

**Support Resources Utilized by Minority Students Majoring in Science, Technology,
Engineering, and Mathematics Disciplines**

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A number of studies have focused on the identification of factors impacting minority students' persistence at four-year colleges and universities. Most of these studies focus on what the students or institutions have done wrong, with fewer studies focusing on the specific factors that successful students, those who have persisted to graduation, have done right to overcome barriers to graduation.

The main objectives of the study are to: a) identify resources utilized by minority students leading to academic success as identified by general and Science, Technology, Engineering, and Mathematics (STEM) discipline retention experts; b) identify the knowledge acquired to access available resources and actions employed to utilize resources by minority students studying in STEM disciplines; c) analyze the associations between resources utilized by graduates of the Hewlett Packard (HP) Scholars Program and the academic majors selected; and d) analyze the associations between resources utilized by HP Scholars and the institutions attended. This study utilized the Padilla Expertise Model of Student Success (1991), with slight modifications, as the theoretical framework.

It is hoped that further research using this framework as a foundation will result in an instrument that is reflective of the needs of minority students studying STEM field disciplines to persist to graduation and will also equip institutions of higher education with the tools to facilitate this success.

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1.0 FIRST CHAPTER

1.1 INTRODUCTION

This study will examine which support resources utilized by graduates of the Hewlett Packard Scholarship Program were instrumental in helping to overcoming barriers to graduation. These minority college students majored in Science, Technology, Engineering, and Mathematics (STEM) fields. The study will also examine what the graduates did to identify and utilize the available support resources resulting in graduation.

To better understand college retention and persistence, it is helpful to briefly examine the history of higher education. For the first 250 years, higher education focused more on institutional survival than on student persistence and retention. In the 1970s and 1980s, public policy focused primarily on access, with federal and state legislation aimed at reducing access barriers to higher education. By the mid 1990s, the discussion moved from the issue of access to issues of choice, affordability, and persistence. Although gaining entry to college is a dramatic accomplishment for some, persisting to degree attainment is most important to the college (Swail, 2000). As the overall trend of degree attainment increases, the expectation that a college degree is a valuable asset also increases. In the competition for entry into higher paying professional positions, a college degree means more than having a high school diploma with only some college education.

The 1990s might be called the era of “persistence.” Persistence and retention as distinct concepts began to fully emerge in the late 1990s. Persistence refers to the desire and action of a student to stay within the system of higher education from beginning year through degree completion while retention refers to the ability of an institution to retain a student from admission to the university through graduation (Seidman, 2005a). More and more, scholars and practitioners began to realize that, while retention is an important concept for many students and for campuses themselves, many students attend more than one college to earn an undergraduate degree. Therefore, student success increasingly has been recognized as the ability to persist to the completion of a degree at *one or more* colleges (Seidman, 2005a).

1.1.1 Problem Statement

While student enrollment has increased yearly, the ability to keep students in school remains a difficult challenge and persisting to graduation a greater challenge. Most researchers generally agree that factors contributing to minority student retention are multifaceted and that non-academic factors play a critical role; however, there is less agreement regarding the identity, extent, and measurability of these retention factors (Tracey & Sedlacek, 1985).

In addressing the minority student retention and persistence challenge, most research and academic achievement has focused on the perspective of student or institutional failure (Pascarella & Terenzini, 1991) – what students or institutions did wrong that lead to the student dropping out or failing. Rather than examine what students and institutions do wrong that lead to failure or departure, this study will focus on what students are doing right that leads to academic achievement and persistence to graduation with degrees in STEM fields.

1.1.2 Purpose Statement

The purpose of this research is to explore which support resources were utilized by graduates of the Hewlett Packard (HP) Scholars Program to overcome barriers to successful completion of their Bachelor's Degree program. Graduating from college within six years of enrollment is the measurement of academic success in this study. The results of this study will be compiled into a guide for future HP Scholarship recipients as well as other minority students studying in the STEM fields, to further increase their chances of persisting to graduation.

1.1.3 Research Questions

The following research questions guide this dissertation study:

1. Which support resources were utilized by Hewlett Packard Scholarship recipients to overcome potential barriers to academic success?
 - 1a. What did HP Scholars Program graduates do to identify resources?
 - 1b. Did HP Scholars Program graduates utilize available resources? If so, what did graduate do to utilize available resources?
2. What associations are there between the resources utilized and the Science, Technology, or Engineering major selected?
3. What are the characteristics of students who have graduated from the HP Scholars Program?
4. What were the overall perceptions of the HP Scholars regarding their undergraduate college experience (e.g., major selected, institutional experience)?

Table 1 Research Questions - Literature Source

Research Question	Literature Source
Q1. Which support resources were utilized by Hewlett Packard Scholarship recipients to overcome potential barriers to academic success?	Sedlacek (1987) suggests that decision and practices regarding minority students should take into consideration non-cognitive factors in order to impact retention and graduation positively.
Q1a-Q1b. What did HP Scholars Program graduates do to identify resources? Did HP Scholars Program graduates utilize available resources? If so, what did graduate do to utilize available resources?	Padilla (1991) suggests that successful minority college students are those students who become experts at being successful at a specific institution. Those students have mastered the required coursework, learned the necessary campus protocol, and have taken timely and appropriate actions to triumph over the barriers most commonly experienced by minority students.
Q2. What associations are there between the resources utilized and the Science, Technology, or Engineering major selected?	Jackson (2003) reports that one of the most significant decisions student must make is deciding what field of study to select as their major and which resources to use that will support their decision. Higher Education administrators cannot just re-divide the resource pie, but must allocate fresh resources to expand educational opportunities in mathematics and science for under-represented groups.
Q3. What are the characteristics of students who have graduated from the HP Scholars Program?	Padilla et al. (1997) developed a minimal local model of successful minority students that incorporates the three factors most often studied regarding minority student success: (1) Pre-college experience and knowledge – academic preparation; (2) Support systems – integration and involvement; and (3) Internal and external awareness (understanding of self and environment) – psychosocial development and personal characteristics.
Q4. What were the overall perceptions of the HP Scholars regarding their undergraduate college experience (e.g., major selected, institutional experience)?	Astin (1993) collected longitudinal data on 24,847 students at 309 different institutions and determined the influences of a host of institutional characteristics on the students' college experience and perceptions of and satisfaction with the college experience.

1.1.4 Significance of Study

Historically, rates of graduation have been exceedingly stable. Dating back to the late 19th century, four-year graduation rates have consistently been around 45 percent with the exception of the period around World War II that saw a large volume of students departing to serve in the war (Tinto, 1982). However, the current median institutional four-year graduation rate is 32 percent (Carey, 2004).

Given the fact that the United States' population is becoming increasingly more diverse, addressing minority student retention and persistence is a top priority for university and college administrators (Swail, Redd, & Perna, 2003). By 2050, The U.S. Census Bureau projects that the minority population will represent approximately 50 percent of the total U.S. population, meaning racially diverse people will no longer be a numerical minority (2004).

In a recent report by the U.S. Census Bureau (2007), director Louis Kincannon notes, "About one in three U.S. residents is a minority; to put this statistic into perspective, there are more minorities in this country today than there were people in the United States in 1910. In fact, the minority population in the U.S. is larger than the total population of all but 11 countries" (p. 1). In 1910, the United States' population was 92.2 million; on October 17, 2006 the U.S. Census Bureau reported that the overall population had topped 300 million. California had a minority population of 20.7 million, 21 percent of the nation's total; Texas had a minority population of 12.2 million, 12 percent of the nation's total (U.S. Census Bureau, 2007).

During the July 1, 2005 to July 1, 2006 period another milestone was reached (see Table 2): the nation's Black population surpassed 40 million, while the Native Hawaiian and Other Pacific Islander group reached the one million mark. Hispanic remained the largest minority group, with 44.3 million on July 1, 2006, and represented 14.8 percent of the total population.

Black was the second largest minority group, totaling 40.2 million in 2006. They were followed by Asian (14.9 million), American Indian and Alaska Native (4.5 million), and Native Hawaiian and Other Pacific Islander (one million). The population of non-Hispanic Whites who indicated no other race totaled 198.7 million in 2006 (U.S. Census Bureau, 2007).

Table 2: Population by Race

	July 1, 2006 Population	July 1, 2005 Population	Numeric Change July 1, 2005 to July 1, 2006	Percent Change July 1, 2005 to July 1, 2006	Percent of Total Population
White Alone or in Combination*	243,825,488	241,837,199	1,988,289	0.82	81.44
Black Alone or in Combination*	40,240,898	39,718,528	522,370	1.32	13.44
AIAN Alone or in Combination*	4,497,895	4,453,026	44,869	1.01	1.50
Asian Alone or in Combination*	14,907,198	14,447,663	459,535	3.18	4.98
NHPI Alone or in Combination*	1,007,644	991,067	16,577	1.67	0.34
Non-Hispanic	255,077,446	253,634,970	1,442,476	0.57	85.20
Hispanic	44,321,038	42,872,091	1,448,947	3.38	14.80
Non-Hispanic, White Alone	198,744,494	198,235,448	509,046	0.26	66.38

AIAN = Asian American and Alaska Native

NHPI = Native Hawaiian/Pacific Islander

*In combination means those respondents who may or may not report another race on their Individual Census Report form. The Census form allows individuals to select multiple race categories. If the number of people in these categories is calculated, it will equal the total number of respondents and will generally exceed the total population.

Source: U.S. Census, 2007.

While the “major minority” population in the U.S. continues to increase, its flagship public institutions of higher education have embarrassingly low persistence rates among minority students. In 2050, it will be the first time in the history of the United States that Caucasians have not been the majority; presenting some very interesting challenges for educational institutions. Higher education in the United States will be compelled to change to reflect the shift in population (Riche, 2000).

In order for colleges and universities to meet the demands of the 21st century's technology- and science-driven workforce, and in accordance with the growing diversity of the population, they must increase efforts to decrease the attrition rates of minorities from the STEM fields. With the changing demographic composition of the U.S., the make-up of the future workforce will be impacted as well. Consequently, due to the current shortage of minorities graduating in STEM disciplines, it is incumbent that a qualified pool of diverse individuals are prepared to populate the workplace. Conducting research on the support resources utilized by the HP Scholars can offer insight to college and university administrators into what is working for their successful students.

The STEM dropout rates for Native American, Hispanics, and African Americans are substantially higher than those of Caucasians or Asians (Morrison, 1995). Approximately half of the African American and Native American freshmen entering STEM drop out or switch majors, and two-thirds of Hispanic students do not complete their degrees (Astin, 1993). J. L. White's review (as cited in National Science Board, 2002) reported that African American, Hispanic, and Native American students accounted for only 12 percent of the total STEM degrees awarded nationally in 1998. To increase the pool of available resources in the STEM fields, minority graduation rates must improve.

The status of minorities in STEM fields is also under the watchful eye of the United States Government. Public Law 96-516, the National Science Foundation Authorization and Technology Equal Opportunities Act, Part B: Women, Minorities, Science, and Technology, requires the Director of the National Science Foundation (NSF) to submit biennial reports to the U.S. Congress on the status of women, minorities, and the disabled in science and technology, by race, sex, and ethnic group (Library of Congress, 1980).

What can be done to turn these dismal statistics around? While there is no single solution, student involvement has been shown to have specific benefits for various subgroups of students on campus, particularly for students from underrepresented populations (Berger & Milem, 1999).

1.1.5 Definition of Terms

Within the context of this study, a number of terms will be used to discuss student retention and the HP Scholars Program. The following definitions will provide uniformity and a common understanding of the terms that appear throughout the study.

Attrition – occurs when students fail to re-enroll at an institution in consecutive semesters (Seidman, 2005a).

Behavior – specific actions employed or taken by students to overcome barriers to academic success.

Barriers – as defined by retention researchers, common barriers include: 1) academic unpreparedness; 2) lack of academic integration and involvement; and 3) lack of development in non-academic factors (e.g., self confidence, self appraisal, goal planning, strong support system – institution, family, peer, community) (Seidman, 2005a).

Degree completion - for the purpose of this study, degree completion should take place uninterrupted within six years, as is the standard in the Department of Education graduation rate studies (Carey, 2004). Many studies use the six-year timeframe to allow for students who did not attend full-time and students who change majors, both instances delaying an otherwise four-year college completion term.

Dismissal – refers to students who are not permitted by the institution to continue enrollment (Seidman, 2005a).

Dropout – refers to a student whose initial educational goal was to complete at least a Bachelor’s Degree but did not complete it (Seidman, 2005a).

Hewlett Packard (HP) Scholar – African American, Latino, and American Indian high school seniors or community college transfer students who will be attending one of the HP Scholar partnership universities and will be majoring in computer science, computer engineering, electrical engineering.¹

Mortality – refers to the failure of students to remain in college until graduation (Seidman, 2005a).

Persistence – refers to the desire and action of a student to stay within the system of higher education from beginning year through degree completion (Seidman, 2005a).

Retention – refers to the ability of an institution to retain a student from admission to the university through graduation (Seidman, 2005a).

Withdrawal – refers to the departure of a student from a college or university campus (Seidman, 2005a).

Minority – for the purpose of this study, the term “minority” will include Black, Hispanic, or American Indian as determined by HP for their scholars program. The definitions for these ethnicities are from Title VII of the Civil Rights Act of 1964, which uses Equal Employment Opportunity Form EEO-1. The definitions are as follows: **a) Black (not of Hispanic origin)** – All persons having origins in any of the Black racial groups of Africa; **b) Hispanic** – All persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture of origin,

¹ In the early years of the Scholars Program, eligible disciplines included mechanical engineering and woman’s studies; but as a result of ongoing Program evaluations these disciplines are no longer eligible.

regardless of race; and **c) American Indian or Alaskan Native** – All persons having origins in any of the original peoples of North America, and who maintain cultural identification through tribal affiliation or community recognition (Civil Rights Act, 1964).

Partner Institution – colleges/universities that HP Scholars can attend (Current Institutions: San Jose State University, University of California - Los Angeles, North Carolina A&T, Morgan State University, or University of Washington; Former Institutions: Northeastern University, Santa Clara University, and Wentworth Institute of Technology).

Science, Technology, Engineering, and Mathematics (STEM) – STEM disciplines are those fields of study selected by students majoring in science, technology, engineering, or mathematics.

Underrepresented Minority – the HP Scholarship has defined an underrepresented minority for the scholarship qualification process as racial and ethnic populations that are underrepresented in higher education relative to the number of individuals who are members of the population involved. In the Science and Technology studies category, this would include Black or African American, Hispanic or Latino, and American Indian students.

1.1.6 Hewlett Packard Scholarship Program

The HP Scholar Award (Hewlett Packard, 2005) is a scholarship opportunity for students interested in pursuing electrical engineering, computer engineering, or computer science majors at selected partner institutions. The total value of the four-year cash scholarship, HP Scholar Productivity Package, and the three paid summer internships exceeds \$40,000 per student. Scholarship awards are \$12,000 (\$3,000 per year for four years) and are intended to help defray educational expenses. Upon acceptance into the program, each HP Scholar receives a

Productivity Package which includes an HP laptop, printer, and PDA. A valuable part of the HP Scholar experience is the internship opportunity. HP Scholars are eligible for three paid summer internships with HP at one of the U.S. locations during the course of their undergraduate work.

The HP Scholar Program offers scholarship opportunities to select underrepresented minority (African American, Latino, or American Indian) students who will pursue a Bachelor of Science Degree in computer science, computer engineering, or electrical engineering at an HP Scholar partnership university. High school seniors and community college transfers that are preparing to attend one of the partnership universities are invited to apply for this scholarship prior to enrollment at the university. Applicants to the HP Scholars Program are evaluated on the following criteria:

- 1) Academic achievement;
- 2) Financial need;
- 3) Family's educational history (priority is given to first generation students);
- 4) Letters of recommendation (from advisor/teacher on official school letterhead);
- 5) Personal statement (communication skills, personal and professional qualities, community involvement, etc.);
- 6) Demonstrated interest in math, science, and engineering;
- 7) Intended major (Computer Science, Computer Engineering, or Electrical Engineering); and
- 8) Willingness to work at major HP locations – California, Colorado, Idaho, Oregon, Washington, and Texas (HP offers students a relocation package to assist students who will need to move to and from the HP location for their summer internship). (Hewlett Packard, 2005)

HP may evaluate exceptions to the selection requirements and criteria on an individual basis.

The original intent in developing the HP Scholars Program was to help increase the numbers of underrepresented minorities entering technical careers. After ongoing program evaluation, HP realized that this initiative would be more effective if participation was tied to the recruitment efforts of the minority engineering program offices at universities where HP already had a recruiting relationship. This effort would provide more effective marketing on the front end of the recruitment process by allowing the university to assist with the application process, resulting in a longer term partnership with the scholars. As part of the program development process, when committed internships were added as part of the scholarship package, the need to put constraints on the number of participating schools also became imperative.

Recruitment of the HP Scholars begins with the minority programs office at each of the partner schools conducting the initial review and sending HP the students' rank order; subsequently, the HP team reviews the applications again and makes the final selection.

There is an on-going effort by the HP Scholars Program manager to carefully evaluate the math SAT score of applicants; while not a perfect predictor of success, it could prove to be a useful tool in the selection process. In addition, HP has begun to examine supply and demand; how does the supply of students meet the demands of the HP workforce? Currently, this means that HP could place a greater emphasis on hiring more computer science majors than electrical engineers in the future, a trend that has continued over the past several years. This evolving trend to hire more computer science graduates is now factored into the student internship commitment.

As the HP scholars Program becomes more dynamic, HP is strengthening relationships with campus representatives to provide hands-on assistance to the students.

1.2 BACKGROUND ON MINORITY STUDENT RETENTION

Retention literature in the United States goes back to at least the beginning of the 20th century. From the beginning, researchers were interested in retention and attrition and their effects on students and colleges. However, it was not until the emergence of mass higher education following World War II, with its burgeoning enrollments and diverse populations, that retention and attrition studies resulted in models that offered transferable solutions to individual problems. Minority college student retention was not a primary focus of early retention researchers (Gaither, 2005).

The report, “A Matter of Degrees: Improving Graduation Rates in Four-Year Colleges and Universities,” notes, “While there has been an increase in the overall graduation rates, completion rates for African American, Hispanic, and Native American students continue to lag behind their peers” (Carey, 2004) (see Table 3). Addressing and resolving the problem of minorities graduating at disproportionate rates is currently a primary emphasis among scholars interested in student retention and persistence (Carey, 2005).

