attended. On the other hand, Latinos in Community Colleges are more likely to see teachers' expectations as a reason why mathematics is a white-male dominated field. In contrast, Latinas are more likely than Latinos to see the impact of teachers' expectations in universities. Latinas are more likely than

¹¹Middle academic courses include algebra I, unified mathematics, and three full-years of mathematics courses such as algebra II and geometry.

¹²Advance academic courses include pre-calculus, calculus, and trigonometry.

Latinos to see the lack of interest by females as the cause of mathematics being white-male dominated. This is especially true for Latinas attending a Community College. Rosser (1995:8) suggests that the reason females are not scientists is because they often are not able to observe the "right things" because the standards regarding what is important and interesting to observe are set by males.

CONCLUSION

Identifying the factors that influence the under-representation of Latinos/as in higher education, especially in mathematics, is the first step to solving the problem. The importance of recognizing the factors that influence Latinos/as decisions to enroll in majors other than mathematics suggests how we might alter the current educational mindsets. Consequently, this places a demand on higher educational institutes to address internal biases both academically and socially. These findings are intended to assist a re-envisioning of research and to secure the SMET workforce demand of the 21st century. To overlook the reality and the importance of Latinos/as as a vital tool for the economic progress of the nation may signify the avoidance of a demand crisis for skilled and talented workers in the technology-based workforce. Unfortunately, avoidance of the problem will not aid the development of a strong economy.

The salient factors identified by the Latinos/as surveyed are: parents' educational background; lack of information about career opportunities with a degree in mathematics; lack of Latino/a role models; other interest than mathematics; the notion that mathematics is too hard and time-consuming; and, finally, the structure of the U. S. educational system. Within each factor there are several "sub-factors." The discussion of the data suggests that these factors overlap creating the interconnections illustrated in Figure 7 below.

The majority of Latino/a parents are unschooled and as a result lack the knowledge to differentiate between two, four, and five year colleges. Unschooled Latino/a parents are less likely to get involved in their children's education at least not in the way teachers expect them to. Financial crisis is yet another determiner that prevents many Latinos/as from attending higher education. Of the Latinos/Latinas surveyed, 90 percent had parents whose educational level consisted of a high school diploma or less. We know from our review of data that a person with a bachelor degree earns almost twice as much as that of a person with a high school diploma. Comparatively, then, a low social economic status equates to less access to higher education.

Latinos/as' perceptions of careers obtainable with a degree in mathematics is limited. Most see teaching as the only career objective of math majors and teaching is often viewed as a mid-to low-income producing career. Latinos/as do not recognize other careers available to those with a degree in mathematics: actuaries, statisticians, mathematicians (applied mathematics, theoretical mathematics, and secondary teaching), and operational research analysts.

The presence of Latino/a role models in higher education and especially in mathematics is a significant factor in choice of majors. The lack of Latino/a role models may contribute to the discipline being white-male dominated and a perpetuation of the status quo. Discrimination and sexism, inefficient counseling, and institutional barriers may increase the under-representation of Latinos/as as mathematics majors.

In addition, mathematics is not described as a "popular" or "traditional" field. The fields Latinos/as find more popular are business, education, and psychology. In addition to mathematics not being a popular discipline, it is frequently viewed as a time-consuming major in which it is necessary to have a master's or PhD to earn a decent income. Latinos/as decide to choose other majors such as engineering that require less amount of time and offer higher salaries than teaching.

In conclusion, the under-representation of Latinos/as in higher education institutions and mathematics in the state of Washington, as elsewhere, is due to several interrelated factors. The lack of education of Latino/a parents, the lack of information about the career opportunities with a

degree in mathematics, the lack of role models, cultural influences and the U. S. educational system itself, interact with one another to influence Latinos/as to choose majors other than mathematics, and finally to lose out on economic gains they might otherwise achieve.

