SELF-EFFICACY BELIEFS AND INTENTIONS TO PERSIST OF NATIVE HAWAIIAN AND NON-HAWAIIAN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS MAJORS

by

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This dissertation is dedicated to my wife Laura H.E. Kaakua and father Joseph W.L. Kaakua.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This study applies the framework of Social Cognitive Career Theory and Astin's (1999) Inputs – Environment – Outcomes model to investigate the personal input and environmental factors associated with self-efficacy beliefs and intentions to persist in Science, Technology, Engineering, and Mathematics (STEM) and to examine the differences of these factors and outcomes between Native Hawaiian and non-Hawaiian students. Conducted at a large, public tier-one research institution in Hawaii, this cross-sectional study gathered survey data from 638 undergraduate STEM majors and analyzed data through factor analysis, regression, and MANOVA techniques. The findings indicate that sense of belonging to major, past performance, and family support explained STEM self-efficacy. Self-efficacy, in turn, predicted intent to complete a STEM degree at the institution. This study also found higher levels of peer interaction, program involvement, family support, and intentions to persist for Native Hawaiians relative to non-Hawaiians. A Ho'okahua or foundation building framework is presented based on self-efficacy, sense of belonging, and involvement to guide educational practice and theory. The implication for practice is that academic communities at the department or discipline level, especially for underclassmen and Native Hawaiians, are important to improve degree completion in STEM. The findings provide direction for Native Hawaiian education research to further investigate socio-cultural aspects of learning and Native Hawaiian congruence in STEM.

CHAPTER 1

INTRODUCTION

Student persistence is one of the most studied topics in the higher education literature. Institutions, educators, and researchers want to better understand the nature of student persistence (or departure), student self-beliefs about their capabilities and motivations to complete a degree, and the influences and capabilities of the institution to support students to graduation. Leading theorists such as Astin (1977, 1993, 1999), Tinto (1975), Kuh (1993), Bean (1980) and Pascarella and Terenzini (1991) have postulated different models and frameworks to identify, study, and understand the complex mix of factors associated with college success.

U.S. educational leaders, researchers, and policy makers have become increasingly interested in understanding persistence issues to improve success in Science, Technology, Engineering, and Mathematics (STEM) as well as retention issues pertaining to underrepresented ethnic minorities. The focus on the STEM educational pipeline is due to the importance of STEM as a national driver of technological advancement, economic prosperity, and global competitiveness (National Research Council [NRC], 2010). Initiatives to develop models of effective programs aimed to increase participation of minority STEM students have gained traction since the 1970s (Landis, 1985). Educators at the University of Hawaii are interested in determining how the research informs smart retention strategies for Native Hawaiians, the indigenous peoples of Hawaii. While the broader context for the motivation of this study is to address the underperforming U.S. STEM educational pipeline, the specific context is the goal of improving college outcomes for Native Hawaiian STEM majors at the University of Hawaii at Manoa. The aim of this study was to investigate two outcomes of interest — self-efficacy beliefs and intent to persist — for Native Hawaiian and non-Hawaiian STEM majors.

This chapter first presents the need for an improved science and engineering workforce and educational pipeline to address local, national, and global demands. The case is made that improving the ways in which higher education involves, prepares, and successfully graduates underrepresented students is a critical piece to meeting the nation's science and engineering demands (NRC, 2010; Museus & Liverman, 2010). Using Astin's theory of student involvement (1977, 1993, 1999), social cognitive theory (Bandura, 1977, 1997), and social cognitive career theory (Lent, Brown, & Hackett, 1994; Lent, 2013) as a framework, this study highlights what is known and what is not known related to improving STEM persistence for underrepresented minorities in general, and for Native Hawaiian STEM students in particular. Finally, this chapter introduces the purpose, parameters, and research questions driving this quantitative study.

Background of the Problem

The United States has, in many ways, led the globe in economic prosperity rooted in its science and engineering enterprises. Science, Technology, Engineering, and Mathematics have been well documented as providing a foundation for the nation's competitiveness (NRC, 2007, 2010). Economic studies have shown over half of the growth in United States' gross national product (GDP) in recent decades has been attributable to direct or indirect results of advancements in science and technology (Boskin & Lau, 1992). National Science Board (NSB) (2010) indicators reveal that while only 4% of the nation's workforce are scientists or engineers, this group disproportionately creates jobs for the other 96%. Advancements in knowledge, leading to technology and innovation, have been a primary driver for the creation of jobs in the twentieth century and are expected to be the source of competitive edge in the future economy.