Six years is the time frame most often used to measure graduation rates. But one should not lose sight of the fact that these are, after all, “four-year” institutions. Since that’s the norm, why tack on two extra years (Carey, 2004)?

In fact, most B.A.-granting institutions are “four-year” colleges in name only. The *large majority* of students don’t graduate “on time” by that measure. A solid majority of beginning, degree-seeking four-year students—63 percent—get a B.A. within six years. Only 37% get a B.A. in four years. In other words, four out of every 10 students who successfully get a B.A. within six years take longer than four years to do so. Institutional graduation rates show a similar pattern. The median institutional four-year grad rate is 32 percent. Barely a quarter of all four-

year institutions graduate more than 50 percent of their students in four years or less (Carey, 2004).

Because a huge number of students successfully complete college during those additional two years, it makes sense to take them into account in gauging postsecondary success. But that does not mean one should lose sight of the four-year completion goal, simply because most people don't meet it. Extra time for degree completion comes at a significant cost, both to the student and to the institution, resources that might be better spent elsewhere. (Carey, 2004).

The negative impact of low completion rates has been largely masked in recent years, because the number of students entering the system has been rising. The percentage of students going on to two-year or four-year colleges and universities increased from less than half in 1975 to almost two-thirds in 2001, with the biggest gains among female and low-income students (Carey 2004). Reviewing overall graduation rates is paramount in comparing and understanding the graduation rates of minorities, and for the purpose of this study, students pursuing undergraduate degrees in STEM disciplines.

Table 3: Six Year Graduation Rates

	Six Year Graduation Rate
Total	63%
Low-Income	54%
High-Income	77%
African American	46%
Latino	47%
White	67%
Men	59%
Women	66%

Source: Carey, 2004.

What is the impact of attrition on higher education? Attrition results in a severe loss of resources by society, by students, and by colleges that spend to provide programs and services to help retain and graduate students. When a student leaves college prematurely, any debt incurred must be repaid, despite the failure to graduate, and the college loses future funding in the form of tuition and fees and auxiliary services (bookstore, food services, and so forth) generated over time. The surrounding college community that supports the college (restaurants, movie theatres, etc.) also suffers an adverse economic impact when the student leaves (Carey, 2004, 2005). In addition, students may be turned off to the educational system in general, never returning to benefit from educational opportunities that may have helped with job attainment, enhancement, or advancement (Seidman, 2005b). The attainment of any postsecondary degree, in particular, a baccalaureate degree, often results in a greater earning potential for minority populations (Carter, 2006).

While there are no guarantees in life with or without a college degree, the odds are increasingly stacked against those with the least education. Education has a profound impact on both the individual and society at large and is one of the surest ways to increase one's social and economic level and overcome the barriers of poverty (Swail, 2000).

Based on this comprehensive assessment of the public and private benefits of higher education, Bowen (as cited in Swail et al., 2003) concluded that the single most important effect of higher education is intergenerational, an effect that is manifested most clearly by the increased educational attainment of one's children.

1.2.1 Summary

The purpose of this study is to determine which support resources were utilized by graduates of the HP Scholars Program, in overcoming barriers to graduation. If institutions of higher education are to meet the demands of a highly technical society, then high student departure rates are seen as a formidable challenge. There are serious economic implications if the departure rates continue at the current rate.

Padilla's (1991, 1997, 1999) local expertise model of minority student success is the theoretical framework for this study. The researcher will survey HP Scholars who have graduated from both former and current partner institutions of HP to determine the resources utilized and their role in fostering persistence to graduation.

2.0 CHAPTER TWO

2.1 LITERATURE REVIEW

This review of literature first presents related research on the theoretical themes of Vincent Tinto's *Dropouts from Higher Education*, Astin's Student Involvement Theory, and the theoretical assumptions of W.E. Sedlacek's noncognitive variables (Sedlacek, 1987) that have been shown to be related to minority student success in higher education. Finally, the literature review will discuss the theoretical assumptions of Raymond Padilla's expertise model of successful minority students, which evaluates the multi-dimensional factors that influence the demands of their specific college system.

2.1.1 Models of Student Retention

2.1.1.1 Why Students Leave College

In 1975, with the publication by Vincent Tinto of his seminal article "Dropouts from Higher Education: A Theoretical Synthesis of the Recent Literature," a theoretical framework was finally articulated to explain students' leaving behavior from higher education. Tinto's longitudinal model took a sociological approach to the issue and posited that it was the interaction between two variables—the college and student—that influenced staying or leaving behavior. Since its initial publication, according to most retention specialists, the Tinto model

has become the most widely accepted and emulated theoretical model concerning student attrition from higher education.

In his explanation of the model, Tinto (1987) states the following:

Persistence requires that individuals make the transition to college and become incorporated into the ongoing social and intellectual life of the college. A sizable proportion of very early institutional departures mirror the inability of new students to make the adjustment to the new world of the college. Beyond the transition to college, persistence entails the incorporation, which is integration, of the individual as a competent member in the social and intellectual communities of the college.
(p. 126)

In order to achieve academic integration within the university environment, students must sometimes emotionally detach themselves from outside influences – family and peer influences – that pull them away from academic obligations. It is important the students incorporate into their active support network only those aspects from their home community that are congruent with their academic and career goals. This separation is particularly important for students with racial and cultural backgrounds different from the predominant university culture. When students are unable to connect with other individuals with similar social and cultural backgrounds on campus, and instead remain emotionally supported by a social network external to the university, they may tend to avoid social contact on campus and fail to integrate with the university culture. This disconnect places them at a high risk of attrition. There is considerable evidence to suggest that an effective strategy to achieve social integration on campus is to establish and strengthen social and ethnic ties of entering students through identification with other individuals on campus with similar values and cultures. This approach can, in effect, create a micro-environment of campus

that mediates the influence of the dominant campus culture (Rocheleau, 2004 as cited in Eaton & Bean, 1995).

Tinto (1975) postulates that academic and social integration influence a student's subsequent commitment to the institution and to the goal of college graduation. The greater the student's level of academic integration, the greater the level of subsequent commitment to the goal of college graduation. Also, the greater the student's initial level of social integration, the greater the level of subsequent commitment to the local college or university. The greater the levels of both subsequent institutional commitment and commitment to the goal of college graduation, the greater the likelihood the individual will persist in college (Seidman, 2005a).

Some researchers contend that student retention and success are influenced largely by student interaction and involvement. In "Leaving College," Vincent Tinto (1987, 1993) theorizes that academic and social experiences that integrated the individual into the institutional environment strengthened individual commitment to personal educational and institutional goals. This commitment lead to satisfaction and persistence to graduation.

Tinto's theory of individual departure is based on elements found in Emile Durkheim's (1951) theory of suicide. Durkheim acknowledges the strength of human interaction and the feeling of belonging to life satisfaction. Building on Durkheim's suicide theory, Tinto (1975) posits that, like suicide victims who were totally removed from the social fabric of society, students who are likewise removed from the social fabric of the college community are more likely to leave college than persist. Tinto also expands on the Durkheim concept claiming that social integration and a feeling of belonging to the campus reduces the likelihood of dropping out of college. The identification of belonging to one's institution of higher education, especially for minority students, seems to be a critical factor in the development of a student's self-concept

as a collegian and to the integration within that self-concept of academic and social success. Tinto's idea of tying student departure to suicide was challenged by Bean (1980). Bean further proposes that researchers interested in student departure should turn to organizational studies that have examined why individuals leave work or a group setting (Carter, 2006).

Tinto's theory suggests that when students experience conditions of social and intellectual malintegration, they often depart the institution (Tinto, 1987, 1993). Tinto further emphasizes that social integration increases student satisfaction with the institution, which leads to a greater likelihood that the student will succeed. As a result, Tinto finds a decrease in dropping out before achieving one's goal of graduation.

Tinto's theory of individual departure provides a way of thinking about the process of student persistence in college. Tinto's three stages include separation from past community, transition between high school and college, and incorporation into the community of the college (Tinto, 1987). When a student fails to successfully negotiate any one of the three stages, he or she develops a weak attachment to the university and is at risk of separation prior to graduation (Elkins, Braxton, & James, 2000).

With respect to student departure, one fairly constant finding is that students leave school because they do not fit in.

2.1.1.2 Student Involvement Theory

Alexander Astin (1993) provides a model for identifying persistence barriers and for giving the students a framework from which to view their education that is widely recognized among retention researchers. Astin indicates that excellence in education is directly related to "student involvement" as measured by five metrics: 1) time and energy devoted to studying, 2) time spent on campus, 3) participation in student organizations, 4) interaction with faculty, and 5)

interaction with other students. Astin's theory of involvement is rooted in a longitudinal study of college student persistence. The findings of this study suggest to Astin that factors contributing to students' persistence indicated their involvement in college. Student involvement refers to the amount of physical and psychological energy that the student devotes to the academic experience; according to Astin the behavior, not thoughts, determine the involvement (Astin, 1996). Astin clearly describes involvement as behavior when he states, "It is not so much what the individual thinks or feels, but what the individual does, how he or she behaves, that defines and identifies involvement" (Astin, 1984, p. 298).

In his study, Astin (1993) collected longitudinal data on 24,847 students at 309 different institutions and determines the influences of a host of institutional characteristics on the students' college experience. The data include 146 input variables that characterize the entering students, including demographic measures, information about parental education and socioeconomic status, pre-college academic performance measures, and self-predictions of a number of outcome variables; 192 environmental variables relating to institutional and faculty characteristics, including measures of the size and type of the institution, faculty demographics and attitudes, institutional emphasis on research, and the nature and extent of student-faculty and student-peer group interactions; and 82 outcome variables, including measures of academic achievement, retention, career choice, self-concept, patterns of behavior, self-reported growth in skills, and perceptions of and satisfaction with the college experience.

Student involvement has been cited as necessary for fostering educational effectiveness where the end result is persistence to graduation. The concept of "social involvement" as expressed by Astin (1985) refers to the amount of physical and psychological energy that the student devotes to the academic experience, which leads to graduation. Tinto (1987) concurs

that minority students often experience feelings of marginality and isolation at predominately White institutions and that minority students, especially those from disadvantaged backgrounds, more often experience academic difficulty, incongruence, and detachment, which can lead to departure.

2.1.1.3 Noncognitive Variables

Variables that affect persistence are generally categorized as cognitive (intellectual), non-cognitive (motivational), and environmental. Environmental variables are further broken down into internal (institutional) and external variables (Astin, 1975; Tinto, 1993). The variables act in concert to influence persistence; however, research efforts and programming efforts historically focus on the cognitive aspects. Personal or social beliefs, motivations and attitudes are the non-cognitive variables of the individual student that affect the student's decision to persist (Hyatt, 2003).

Recognizing that both individual characteristics and university environment combine to contribute to the successful retention and persistence of college students, most universities have introduced a variety of programs that include retention strategies targeted to pre-college, university, and personal factors identified with college success in order to improve the academic and social integration of students and increase the graduation rates of minority students (Perez, 1998). Rocheleau (2004) states, “However, many of these programs address cognitive factors, focusing on the improvement of student grades and other programs that target the retention of minority students and attempt to shape admissions, orientation, teaching, and advising practices in order to incorporate some of the personal characteristics identified by minority retention experts as critical to student persistence and academic success” (p. 78).

Sedlacek and Brooks (1976) hypothesize that there are eight non-cognitive variables that are critical in the lives of minority students. How students adjust to these dimensions and how faculty and staff encourage this adjustment determine the success or failure of the minority student. Tracey & Sedlacek (1985) demonstrate the validity of the seven variables plus an eighth, nontraditional knowledge acquired, by showing the usefulness of a brief questionnaire, the Noncognitive Questionnaire (NCQ), in predicting grades, retention, and graduation for minority students for up to six years after initial matriculation. The non-cognitive variables of the NCQ are: 1) positive self-concept or confidence, 2) realistic self appraisal, 3) understands and deals with racism, 4) demonstrated community service, 5) prefers long-range goals to short-term or immediate needs, 6) availability of strong support person, 7) successful leadership experience, and 8) knowledge acquired in a field.

Some of the noncognitive variables discussed by Sedlacek (1987) may seem applicable to all students. While this may be true to some degree, the evidence presented is intended to show that the points raised are unique to minorities; for instance, all students may have self-concept problems but not all feel the alienating effect of racism.

Sedlacek (1987) suggests that decision and practices regarding minority students should take into consideration non-cognitive factors in order to impact retention and graduation positively. Findings from Sedlacek's studies focusing on one or more non-cognitive variables support the assumptions that the processes and factors involved in academic achievement for minority students are different and at some institutions may be more challenging because of the student's minority status.

The eight noncognitive variables outlined above represent the personal characteristics that college students bring to their college experience. This study examines how these personal

characteristics and utilization of available support resources offered at one's respective campus contributed to the HP Scholars Program's graduates' overall academic success.

2.1.2 Characteristics Found to Aid Retention of Minority Students

A variety of student characteristics have been identified in studies as having the capability of aiding the persistence and retention of minority students on majority campuses. Characteristics such as positive self-image, self-esteem, and viewing locus of control as internal have been found to correlate with successful academic achievement and retention of minority students. Student background and family educational and income levels have also been found to correlate with student success (Fleming, 1984; Sedlacek, 1987).

Minority students who have been successful on majority campuses have developed important coping skills that have aided their success. Several studies have identified coping skills that correlate positively with retention and persistence (Sedlacek, 1987; Seidman, 2005b). Such skills include dealing effectively with racism, the ability to positively identify with the institution, the ability to bridge gaps from student culture to institutional culture, involvement in community services, having strong support systems, demonstrated leadership skills, and culturally related ways of knowing. According to Fleming (1984), students who made satisfactory adjustments in their academic and career development were also those students who made positive adjustments to the overall college environment. Minority students who actively integrate into the social and academic environment of the campus are more likely to achieve and persist to graduation (Astin, 1996; Tinto, 1982, 1993).

In their seminal study of the experiences of minority students in highly selective colleges and universities, Bowen and Bok (1998) examined a number of programs designed to increase

minority student retention. The results of their study recognize the transformative nature of the college experience on students and support the importance of student socialization into the culture of the institution through multiple social and academic interactions.

Successful minority student retention programs typically combine all or most of several features. They create an aura of high expectations, with an emphasis on meeting intellectual challenges rather than receiving remediation to achieve a minimum standard; they encourage participants to work in groups where students can help one another and provide mutual support; they offer appropriate advising and counseling; they often assign students to successful minority professionals who act as mentors; they provide summer internships to broaden student experience; and they offer enough financial aid to remove the risk of students having to work excessively to support themselves or even drop out for lack of funds. Some programs involve parents and keep them continuously informed as they can lend psychological support and encouragement to their children (Bowen & Bok, 1998).

2.1.2.1 Self Concept

Self-concept is defined as “strong self-feeling, strength of character, determination, independence” (Sedlacek, 1987, p.489) and is a common thread running through the literature on minority students’ self concept for several decades. For instance, Sedlacek (1987) and Astin (1975, 1984) provide evidence that identification with an institution is a more important correlate of retention for minorities than for other students.

In addition to the usual school pressures, a minority student must typically handle cultural biases and learn how to bridge his or her minority culture with the prevailing culture at the White university. Sedlacek (1987) finds that minorities who make this transition are more likely to stay in school than are minorities who do not.

Kuh and Whitt (1988) propose that the culture of a college or university defines, identifies, and legitimates authority in educational settings. However, they caution that institutions may have, perhaps even unwittingly “properties deeply embedded in their cultures that make it difficult for minority students to excel socially and environmentally” (p. 15). In these instances students already potentially at risk often find themselves decidedly at odds with popular social and cultural norms on campus (Rendon, Jalomo, & Nora, 2000).

Sedlacek (1987) notes that successful minority students may receive considerably different profiles on standardized personality measures than their majority counterparts. Thus, there is evidence that important cultural differences between minorities and the majority affect the manner in which self-concept is put into practice. Fleming’s (1984) research reveals that minority students attending predominately White schools experience heightened awareness of being a minority because they are reminded of it constantly, often times resulting in a diminished self-concept.

However, if a student’s self concept as academically capable is defined or reinforced as a result of positive interpersonal contact with faculty, it is likely that he or she will be more motivated to persist in difficult academic content or to seek out university resources to assist him or her to achieve academic and career goals (Blockus, 2000).

2.1.2.2 Realistic Self-Appraisal

An important variable that exists in combination with self-concept is how well minority students at predominately White schools are able to assess how they are doing. This self-assessment or self-appraisal pertains to both academic issues and to student life. Success for any student involves the ability to assess their current situation and make adjustments before the grades are in or before fully developing a lifestyle that is not conducive to success (Sedlacek, 1999).

Because faculty members, students, and staff often view minority students differently than they do White students, it is harder for minorities to get straightforward information on which to base their evaluations of how they are faring (Sedlacek, 1987). Connection to a campus-based support group that includes faculty and staff may help minority students increase their ability to realistically assess their academic deficiencies and develop realistic plans for addressing them. The support group may also foster trusting relationships with other students, faculty, and staff, allowing for the transmission of heuristic knowledge that better enables a student to succeed at their institution. With respect to the role of an institution in developing a minority student's positive self appraisal, colleges can take advantage of peer diversity and train faculty in a variety of pedagogies, thus encouraging student persistence (Carter, 2006).

Focusing on the academic success of Latino students, Gonzalez (1997) states that college advisors can often help students make a more realistic self appraisal of their academic progress and can make the difference between success and failure. With a good advisor, students can better marshal university resources to help them succeed and build "on the positive experiences and use the negative ones as learning experiences" (Gonzalez, 1997, p. 111). In short, when a student feels connected to other students, faculty, and even the university, he is better able to realistically assess his academic performance.

2.1.2.3 Admissions

There is considerable evidence that traditional measures such as standardized tests and high school grades are not as valid for minorities as they are for White students. However, most institutions have continued to employ traditional measures for minority students since the 1960s. The negative outcomes in admissions for minorities include being rejected for admission because of invalid measures or being accepted on the basis of lower "standards" that may result in

reduced self-esteem. In addition, faculty may stereotype minorities as less competent than Whites, which could lead to more negative treatment of minority students (Sedlacek, 1987).