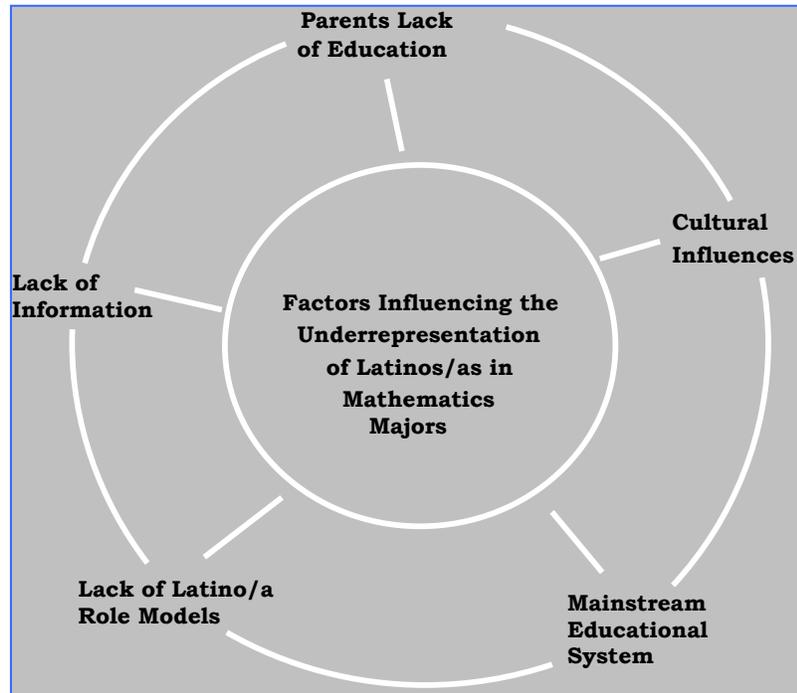


Figure 7

REFERENCES

- American Federation of Teachers. (2004). *2003 Survey and Analysis of Teacher Salary and Trends*. Retrieved October 10, 2004. <<http://www.aft.org/salary/index.htm>>
- Commission on Hispanic Affairs. (2003). *2003 Annual Report*. Retrieved March 2004. <<http://www.cha.wa.gov/pdf/2003annrep.pdf>>
- Committee of Equal Opportunities in Science and Engineering (2000). *2000 Biennial Report to the United States Congress*. Retrieved October 3, 2004. <http://www.nsf.gov/pubs/2001/ceose2000rpt/congress.pdf>
- Guba, G. D. and Lincoln Y. S. (1994). "Competing paradigm in qualitative research." In N. K. Denzin and Y. S. Lincoln (Eds.). *Handbook of qualitative research*. London: SAGE Publications, 105-117.
- Guzman, B. (2001). The Hispanic population: Census 2000 brief. *U.S. Census Bureau*. Retrieved March 2004. <<http://www.census.gov/prod/2001pubs/c2kbr01-3.pdf>>
- Higher Education Coordinating Board Members (2001). Higher education statistics: State of Washington. *Higher Education Coordinating Board*. Retrieved March 2004. <<http://www.hecb.wa.gov/Docs/facts/Factbook.pdf>>
- Ibarra, R. A. (1996). Latino experiences in graduate education: Implications for change. *Council of Graduate Schools*. Washington, DC: Eric Reproduction Services, No. ED 397764.
- Koncz, A. (2004). News from media professionals: Year-end report shows salary gains for class of 2004. *National Association of Colleges and Employers*. Retrieved September 26, 2004. <<http://www.nacweb.org/press/display.asp?year=&prid=197>>

- National Science Foundation. (1998). *Women, Minorities, and Persons with Disabilities in Science and Engineering*. Arlington: NSF.
- National Science Foundation, Division of Science Resources Statistics. (2004). *Women, Minorities, and Persons with Disabilities in Science and Engineering*. Arlington: NSF.
- Nieto, S. (2000). *Affirming Diversity: A Sociopolitical Context of Multicultural Education* (3rd ed.). New York: Longman.
- Office of Admissions and Registration, Walla Walla Community College. (2004). *Tuition and Fees*. Retrieved October 5, 2004. <<http://www.wbcc.edu/admiss/cost.cfm>>
- Office of Students Financial Aid. (2004). *Estimated Costs of Attending Washington State University 2004-2005 Academic Year*. Pullman, Washington: Author. Retrieved October 5, 2004. <http://www.finaid.wsu.edu/colcosts2004_2005.htm#19credits>
- Peters, R. L. (1997). *Getting What You Came For* (Revised edition). New York: Farrar, Straus, and Giroux.
- Postsecondary Education Opportunity. (2003). Education and training pay: unemployment rate in 2003/median earnings in 2002. Retrieved September 25, 2004. <<http://www.postsecondary.org/archives/Posters/EducTrain04.pdf>>
- Rosser, S. V. (1995). *Teaching the Majority: Breaking the Gender Barrier in Science, Mathematics, and Engineering*. New York: Teachers College Press.
- Solórzano, R. W., and Solórzano D. G. (1999). Beginning teacher standards: Impact on second-language and implications for teacher education. *Teacher Education Quarterly*, 26, No. 3. City: publisher.
- State of Washington Commission on Hispanic Affairs. (2001). *Washington State Demographic Highlights*. Retrieved March 2004. <http://www.cha.wa.gov/pdf/2001demographic_highlights.pdf>
- Tinkler, B. (2002). A review on Hispanic/Latino parent involvement in K-12 education. *Assets for Colorado Youth*. Retrieved September 11, 2004. <<http://www.buildassets.org/products/latinoparentreport/latinoparentrept.htm>>
- U.S. Census Bureau. (2004). *Washington Quick Facts*. Retrieved September 25, 2004. <<http://quickfacts.census.gov/qfd/states/53000.html>>
- U.S. Department of Education, National Center for Education Statistics. (2003). *Status and Trends in the Education of Hispanics*. Washington DC: NCES.
- Washington State University Student Data Warehouse. (2004). *Number of Mathematics Majors by Race and Ethnicity 2003/2004* [internal document]. Office of Institutional Research, Washington State University.