The nation's strategic leadership in science and technology, however, is diminishing relative to global competition. Consider that the World Economic Forum (2010) ranked the

United States 48th in quality of mathematics and science education, the United States ranks 27th among developed nations in the proportion of college students receiving undergraduate degrees in science or engineering (Organization for Economic Cooperation and Development, 2009), and that 49% of United States adults do not know how long it takes for the Earth to revolve around the Sun (NSB, 2010). The inability of the U.S. educational system to keep pace with global competitors to produce a citizenship literate in STEM and a STEM workforce that is well-trained and well-educated has been called “the quiet crisis” (Friedman, 2006; Jackson, 2004). The United States faces an increasing threat to economic prosperity, security, and strategic leadership in science and technology in the wake of a flattening world.

Recent national reports echo the daunting outlook of U.S. prosperity rooted in America’s comparative edge in innovation. The National Academies’ *Rising Above the Gathering Storm* (NRC, 2007) detailed a national call to action to address America’s eroding leadership in science and technology. The follow-up report *Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5* (NRC, 2010) updated that in the five years since the original report, the nation’s outlook had worsened. President Obama (2011) characterized the problem of global competition as an opportunity in science and engineering as “our generation’s Sputnik moment”. Education, government, and industry leaders are challenged to identify the opportunities to improve STEM education and capacity.

Improving the nation’s outlook is associated with improving the U.S. human capital in science and engineering. The percentage of U.S. students pursuing first (undergraduate) degrees in engineering (6%) is the second lowest among developed countries (NSB, 2010). In comparison, over one-third of undergraduate students in China are enrolled in engineering study (NSB, 2010). For students in the United States that do enter in science and engineering, less than half complete their science or engineering degree within five years. Underrepresented minorities drop out of science and engineering programs at a higher rate than other groups (NSB, 2010). This translates to a smaller domestic talent pool to enter advanced degrees and the science and engineering workforce.

Major segments of the domestic U.S. population, particularly ethnic minority groups and women, are significantly underrepresented in STEM. African Americans, Hispanics, Native Americans, Native Hawaiians, females, and persons with disabilities account for a significant portion of the population and workforce, but are disproportionately found in science and engineering classrooms, research laboratories, and the corporate environment (Jackson, 2004). Achievement gaps exist between minority and non-minority students with regard to pre-college preparation, college access, and STEM degree completion (Huang, Taddese, Walter, & Peng, (2000). Although only half of all U.S. engineering majors graduate in engineering (National Science Foundation, 2011), the completion rate for minority students in engineering is even lower (Hurtado, Newman, Tran, & Chang, 2010; NRC, 2007). This implies that the higher education pipeline accelerates minority underrepresentation in the STEM workforce, rather than reverses it.

Underrepresented ethnic minorities are those whose group composition (college enrollment) in education is below that of their composition in the general population (NRC, 2010). African Americans, Hispanics, Native Americans, Alaskan Natives, Native Hawaiians and Pacific Islanders are largely underrepresented in STEM higher education and in the STEM workforce (Duderstadt, 2008; Leggon & Pearson, 2009; NSB, 2010). Asians, while a minority group in the U.S. population, are typically overrepresented in science and engineering fields. Pacific Islanders, including indigenous peoples to Samoa, Guam, Micronesia, and Polynesia, are considered an underrepresented group although they are commonly aggregated with Asians in national data sets on STEM fields.

While ethnic minorities are largely underrepresented in science and engineering they are also the most rapidly growing segment of the U.S. population (Committee on Science, Engineering, and Public Policy [CSEPP], 2011). Demographic trends project a steep increase in minority populations, especially amongst the college-going 18–24 year old age group, such that by 2050 almost half of the U.S. population will be non-White. Diversifying the domestic STEM workforce by increasing participation from all populations is a key element to address the *quiet crisis.*

STEM researchers, industry professionals, and policy makers believe if U.S. educational institutions improved the recruitment, retention and success rates of minority students in STEM, then the country would be better equipped to innovate, compete, and problem solve (NRC, 2007, 2010; Duderstadt, 2008). Slaughter (2008) writes of the New American Dilemma, which is marked by the post-Sputnik generation of white male engineers and technology workers retiring in record numbers. Slaughter (2008) states, “Given the demographic changes in the U.S. population, we cannot–and should not–expect white males to replace them. The solution to America’s competitiveness problem lies in bringing young underrepresented minorities into STEM careers in dramatically increased numbers” (p. 4). While there are many different pathways and solutions to “fixing” the STEM education problem, researchers recognize that “there are issues that are specific to underrepresented minorities, in general and in STEM, focused on preparation, access, and motivation, financial aid, academic support, and social integration” (CSEPP, 2011, p. 5).

In light of these concerns, several questions loom: How will the science and engineering professions draw more students from an increasingly diverse population? What factors most influence student success of underrepresented minorities in STEM and how can higher education utilize this information? What role will Hawaii educators and Native Hawaiian students play in addressing the increasing the quality, quantity, and diversity of tomorrow's STEM workforce?