To address slumps in admissions, higher education administrators could review current admissions policies for ways to make adjustments that will benefit the diversity of the campus community. The University of California at Los Angeles (UCLA) adopted a more holistic admissions model in response to declining Black enrollments in the STEM disciplines. The new model, approved by UCLA's Academic Senate, will replace a system in which portions of each application were fielded off to different reviewers with a system under which each application is examined in its entirety. The university's acting chancellor, Norman Abrams, and leaders of the Academic Senate said the change would help ensure that each applicant's academic achievements were considered in a broader context, taking into account factors such as school quality and how much the applicant appeared to have sought out challenges (Chronicle, 2006).

The adoption of a holistic approach parallels steps taken by leading public universities, such as the University of Washington and the University of Wisconsin in the wake of the U.S. Supreme Court's rulings on affirmative action in admissions in 2003. Future HP Scholars attending partner institutions, UCLA and University of Washington, can look forward to a cutting edge approach to admissions and can also expect to reap the benefits of the revamped admissions process.

2.1.2.4 Relationships with Faculty

Minority students have consistently reported believing that non-minority faculty are prejudiced toward them (Fleming, 1984). This perceived prejudice can take forms such as lower expectations of minority students than are warranted, overly negative reactions to work quality, reducing the quality of communications, and reducing the probability that faculty know students

well enough to write reference letters (Sedlacek, 1987). Grandy (1998) reports that contact with faculty has a significant impact on scientific ambition, commitment to the institution, and persistence to graduation. Investigating why minorities with high academic ability leave STEM fields, Grandy finds lack of supportive contact with faculty to be more important in regard to the desire to persist than academic performance.

Minority students have expressed concerns about the lack of minority faculty and staff in a number of studies (Seymour & Hewitt, 1997; Rendon, Jaloma, & Nora, 2000; Good, Halpin, & Halpin 2002). Absence of powerful minority figures as role models has a strong effect on the feelings of loneliness and isolation of minorities. The lack of a variety of viewpoints or cultural perspectives relevant to minority students can also adversely affect their learning, development, and identification with the institution (Gaither, 2005). Seymour and Hewitt (1997) posit that minority students have a higher probability of becoming academically and socially isolated on majority campuses and in STEM majors than do non-minorities.

Other studies, such as Good's (1998) and White's (2006) have shown success to be significantly affected by the amount of contact minorities had with faculty and staff. Good, Halpin, and Halpin (2002) note that participation in retention programs has a clear impact on academic outcomes (test scores, GPA, etc.) and plays a significant role in the decision to persist in the STEM field disciplines. Lastly, interactions with diverse student peers and with diverse faculty have also been identified as producing self-reported increases in student critical thinking skills and writing ability.

2.1.2.5 Campus Life

Problems for minority students have been documented in many arenas on campus, including, residence halls, fraternities, with campus police, in dating, in athletics and campus life in general Sedlacek (1987). Contradictory norms on campus also cause problems for minority students. Sedlacek finds that when students of ethnic majority entered a predominately White university in the early 1980s they expected the social norms to be conservative on social and political issues (e.g., government policies, abortion rights) but liberal on personal freedoms (e.g., drug use, sexual behavior). Conversely, minority students tended to expect the norms to be exactly the opposite, resulting often times in problems identifying with campus life.

Frequently, minority students experience exclusion, racial discrimination, and alienation at predominately White campuses. In contrast, it is no surprise that it is reported that at historically Black colleges and universities, minority students emphasize feelings of engagement, connection, acceptance, and encouragement (Carter, 2006).

It has been asserted that “most institutions of higher education have not considered that the members of many racial and ethnic groups have complex identities based on class, generational status, gender, sexual orientation, ethnic identification abilities, spirituality, etc.” further complicating the persistence dilemma (Chronicle of Higher Education, 2006, p. B-7).

According to (Kuh & Love, 2000) students’ connection to environment, often called student engagement, and student involvement are important factors in retention and persistence (as cited in Carter, 2006). Bonous-Harmarth (2000) reports that students who engage on campus may take advantage of more opportunities to secure academic membership and ultimately improve chances of persistence.

It does not seem to matter what type of college or university is considered (e.g., public or private; Historically Black Colleges and Universities [HBCU], or predominately White, etc.), what does matter is that every student must find within the chosen university setting an environment that he or she finds welcoming, supportive, and academically rewarding (Nora, Kraemer, & Itzen, 1997).

2.1.2.6 Attitudes of Non-minority Students

The discomfort of non-minority students around minorities and the negative stereotypes of minorities often held by non-minority students have been well documented. These underlying attitudes seem unchanged throughout the years. A series of studies at the University of Maryland, all employing the same instrument (the Situational Attitude Scale) and the same methodology, have shown consistently negative attitudes of non-minority students toward minorities in a wide variety of situations (Balenger, Hoffman, & Sedlacek, 1992). However, it has been demonstrated that it is possible to alter racial attitudes in an orientation program using an experimental control group approach.

Feagin, Vera, and Imani (1996) report that minority students often times feel that non-minority students see them as being not “full human beings with distinctive talents, virtues, interests, and problems” (p. 14). Black students at predominately White institutions often feel anxiety and fear at being the only one of a few in a particular environment (Smedley, Myers, & Harrell, 1993). This anxiety can mean that minority students look for the increased company of other minorities for support.

In a study involving Hispanic and Asian students, Sedlacek finds that “the better Gates Millennium Scholars (who were African American, American Indian, Asian American, and Latino) handled perceived racism, the higher were their college grades” (Sedlacek, 2004, p. 43).

An inclusive and welcoming environment and the connection of minority students to their non-minority faculty, staff, and students in that environment have been linked to persistence.

2.1.2.7 Community

As part of a viable support system, it is important for minorities to have identification with and be active in a community. The community may be on or off campus, large or small, but it will commonly be based on race or culture. Because of racism, minorities historically have been excluded from being full participants in many of the White-oriented communities that have developed in the United States and in the educational system (Sedlacek, 1987). As a result, minorities need a supportive group that can give them advice, counsel, and orientation to sustain them as they confront the larger systems they must negotiate. Fleming (1984) suggests that there needs to be a “critical mass” or sufficient number of minorities on a campus to develop a community or communities. Thus, a relevant community is probably harder for minorities to develop on a White campus than a predominately minority campus.

Sedlacek (1987) finds that athletics may be an important way for minorities to develop a community on campus. Sedlacek also finds that minorities who were interested in activities sponsored by the student union have better retention than those who were not interested, making the student union a central part of minority students’ community development.

2.1.2.8 Long Range Goals

The extent to which minority students are able to defer gratification is correlated with their retention and grades in school. Minorities have had a more capricious experience in setting goals and receiving reinforcement for their accomplishments than have non-minorities. A key assumption in the higher education system is that students work currently for rewards received

later (Sedlacek, 1999). For minority students, history has demonstrated that hard work and clearly defined goals do not always translate into success. Westbrook and Sedlacek (1988) note, “Skinnerian principles suggest that people delay gratification with reluctance when they can get today looks more attractive than what they can get by waiting until some later time or when they have no reliable data to suggest that they will get in the future what they work for today” (p. 87). When the connection between effort and reward is unclear, setting long term goals may prove to be difficult. However, when the link between effort in the present to academic and career goals in the future is made, there is a higher likelihood that students will persist to graduation.

Gonzalez (1997) makes the interesting point that successful Latino students may develop a “clearer understanding of their goals as they progress academically” (p. 112). That is, for students whom college attendance is not normative, the enormity of a long-range goal such as college graduation can best be handled by breaking it into smaller short-range goals such as gaining entrance to college and choosing a major. The long-term goal of college graduation thus becomes more attainable the longer the student persists (Rocheleau, 2004). Gonzalez (1997) finds that Latino students increase in confidence and goal specificity after their high school graduation, again after their completion of a summer bridge program between high school and college, and after each term where they are able to see clear progress toward academic goals. Goodwin (2002) finds that “the quality of social and academic integration of incoming students into the college environment are critical determinants of the likelihood of successful environment of the students’ goals and objectives at a particular institution,” an attribute of a high level of resiliency (pg. 157).

Astin (1975) finds that those minorities with lower aspirations and vaguer goals than other minorities are more likely to leave school. Astin’s conclusion is supported in studies by

noting that minority high school students with specific plans for college are much more likely to attend college than those with less clear goals (Padilla, 1991; Pascarella & Terenzini, 1991; Sedlacek, 1996; Swail, 2000).

2.1.2.9 Availability of Support

Students face difficult adjustments in their path to college success. To the extent that students are able to identify specific sources of emotional support and forge trusting relationships with college faculty or staff, they are better able to traverse the academic and social pitfalls that they will inevitably encounter. Sedlacek (1996) extends this idea when he notes, “Seeing the necessity of developing such a relationship with a support person, identifying the person and effectively utilizing that support probably require both experiential and contextual intelligence” (p. 82).

While challenges associated with support affect most students, the problem can be magnified for minority students. Because minority students are dealing with racism and face difficult adjustments to a predominately White university, they are particularly in need of a person they can turn to for advice and guidance. As discussed previously, minority students often find difficulty forming relationships with non-minority faculty and staff. Additionally, minority faculty and staff are not available and minority students have expressed a need for more minority faculty, staff, and counselors in particular (Sedlacek, 1987; 1996). Students with a strong and identifiable support network will be more likely to maintain their original achievement goals and persist (Sedlacek, 1999; Bank, Slavings, & Biddle, 1990).

2.1.2.10 Leadership

As in acquiring knowledge or performing community work, minority students are more likely to exhibit leadership off campus, in the community, or in their church than are White students. When minority students show leadership on campus it is often through informal or minority-oriented channels (Sedlacek, 1987).

African American and Hispanic American students who are successful in college have often demonstrated an ability to “organize and influence others through their cultural racial context” (Sedlacek, 1999, p. 543). Seeing issues from diverse points of view (experiential) and influencing others via mediation through advice giving or consultation (contextual) are both components of leadership (Sedlacek, 1996).

The presence of minority faculty and seeing other minority students in leadership roles set a positive message of inclusion and diversity (Fries-Britt, 1994; Fuentes, Sedlacek, & Liu, 1994; Gonzales, 1997). Equally important on campus is a broad communication that students’ cultural capital, talents, customs, social traditions, music, and ideas are welcomed. This acceptance sends a powerful message of inclusion that creates in students the desire for additional interactions, which in turn build a sense of community and institutional commitment (McNary, 1996).

Lavant and Terrell (1994) suggest that student affairs professionals must continue to encourage ethnic minority students to become widely involved in student governance activities. This involvement will help to foster an environment where the students’ voices can be heard; this can promote human growth and development also aiding the institution in retaining these students.

2.1.2.11 Non-traditional Knowledge

Because minorities have not always been welcomed in the formal educational system, they have developed ways of learning outside the formal academic system or institution of higher education. These ways are often creative and culturally relevant (Sedlacek, 1999). Astin (1975) finds that minority students who are able to demonstrate knowledge they gained in nontraditional ways through credit by examination² are more likely to stay in school than those who could not. The increase in student retention associated with demonstrating knowledge in this manner was more than twice as great for minorities as for non-minorities.

2.2 SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM)

As previously mentioned, eligibility for the HP Scholarship requires that students study electrical engineering, computer engineering, or computer science. These majors are included in the Science, Technology, Engineering, and Math fields, also known as STEM disciplines. Providing a background on STEM and its relationship to minority students is essential for this study.

As the United States shifts from a manufacturing-driven to a technology-driven economy, the diversity of the STEM workforce becomes increasingly important; this transition has not gone unnoticed elsewhere in the world. In recognition of the connection between sustained economic growth and a technically trained workforce, other countries have aggressively pursued policies that restructured higher education to keep more of their citizens at home (National Science and Technology Council, 2000). This technology driven economic shift makes it

² An example of credit by examination is the College Level Examination Program (CLEP) which gives college credits for what one may have already learned outside a formal classroom

necessary to educate more of the population in STEM for what might become shortages in the near future. If educators ignore this shift, it could be at their own peril.

The nation's changing demographics and continued need to remain globally competitive make it clear that colleges and universities should work to increase the number of minority students earning degrees in the STEM disciplines (Anderson, 2006). While the minority population is increasing; minorities still comprise a disproportionately small part of the STEM field. Thirty-nine percent of people under age 18 in the United States are minorities, and this percentage will continue to increase (U.S. Census Bureau, 2004). Young minority students are at the vanguard of the next generation. It is upon this generation that the nation places its hopes for continued economic competitiveness in the Information Age (Anderson, 2006).

The United States must look increasingly within its emerging demographics. Greater numbers of STEM field graduates must come from the talent pool comprised of this new majority – not to displace any particular group, but to expand our capacity to innovate within a framework of inclusiveness and opportunity for all (Jackson, 2003). A report by the Congressional Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology (SET) Fields (2000), “Land of Plenty: Diversity as America’s Competitive Edge in Science, Engineering and Technology,” marks a significant shift in the framing of the lack of underrepresented minorities in the SET fields challenge. “Land of Plenty” and other reports move beyond the affirmative action rationale for increasing underrepresented minorities in the SET fields by recognizing that it is no longer appropriate to consider underrepresentation in society merely as a social problem or a moral imperative. It is now an economic problem and a national imperative.

Underrepresented minorities that stay the course from high school to higher education drop out of science and engineering majors in disproportionate numbers. A common belief is that African American and Hispanic students do not enter higher education at the same rate as Whites and Asians. Another common belief is that underrepresented minority students do not have the same academic preparation necessary to move beyond first-level STEM courses that are considered filters (Anderson, 2006). However, data reveal that minority students enter higher education with the same level of interest in the STEM fields as their peers, but that they fail to persist in these majors at the same rate as their White and Asian American classmates. The variation in persistence rates among ethnic groups is related to a variety of factors (Anderson, 2006).

2.2.1 Scientific Competitiveness

Among the many roles of the U.S. higher education system, one is to educate and train the next generation of citizens who will help the nation maintain its competitiveness in an increasing global marketplace. Competition from abroad is increasing, as emerging economic powers such as China and India produce more individuals trained in the STEM fields than the U.S.. Commonly cited statistics suggest that each year, for every two Bachelor's Degrees in engineering conferred to an American by a U.S. institution, China awards five degrees (Anderson, 2006). In "The Quiet Crisis: Falling Short in Producing American Scientific and Technical Talent," Jackson (2003) reports that a crisis stems from the gap between the nation's growing need for scientists, engineers, and other technically skilled workers and its production of them. As the generation educated in the 1950s and 1960s prepares to retire, U.S. colleges and universities are not graduating enough scientific and technical talent to step into these soon-to-

be-vacant positions. This gap represents a shortfall in our national scientific and technical capabilities (Jackson, 2003). Consequently, the U.S. cannot – literally or figuratively – afford to squander its human resources; it is imperative that the U.S. develops and nurtures the talent of all of its citizens (Leggon, 2006).

According to (Jackson, 2003), the American public has not focused on this “quiet crisis” because it has grown accustomed to the fruits of technology. The technological advances of the past 100 years created a cornucopia of riches that have dramatically altered the quality and nature of daily life. Few Americans can actually remember life before electricity and electronics; ground, air, and space transport; radio and television broadcast; nuclear technologies, fiber optics; and satellite communications (Jackson, 2003). These technologies, at one time a novelty, are now considered a part of everyday life.

Over time, the United States’ economic base has shifted from the manufacturing of durable goods to processing and analyzing information. In this information-driven economy, the most valuable asset is human resources. Therefore, in order to compete successfully in the global economy the U.S. needs citizens who are literate in terms of the STEM fields (Friedman, 2005).

It is important to note that the need to improve the participation of underrepresented minorities in STEM is not solely driven by demographics and supply-side considerations. An even more important driver is that STEM workers from a variety of backgrounds improve and enhance the quality of science insofar as they are likely to bring a variety of new perspectives to bear on the STEM enterprise – in terms of both research and application (Jackson, 2003; Leggon, 2006).

2.2.2 Field of Study

Upon enrolling, students make choices that have a tremendous effect on their success. They decide the number of courses they will take; what they will study; how often they will interact with their faculty; the balance between study, work, and play; and how engaged they will be with their institution. Of these choices, one of the most significant decisions students must make is deciding what field of study to select as their major. Although students are not typically required to select a major immediately, many students begin college with a strong preference for a specific field of study (Jackson, 2003). However, for this study, the HP Scholars have pre-selected majors of electrical engineering, computer science, or computer engineering and have been accepted into the selected major by the partner institution as a condition of scholarship eligibility. The Scholars are also required to maintain enrollment in the selected major through graduation to maintain their scholarship, as a result deeply influencing their decision to persist to graduation.

2.2.3 STEM Student Persistence

Understanding why African American and Hispanic students who major in the STEM fields graduate at different rates from their White and Asian American counterparts requires an examination of the effect a student's major field of study might have on his or her persistence toward a degree.

In order for universities and colleges to meet the demands of the 21st century work force and in accord with the growing diversity of the population, they must seek to decrease the rates of attrition of minorities from the STEM disciplines (National Science and Technology Council,

2000). Conducting research into the persistence of student interest in STEM is consistent with that goal. A somewhat surprising finding is that a stronger investment in national talent through education boosts productivity more than any other means—more than increases in work hours or in capital stock (Jackson, 2003).

Even among the students most likely to succeed, those who begin their college career as full-time freshmen in four-year colleges and universities, only six out of every 10 of them, on average, graduate with a Bachelor's Degree within six years (Carey, 2004). In a report based on a study of data from the U.S. Department of Education that breaks down college graduation rates by students' gender, race, and ethnicity, the report's author, Kevin Carey, says that at the average four-year college, the gap in the graduation rates between White and minority students is more than 10 percentage points. At a quarter of all four-year colleges, he says, the gap is 20 points or more (Carey, 2004). Another important fact is that graduation rates for minority students typically lag behind those of non-minority students, and the chance of graduating decreases even more with students majoring in the STEM field (Carey, 2005).

In the report "Higher Education: Federal Science, Technology, Engineering, and Mathematics Programs and Related Trends" (U.S. Government Accountability Office, 2005), officials from 13 federal civilian agencies reported spending about \$2.8 billion in fiscal year 2004 for 207 education programs designed to increase the numbers of students and graduates or improve educational programs in STEM fields. The National Institutes of Health and the National Science Foundation had most of the programs and spent most of the funds.

Report data was collected from the Department of Education's (Education) National Center for Education Statistics (NCES), Department of Labor's (Labor) Bureau of Labor, Statistics (BLS), and National Postsecondary Student Aid Study (NPSAS). It was reported that

eight percent of Blacks/African Americans, seven percent of Hispanics/Latinos, and one percent of Native Americans graduated in STEM fields during 2002-2003 (see Table 4) (U.S. Government Accountability Office, 2005).