Statement of the Problem

The National Academies highlight three challenges in their strategic plans to increase participation of minorities in science and engineering for America's competitiveness (NRC, 2007, 2010). First, the sources for the future science and engineering workforce are uncertain and changing increasingly relying on non-US citizens and fluctuating from a predominantly white male workforce. Second, demographics show that the groups most underrepresented in STEM are also the fastest growing in the domestic population, including the school-age population from which the workforce may draw future talent. Finally, the strategy recognizes that diversity is an asset in to enhance innovation, sustainability, and health of the nation. The challenges associated with improving a national STEM educational pipeline can be investigated on a local level. This section discusses Native Hawaiians in STEM, Native Hawaiians at the University of Hawaii, and the effects of Native Hawaiian underrepresentation.

Native Hawaiians in STEM

Native Hawaiians, the indigenous peoples of Hawaii, have traditionally held a familial relationship with their environment. Because of this inseparable connection, Native Hawaiians were keenly aware and therefore experts in the STEM fields of Hawaii (University of Hawai'i Hawaiian Studies Task Force [UoHHSTF], 1986; Kame'eleihiwa, 1992). For example, the NH people established a well-functioning resource management system, the ahupuaʻa, which was able to sustain a population of over one million NHs prior to western contact (Stannard, 1988). Hawaii's natural laboratory and geographic advantages have contributed to it being one of the leading locations in the world for the study of ocean sciences, astronomy, and geology. Therefore, in today's higher education system in Hawaii, it would be expected that these STEM areas would be highly populated with Native Hawaiian students. However, in the University of Hawaii at Manoa (UHM), the flagship campus of the state's higher education system, this is not the case. Of the 2,520 Native Hawaiian students enrolled at UHM, there are only 30 students in Marine Biology, 9 students in Geology, and 1 student in Astronomy (University of Hawaii Institutional Research Office [UoHIRO], 2012). NHs are not found pursuing culturally-important STEM disciplines at the University in high numbers.

Like other indigenous U.S. citizens, many Native Hawaiians have not experienced success in the STEM educational pipeline. High school, pre-college preparation, and college success outcomes are lower for NHs than their non-Hawaiian counterparts. NH children lag behind statewide averages by approximately 10 percentile points in reading and math and the achievement gap widens as students progress to higher grades (Kamehameha Schools Press [KSP], 2005). NHs have lower transition rates between middle and high school, are retained in high school more often, and are less likely than non-Hawaiians to graduate, to enroll in college, or to complete a bachelor's degree in the expected timeframe (Benham, 2006; Hokoana, 2010). At UH Manoa, NH students are the least likely of Hawaii's major ethnic groups to graduate within six years and are most likely to be working full-time while attending school (22.3% versus 17.8% statewide) (Hokoana, 2010; KSP, 2005). These findings support Benham's (2006) assessment that Native Hawaiians are not fairing well in their own homeland.

In postsecondary education, Native Hawaiians continue to be underrepresented, particularly in the STEM fields. Native Hawaiians comprise 23.1% of the state of Hawaii population but comprise only 12.8% of the student body and 3.8% faculty at the University of Hawaii at Manoa (UoHIRO, 2010). In the STEM disciplines, Native Hawaiian undergraduate and graduate student enrollments in each of the STEM colleges/schools are well below parity with the State population (23.1%): 13.2% in Tropical Agriculture, 11.9% in Engineering, 8.8% in Natural Sciences, 6.5% in Medicine, and 4.4% in Ocean and Earth Sciences (UoHIRO, 2010). More so, the Native Hawaiian population is expected to double in size from 2000 to 2050 (Hsu & Nielson, 2010). Overall Native Hawaiian enrollment numbers increased by 21% at the University of Hawaii at Manoa between 2004 to 2008, but the graduation rate with a four year degree has not significantly changed, remaining between nine and twelve percent in the past three decades (Matsumoto, 2010).

Finally, NHs are significantly underemployed in the STEM workforce. The combined working population of NHs, Pacific Islanders, and 'Other Race' (grouped by U.S. Census due to small sample size) represents 4.6% of the total U.S. workforce, but only 1.4% of STEM occupations (Landivar, 2013). This makes NHs and Pacific Islanders the most underrepresented ethnic group in the nation in STEM employment (factor of 3.3), more so than Hispanic (2.3), African American (1.7), and American Indian and Alaska Native (1.5) groups.

University of Hawaii and Native Hawaiians

The University of Hawaii bears a unique responsibility to improve the educational success, such as STEM persistence and graduation, of Native Hawaiians. The mission of the University the Board of Regents affirm:

> as the only provider of public higher education in Hawaii, the University embraces its unique responsibilities to the indigenous people of Hawaii and to Hawaii's indigenous language and culture. To fulfill this responsibility, the University ensures active support for the participation of Native Hawaiians at the University. (University of Hawaii Board of Regents [UoHBR], 2012, 4-2)

Native Hawaiian educational attainment is a performance measure guiding the UH System in their 2008-2015 strategic plan to "position the University of Hawaii as one of the world's foremost indigenous-serving universities by supporting the access and success of Native Hawaiians" (University of Hawaii Office of the Vice President for Academic Planning & Policy [UoHVPAPP], 2008, p. 2). The associated performance goal is to increase degree attainment of Native Hawaiians at UH by 6-9% per year.

Although there has not always been commitment by leadership or successful educational outcomes for Native Hawaiians at the University of Hawaii at Manoa (UoHHSTF, 1986; KSP, 2005), the institution has more recently affirmed in its UH Manoa 2011-2015 Strategic Plan the mission:

> dedicated not only to academic and research excellence but also to serving with aloha the local, national, and internal communities that surround us. Taking as its historic trust the Native Hawaiian values embedded in the concepts of kuleana, 'ohana, and ahupua'a that serve to remind us of our responsibilities to family, community and the environment. (University of Hawaii at Manoa, 2011)

The UHM faculty senate Strategic Plan Implementation Committee unanimously approved the 2012-2013 Native Hawaiian Scholarship initiative based, in part, on the 2012 UHM Native Hawaiian Task Force report (University of Hawai'i at Manoa Native Hawaiian Advancement

Task Force [UoHMNHATF], 2012). Improved Native Hawaiian participation is a strategic initiative of the institution.

Effects of NH Underrepresentation

Effects of Native Hawaiian underrepresentation in STEM are two-fold. First, Native Hawaiians continue to be underemployed in STEM professional careers translating to a loss in talent nationally and diminishing benefits for individuals and their families. Advancement in the areas of STEM is associated with economic benefits and has been directly correlated to a higher living standard and improved quality of life (Burke & Mattis, 2007). NH families have the lowest mean family income and NH individuals have the highest percentage of individuals living below the poverty threshold compared with all other major ethnic groups in the state (KSP, 2005). The studies are clear that a college degree is economically and socially beneficial (Adelmann, 1999; Choy, 2001; Hokoana, 2010; Day & Newburger, 2002). A focus on STEM college and career pathways is warranted for NHs to address socioeconomic disadvantage, job stability, and future economic well-being as well as for the nation to address the most underrepresented population group in the national STEM workforce.

Second, because Native Hawaiians are underemployed in the STEM professions, they have an underrepresented voice and less impact on policy and practices that affect communities and environments. For example, forecasts of scarce freshwater supply and watershed recharge, damage to fisheries, reefs, and ocean ecosystems, and congested infrastructure development to accommodate the swelling population magnify global issues locally. Challenges faced by Native Hawaiians, Hawaii, and the United States including energy dependency, climate change, and environmental protection requires STEM solutions from diverse perspectives. If the University of Hawaii is successful in increasing STEM participation (capabilities, motivation, and completion) among the growing number of Native Hawaiians, then the local and global workforce will strengthen.

Purpose of the Study

The purpose of this study is to investigate the factors related to involvement, self-efficacy, and intent to persist for Native Hawaiian and non-Native Hawaiian college students in STEM fields. Astin's involvement and I-E-O framework (1975, 1993, 1999) was utilized as a relevant model to understand undergraduate college *inputs*, *environments*, and *outcomes*. A conceptual model based on the frameworks of social cognitive theory (Bandura, 1977, 1997) and Social Cognitive Career Theory (Lent, Brown, & Hackett, 1994, 2000) were used to investigate the influences of eight input characteristics: ethnicity, gender, socioeconomic status, financial ability, pre-college academic performance, STEM college/major, academic level, and incoming student status; and ten environmental factors: family support, peer interaction, faculty interaction, faculty support, participation in a minority STEM program, college academic performance, satisfaction, and sense of belonging to major, to school, and to campus community; on two outcomes: STEM self-efficacy and intent to persist in STEM major.

Self-efficacy in STEM was measured to assess undergraduate STEM major's beliefs about their own *capabilities* to complete their Bachelor's degree in STEM. Intent to persist was measured to assess STEM major's beliefs about their *intentions* or commitment to complete their Bachelor's degree in STEM. These cognitive self-beliefs describe the level of confidence in what one *can do* and what one *will do*. Research has shown these outcome measures to be strong predictors of actual persistence and degree completion (Cabrera, Castaneda, Nora, & Hengstler, 1992; Pascarella & Chapman, 1983; Hausmann, Schofield, & Woods, 2007; Lent et al., 1994; Lent, 2013).

To contribute to the literature regarding STEM persistence and self-efficacy for underrepresented college students, this study focused on three research questions:

1. What are the personal input and environmental factors associated with STEM self-efficacy beliefs of undergraduate STEM students?
2. What are the personal input and environmental factors associated with intent to persist in STEM of undergraduate STEM students?
3. How do these factors and outcomes differ, if at all, amongst Native Hawaiian and non-Hawaiian students?