Table 4: Numbers and Percentage Changes in Domestic Minority Graduates in STEM Fields by Education Levels and Race or Ethnicity for Academic Years 1994-1995 and 2002-2003

Race or Ethnicity	Degree Level	Number of graduates in STEM fields 1994-1995	Number of graduates in STEM fields, 2002-2003	Percentage change in graduates	Percentage of total graduates in STEM fields, 1994-1995	Percentage of total graduates in STEM fields, 2002-2003
Black or African American	Total	33,121	44,475	34	6	8
	Bachelor's	28,236	37,195	32	5	7
	Master's	4,358	6,588	51	1	1
	Doctoral	527	692	31	0	0
Hispanic or Latino origin	Total	25,781	37,056	44	5	7
	Bachelor's	22,268	32,555	45	4	6
	Master's	3	4,121	37	1	1
	Doctoral	498	680	37	0	0
Asian/Pacific Islanders	Total	37,393	46,941	26	7	8
	Bachelor's	29,389	39,030	33	6	7
	Master's	6,064	6,814	12	1	1
	Doctoral	1,940	1,087	-43	0	0
Native Americans	Total	2,488	3,409	37	0	1
	Bachelor's	2,115	2,903	37	0	1
	Master's	320	425	33	0	0
	Doctoral	53	81	53	0	0

Source: U.S. Government Accountability Office (GAO), 2005.

Leggon (2006) posits that successful interventions to improve the persistence of minority students in the STEM disciplines must be institutionalized. The improvement process is not a stand-alone or marginal component but rather an integral part of the standard operating procedures of an institution – the criterion upon which the performance of faculty and administrators is evaluated. Including performance measures in the evaluations of faculty and

administrator sends a clear message on the importance of improving the graduation rates of minority students studying in the STEM disciplines.

The variation of student success in the STEM fields by race/ethnicity raises important questions about the characteristics of students selecting various majors, the experience of those students in these fields of study, and the financial implications for students who select a particular college major but drop out.

2.2.4 STEM Degree Path

In 2000 only 13 percent of Bachelor's Degrees awarded to minorities were in STEM fields, compared with 31 percent for Asian and 16 percent for Whites. These figures have changed very little in the past decade. These facts and those previously mentioned have led to a variety of efforts to build interest in the STEM fields among minorities (Anderson, 2006).

Is the reason for minority students' lack of persistence in the STEM fields simply that these students do not measure up academically or is the picture more complex? To answer this question it is necessary to chart the path of students who begin their postsecondary education interested in studying a STEM field. A report by Anderson (2006), "Increasing the Success of Minority Students in Science and Technology," is based on a longitudinal study in which the U.S. Department of Education collected data over six years on the progress of 12,000 students who began college in the fall of 1995. The students were followed over a six-year period, tracking their enrollment status, attendance status, college experience and numerous other variables. Of the 1995-96 cohort among degree-seeking students who began at four-year institutions, Hispanic students majored in the STEM field at rates nearly as high as Asian American students (22.7 percent and 26.4 percent, respectively). Additionally, White and

African American students selected STEM fields as a major at almost the same rate, about 18 percent. Three years later in 1998, the percentage of these students in each racial/ethnic group who continued studying STEM fields was nearly identical. Fifty seven percent of Whites and Asian Americans who initially selected STEM and 56 percent of African Americans and Hispanics remained in STEM fields (see Table 5) (Anderson, 2006).

Table 5: Major/Field of Study by Race

	Whites	African Americans	Hispanics	Asian Americans
Major	%	%	%	%
Humanities	10.3	7.1	8.1	7.0
Social Sciences	8.8	7.5	9.6	6.0
STEM	18.0	18.6	22.7	26.4
Education	8.1	6.5	6.8	1.0
Business	10.3	10.9	15.2	10.0
Health	6.8	7.11	5.9	10.0
Technical/Professional	8.7	6.1	7.8	3.0
Undecided	28.9	36.4	23.9	36.8

Source: Anderson, 2006.

It was after the third year that their journeys began to differ. The largest difference was the sizeable number of African American and Hispanic students who had majored in the STEM fields in 1998 but had not obtained their degrees in that area. By spring 2001, 62.5 percent of African American and Hispanic students who had majored the STEM fields in 1998 obtained their degree in that area, far lower than the 94.8 percent of Asian American and 86.7 percent of White students in the same cohort who had earned their degree in STEM areas. The majority of those who did not obtain a STEM degree had not dropped out; they were still enrolled and working toward a degree, but at a much slower pace (Anderson, 2006)

What happened to the 28.8 percent of African American and Hispanic students who began in the STEM fields, persisted past their third year, were still enrolled, but had not obtained

a degree? Examining how these non-completers differ from their peers who earned a Bachelor's Degree within six years may provide important clues to understand the persistence of African American and Hispanics in the STEM fields. To explore this issue more deeply, Anderson's (2006) study combines racial/ethnic groups in order to compare the non-completers with the completers.

There were several differentiating factors between the completers and non-completers *before* entering college. These factors include: 1) nearly 42 percent of the completers in the STEM fields took what is considered highly rigorous curriculums in high school, compared to only 18 percent of non-completers; 2) 97.6 percent of completers, compared with 83.9 percent of non-completers were younger than 19 years old when they entered college; 3) two of every three completers (64.4 percent) had at least one parent with a Bachelor's Degree or higher, compared with 38 percent of non-completers; and 4) 47 percent of completers came from families with income levels in the highest third of the national average, compared with 28.1 percent of non-completers. Factors differentiating completers and non-completers *after* they entered college continued. These factors include: 1) three of every four completers in the STEM fields were enrolled exclusively on a full-time basis during their college years; 2) the remaining 25 percent varied their enrollment between full- and part-time; 3) the non-completers' attendance patterns were divided almost evenly between full-time (49.3 percent) and part-time (50.7 percent) enrollment; 4) non-completers were more likely to work 15 hours or more per week (42.6 percent for non-completers and 27.1 percent for completers); 5) the non-completers were far less likely to receive financial aid grants exceeding \$5,000 during their first year of study (7.6 percent of non-completers and 38.5 percent of completers); and 6) completers were twice as likely to

have the highest level of social integration at their institution (30.3 percent versus 13.9 percent) (Anderson, 2006).

The findings of this study suggest that this challenge is not specific to the STEM fields and the strategies for increasing minority student degree completion, but are the same as increasing success in other majors. However, several key differences related to ethnicity remain (see Table 6).

Table 6: Factors Influencing Student Persistence

Factors Influencing Student Persistence by Race/Ethnicity		
Student Race/Ethnicity	Positive Predictors of Obtaining a Bachelor’s Degree	Negative Predictors of Obtaining a Bachelor’s Degree
African American	At least one parent with a Bachelor’s Degree or higher, full-time attendance, grant aid of more than \$5,000, working 14 hours or fewer per week	First generation college student
Asian American		Taking a “not rigorous” high school curriculum and delaying enrollment
Hispanic	Full-time attendance	Taking a “new basics” high school curriculum, low parental income and working 14 hours or fewer per week
White	Not first-generation college attendee, full-time attendance, grant aid of more than \$5,000 and working more than 15 hours per week	Did not take “highly rigorous” high school curriculum, low parental income, and working 14 hours or fewer per week

Source: Anderson, 2006.

What does the statistical data presented in this study really mean? In summary, the talent pool needed to increase the number of Bachelor’s Degrees produced in the STEM fields already

exists in colleges and universities across the nation. The nation should begin to focus on this talented pool of minority students who are majoring in STEM fields but who are struggling to earn their degrees. While this challenge is costly, the benefits far outweigh the costs. Because of the national importance of increasing the pool of individuals trained in the STEM fields, institutions may need to enlist support from federal, state, and local government entities as well as the private sector – especially the technology industry. With more support from outside sources, institutional leaders should be able to increase the size of the science and technology workforce, while simultaneously diversifying this important sector (Anderson, 2006).

2.3 PADILLA’S EXPERTISE MODEL OF SUCCESSFUL MINORITY STUDENTS

Padilla et al. (1997) developed a minimal local model of successful minority students at a large public university in the Southwest (see Figure 1). Padilla’s expertise model of successful minority college students incorporates the three factors most often studied regarding minority student success:

1. Pre-college experience and knowledge – academic preparation;
2. Support systems – integration and involvement; and
3. Internal and external awareness (understanding of self and environment) – psychosocial development and personal characteristics. (1997)

2.3.1 Expert Systems Theory

The expertise model of successful minority students takes into account the student's knowledge, experience, and behavioral characteristics in assessing responses to specific challenges at college. Padilla's expertise model of successful minority students is based on expert systems theory. Expert systems theory resulted from attempts to explain and recreate the human problem solving process for artificial intelligence. Cognitive psychology and artificial intelligence researchers suggested that problem solving could be best understood as information processing (Padilla, 1991).

Harmon and King (1985) define problem solving as the process of starting at an initial stage or situation and then searching through stored knowledge to identify the sequence of operations or actions that would lead to the desired goal. Problem solving is possible because one has knowledge. Harmon and King assert that an individual's knowledge could be characterized into three types:

1. Heuristic knowledge – knowledge that is gained through experience or mentors.
This type of knowledge is local or limited to a specific domain;
2. Theoretical knowledge – knowledge gained through formal study (e.g., school and text books). This type of knowledge is universal; and
3. Compiled knowledge – knowledge that is organized and stored for easy access.
This knowledge is an accumulation of formal and informal knowledge. (1985)

Padilla (1991) suggests that successful minority college students are those students who become experts at being successful at a specific institution. Those students have mastered the theoretical knowledge (required coursework), learned the necessary heuristic knowledge (campus protocol), and have taken timely and appropriate actions to triumph over the barriers

most commonly experienced by minority students at predominately White colleges and universities. Success requires the mastery of all three of the previously mentioned areas (Padilla, 1991).

Traditionally, success is measured in terms of demonstrated competencies of theoretical knowledge; however, Padilla's model includes assessment of a student's heuristic or informal knowledge and responses to his respective campus environment. Padilla (1991) points out that the principal characteristics of heuristic knowledge are in its localism and its experiential mode of acquisition. He describes heuristic knowledge as concrete, specific, and bound to a particular domain. The rules and requirements, as well as the conditions under which they are learned or communicated, are locally defined and sanctioned. Padilla's expertise model focuses on the specific knowledge and actions required to succeed at a particular campus. The data resulting from research based on Padilla's model of expertise will provide campus-specific information regarding necessary heuristic knowledge, support resources utilized by minority students, and actions minority students take to prevail.

As shown in Figure 1, for the student group studied and the given campus, the barriers that these students must overcome in order to be successful can be grouped into four classes or types: 1) discontinuity barriers, 2) barriers that are experienced as a lack of nurturing, 3) barriers related to a lack of presence on campus, and 4) resource barriers. Examples of the discontinuity barriers include the transition from a small town to an urban setting, students having to learn to be on their own, and difficulty in coming to terms with choosing between the value of an immediate job and the long term value of gaining an education. Knowledge needed to overcome the discontinuity barrier includes understanding and expecting discontinuity, sacrifice is worth it, and developing strategic knowledge. Necessary actions within the discontinuity barrier are

building a support system, promoting independence, and becoming an informed consumer (Padilla, 1997).

For the purpose of this study the barrier categories identified in the Padilla (1997) model are used to develop similar groupings for identifying support resources utilized by graduates of the HP Scholars Program to overcome the barriers to academic success.

Examples of barriers related to nurturing involved a student feeling a lack of nurturing on campus including lack of minority role models, the perception of low expectations of minority students by faculty and staff, the lack of family support or understanding, and the outright lack of nurturing itself. Knowledge needed to overcome lack of nurturing includes knowledge of how to nurture one's self, and in turn, to receive nurturing from others. Actions to aid in triumph over lack of nurturing include self nurturing and receiving nurturing from others (Padilla, 1997).

In a related fashion, examples of lack of presence barriers include racial isolation, lack of minority role models and mentors, cultural isolation, lack of visibility of minority support programs, and lack of minority issues or materials in the curriculum. With the lack of presence barrier, knowledge needed to overcome barriers to persistence includes understanding sources of minority support, seeking and asking questions, and awareness/prior knowledge (Padilla, 1997).

Finally, examples of resource barriers include lack of money and problems with the financial aid system. Within the resources barrier, knowledge possessed by successful students includes preparation, networks, and skills (Padilla, 1997).

Lack of financial aid in the form of grants and scholarships is a major deterrent to a minority student's decision to attend and persist through college. A large proportion of federal grants to minority students have been replaced by loans, which are often a disincentive for many minority students who are reluctant to incur large debts (Thomason & Thurber, 1999). Previous

analysis of differences among racial groups with regard to student aid indicated that African American and Hispanic students are less likely to persist if financial aid levels are not adequate (Kaltenbaugh, St. John, & Starkey, 1999; Babco, 2003). The HP Scholars grant coupled with the opportunity to earn money during the summer through paid internships would naturally be an incentive for program participants to persist.

For each barrier identified, a successful student possesses heuristic knowledge that helps that student to understand the nature of the barrier and the possible solutions to it for the particular campus studied. Based on this knowledge, the successful student then takes effective actions to overcome the barrier. Thus, for the entire set of barriers, support resources are utilized by a particular group of students; there exists a corpus of knowledge and a repertoire of behaviors that allow successful students to overcome the barriers to degree attainment.

2.3.2 Significance

Padilla contends that the expertise model has practical significance for colleges and universities. Using this model, researchers will be able to identify and address the nature of student success at a particular institution at a given time. Research based on a local model speaks directly to a local situation, thereby resulting in more direct or campus-specific applications rather than normatively based models that attempt to address situations and practices on the basis of research summarized from different campuses (Padilla, Trevino, & Gonzales, 1997).

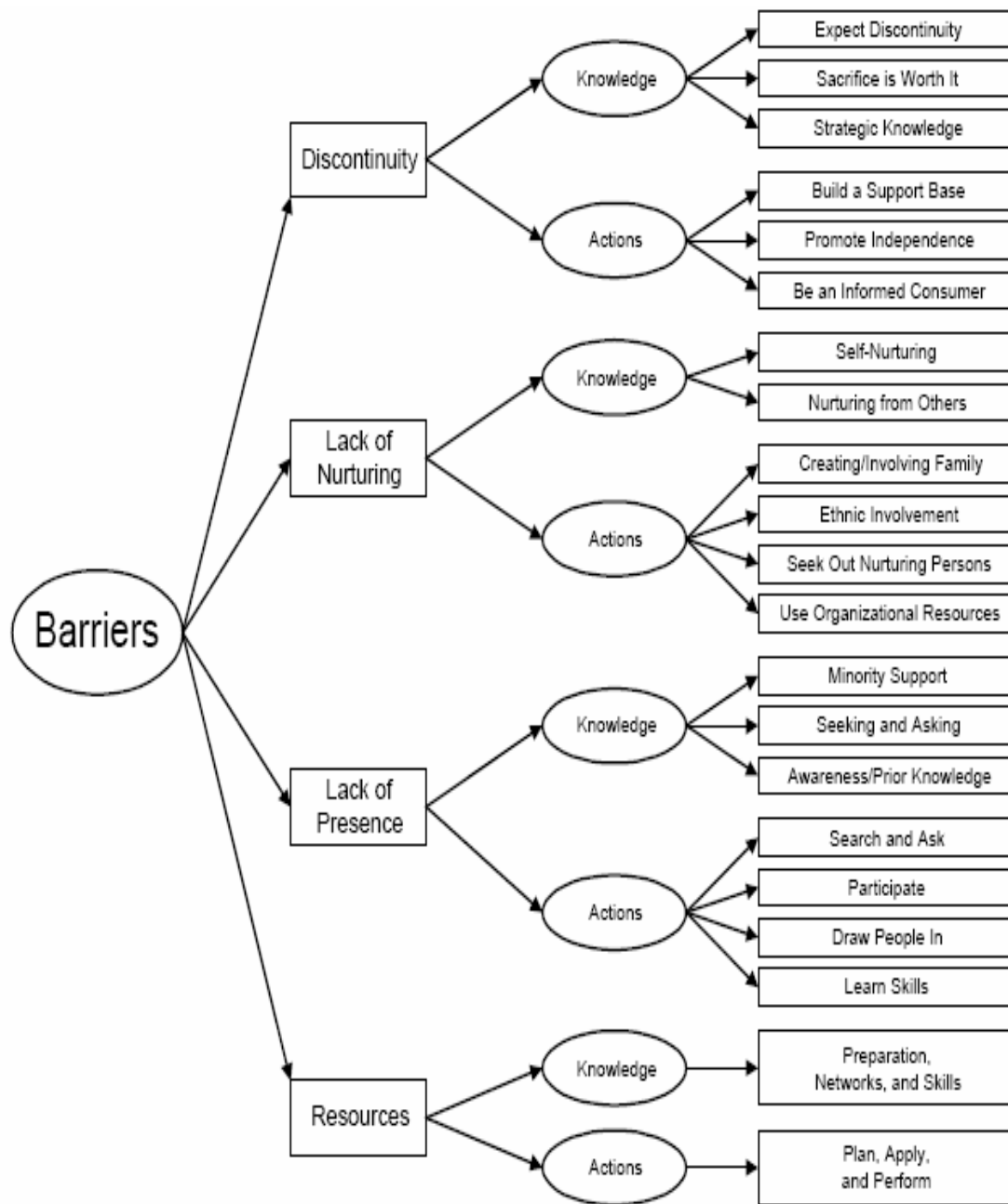


Figure 1: Source (Padilla et al., 1997)

3.0 THIRD CHAPTER

3.1 METHODOLOGY

This research examines the support resources utilized by graduates of the HP Scholars Program to overcome barriers to academic success. The methodological framework for this study is based on Raymond Padilla's local model of minority student success in college (1997). Padilla's expertise model focuses on the knowledge that successful students possess and the actions they employ to overcome barriers. The Padilla model, for the purposes of this study, is used to identify available support resources and actions taken to utilize these resources. The expertise model suggests that successful college students are those who are "experts" at being successful as students at a specific college or university. Consistent with the Harmon and King (1985) theory, expertise is viewed as compiled knowledge, which comprises two key components: theoretical and heuristic. This study first identifies which support resources were available to HP Scholars at their respective institutions. Second, this study identifies what it took to raise the HP Scholars' awareness of available resources and the actions taken, if any, to utilize the identified resources. This study also includes the identification of HP Scholar characteristics and their overall perception of their undergraduate experience.