This cross-sectional, single-institution study consisted of administration of a web-based survey to all undergraduate STEM majors at the University of Hawaii at Manoa (N=3,592) including a subset of Native Hawaiian STEM majors. A 17.7% response rate netted a sample size of n=638. A quantitative approach was taken to answer the three research questions by examining the relationships between input, environment, and outcome variables. Analyses involving descriptive statistics, factor analysis, regressions, and analysis of variance were performed to address this study's three research questions.

Importance of the Study

For the United States to best address the "quiet crisis" of global competition, each state and educational institution must improve its STEM education pipeline and pathways. Engaging groups historically underrepresented in the STEM fields can significantly increase the domestic talent pool in science and engineering (Duderstadt, 2008). If the intellectual talent inherent in ethnic minority groups, which will soon constitute a new majority of the domestic population, are identified, nurtured, and encouraged, the projected gap of scientists and engineers can be filled (Jackson, 2004). There is potential for the University of Hawaii to improve the STEM education pipeline by addressing STEM participation of the indigenous peoples on Hawaii.

This study will address a gap in the extant research by investigating college outcomes for Native Hawaiians in the STEM fields. While some studies exist on the college-going experiences of Native Hawaiian students in general and for Native Hawaiian students in community college vocational programs, few, if any, focus on behavior or motivation in STEM fields in particular. The literature analyzes interventions and promising programs to improve minority representation at the undergraduate, graduate, and faculty level and this study will extend that analysis to minority STEM programs at the University of Hawaii at Manoa. Understanding the factors that influence student persistence and self-efficacy in STEM, for Native Hawaiian and non-Hawaiian students at a single-institution, can be used to develop potential improvements and recommendations at the local and national level.

Organization of the Dissertation

Chapter 1 of this dissertation presents the backround of the study, the statement of the problem, the purpose of the study, the research questions, and a brief description of the research methodology. Chapter 2 presents a review of the literature highlighting the conceptual framework guiding the study and a discussion of the variables selected for investigation. Chapter 3 presents the methodology including the research design and a description of the setting, sample, instrumentation, and data collection procedures. Chapter 4 presents the analysis and findings of this quantitative study. Chapter 5 summarizes the findings, addresses implications of the study, and provides recommendations and conclusions. Finally, references and an appendix conclude this dissertation.

CHAPTER 2

LITERATURE REVIEW

This chapter describes the focus areas of this study related to involvement, self-efficacy, and intent to persist for Native Hawaiian and non-Native Hawaiian college students in STEM fields. First, Astin's involvement and I-E-O framework (1975, 1993, 1999) will be presented as a relevant model to understand undergraduate college *inputs*, *environments*, and *outcomes*. Second, social cognitive theory and self-efficacy theory will be presented as they inform Lent et al.'s (1994, 2000) Social Cognitive Career Theory (SCCT). Empirical support for SCCT is presented related to its limitations and utility in studying the influences of background and environmental factors as they contribute to self-efficacy and intent to persist in STEM. A conceptual model based on the presented literature is detailed to provide a guide for this study. The research questions focus on eight input characteristics: gender, ethnicity, socioeconomic status, financial ability, pre-college academic performance, STEM College/major, educational level, and incoming student status; ten environmental factors: family support, involvement in a minority STEM program, peer interaction, faculty interaction, faculty support, college academic performance, sense of belonging to school, major, and campus community, and satisfaction; and their association with two outcomes: STEM self-efficacy and intent to persist to STEM degree attainment. Theoretical and empirical support for the selection and utility of these variables will be presented. Finally, STEM retention studies regarding involvement, self-efficacy, and intention to persist of underrepresented minorities in STEM and Native Hawaiian students in particular will follow. This chapter will provide readers with adequate knowledge to comprehend the nature of this study's three investigative questions:

1. What are the personal input and environmental factors associated with STEM self-efficacy beliefs of undergraduate STEM students?
2. What are the personal input and environmental factors associated with intent to persist in STEM of undergraduate STEM students?
3. How do these factors and outcomes differ, if at all, amongst Native Hawaiian and non-Hawaiian students?

Theory of Student Involvement

Involvement theory builds on and provides insight to the conversation of higher education student development literature. Beyond providing a clear characterization of what supports student persistence, Astin's longitudinal studies (1993, 1999) provide a breadth of data on student inputs, environmental factors, and their correlation with student outcomes and effects. Other theorists such as Kuh (1993), Tinto (1993), and Tierney (2004) have contributed to the conversation with regard to the understanding of the effects of the college environment and the role of the institution in the area of student engagement, sense of belonging, and departure.