This chapter identifies the research design and methods used to conduct the study. In addition, the researcher discusses data collection methods, sources, and analyses. Furthermore,

the researcher delineates which support resources are utilized by graduates of the HP Scholars Program, leading to success, and ultimately resulting in graduation:

1. Which support resources were utilized by Hewlett Packard Scholarship recipients to overcome potential barriers to academic success?
 - 1a. What did HP Scholars Program graduates do to identify resources?
 - 1b. Did HP Scholars Program graduates utilize available resources? If so, what did graduate do to utilize available resources?
2. What associations are there between the resources utilized and the Science, Technology, or Engineering major selected?
3. What are the characteristics of students who have graduated from the HP Scholars Program? and
4. What were the overall perceptions of the HP Scholars Program graduates regarding their undergraduate experience (e.g., major selected, institutional experience)?

3.1.1 Research Design

The guiding research includes a mixed methods approach using, as Johnson and Onwuegbuzie (2004) describe, a within-stage mixed model design. The use of a within-stage model design involves, for example, the use of a questionnaire that includes a summated rating scale (quantitative data collection) and one or more open-ended questions (qualitative data collection). The goal of mixed methods research is not to replace the qualitative or quantitative approaches but rather to draw from the strengths and weaknesses of both in a single research study.

Methodological work on the mixed methods research paradigm can be seen in several recent books (Creswell, 2003; Johnson & Christensen, 2004).

Rossmann and Wilson (1985) identify three reasons for combining quantitative and qualitative research. First, combinations are used to enable confirmation or corroboration of each other through triangulation. Second, combinations are used to enable or to develop analysis in order to provide richer data. Third, combinations are used to initiate new modes of thinking by attending to paradoxes that emerge from the two data sources.

Since the participants of this research study were asked to include information on specific actions taken to achieve academic success, it is natural that qualitative questions are included. Qualitative research was employed because, “Qualitative research methods have been deemed more appropriate for investigating the experiences and interpretations of individuals” (Patton, 1991, p. 392). Another reason for including qualitative research methodology in this study is to reveal or establish cause and effect relationships in or among experiences or occurrences (Mauch & Birch, 1998). Translated for the specific purpose of this study, qualitative or open-ended questions are used to identify support resources that are not identified by retention experts in the literature review and to identify actions taken to identify these resources. Padilla (1997) maintains that participants (in this case students) benefit by sharing useful knowledge.

Categorical identification of resources utilized by minority students were determined, and this was best handled through the quantitative component of the survey instrument. A study using quantitative research aims to quantify attitudes or behaviors, measure variables on which they hinge, compare, and point out correlations. It is most often conducted via a survey on a sampling that must be representative so that the results can be extrapolated to the entire

population studied. It requires the development of standardized and codifiable measurement instruments (structured questionnaires) (Gay & Airasian, 2006).

3.1.2 Pilot Study

3.1.2.1 Overview

Pilot studies are conducted as tools in determining, in an introductory or preliminary approach, the feasibility of a subsequent study. Aspects of the research plan can be tested in a pilot study in which the plan or parts of it are tested on a small scale. In a pilot study all or part of the plan is tried out to identify unanticipated problems or issues; valuable experience can be gained from a pilot study. The research plan will almost always be modified as a result of a pilot study and in some cases it may be substantially overhauled. Conducting even a small pilot study should be considered a very worthwhile use of time (Gay & Airasian, 2006). One of the advantages of conducting a pilot study is that it might give advance warning about where the main research project could fail, where research protocols may not be allowed, or where instruments are inappropriate or too complicated (Baker, 1994). A pilot study can be used to test a questionnaire (e.g., the wording and the order of the questions or the range of answers on a multiple choice question). For qualitative research proposals, Krathwohl (1988) and Meloy (1994) suggest that a pilot study be conducted to enhance the quality of a subsequent study, minimizing the likelihood of unexpected delays and potential failure. Conducting a pilot study does not guarantee success in the main study, but it does increase the likelihood.

The researcher conducted a pilot study of the HP Scholars graduates. The sample population consists of 10 graduates of the HP Scholars Program from the pool of graduates of the HP Scholars Program. Participants were identified as graduates by the HP Scholars Program

manager for inclusion in the study. The participants' identities were confidential, as was their institution. Pilot study data collection involved a Web based survey that was administered by e-mail. The purpose of the study was included in the letter of introduction sent to each student when requesting his participation in the research study. The purpose was also reiterated in the instruction section of the survey.

For this pilot study, it was important that the survey not be too lengthy and time consuming, which could have resulted in a low response rate. Since the study did not include graduation dates, it was not clear when the Scholars had graduated, again making survey length and reader friendliness important to minimize students having to struggle to recall experiences that were not still fresh in their minds. It is important to note that graduates did not respond to the initial request to participate, but did respond when provided with the link to the actual survey, which served as their consent to participate. As a result, the survey link was provided in the initial invitation to participate in the dissertation study, which was sent by U.S. mail.

In the pilot study survey instrument, support resources utilized by graduates of the HP Scholars Program were measured by the following categories: Academic, Financial, Social, and Personal experiences. These four (4) categories are intended to model the discontinuity, resources, lack of presence, and lack of nurturing categories represented in Figure 1 – Padilla's Expertise Model (1997).

3.1.2.2 Pilot Survey Data Analysis

This pilot study examined the support resources utilized by eight HP Scholars Program graduates. The study had an 80 percent response rate; surveys were sent to 10 graduates of the HP Scholars Program with eight responding.

It is important to note that the HP Scholars Program began in 1998. The study includes students who began their studies in years 1998, 1999, 2000, 2001 2002, and 2003 and had graduation rates of 45.9, 37.2, 53.6, 22.7, 33.3 and 24.0 percent respectively (see Table 7). While the benchmark used for graduation in this study is six years; the study does include students who have graduated in less than six years. It was important to include the students who graduated in less than six years, as their undergraduate experience was equally important. With the exception of students beginning their studies in 2002 and 2003, who at this point have not been enrolled for six years (the number most retention experts use to measure graduation rates), the graduation statistics closely align with retention literature.

Table 7: HP Scholars History

Year Studies Began	Total Selected	Total Enrolled	Currently Active	Dropped	Graduated	Graduated Pct	Status Unknown
2003	25	25	11	8	6	24.0%	0
2002	36	36	3	21	12	33.3%	0
2001	22	22	2	13	4	22.7%	2
2000	29	28	0	11	14	53.6%	2
1999	43	43	0	16	16	37.2%	11
1998	38	37	0	12	17	45.9%	6
Totals	193	191	16	81	71	37.2%	23

Note: Total Enrolled = Currently Active + Dropped + Graduated + Status Unknown. Students in the dropped category have either switched majors, requiring disqualification from the HP Scholars Program or have dropped out of school completely. Years 2001 and 2003 had lower enrollment rates, resulting in lower graduation percentages than years with higher enrollments.

It was not surprising to the researcher that the Academic category of the survey resulted in the most responses, with a total of 30 responses out of a possible 56, since the area of academics is often regarded as the single greatest factor in persistence to graduation. Six out of eight students utilized the library for quiet time or studying and also received tutoring from peers or friends. Other high scoring resources utilized in the Academic category by graduates were,

“Met with instructors regarding courses and participated in a student organized study group” – each with five out of eight responding. Utilizing the library to study and receiving tutoring from peers are typically mentioned by retention experts as actions taken by successful students (Astin, 1975; Pascarella & Terenzini, 1979; Sedlacek, 1987).

A summary of open-ended responses provided by pilot survey participants listed barriers to academic success and support resources utilized to overcome these barriers not included in the survey (see Table 8):

Table 8: Pilot Survey – Open-Ended Questionnaire Summary

Barrier	Support Resource and Actions
Lack of time management skills	Seek availability of time management workshops. Take advantage of time management workshops offered by student services
Inability to cope with stress	Seek availability of counseling services. Take advantage of student counseling and wellness services
Lacking diversity sensitivity	Seek availability of meetings or events sponsored by diverse groups on campus. Take advantage of diversity training or networking with diverse groups
Beginning academic career as a commuter	Seek information on student housing opportunities. Take necessary steps to become a resident student

To further elucidate the summary of open-ended questions with specific responses, here are the remainders of the open-ended question responses: First, “I found that while living at home with my parents for the first years of college, I did not perform as well possibility due to lack of independence and responsibilities. Once I moved out on my own, my performance excelled and I found myself to become more serious about coursework.” Second, “Ironically being at home was a support system for me financially but it was a barrier for academic success.”

Most retention studies view a strong family support system as positive, but family support for these students produced a level of dependency that resulted initially in poor academic performance.

The Personal category scored the second highest number of responses with 23 total responses. Seven of eight respondents talked with on campus friends, and six maintained close ties with friends outside their institution and maintained close communications with family members. Only four, or 50 percent, of the respondents talked with a faculty member, counselor, or staff member about personal concerns. Recent literature has shown that institutions are encouraging faculty to foster relationships with students in hopes of giving students someone to confide in or a referral source when experiencing personal problems (Rocheleau, S. E., 2004; Sedlacek, 2004).

In the Financial category there are 22 total responses. Seven of eight (88%) respondents received scholarship assistance from sources outside of their respective institution, and five received scholarship assistance from within their institution. Only three of the eight (38 percent) respondents received financial support from their families; two (25 percent) respondents each used loans and explored work/study or other employment opportunities. Most studies focus heavily on the connections between finances to college student retention, persistence, and ultimately graduation; however, HP Scholars only received \$3,000 per year in monetary compensation toward their academic expenses as part of the scholarship package leaving the balance to be paid by other sources.

Cabrera, Nora, and Castaneda (1992) propose a financial model of student retention. From testing their model, they assert “financial aid and its concomitant attitude, is important...because it equalizes opportunities between affluent and low-income students” (p.

571). Financial aid also helps students assimilate into the academic and social communities of the college and influences their decision to remain in college.

Interesting findings on financial aid have been reported by the National Center for Educational Statistics (NCES) (2005) in the National Postsecondary Student Aid study, a comprehensive study on how students and their families pay for postsecondary education. A key finding of the study is that the average amount of grants received was \$4,000. As previously reported, HP Scholars received \$3,000 per year in the form of a scholarship, which closely mirrors the average grant amount reported by the NCES study.

It is consistently reported that financial resources for higher education are in short supply; however, the HP Scholars have been successful in locating the money to complete their education, with eight out of eight reporting having received scholarships from outside sources.

There were 22 responses relating to the HP Scholar's social experiences. Six of eight (75 percent) respondents met with faculty members socially; five respondents or 63 percent attended social events sponsored by minority student organizations. This particular result resonates with findings reported by Littleton (2002) who conducts interviews with 24 minority students and finds that nearly half of the students he interviews acknowledge that their social involvement experiences help them to persist in college.

Appropriate changes to the pilot study survey instrument were made to add clarification to questions that were unclear to respondents. A demographic section was added that is not intended to specifically identify participants but rather to identify common characteristics for comparison purposes.

3.1.2.3 Pilot Study Summary

The pilot study survey was designed to test the instrument that would be used for the dissertation research study. Even though a major limitation of the pilot study is the small sample size, valuable information was collected and used to modify the survey extensively for the dissertation data collection process, accomplishing its intended purpose.

3.2 CURRENT STUDY

When conducting educational studies using surveys consideration must be given to the design and level of detail of the survey, size of the sample response rates, accuracy of information, missing data, administrative cost, etc. (Porter, 2004). To address these concerns, the length of the instrument is kept to a minimum in order to lessen respondent fatigue, maximize response rates, and improve reliability.

Survey research is not simple and requires that each step be conscientiously executed – identify a topic or problem, review the literature, select an appropriate sample of participants, collect valid and reliable data, analyze data, and report conclusions. Surveys are often viewed with disdain because many people have encountered poorly planned and poorly executed survey studies utilizing poorly developed instruments. However, survey research at its best can provide very valuable data (Gay & Airasian, 2006).

The survey instrument is administered through Zoomerang a Web-based survey tool, to graduates of the HP Scholars Program. The survey is self-developed by the researcher. Web, or Internet or World Wide Web, surveying is increasingly used as a means of surveying the public (Couper, 2000). Web surveys administered by Schaefer (2001) for the *Students Life Experiences*

Survey conducted at the Illinois Institute of Technology determined that the average cost of paper surveys was \$2.07 per student compared to the average cost of \$0.88 for Web-based surveys.

Gunn (2002) describes other advantages of Web surveys as receiving a faster response rate; more easily sending reminders to participants; more easily processing data, since responses could be downloaded to a spreadsheet, data analysis package, or a database; dynamic error checking capability; option of putting questions in random order; the ability to make complex skip-pattern questions easier to follow; the inclusion of pop-up instructions for selected questions; and the use of drop-down boxes. These are possibilities that cannot be included in paper surveys.

Two strategies are used to contact survey participants. The invitation to participate in the study is distributed by U.S. mail and e-mail in an attempt to reach the maximum number of participants. Although response rates for Web surveys are noted to be lower than mail surveys, recent studies have identified several ways to improve response rates (Zanutto, 1991; Gunn, 2002). Solomon (2001) states that personalized e-mail cover letters, follow-up reminders by e-mail, pre-notification of the intent of the survey, simpler formats, and plain designs have all been shown to improve response rates for Web-based surveys. While a preponderance of information regarding administering Web surveys exists, research has revealed concerns on the part of potential survey participants that are particularly salient for Web users, including Internet security and the receipt of electronic “junk mail” or “spam” (Sills & Song, 2002).

In a recent study Sax, Gilmartin, and Bryant (2003) examine response rates to the same survey using different paper and Web-based administrations and found the following response rates: a) paper only yielded 22 percent; b) paper with Web option yielded 24 percent; c) Web-only with response incentive yielded 17.1 percent; and d) Web-only without response initiative yielded 19.8 percent (p. 417).

3.2.1 Data Collection

The study includes 71 eligible participants who began enrollment in the HP Scholars Program between 1998 and 2003 and have now graduated. As of September 2007, 25 graduates have been hired by the Hewlett Packard Company as engineers and eight have gone on to graduate school.

Also, in order to maximize response rates, Chiu and Brennan (1990) suggest the following:

- 1) Provide preliminary notification by mail or telephone before administering the survey;
- 2) Use a cover letter signed by a person of importance to the respondents;
- 3) Use a follow-up letter postcard. (p. 13)

In this study, the first two methods are combined and a follow up letter is sent in order to increase the response rate to the Web-based survey. An invitation to participate is sent by e-mail and U.S. mail; however, since the participant list had not been maintained after graduation some of the contact information is dated. Invitations are sent by U.S. mail to 71 potential respondents; 18 (25 percent) were returned, "Address Unknown." In the invitation sent by U.S. mail, the purpose of the study is explained and includes the link to the actual Zoomerang survey; the letter is also signed by Howard Templeton, HP Scholars Program Manager. Mr. Templeton forwarded the invitation to participate in the survey to employees of HP, since as employees their contact information is considered confidential. The decision to include the link in the invitation to participate is a result of the pilot study. In the pilot study, several attempts were made by the HP

Scholars Program manager to secure permission to participate in the study; however, when the link was included in the invitation, the graduates promptly responded. In the current study, follow-up reminders are sent by e-mail and U.S. mail after two weeks, due to a low response to the initial survey request.

Of the 71 potential participants, 59 had e-mail addresses listed of which 45 were valid. A total of 26 (58.9 percent) of the valid e-mail surveys are completed by respondents, although there were 39 (87.0 percent) visits to the Zoomerang survey Web site. It is not known why some of the visitors to the survey Web site chose not to complete the survey. However, Sheehan and McMillan (1999) suggest that the length of a questionnaire is, more than in postal surveys, relevant to e-mail surveys, as an average print page can take up the space of several computer screens. Hence, the conventional surveys may give the impression of an unduly long questionnaire when sent by e-mail, which can in turn negatively influence the response rate. In this case the survey has 50 questions, which is 16 pages in length on the computer screen; potentially discouraging participation.

4.0 FOURTH CHAPTER

4.1 RESULTS AND DISCUSSION

Introduction

This chapter presents the statistical analysis of responses to the Zoomerang Web survey that includes close-ended questions and an analysis of the qualitative data gathered in the survey. There are 49 close-ended questions and three open-ended questions that allow the respondent to record three separate responses to the same question. It is important to include the open-ended questions to give the respondents an opportunity to present support resources utilized that are not named in the survey.

The purpose of this research is to investigate the support resources used by HP Scholars Program graduates that lead to persistence and ultimately graduation. As previously stated in Chapter One, the greater the student's commitment to academic integration, the greater the level of subsequent commitment to the goal of college graduation. The greater the levels of both subsequent institutional commitment and commitment to the goal of college graduation, the greater the likelihood the individual will persist in college (Seidman, 2005a). As mentioned earlier, the four categories used in the survey (academic, personal, social, and financial) are meant to model those of Padilla's Expertise Model (discontinuity, lack of nurturing, lack of presence and resources).

This chapter presents the findings of the study as guided by the following research questions:

1. Which support resources were utilized by Hewlett Packard Scholarship recipients to overcome potential barriers to academic success?
 - 1a. What did HP Scholars Program graduates do to identify resources?
 - 1b. Did HP Scholars Program graduates utilize available resources? If so, what did graduates do to utilize available resources?
2. What associations are there between the resources utilized and the Science, Technology or Engineering major selected?
3. What are the characteristics of students who have graduated from the HP Scholars Program?
4. What were the overall perceptions of the HP Scholars regarding their undergraduate college experience (e.g., major selected, institutional experience)?

See Appendix E for the matrix that gives a graphic illustration of the research question and the corresponding survey section.

It is noteworthy to mention that descriptive findings are presented due to the small sample size.

4.1.1 Survey Results Analysis

Survey Section I. - Characteristics of Survey Respondents

Each of the seven sections of the survey instrument is analyzed and results reported, including associations to the literature review.

To assist in evaluating the gender/ethnicity characteristics of the survey respondents, it is important to present the same characteristics from the overall graduate pool alongside the survey reporting group (See Table 9: Characteristics of the HP Scholars Program Graduates [gender/ethnicity]).

Table 9: Characteristics of HP Scholars Program Graduates and Reporting Group (gender/ethnicity)

Gender/Ethnicity	HP Scholars Program Graduates		Survey Reporting Group	
	N	Percentage	n	Percentage
Hispanic Males	25	35.2	6	23.1
Hispanic Females	8	11.3	4	15.4
African American Males	22	31.0	8	30.8
African American Females	9	13.0	7	26.9
American Indian Males	1	1.0	0	0.0
American Indian Females	6	8.5	1	3.8
Total Males				
	48	67.6	15	57.7
Total Females				
	23	32.4	11	42.3

A descriptive tabulation of the characteristics of the 26 survey respondents is presented in Table 10. Fifty-eight percent of the survey respondents are male, which is slightly lower than the 68 percent of the graduate pool that are males. The slightly lower number of women responding to the study can be explained through several studies. Women are more likely than men to graduate from high school and enroll in college, but are less likely to major in the traditionally defined “hard” sciences and engineering (Astin, Korn, Sax, & Mahoney, 1994). Research demonstrates that the underrepresentation of women in STEM majors increases during the undergraduate years, because the attrition rate of women from STEM majors is greater than that for men (Astin & Astin, 1993).

Respondents report having attended seven different institutions, with 10 (39 percent) at UCLA and only one (4 percent) at Santa Clara University and Wentworth Institute of Technology. As previously mentioned, several respondents graduated from institutions that are no longer partner schools. The decision by HP to re-evaluate partner school relationships is directly related to the disciplines offered at the institution. As the technology boom increases, institutions with strong computer engineering programs are more likely to be retained as partners.

Research has shown that part-time employment on campus, ideally in a position related to one's academic interests, positively affects persistence and degree completion (Pascarella & Terenzini, 2005). Nineteen (73 percent) respondents report that they were employed while attending college and 9 (34 percent) report working at least 20 to 29 hours per week. Tinto (1987) explained the importance of work-study as follows: "On one hand it provides much needed financial aid. On the other, it leads students to make contact with people on campus in particular faculty and staff. As a result, work-study alters both the cost and benefit side of the equation" (Tinto, 1987, p. 68). Further supporting student employment positively affecting persistence and graduation is the summer employment opportunity provided by HP to scholarship recipients, as referenced in Chapter 3.

When student employment and its effect on academic performance are discussed, some researchers also review whether it has a direct impact on Grade Point Average (GPA). For students who work, however, working more than part time does seem to have a negative impact on grades at most types of institutions. For the purpose of this study part time employment is defined as "An employee who is employed for an average of fewer than 20 hours per week or

who has been employed for fewer than 6 of the 12 months preceding the date on which notice is required”(Law Library, 2007)

At public and private not-for-profit four-year institutions, those who work one to 20 hours per week do slightly better, on average, than those who do not work at all. However, as the number of hours spent working increases, the average GPA for students who work declines modestly (King, 2002). Ten (39 percent) respondents report an average GPA of between 3.0 and 3.4. However, only three (12 percent) reported GPAs between 2.0 and 2.4, indicating that being employed while attending school does not appear to impact the respondents academically. To further illustrate this relationship, 18 (70 percent) respondents averaged 12 to 15 credits per semester, which is considered a full-time course load.

Table 10 –Characteristics of Survey Respondents

		N	%
Gender (n=26)	Male	15	57.7
	Female	11	42.3
Ethnicity (n=26)	American Indian	1	3.8
	African American or Black	15	57.7
	Hispanic or Latino	10	38.5
Major (n=26)	Computer Engineering	4	15.4
	Computer Science	8	30.8
	Electrical Engineering	10	38.5
	Mechanical Engineering	3	11.5
	Woman/Chicano Studies	1	3.8
Institution (n=26)	Morgan State	3	11.5
	North Carolina A&T	6	23.1
	San Jose State	3	11.5
	University of CA – Los Angeles	10	38.5
	Northeastern University	2	7.8
	Santa Clara University	1	3.8
	Wentworth Institute of Technology	1	3.8
Average Grade Point Average (n=26)	2.0-2.4	3	11.5
	2.5-2.9	7	26.9
	3.0-3.4	10	38.5
	3.5-4.0	6	23.1

Employed during college (n=26)	Yes	19	73.1
	No	7	26.9
Hours worked per week (n=19)	Fewer than 10	3	15.8
	10-19	5	26.3
	20-29	9	47.4
	30-40	2	10.5
Hours studied per week (n=26)	1-5	1	3.8
	8-12	13	50.0
	13-20	8	30.8
	More than 20	4	15.4
Average credits per term (n=26)	9	5	19.2
	12	9	34.6
	15	9	34.6
	More than 15	3	11.6

Survey Section II. – Resources Utilized and Major Selected

Research Question 2 asks, “What associations are there between the resources utilized and the Science, Technology, or Engineering major selected?” Chi-square analysis is used to determine significant relationships between the majors selected and students’ GPAs and those who used the library to study; a significance level of .05 is used for statistical analysis. The GPAs and library utilization were the only two categories that met the .05 significant relationship level test and as a result were considered significant results. Additional results are provided through descriptive analysis.

Students in Mechanical Engineering had lower average GPAs than students in Computer Science, Computer Engineering, or Electrical Engineering. Chi-square analysis indicates a significant difference in the GPAs of the HP Scholars: $\chi^2 (3, N = 25) = 7.739, p = .052$.³ (Note:

³ Since there is only one graduate who studied Women/Chicana(o) Studies, for Section II only the sample size of 25 is used.

the sample size limitation is a significant factor in the Chi-square interpretation).⁴ Eighty percent of students majoring in Electrical Engineering had GPAs greater than 3.0 compared to 0% of Mechanical Engineering. In addition, 63 percent of Computer Science and 50 percent of Computer Engineering students had GPAs greater than 3.0 (See Table 11).

Table 11: GPA by Major

Major	GPA			
	2.0-2.4 n (%)	2.5-2.9 n (%)	3.0-3.4 n (%)	3.5-4.0 n (%)
Computer Engineering	1 (25.0)	1 (25.0)	1 (25.0)	1 (25.0)
Computer Science	0 (0.0)	3 (37.5)	4 (50.0)	1 (12.5)
Electrical Engineering	0 (0.0)	2 (20.0)	4 (40.0)	4 (40.0)
Mechanical Engineering	2 (66.7)	1 (33.3)	0 (0.0)	0 (0.0)

Chi-square(3) = 7.739, p = .052

Students in Mechanical Engineering took more credits per term, on the average, than students in the other three majors. Three (100 percent) Mechanical Engineering students took 15 or more credits per semester and used the library more often to study than students of other majors included in the study; two (67 percent) used HP mentoring services for personal concerns.

Students in Mechanical Engineering (100%) used the library to study more than the students in Computer Science, Computer Engineering, or Electrical Engineering. Chi-square analysis indicates a significant difference in respondents using the library to study: χ^2 (3, N = 25) = 9.841, p = .020. (Note: the sample size limitation is a significant factor in the Chi-square interpretation). (See Table 12).

⁴ The limitations imposed by sample size are related to the expected values for chi square analysis. One of the assumptions/restrictions in using chi-square is: "No more than 20% of the expected counts are less than 5 and all individual expected counts are 1 or greater" (Yates, Moore & McCabe, 1999, p. 734).

Table 12: Used Library to Study by Major

Used library to study	Never	< 1 time per month	1 time per month	2-5 times per month	> 5 times per month
	n (%)	n (%)	n (%)	n (%)	n (%)
Computer Engineering	0 (0.0)	0 (0.0)	1 (25.0)	2 (50.0)	1 (20.0)
Computer Science	2 (25.0)	0 (0.0)	2 (25.0)	1 (12.5)	3 (37.5)
Electrical Engineering	2 (20.0)	5 (50.0)	1 (10.0)	2 (20.0)	0 (0.0)
Mechanical Engineering	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (100.0)

Chi-square(3) = 9.841, p=.020

Students in Computer Science and Electrical Engineering met with faculty in a social setting *more* often than students in, Computer Engineering or Mechanical Engineering. As previously mentioned relating to the pilot study results, this particular result resonates with findings reported by Littleton (2002) who conducted interviews with 24 minority students and finds that nearly half of the students he interviewed acknowledged that their social involvement experiences helped them to persist in college (See Table 13).

Table 13: Met with Faculty in a Social Setting by Major

Met with Faculty Socially	Never	< 1 time per month	1 time per month	2-5 times per month	> 5 times per month
	n (%)	n (%)	n (%)	n (%)	n (%)
Computer Engineering	4 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Computer Science	4 (50.0)	3 (37.5)	0 (0.0)	1 (12.5)	0 (0.0)
Electrical Engineering	3 (30.0)	6 (60.0)	1 (10.0)	0 (0.0)	0 (0.0)
Mechanical Engineering	3 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Additionally, respondents report that students in Mechanical Engineering are *less* likely to receive a scholarship from their institution; as a result, it comes as no surprise that these

students also respond as being *more* likely to receive financial support from their family than students from other majors.

Survey Section III. – Social Support Resources Utilized

Padilla's (1991) barriers related to a lack of presence on campus are encompassed in the social support resources category of the survey. Examples of lack of presence barriers include racial isolation, lack of minority role models and mentors, cultural isolation, lack of visibility of minority support programs, and lack of minority issues or materials in the curriculum. Most retention researchers stress the importance of providing social-related outlets for students in promoting persistence and more importantly for minority students, who often feel isolated. Responses in Section III ranged from, 1 = never, 2 = less than 1 time per month, 3 = 1 time per month, 4 = 2-5 times per month and 5 = more than 5 times per month. Respondents report that eight (31 percent) attended social events sponsored by an affinity group at least one time per month. With regard to attending non-minority social events, eight (31 percent) respond with either "never" or "1 time per month." Research has shown that students who are socially integrated by forming peer relationships, interacting with faculty members and getting involved with campus activities are more likely to remain in college than those students who are not socially integrated (Pascarella & Terenzini, 1979; Terenzini & Pascarella, 1977; Tinto, 1975).

Ten respondents (39 percent) report participating in community service projects, while seven (30 percent) never participated. It is somewhat surprising to the researcher that four (15%) reported participating more than 5 times per month, which seems somewhat aggressive for a full-time student studying in the STEM disciplines.

Respondents also report that 14 (54 percent) never met with faculty in a social setting. Pascarella, Terenzini, and Hibel's (1978) study finds that students' informal interactions with faculty members are the most important, and non-classroom student-faculty contact may influence student success.

It is the researcher's belief that a possible contributing factor to the lower response rates in the utilization of support resources in the social support categories is the rigorous course load of the HP Scholars Program graduates. While socialization is considered a critical component of retention and persistence research, it is likely that a full course load and rigorous course requirements could limit time for socialization. Descriptive statistics relating to social support resources utilized can be found in Table 14.

Table 14: Section III. - Social Support Resources Utilized

Social Support Resources	Never	< 1 time per month	1 time per month	2-5 times per month	> 5 times per month
	n (%)	n (%)	n (%)	n (%)	n (%)
Attend minority student sponsored events	3 (11.5)	5 (19.2)	8 (30.8)	6 (23.1)	4 (15.4)
Participate in non-minority events sponsored	8 (30.8)	7 (26.9)	8 (30.8)	3 (11.5)	0 (0.0)
Meet with faculty member socially	14 (53.8)	9 (34.6)	2 (7.7)	1 (3.8)	0 (0.0)
Attend sorority/fraternity event	9 (34.6)	10 (38.5)	3 (11.5)	2 (7.7)	2 (7.7)
Attend other social events	5 (19.2)	9 (34.6)	2 (7.7)	8 (30.8)	2 (7.7)
Participate in off-campus social events	10 (38.5)	8 (30.8)	5 (19.2)	3 (11.5)	0 (0.0)
Participate in community service project	7 (26.9)	10 (38.5)	4 (15.4)	1 (3.8)	4 (15.4)

Survey Section IV. – Personal Support Resources Utilized

The personal support category is intended to model the lack of nurturing category of the Padilla's expertise model. Examples of barriers related to a "felt lack of nurturing" on campus include lack of minority role models and a lack of family support or understanding (Padilla, 1999). Mentoring by minority peers, faculty, or staff can be considered personal support; also included are career or personal counseling services offered by the institution. An absence of these support resources can lead to feelings of lack of nurturing and can result in a barrier to academic success. Responses in Section IV ranged from, 1 = never, 2 = less than 1 time per month, 3 = 1 time per month, 4 = 2-5 times per month and 5 = more than 5 times per month. Not surprisingly, 25 (96 percent) respondents report that they communicated with their friends on campus more than five times per month, with a mean value of 4.96 (*SD* 0.196), even above family. Endo and Harpel (1982) note, "Faculty may be strong models for intellectual growth, but peers may be the primary models for personal/social and value related outcomes" (p. 133).

To be successful, a student should initiate contact with faculty and begin a process of relationship building. Westbrook and Sedlacek (1988) write:

Minority students who are unable to penetrate the informal communication system that goes on among students, faculty, and staff are more likely to have difficulty determining what is important and what is not. Minority students who do not know how evaluation is done in the school, students who are not on the 'past exam circuit,' students who do not know how they are doing until grades come out, and students who do not know how they compare to the other students in their class are at a disadvantage. (p. 86)

Although communication with friends ranks first among respondents in the personal support category, communication with family members comes in a close second with 21 (81

percent) reporting communication more than five times per month. Use of the HP e-mail mentoring support was extremely infrequent with a mean value 1.15 (*SD* .368); only four (15 percent) respondents report using this resource. Seventeen (65 percent) report communicating with friends outside their institution more than five times per month.

Responses indicate that the HP Scholars did not experience the lack of nurturing barrier that was reported by Padilla; conversely, they report strong personal support from friends, family, faculty, and their institution (See Table 15).

Table 15: Section IV. - Personal Support Resources Utilized

Personal Support Resources	Never	< 1 time per month	1 time per month	2-5 times per month	> 5 times per month
	n (%)	n (%)	n (%)	n (%)	n (%)
Communicate with friends on-campus	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.8)	25 (96.2)
Communicate with family members	0 (0.0)	1 (3.8)	0 (0.0)	4 (15.4)	21 (80.8)
Communicate with friends outside their institution	0 (0.0)	0 (0.0)	3 (11.5)	6 (23.1)	17 (65.4)
Talked with faculty about personal issues	10 (38.5)	10 (38.5)	1 (3.8)	4 (15.4)	1 (3.8)
Contact campus wellness center	12 (46.2)	8 (30.8)	0 (0.0)	1 (3.8)	0 (0.0)
Contact campus counseling center	22 (84.6)	1 (3.8)	2 (7.7)	1 (3.8)	0 (0.0)
Consult with clergy	17 (65.4)	3 (11.5)	2 (7.7)	4 (15.4)	0 (0.0)
Use HP mentoring services for personal concerns	22 (84.6)	4 (15.4)	0 (0.0)	0 (0.0)	0 (0.0)

Survey Section V. – Financial Support Resources Utilized

The financial support category is intended to model the resource barriers category of Padilla's expertise model, which includes lack of money and problems with the financial aid system at an institution. Eighty-five percent (*SD* 0.366) of respondents report that they received scholarships from their institution in addition to their scholarship assistance from HP. Grants and scholarships have often been found to be the best type of aid for promoting persistence, and they are most effective when targeted at financially needy students who need the aid in order to afford to stay enrolled in college. A generous financial aid package made up of grants, and not loans, enables a student to reside on campus, engage with the campus community, spend more time engaged in study, and be able to participate in campus-based activities, all geared to increasing his or her attachment to the university (Tinto, 1987). As reported earlier, the HP Scholars Program provides \$3,000 per year in scholarship assistance; however, it is surprising that 11 (42 percent) respondents report not using loans to finance their education. It is often reported that scholarships are in short supply and that most students use loans to finance a major portion of the education through student or parental loan programs. Students with adequate financial aid are typically more satisfied with their college experiences than those who struggle to secure financial resources (Taylor & Olswang, 1997).

Twenty-one (81 percent) respondents report receiving both scholarship assistance from outside their institution and meeting with financial aid counselors. There could be a direct connection between the successes of graduates securing scholarships by meeting with financial aid counselors, who would have knowledge of available scholarships. Being aware of available scholarships, including eligibility criteria and deadlines, is essential to students seeking financial aid, and a financial aid counselor is an excellent resource that many students may often overlook.

Sixty-nine percent of respondents report utilizing work-study or other employment opportunities. Astin (1975) finds that work-study programs can increase student persistence by 15 percent. These opportunities provide students with money, experience in the field and, perhaps most important, networking capabilities for future employment and research possibilities.

Only 35 percent of respondents report contacting government agencies for assistance in completing financial aid forms. In the researcher's experience, a major stumbling block reported by fellow students seeking financial aid is completion of government forms, often delaying receipt of financial assistance. It is not known by the researcher if assistance with completing forms results in receiving aid.

Colleges must be proactive in advising families of the price of college and the availability of financial aid opportunities. The application process must also be designed so that it does not deter families from applying for financial aid. Lastly, financial aid counseling is the foundation for grants, loans, and work study programs. Counseling allows campuses to reach out to families and students and offer a variety of avenues to finance college attendance (Galloway & Hoke, 2005)

(See Table 16).

Table 16: Section V. – Financial Support Resources Utilized

Financial Support Resources	Frequency (%)	
	Yes	No
Receive scholarship from institution	22 (84.6)	4 (15.4)
Meet with financial aid counselors	21 (80.8)	5 (19.2)
Receive scholarship from outside institution	21 (80.8)	5 (19.2)
Participate in work study or other employment opportunities	18 (69.2)	8 (30.8)
Receive financial support from family	17 (65.4)	9 (34.6)
Receive assistance from institutions' in completing financial aid applications	16 (61.5)	10 (38.5)
Funding availability affected decision to attend the institution selected	16 (61.5)	10 (38.5)
Use loans to finance education	15 (57.7)	11 (42.3)
Assistance in completing financial aid applications from family members	12 (46.2)	14 (53.8)
Contact government agency for assistance with financial aid applications	9 (34.6)	17 (65.4)

Survey Section VI. - Overall Satisfaction with Undergraduate Experience

Tinto (1991) emphasizes that social integration increases student satisfaction with the institution, which leads to a greater likelihood that the student will succeed. Responses in Section VI ranged from 1 = Very Dissatisfied, 2 = Dissatisfied, 3 = Satisfied and 4 = Very Satisfied. Eleven (42 percent) respondents report satisfaction with the social support services provided by their institution and ten (39 percent) report being very satisfied. Social integration has a more influential role in predicting minority student persistence than does academic integration (Milem & Berger, 1997). Thus, social support appears to be a major determinant of both students' satisfaction with college and their persistence decisions. With financial support being a key factor in retention and persistence, 16 (62 percent) respondents report being satisfied with the financial support provided, and seven (27 percent) report being very satisfied. Only three (12 percent) report being dissatisfied with financial support. To support this finding, Tinto (1987) suggests that the impact of financial problems is indirect and that for academically

capable minority students, it is the cumulative effect of a variety of challenges that might result in attrition. Eighteen (69 percent) were satisfied with personal support (which includes communication with family and friends, both on and off-campus). Personal support is the only category related to the overall satisfaction with the undergraduate college experience where a very dissatisfied response is recorded by one (4 percent) respondent. (See Table 17).