Astin's theory of student involvement emerged from his 1975 longitudinal study of college dropouts seeking to identify significant factors affecting student college persistence. The key finding was that virtually all effects contributing to college persistence suggested increased student involvement, while all effects contributing to student departure suggested a lack of involvement (Astin, 1999). In *What Matters in College* (1993), Astin reports highly consistent results with his involvement theory of student retention (1975, 1999). Significant positive associated variables with persistence suggest high involvement with other students, with faculty, and with academic work. More so, significant negative correlates with persistence included working off campus, commuting, reading for pleasure, and other involvements that take time and energy away from the academic experience (Astin, 1993). The analysis of a variety of input characteristics, environmental factors, and effects led to a theory of involvement. The theory of student involvement is better understood in terms of the nature of input characteristics and their correlated effects.

Astin (1999) defines “student involvement” as the “amount of physical and psychological energy that the student devotes to the academic experience” (p. 519). Involvement is related to the concepts of “effort,” “time on task,” and “vigilance” (p. 518). Astin (1999) gives additional postulates of student involvement theory: involvement occurs across a continuum such that a student can manifest different degrees of involvement in different objects at different times; involvement has both quantitative and qualitative features; student learning and personal development is directly proportional to the quality and quantity of student involvement; and the effectiveness of educational policy or practice is directly related to the capacity of the policy or practice to increase student involvement. These postulates suggest that the means for faculty, educators, and institutions intending to increase student learning and development are to focus on the motivation, behavior, and involvement of the student. The charge for educators is to develop environments that elicit sufficient student effort and investment of time, energy, and active participation by the student. Thus, Astin’s theory suggests that the *most* important institutional resource is the student’s time.

Inputs-Environment-Outcomes Model

A key element to Astin’s methodology is the I-E-O or Inputs, Environment, Outcomes model. Pascarella and Terenzini (2005) calls Astin’s I-E-O model “one of the first and most durable and influential college impact models” (p. 53). In order to study college affects, the conceptual/methodological guide views college outcomes as functions of inputs (such as pre-college academic experiences, demographic characteristics, socioeconomic status), environment (such as the college experiences students encounter in college), and outcomes (such as student characteristics, knowledge, beliefs, values, and behaviors). Astin's extensive variables and measures were analyzed to find patterns, correlations, and findings that gave empirical credibility to the I-E-O and student involvement theory.

Student involvement and the I-E-O framework provide a model for investigating college student development. However, Astin is more concerned with defining and identifying *involvement* in the behavioral sense (how a student behaves) rather than in the cognitive or motivational sense (how a student thinks or feels). In order to investigate the attitudinal, affective, and cognitive beliefs of college students, such as self-efficacy and intent to persist in STEM, involvement theory by itself is insufficient.

This cross-sectional study, further described in Chapter 3, does not intend to directly investigate STEM persistence or STEM graduation behavioral measures, but instead to focus on predictive cognitive measures of STEM self-efficacy beliefs and intent to persist. It is not only important to identify *what* a student does but *why* a student does (or does not). Social cognitive theory and social cognitive career theory expand on the role of input and environmental factors as they influence cognitive beliefs and student interpretations of their environment and experiences.

Social Cognitive Theory

Bandura's (1986) social cognitive theory of human behavior offers a key framework related to the study of motivation and in mediating academic persistence. The beliefs individual's hold about their abilities and the outcome of their efforts strongly influence their actions and behaviors (Parajes, 1996; Bandura, 1977, 1986). Built on the concept of *reciprocal* *determinism*, social cognitive theory offers the view that (a) personal factors (e.g. thoughts and beliefs), (b) behavior, and (c) environment mutually influence each other (Parajes, 1996). Personal beliefs, including those stemming from self-reflection and self-evaluation, are influenced by and can influence the individual's environment and behavior.

The key factor for human agency, Bandura (1997) argues, is self-efficacy. Bandura (1977, 1997) formally defined self-efficacy as personal judgments of one's capabilities to organize and execute courses of action to attain desired goals. Self-efficacy is a performance-based measure of perceived capability related to specific tasks in a given domain. Self-efficacy beliefs influence three behaviors: the individual's goal choice, the effort enacted to reach those goals, and the persistence when difficulties arise (Bandura, 1997; Pajares & Urdan, 2006; Rittmayer & Beier, 2009). The construct of self-efficacy, first introduced extensively in Social Cognitive Theory (Bandura, 1977), is the focus of this study as applied to choice and persistence in STEM.

Self-Efficacy Theory

Belief in one's capabilities to perform a specific task is referred to as self-efficacy. Bandura (1977, 1997) describes three characteristics of self-efficacy: *level, generality,* and *strength*. These, respectively, pertain to dependence of the difficulty of the task, the transferability of self-efficacy beliefs — such as from writing to algebra, and the amount of one's certainty about performing a certain task. Self-efficacy is focused on *performance capabilities* as opposed to personal qualities such as physical or psychological characteristics (Zimmerman, 2000). Judgments are made about one's confidence in accomplishing a task, not about who they are or how they feel about themselves in general.