Table 17: Section VI. - Students' Level of Satisfaction with Undergraduate Experience

Satisfaction with Undergraduate Experience	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
	n (%)	n (%)	n (%)	n %
Satisfaction with academic support from institution	7 (26.9)	16 (61.6)	3 (11.5)	0 (0.0)
Satisfaction with social support from institution	10 (38.5)	11 (42.3)	5 (19.2)	0 (0.0)
Satisfaction with financial support from institution	7 (26.9)	16 (61.6)	3 (11.5)	0 (0.0)
Satisfaction with personal support from institution	5 (19.2)	18 (69.3)	2 (7.7)	1 (3.8)
Satisfaction with overall support from institution	10 (38.5)	14 (53.8)	2 (7.7)	0 (0.0)

Student satisfaction data have high utility as a baseline in different types of student outcomes assessment, undertaken by institutions of higher learning in response to external pressures for accountability (Upcraft & Schuh, 1996). Therefore, it is incumbent upon college and university administrators to collect data on student satisfaction for monitoring their institutions' progress in many areas of campus life and student development.

Survey Section VII. - Support Resources Utilized

Respondents are asked to identify any support resources not listed on this survey that helped them to achieve success, which resulted in graduation; the response should include awareness and actions that took place as a result of identifying the resource.

Section VII is the only open-ended response section of the survey (See Table 18 for a descriptive tabulation). A disadvantage of using open-ended questioning is that they require more time and thought on the part of the respondent. Another disadvantage is that many respondents will not take the time to respond to open-ended questions or will give unclear or useless responses. However, for certain topics or purposes, open-ended questions may be necessary (Gay & Airasian, 2006). Since the questionnaire has 49 questions prior to the open-ended questions, this could be a factor in the low response rate; as previously reported, lengthy questionnaires/surveys often have lower response rates. Another potential contributor to the low response rate on the open-ended questions could be that this section is optional and the close-ended questions are mandatory, giving respondents a choice in whether to answer or skip this section.

Table 18: Section VII - Open-Ended Survey Responses

Resources	Center for Embedded Networked Sensing
Awareness	Learning about research opportunities and graduate school
Action	Did research, attended seminars, got help with graduate application
Resources	LaJoteria de UCLA
Awareness	Learned about group through interaction with other students
Action	Found friends with similar interests and goals
Resources	MEChA de UCLA
Awareness	Learned about the diversity group through Student Retention Center
Action	Diverse interactions (people/activities)
Resources	Center for Excellence in Engineering and Diversity
Awareness	Through campus postings, Center provided information about financial, academic, and career support
Action	Attended summer programs, workshops, corporate events, and scholarship information sessions

Resources	Math and Science Workshops
Awareness	Learned about workshops through other students
Action	Attended Self Improvement Workshop sponsored by Minority Engineering Program (MEP)
Resources	Financial assistance for standardized tests (GRE)
Awareness	Communicated with faculty on campus to learn of availability
Action	Met with faculty to apply for and secure funding to take the GRE exam
Resources	MEChA Calmecac Group
Awareness	Learned of peer counseling sub-group through MEChA de UCLA
Action	Attended group to ease transition to UCLA by minority students

However, the advantages of open-ended questioning include the respondent can answer in any way he or she wishes, and the researcher may discover information that he or she may not have previously thought about (Kumar, 2005). As previously mentioned, the primary purpose for including the open-ended section is to capture resources used by graduates that were not named in the survey.

Respondents list primarily social resources that include involvement with faculty, staff and, peers. One respondent reports meeting with his advisor to learn of funding available to take the Graduate Record Examination (GRE) needed to apply for graduate school. Knowledge of the availability of resources is important; one cannot take advantage of a resource that he or she is unaware of. As stated earlier by Gonzalez (1997), with a good advisor, students can better marshal university resources to help them succeed. Peers have a powerful influence on a student's academic success (Astin, 1999). The values and attitudes exerted by the various peer groups are important in predicting student persistence (Bank, Slavings, & Biddle, 1990).

Another respondent reports learning from a fellow student of a peer sub group on campus that was designed to facilitate the transition to college for students of their ethnic background. As stated by Tinto (1987), persistence requires that individuals make the transition to college and

become incorporated into the ongoing social and intellectual life of the college. A sizable proportion of very early institutional departures mirror the inability of new students to make the adjustment to the new world of the college.

A respondent also reports participating in an ethnicity-based technical organization to gain awareness of the availability of summer programs, workshops, and scholarship information sessions. Within the environment of a minority-specific, technical organization (e.g., Minority Engineering Program [MEP]) students meet with other individuals of color with similar interests and, through participation in local chapters and regional and national conferences, are exposed to potential role models and mentors and see individuals similar to themselves who are succeeding in difficult technical disciplines. Through participation in minority technical organizations, “the critical mass of other individuals at an academic or industrial level with whom the student shares a common background or culture, changes the student’s perspective regarding information or issues” (Rocheleau, 2004 as cited in St. Omer, Sampson, & Lee, undated, p. 5)

Open-ended responses reported in Section VII support research that posits that the availability of support resources; a person or place to turn to during crisis or for encouragement is important. The ability to identify and utilize these support resources is critical to minority student academic success and college retention; according to Mallinckrodt (1988), “because of random reinforcement of the relationship between individual effort and positive outcome, a relatively small obstacle or set of obstacles may make a student of color drop out or fail school” (as cited in Sedlacek, 2004, p. 46).

4.1.2 Summary

Although all of the support resources reportedly used by respondents appear to exert some influence on an individual's ability to gain academic, social, financial, and personal integration within the university environment, the personal category appears to be the most salient. This category includes respondents reporting communication with friends both on and off campus and close communication and relationships with family. As reported earlier, in order to achieve academic integration within the university environment, students must sometimes emotionally detach themselves from outside influences – family and peer influences – that pull them away from academic obligations. It is important the students incorporate into their active support network only those aspects from their home community that are congruent with their academic and career goals. Through their responses, HP Scholars Program graduates have demonstrated their ability to remain connected to friends on and off campus as well as family, with most respondents reporting communication with family and friends more than five times per month.

5.0 CHAPTER FIVE

Chapter Five represents an interpretation of the findings in Chapter Four and includes a discussion of the most salient issues for the persistence of under-represented minority students in engineering and technology-related disciplines, and presents recommendations for future research and practice.

5.1.1 Theoretical Implications

The findings in this study corroborate the findings of Padilla's research and theory regarding minority student success. Padilla's study reveals that successful students are identified as students who seek support, acquire needed skills and information, and create a "niche" for themselves in order to address certain challenges at their college (Padilla, 1997, 1991). Padilla asserts that in addition to mastering the required course content (theoretical knowledge), successful students identify potential barriers, figure out solutions, and then apply what they know. Padilla also states that application of the acquired heuristic knowledge is specific to a particular campus. While the Padilla model yields results from a specific college, the results of this study provide additional information to the body of knowledge regarding support resources utilized by minority students in the STEM disciplines.

Persistence rates vary among racial/ethnic groups because of what students do upon matriculation. Research suggests that persistence in college is related to students' abilities to build academic and social connections within their institutions (Tinto, 1987, 1993; Pascarella & Terenzini, 1991). Students typically build these connections by becoming involved in campus organizations and study groups and from contact with professors outside the classroom. Littleton (2002), who conducted interviews with 24 minority students, finds that nearly half of the students he interviewed acknowledged that their social involvement experiences helped them to persist in college. However, academic and social integration can be more of a challenge for minority students at a majority institution because the students and faculty who surround them do not resemble the communities from which they came and with which they may feel most comfortable.

Another theoretical consideration coming from this study is student interaction. Research has shown that students who are socially integrated by forming peer relationships, interacting with faculty members and getting involved with campus activities are more likely to remain in college than students who are not socially integrated (Pascarella & Terenzini, 1979; Terenzini & Pascarella, 1977; Tinto, 1975). Furthermore, a critical mass of highly able minority peers can enhance academic and social support and reduce perceptions of racism, contributing to STEM persistence and success (Fries-Britt, 1994). Mastery of the subject matter and development of critical skills using proven methods are essential for student confidence and success. For example, involvement in peer study groups has been shown to result in enhanced technical knowledge mastery and course performance for STEM minority students (Maton & Hrabowski, 2004). Another area that represents success to minority students in STEM majors is support and motivation. This study supports Astin's (1984) student engagement theory, which indicates that

peer-to-peer interaction has an effect on retention, and in the case of this study is statistically significant, again taking into consideration the small sample size and low response rate. Also supported in this study is strong financial aid support in place, academically supportive friendship networks, involvement with faculty, tutoring, and emotional support (Grandy, 1998; May & Chubin, 2003; Seymour & Hewitt, 1997).

5.1.2 Expertise Model

Padilla (1997) finds that successful minority students acquire knowledge and employ specific actions that enhance their ability to overcome barriers. Students who are experts of the specific college system know the availability and limits of campus resources, facilities, and policies. Acquired informal knowledge and responsive action enable the student to function and negotiate competently throughout campus. Successful minority students participating in the HP Scholars Program understood the nature of specific challenges and took appropriate action to resolve them. The results of the study indicate that successful HP Scholars Program graduates:

1. Expended time and effort to find various support systems on and off campus; and
2. Developed specific skills and strategies to meet academic expectations.

Study results provide support for an integrated theory of student retention that includes these findings: a) non-cognitive abilities play a large role in student retention, and b) heuristic knowledge is critical to the successful negotiation of a university campus.

Supportive relationships were established through faculty advising, work-study employment, or faculty/staff socialization experiences, which appear to have reinforced the HP Scholars' identification with their respective institutions, providing both academic and social benefits. A strong identification with the college or university through its faculty and staff

helped to support academic integration and to reinforce the formation of a strong academic self concept. As students become more familiar with faculty and staff and accustomed to the university environment, they are able to take advantage of support resources, such as tutoring, when needed.

The ability to accept assistance in the form of support resources enhanced scholars' overall achievement. Summer programs, workshops, scholarship availability, and financial aid counseling are mentioned by respondents as support resources utilized at their respective universities.

The data appear to support Padilla's expertise model, whereby successful students are able to develop heuristic and conceptual knowledge that helps them overcome apparent barriers to academic success.

5.1.3 Integration and Involvement

According to Padilla (1997), minority students emphasize a continuity of their "home" community. Minority students incorporate their cultural community within the majority campus environment. These cultural communities created by a minority student can provide support and encourage success and a strengthened commitment to a personal goal, in this case, persistence to graduation. Successful minority college students are more likely to move in and out of parallel majority/minority college communities. These students are capable of creating or finding a supportive community as well as negotiating the challenges of integration and interaction within the majority college community. The attachment for many minority students is to the minority college community or support systems rather than the institution.

As the literature suggests, academic and social experiences that integrate the individual into the institutional environment strengthen individual commitment to personal educational and institutional goals. This commitment leads to satisfaction and persistence to graduation.

Through their responses, the researcher concludes that respondents indicate that they had maintained the necessary interaction and relationships within the majority community where formal and informal learning takes place. Those supportive relationships that minority students establish, and to which they remain attached, are crucial to academic success and persistence to graduation. Similar to Padilla's findings, respondents successfully navigated through the social world of their respective universities. Respondents report meeting with faculty in a social setting, which is a non-traditional resource presented in retention literature. While not widely used currently, meeting with faculty in a social setting could be utilized by students as a support resource. Respondents also report utilizing social events sponsored by minority student organizations, as well as social events sponsored by the institution.

Again, connection to a campus-based support group that includes faculty and staff may help minority students increase their ability to realistically assess their academic strengths and deficiencies and develop realistic plans for addressing them. Such programs create a secure environment for students to build trusting relationships with other students, faculty and staff – relationships that form the core of a support network that allows for the transmission of heuristic knowledge that will help a student succeed within a particular academic environment.

As reported in Chapter One, Astin (1993) indicates that excellence in education is directly related to "student involvement" as measured by five metrics: 1) time and energy devoted to studying, 2) time spent on campus, 3) participation in student organizations, 4) interaction with faculty, and 5) interaction with other students. Survey results strongly support

utilization of support resources as outlined in Astin's student involvement model. Respondents report spending substantial time studying, meeting with faculty, staff, and friends on campus, participating in both social and professional student-centered groups, and interacting with other students on and off campus.

5.1.4 Noncognitive Variables

The results of this study also correspond with Sedlacek's (1976, 1987) non-cognitive variables as indicators of college success. Graduates in this study cite many responses demonstrating characteristics similar to the variables proposed by Sedlacek and Brooks (1976). Sedlacek (1976) asserts that non-cognitive or variables that are not related to academics are better predictors of academic success and persistence than traditional measures for minority students. Respondents report joining affinity groups to minimize the impact of transitioning from high school to college and potential discomforts of being a minority, meeting with faculty within the Engineering discipline for support and guidance, and advising from professor on graduate school opportunities in support of long range goals. Even though there is general agreement among researchers that nonacademic factors play an important role in college persistence, there is little consensus regarding the identity of these factors and how to measure them.

The non-cognitive variables of the NCQ are: 1) positive self-concept or confidence, 2) realistic self appraisal, 3) understands and deals with racism, 4) demonstrated community service, 5) prefers long-range goals to short-term or immediate needs, 6) availability of strong support person, 7) successful leadership experience, and 8) knowledge acquired in a field (Tracey & Sedlacek, 1984).

As discussed in Chapter 2, Sedlacek (1999) concludes that some of the non-cognitive variables discussed may seem applicable to all students. Although this may be true to some degree, the evidence presented is intended to show that the points raised are unique to minorities in intensity, if not in form. For instance, many non-minority students may have self-concept problems, but these do not include the alienating effects of racism. Non-minorities may lack a support person, but the process of developing a relationship is not the same as for minority students because of racial and cultural variables.

Good, Halpin, and Halpin (2002) suggest that non-cognitive factors, such as lack of community and identity on college campuses, exacerbate the attrition problem for students in the STEM disciplines. The noncognitive factors provided through involvement in a minority engineering program appear to be essential to understanding retention as are the cognitive factors of student achievement.

5.1.5 Limitations of the Study

A major limitation of the present study is the small sample population and low response rate, which was primarily a result of the dated contact information. Participation was likely limited to those whose contact information had not changed since graduation (e.g., recent graduates) because contact information has not been maintained or those who were currently employed by HP, the opinions of individuals who were successful and persisted to graduation after leaving the HP Scholars Program, may not have been reflected in the results.

The study population is limited to specific minority groups (African American, Hispanic, and American Indian only), representing a limitation; a future area for research is to determine

the extent to which the findings of this study apply to other underrepresented minority populations as compared to non-minority students at the institutions represented in the study.

Participants in the Zoomerang survey are anonymous; however, the number of visits to the survey Web site was tracked. There were actually 39 visits to the Web site, but only 26 completed responses; no incomplete responses were recorded because all of the close-ended questions required responses; only the opened questions were optional. It is also not known if the recording of 39 visits to the Web site actually included individuals who visited the site multiple times to complete a survey. Since the researcher does not know the identify of any of the participants, she had no ability to follow up personally with individuals who visited the survey Web site but did not actually complete the survey.

It is often suggested that incentives produce increased response rates. When conducting a Web survey, one should consider offering incentives - gifts, prizes, etc. Studies show that incentives need not be large to increase response rates. A small token, gift certificate, etc., can increase responses considerably (Dillman, D.A., Tortora, R.D. & Bowker, D. 1998). Respondents were not offered incentives, which may have contributed to the low response rate.

The findings of the present research study offer several suggestions on the support resources that should be utilized by minority students studying in the STEM disciplines that could lead to academic success and persistence to graduation. The suggestions include support for strong study habits, 50 percent studied 8-12 hours per week; meeting with instructors regarding courses, 38 percent reported meeting with instructors to discuss grades, assignments, etc. 2-5 times per month; 42 percent received tutoring from peers or friends 2-5 times per month; 81 percent met with financial aid counselors and 35 percent made contact with government agencies regarding financial aid. The low number of respondents, limited institutional

representation, and the non-cognitive and institutional factors that were perceived as contributing to college success might not be similar to those deemed important by minority students studying in the STEM disciplines at other institutions.

5.1.6 Implications for Further Research

The following are topics for future research:

1. Replication of the study with non-HP Scholars minority students studying in the same disciplines and limiting the study to partner institutions attended by the Scholars, to determine noncognitive variables and support resources utilized by successful students. It is the researcher's belief that the findings of this study would prove to be valid for other minority students at the institutions being studied, but further exploration is needed.
2. A longitudinal study of the HP Scholars from admission through graduation, with studies conducted yearly. Revision of the quantitative questioning when administering to freshmen HP Scholars to include high school GPA, educational background of parents, which are factors presented in other studies as being key predictors of academic success. This study could: 1) track the patterns of support resource usage; 2) note changes over the course of their academic career in the use of support resources; and 3) keep track of students exiting the program.
3. Again, using both qualitative and quantitative methodology would be useful in replicating this study. However, conducting telephone interviews would more likely provide responses with more detail and clarity than the open-ended survey question format used in the current study. Through personal interaction with the respondent, the opportunity is given to ask questions for clarification purposes and provides two-way dialogue.

4. An investigation of students who persisted to graduation in the STEM discipline at a non-HP partner institution.
5. A comparison of support resources utilized by male and female students in the HP Scholars Program. Many studies have shown that women in STEM majors drop out at an even higher rate than minorities in general, so a study that includes extensive analysis of support resources used by gender could prove to be a useful study in promoting success and persistence in the HP Scholars Program.
6. An investigation of students who changed majors after leaving the program, this information could prove useful in developing strategies to reduce the number of STEM students leaving the scholars program.
7. Replication of the study with other groups of students, minority and majority, to chart the noncognitive variables and support resources utilized as compared to those deemed critical for retention and persistence.
8. Use of Tracey and Sedlacek's (1984) written instrument, the Non-Cognitive Questionnaire (NCQ), to assess HP Scholars noncognitive dimensions as predictors of college success.

5.1.7 Recommendation for Hewlett Packard

Many organizations require program managers to provide justification for funding. To further support the Hewlett Packard Scholars program, the organization should consider putting tracking mechanisms in place with the partner institutions' to maintain contact with scholars. This approach would better ensure that if students are contemplating dropping out of school all together or switching majors, counseling from HP mentors may change the outcome. To handle

these responsibilities, researcher is encouraging HP to hire a consultant for program evaluation. This person/firm would be responsible for tracking students and identifying outcomes as well as experiences.

5.1.8 Epilogue

Students are more likely to succeed when they find themselves in settings that are committed to their success, hold high expectations for their success, provide needed academic, social, and financial support, provide frequent feedback, and actively involve them, especially with other students and faculty. An important concept is that of educational community and the capacity of institutions to establish educational communities that involve all students as equal members (Seidman, 2005b).

Another important concept is for higher education institutions to know how to better identify those students who need support and what type of support, both cognitive and non-cognitive, that would be most helpful in order to be successful in the STEM disciplines. Studies have shown that the interest in the STEM fields of minorities and non-minorities are comparable in the freshman year; however, it is in subsequent years that the differences surface. As a result, the focus should not be on admission but retention and persistence.

Sedlacek (2004) stresses that we must recognize that cultural and racial differences exist and we must discuss them openly, because differences are not a negative for society. Westbrook and Sedlacek (1988) state, “Although majority students typically perceive the university system as belonging to them...minority students often view the situation in the opposite way and fear a reaction from the system...” (p. 87).

Students from differing backgrounds/cultures experience the campus environment in differing ways, and campus climate has a major impact on student success and persistence at a college or university.

The talent pool needed to increase the number of bachelor's degrees produced in the STEM fields already exists in the colleges and universities across the nation. Unless we as a nation can find ways to fully develop the talent potential of all of our people, we will languish in our current state of mediocrity in producing a solid talent pool of STEM field graduates.

I do not believe that it is too late; however, we are certainly at a crossroad. As the nation rapidly approaches the year 2050 when the minority ethnic population will become the majority, we must begin to recognize the diverse makeup of this great nation. Because of the national importance of Americans trained in STEM fields, institutions should seek support from state and federal government as well as corporations, especially the technology industry. With more support from public and private sectors and a heightened awareness of the problem at hand, institutional leaders should be able to increase the size of the STEM workforce while diversifying this sector. Lastly, if we as a nation invest financially and emotionally in the development of skills, talents, and academic endeavors of the African American, Hispanic, and American Indian youth with interest in pursuing the STEM disciplines, I believe that we will begin to strengthen and build that talent pool of diverse men and women that this country needs to take us into the future.

APPENDIX A

HEWLETT PACKARD APPROVAL LETTER

Hi Renee,

Thank you for taking the time to speak with me this morning! I am very excited about sharing our data with you so we can see what impact the HP Scholar program has had from your perspective!

As we discussed, HP looks forward to seeing your findings, however, we will not ask you to alter your findings in any way. We do, however, need to see anything you will publish so we can have our communications department review any statements about HP. Any changes that we request will be limited to the accuracy of anything that mentions HP, not to any of your findings.

We are ready to move forward once you are ready! As we discussed, the first step will be to contact the students to ensure that we have their support and permission to share the information we have, and you and I can work together on that step as soon as you are ready to begin the process.

Best regards,
Sandy Brooks
Program Manager
HP Philanthropy and Education
(916)785-3809
www.hp.com/go/hpscholars

APPENDIX B

PARTICIPANT LETTER OF ACTUAL STUDY

October 17, 2007

Dear Hewlett Packard Scholars Program Graduate,

I am writing to request your participation in a dissertation research study for Renee Galloway of the University of Pittsburgh. The objective of the study is to:

1. Identify and examine support resources utilized by graduates of the HP Scholarship Program which helped to overcome barriers to academic success resulting in graduation.
2. Understand the actions necessary to become aware of and to utilize support resources offered by your respective college or university to overcome barriers to academic success.
3. Compile a resource guide of strategies that future Hewlett Packard Scholars and other minority students can employ to help ensure their academic success.

There is no cost to you for participating in this study and you will receive no direct benefit from participating in this study. However, by participating in this study, you can indirectly contribute to the future academic success of other students, which we are confident, is important to you.

All information is confidential and anonymity will be provided for all participants; no identifiable information will be collected from HP or the survey. Data will be collected through a Web based survey tool - Zoomerang. Participation is voluntary and your agreement to participate in the research project will have no impact on your current or future relationship with Hewlett Packard or the University of Pittsburgh.

I hope you will agree to participate in this research project by completing the survey located at <http://www.zoomerang.com/survey.zgi?p=WEB2272MBHSQQP>. The survey will take 10-15 minutes to complete. **Responses are due by November 18, 2007.** By completing the survey, you are consenting to participate.

Also, feel free to contact Renee Galloway at 412-624-5261 or gallowayr1@comcast.net if you have any questions, or to request a hard copy of the survey or to provide a current e-mail address. Please feel free share this survey information with other program graduates whom you are still in contact with. Thank you in advance for your participation.

Respectfully,
Howard Templeton



HP Scholars Program Manager
541 715 4181

APPENDIX C

IRB APPROVAL



University of Pittsburgh
Institutional Review Board

3500 Fifth Avenue
Ground Level
Pittsburgh, PA 15213
(412) 383-1480
(412) 383-1508 (fax)
<http://www.irb.pitt.edu>

Memorandum

TO: [RENEE GALLOWAY](#)
FROM: [SUE BEERS PHD](#), Vice Chair
DATE: 8/13/2007
IRB#: PRO07080007
SUBJECT: Support Resources Utilized by Participants in the Hewlett Packard Scholars Program in Overcoming Barriers to Academic Success

The above-referenced project has been reviewed by the Institutional Review Board. Based on the information provided, this project meets all the necessary criteria for an exemption, and is hereby designated as "exempt" under section 45 CFR 46.101(b) (2).

Please note the following information:

- If any modifications are made to this project, please contact the IRB Office to ensure it continues to meet the exempt category.
- Upon completion of your project, be sure to finalize the project by submitting a termination request.

Please be advised that your research study may be audited periodically by the University of Pittsburgh Research Conduct and Compliance Office.

APPENDIX D

SURVEY INSTRUMENT

Support Resources Utilized by Graduates of the Hewlett Packard Scholars Program in Overcoming Barriers to Academic Success

Most college students are challenged in a variety of ways; these challenges can be considered barriers to academic success. By utilizing available support resources, many students are able to overcome these barriers to academic success, resulting in graduation.

Examples of resources utilized to overcome barriers to academic success include, but are not limited to the following areas: **academic** – taking advantage of peer tutoring services, **social** – attending social events sponsored by sorority or fraternity, **financial** – meeting with financial aid personnel for assistance with completing financial aid application – **personal** – receiving mentoring from family members or friends.

Section I.

Directions: Answer Questions 1-10 by checking the answer that most closely applies.

1. What is your gender?
 - Male
 - Female

2. How do you describe yourself?
 - American Indian
 - African American or Black
 - Hispanic or Latino

3. What was your Academic Major?
- Computer Engineering
 - Computer Science
 - Electrical Engineering
 - Other
4. What was your Institutional affiliation?
- Morgan State
 - North Carolina A&T
 - University of California – Los Angeles
 - Washington University
 - Other
5. What was your average GPA/QPA?
- 3.5 – 4.0
 - 3.0 – 3.4
 - 2.5 – 2.9
 - 2.0 – 2.4
 - Below 2.0

6. Were you employed while pursuing your degree?
- Yes
 - No

If you answered “**Yes**” to question #6, proceed to question #7. If you answered “**No**” to question #6, proceed to question #8

7. Number of hours worked:
- Fewer than 10
 - 10 – 19
 - 20 – 29
 - 30 – 40
 - More than 40
8. On average, how many hours did you study or prepare for your courses per week
- None
 - 1 – 5 hours
 - 8 – 12 hours
 - 13 – 20 hours
 - More than 20 hours

9. What is the average number of credits that you have taken per term?
- 9
 - 12
 - 15
 - More than 15
10. If I had not been selected as an HP Scholar, I would have been unable to attend college.
- Yes
 - No

Directions – Think of your pattern of activities during the pursuit of your degree and check the answers that most closely apply.

Section II. This second set of questions are in regard to **Academic** resources. How frequently did you...

11. meet with your academic advisor for assistance? (e.g., selecting courses, determining major, etc.)
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month
12. meet with Instructors regarding courses that you were taking? e.g. assignments, grades, etc.)
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month
13. utilize the library for quiet time or studying?
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month
14. utilize tutoring services offered by your institution for various subjects?
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month

15. participate in a student organized study group?
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month
16. receive tutoring from peers or friends?
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month
17. utilize HP e-mail mentoring services for academic assistance?
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month

Section III.

This third set of questions are in regard to social resources.
How frequently did you...

18. attend social events sponsored by a minority student organization?
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month
19. attend social events sponsored by non-minority student organizations?
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month

20. meet with faculty member in a social setting for a meal or beverage?
(e.g., cafeteria, coffee shop)
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month
21. attend a sorority or fraternity sponsored social event?
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month
22. participate in social events sponsored by your institution (e.g., student/residence life, student affairs)
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month
23. participate in social events off campus, sponsored by a neighboring college or university?
(e.g., sorority or fraternity sponsored event)
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month
24. participate in community service project sponsored by your institution
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month

Section IV.

This fourth set of questions are in regard to Personal resources. How frequently did you...

25. communicate with family members? (e.g., phone, e-mail, text message, etc.)
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month
26. communicate with friends, outside your institution? (e.g., friends at home or attending other colleges or universities, etc.)
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month
27. communicate with friends' on-campus
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month
28. talk with a faculty member regarding personal concerns?
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month
29. contact the campus wellness center for health related or medical concerns?
- Never
 - Less than 1 time per month
 - 1 time per month
 - 2 – 5 times per month
 - More than 5 times per month

30. contact campus counseling center (e.g., regarding personal or family problems)

- Never
- Less than 1 time per month
- 1 time per month
- 2 – 5 times per month
- More than 5 times per month

31. speak or meet with clergy on or off campus?

- Never
- Less than 1 time per month
- 1 time per month
- 2 – 5 times per month
- More than 5 times per month

32. utilize HP's e-mail mentoring service for personal concerns?

- Never
- Less than 1 time per month
- 1 time per month
- 2 – 5 times per month
- More than 5 times per month

Section V.

This fifth set of questions are in regard to **Financial** resources.

Directions: Answer the following questions with **Yes** or **No**...

33. Did you receive scholarship assistance from your institution?

- Yes
- No

34. Did you receive scholarship assistance from outside your institution?

- Yes
- No

35. Did you meet with financial aid counselors at your institution to discuss financial aid options?

- Yes
- No

36. Did you receive assistance from your institutions' financial aid office when completing financial aid applications?

- Yes
- No

37. Did you receive financial support from your family?

- Yes
- No

38. Did you receive assistance in completing financial aid applications from family members?

- Yes
- No

39. Did you participate in work study or other employment options to supplement finances?

- Yes
- No

40. Did you contact governmental agencies (federal or state) for assistance with financial aid applications?

- Yes
- No

41. Did you use loans to finance your education?

- Yes
- No

42. Did the availability of funding affect your decision to attend the institution that you selected?

- Yes
- No

Directions: Select the answer that most closely applies:

43. On average, in a single year, what percentage of funding came from scholarships?

- 0%
- 1 – 25%
- 26 – 50%
- 51 – 75%
- 76 – 100%

44. On average, in a single year, what percentage of funding came from loans?

- 0%
- 1 – 25%
- 26 – 50%
- 51 – 75%
- 76 – 100%

Section VI

This **sixth** set of questions are in regard to your satisfaction with your undergraduate college experience. How satisfied were you with...

45. the academic support provided by your institution? (availability of tutoring, library facilities)

- Very Satisfied
- Satisfied
- Dissatisfied
- Very Dissatisfied

46. the social support provided by your institution? (e.g., social events, great and meet gatherings, community service projects)

- Very Satisfied
- Satisfied
- Dissatisfied
- Very Dissatisfied

47. the financial support provided by your institution? (e.g., availability of internal grants/scholarships, information on external grants/scholarships)

- Very Satisfied
- Satisfied
- Dissatisfied
- Very Dissatisfied

48. the personal support provided by your institution? (e.g., peer support, counseling services)

- Very Satisfied
- Satisfied
- Dissatisfied
- Very Dissatisfied

49. your Institution overall?
- Very Satisfied
 - Satisfied
 - Dissatisfied
 - Very Dissatisfied

Section VII.

- (1) Identify any support resources, not listed on this survey that helped you to achieve success, which resulted in graduation.
- (2) When listing support resources, also include what you had to do to identify these resources and action taken to take advantage of the resources.
For example: **Resource:** on campus workshops available to promote student academic success through improved study habits. **Awareness:** investigating where to go to find resources to assist in developing solid study habits. **Action:** attended workshop for improving study habits.
-

50. List Resource – Awareness - Action
Resource: _____
Awareness: _____
Action: _____

51. List Resource – Awareness - Action
Resource: _____
Awareness: _____
Action: _____

52. List Resource – Awareness - Action
Resource: _____
Awareness: _____
Action: _____

APPENDIX E

RESEARCH QUESTIONS WITH SUPPORTING SURVEY QUESTIONS

Research Question	Survey Question
<p>R1. Which support resources were utilized by Hewlett Packard Scholarship recipients to overcome potential barriers to academic success?</p>	<p>Sections II., III., IV. and V. How frequently did you:</p> <ul style="list-style-type: none"> • Meet with your academic advisor for assistance? • Meet with instructors regarding courses that were taking? • Utilize the library for quiet time or studying • Utilize tutoring services offered by the University? • Participate in a student organized study group? • Receive tutoring from peers or friends? • Utilize the HP e-mail mentoring service for academic assistance? • Attend social events sponsored by non-minority student organizations • Meet with faculty in a social setting • Attend a sorority or fraternity sponsored social event • Participate in social events sponsored by the University • Participate in social events off campus, sponsored by a neighboring college or university • Participate in community service project sponsored by your institution • Communicate with family members

	<ul style="list-style-type: none"> • Communicate with friends, outside your institution • Communicate with friends on campus • Talk with faculty member regarding personal concerns • Contact campus wellness center for health related concerns • Contac campus counseling center • Speak or meet with clergy on or off campus • Utilize HP’s e-mail mentoring services for personal concerns • Did you receive scholarship assistance from your institution • Did you receive scholarship assistance outside your institution • Did you meet with financial aid counselors at your institution to discuss financial aid options • Did you receive assistance in completing financial aid applications from financial aid office • Did you receive financial support from family • Did you receive assistance in completing financial aid application by family member(s) • Did you participate in work study or other employment options to supplement finances • Did you contact government agency for assistance with financial aid application • Did you use loans to finance your education • Did the availability of funding affect your institutional selection • On average in a single year, what percentage of funding came from scholarships • On average in a single year what percentage of funding came from loans
<p>R1a-R1b. What did HP Scholars Program graduates do to identify resources? Did HP Scholars Program graduates utilize available resources? If so, what did graduates do to</p>	<p>Section VII.</p> <ul style="list-style-type: none"> • Identify any resources, not listed on this survey that helped you to achieve success, which resulted in graduation

utilize available resources?	<ul style="list-style-type: none"> • When listing resources also include what you had to do to identify these resources and action taken to take advantage of resources
R2. What associations are there between the resources utilized and the Science, Technology, or Engineering major selected?	<p>Section I. What was your academic major?</p> <p>Sections II., III., IV. and V. How frequently did you:</p> <ul style="list-style-type: none"> • Meet with your academic advisor for assistance? • Meet with instructors regarding courses that were taking? • Utilize the library for quiet time or studying • Utilize tutoring services offered by the University? • Participate in a student organized study group? • Receive tutoring from peers or friends? • Utilize the HP e-mail mentoring service for academic assistance? • Attend social events sponsored by non-minority student organizations • Meet with faculty in a social setting • Attend a sorority or fraternity sponsored social event • Participate in social events sponsored by the University • Participate in social events off campus, sponsored by a neighboring college or university • Participate in community service project sponsored by your institution • Communicate with family members • Communicate with friends, outside your institution • Communicate with friends on campus • Talk with faculty member regarding personal concerns • Contact campus wellness center for health related concerns • Contact campus counseling center • Speak or meet with clergy on or off campus

	<ul style="list-style-type: none">• Utilize HP’s e-mail mentoring services for personal concerns• Did you receive scholarship assistance from your institution• Did you receive scholarship assistance outside your institution• Did you meet with financial aid counselors at your institution to discuss financial aid options• Did you receive assistance in completing financial aid applications from financial aid office• Did you receive financial support from family• Did you receive assistance in completing financial aid application by family member(s)• Did you participate in work study or other employment options to supplement finances• Did you contact government agency for assistance with financial aid application• Did you use loans to finance your education• Did the availability of funding affect your institutional selection• On average in a single year, what percentage of funding came from scholarships• On average in a single year what percentage of funding came from loans
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<p>R3. What are the characteristics of students who graduated from the HP Scholars Program?</p>	<p>Section I.</p> <ul style="list-style-type: none"> • What is your gender? • What is your ethnicity? • What is was your academic major • What was your institutional affiliation • What was your average GPA/QPA • Were you employed while pursuing your degree • If yes, how many hours did you work • On average, how many hours did you study or prepare per week? • What is the average number of courses you have taken per term? • If I had not been selected as a HP Scholar, I would have been unable to attend college • My career expectations required that I complete my college education
<p>R4. What were the overall perceptions of the HP Scholars regarding their undergraduate college experience (e.g., major selected, institutional experience)?</p>	<p>Section VI</p> <ul style="list-style-type: none"> • How satisfied were you with the academic support provided by your institution? • How satisfied were you with the social support provided by your institution? • How satisfied were you with the financial support provided by your institution? • How satisfied were you with the personal support provided by your institution? • How satisfied were you in general with the overall support provided by your institution?

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