With regard to content, perceptions of efficacy depend on *mastery criterion* of performance as opposed to how well one expects to do in comparison with others. Self-efficacy beliefs may differ across domains (a student has high levels of self-efficacy in mathematics but not in biology) and may differ across tasks (a student has high self-efficacy in conducting engineering research but low levels of self-efficacy in completing an engineering design project). In addition, measures of self-efficacy are *context* specific, and are sensitive to changes in the performance context. For example, a student's self-efficacy for getting an A in an exam can differ if administered in an uncomfortable, noisy environment, if taken after three other exams, or if taken under optimal conditions. Finally, self-efficacy beliefs specifically refer to capabilities of *future* performance.

Related Constructs

Self-efficacy differs from the related constructs *self-concept*, *self-esteem,* and *ability.* Efficacy beliefs refer to contextual and task-specific capabilities such as, "I believe I can score a B or better on my next chemistry assignment." It is not meaningful to say someone has high (or low) self-efficacy in general. It is appropriate to say one has high math self-efficacy or low self-efficacy in writing a term paper. By definition self-efficacy beliefs are goal specific. Self-efficacy beliefs *to complete a STEM degree* were the focus of this study.

In contrast, self-concept describes self-perceptions that are more general than self-efficacy. Whereas self-efficacy focuses on beliefs about capabilities of future performance of a specific task, self-concept includes affective and evaluative components of the broader domain. For example, "I am good at chemistry" or "I hate chemistry" are beliefs describing self-concept. An individual can have a high self-concept in engineering, but may have low self-efficacy to complete a specific engineering project due to reasons affecting their capabilities (can't understand the professor, team members are not reliable contributors, insufficient budget to accomplish design, etc.). However, self-concept is often positively related to self-efficacy and both motivational constructs develop in similar ways through reinforcements and evaluations of others, self-judgments about past experiences, and interpretations of their environmental conditions (Schunk & Pajares, 2002; Rittmayer & Beier, 2009).

Beliefs about general abilities in a domain (self-concept) and task-specific capabilities of achievement (self-efficacy) are closely related to, and partly based on self-esteem. Self-esteem relates to global, evaluative feelings of self-worth. Research has shown self-efficacy to be a stronger predictor of task-specific performance than self–concept and self-esteem (Pajares & Urdan, 2006; Zimmerman, 2000).

Much of the discussion thus far, has centered on the notion of self-*perceived* ability to accomplish a task, what then of *actual ability*, its relation to self-efficacy, and their collective results on academic performance? Certainly self-efficacy alone cannot enable someone to accomplish a task without some level of ability. However, given two persons of equal ability, unequal levels of self-efficacy will lead to unequal performance behaviors and goal attainment (Pajares & Urdan, 2006). For example, Betz and Hackett (1981) found that among women and men of equal prior academic performance (grade point average) in science, engineering, and mathematics fields, men tended to estimate their capabilities higher (higher self-efficacy) than that of women (lower self-efficacy) in future coursework. This difference, in part, led to uneven subsequent performance and decision to persist or leave the science/engineering field. It is noted in this example that self-efficacy is derived from socio-cultural factors including gender differences in one's interpretations of their experiences and environmental cues. Higher self-efficacy allows individuals to better organize, manage, and make the most of their talents. Those who doubt their capabilities may be less likely to persist or expend additional effort on a goal or they may chose to avoid the goal altogether.

Although research has shown the benefits of high self-efficacy, too much self-efficacy (relative to actual abilities) is not a good thing for future motivation and performance. Overconfidence in self-capabilities in relation to actual abilities may lead to under-preparation, underperformance, and ill-fitted choice goals that lead to failure and future discouragement. Similarly, when self-efficacy levels are too low in relation to actual abilities (under-confidence), performance may be negatively affected by diminished effort and persistence in the face of setbacks, anxiety and unnecessary physiological detriment, lower goals, and avoidance of realistic challenges (Bandura, 1986; Lent, 2013). Both types of misjudgments of actual ability can hamper skill development, motivation, and performance (Zimmerman, 2000). Lent (2013) discusses the benefit of slight overconfidence or congruence with actual abilities which encourages motivation for pursuing task challenges, promotes proximal learning development, and promotes future and ongoing performance.

Development of Self-Efficacy

Bandura (1986, 1997) theorizes four sources of influence on self-efficacy: mastery experiences (from past accomplishments), vicarious learning experiences, social persuasion, and physiological reaction/affective states. Mastery experiences refer to prior performance outcomes and one's interpretation of their successes, challenges, and abilities. Prior experience affords the individual a better understanding of their capabilities to succeed in the future. Successful prior performance will likely lead an individual to feel confident in their capabilities to succeed in a like task in the future, however, poor prior performance is likely to cast doubt on the individual's self-perceived ability to do well on the next, like task.

Vicarious learning experiences refer to observations of similar others succeeding or failing at particular activities. This is another strong source of influence for determining one's own self-efficacy, especially if one has little direct experience to estimate one's own capabilities. Role models or persons perceived as similar to the subject are best influences for the subjects' self-efficacy for like tasks. If a model is viewed as having much higher talent or abilities as the observer, than the relevance may be discounted by the observer.

Social and verbal persuasion refers to others feedback, support, and influence. In academic settings, feedback and judgments from faculty/teachers, counselors, and peers can enhance and erode self-efficacy. Verbal persuasion, however, may have less impact on the learner than observer or direct experiences because outcomes are described and not witnessed and thus relies heavily on the credibility or influence of the other (faculty, parents, etc.). Verbal persuasion is strongest when tied to mastery experience such as feedback relative to a specific previous task performance (Pintrich, 2003; Betz & Schifano, 2000).

Finally, physiological reaction refers to how one interprets their emotional and physical states to determine their self-efficacy beliefs. Fatigue, nervousness, "butterflies", stress, and fear of failure are all physiological reactions that can affect self-efficacy and the increased anxiety on subsequent performance.

Social Cognitive Career Theory

Social Cognitive Career Theory (SCCT) (Lent et al., 1994; Lent, 2013) is an application and extension of Bandura's (1986) social cognitive theory. It shares the core elements of social cognitive theory that emphasizes the role of *triadic reciprocity* between people, their behavior, and their environment. Concurrent with social cognitive theory, personal agency or self-direction also plays a central role in mediating behavior, although the interchange with environmental supports, barriers, and other factors can strengthen, weaken, or even override personal agency (Lent, 2013). Individuals possess self-regulatory skills to organize, reflect, and regulate their own behavior and make alterations to their environment and personal factors. This, in turn, leads to changes in their subsequent behavior. Individuals are seen as contributors to their life circumstances rather then as by products of their life circumstances.

SCCT is a relatively recent framework to better understand educational and career development behavior. The theory attempts to describe the interactions between background characteristics (e.g. gender, ethnicity, predisposition) and the environment with cognitive-person factors (e.g. self-efficacy, outcome expectations, and goals). The four academic and career development outcomes modeled by social cognitive career theory are career and academic interest, choice, performance, and most recently satisfaction/well-being. SCCT is useful in this study to explore the relationships between self-efficacy and intent to persist, while also exploring the complex ways in which social cognitive factors, environment and personal influences describe persistence, performance and development in STEM.

Career development and academic choice and success, Lent et al. (1994) argue, are quite similar although they typically appear in different literatures. SCCT offers a segmental model of career behavior focusing primarily on issues of career interest, preparation, choice, and entry. This dovetails (in late adolescence and early adulthood) with academic development. Causal models and mechanisms appear in both career and academic development study. The dynamic nature of the influential factors within persons, environments, contextual supports and contextual barriers are relevant. For example, investigating the factors related to choice, performance, and persistence for undergraduate students considering a STEM major closely mirrors that of individuals considering a STEM career.

Empirical Support for Theoretical Models

There is empirical support for the use of SCCT to explain how personal inputs, social cognitive variables, and college environment aid in our understanding of academic behavior, motivation, and outcomes. Meta-analytic methods provide a quantitative way to integrate, compare, and contrast the results from multiple, independent studies. This is advantageous in reviewing a model because larger data sets may be able to increase statistical power and better estimate true effect size. Meta-analytic reviews also allow researchers to investigate inconsistencies and variation between studies. Caution must be taken into account, however, for selection of poorly designed (methodologically unsound) studies, sources of bias, and combination of summary measures.

Several meta-analysis of research focusing on young adults have directly tested a number of SCCT's hypotheses. Rottinghaus, Larson, and Borgen (2003) empirically synthesized and evaluated 60 independent samples (N=39,154) finding a strong overall relationship (r = .59) between self-efficacy and career interests. Regarding choice hypothesis, Sheu, Lent, Brown, Miller, Hennessey, and Duffy (2010) found in their meta-analysis of SCCT studies that self-efficacy, interests, and outcome expectations strongly predicted choice goals. Multon, Brown, and Lent (1991) conducted an efficacy-performance meta-analysis from 36 studies yielding a total of 38 samples (N=4,998) of subjects. Studies included a mix of experimental (18) and correlational (13) design and included subjects from elementary to college level. Multon et al. (1991) found support for the hypothesized relationships of self-efficacy to academic performance and persistence. The relation of self-efficacy to performance varied by students' prior academic achievement with stronger relations found among low-achieving students. College and high school student samples also evidenced stronger effect sizes for efficacy-performance relationship than did elementary students. In summary, research findings suggest that self-efficacy beliefs are generally related to academic behaviors in the ways that support Bandura's (1977, 2001) social cognitive theory and its extension to social cognitive career theory.

Betz and Hackett (1981) were one of the first to apply SCCT to investigate differences among women and men in undergraduate career choice interest and persistence in engineering. They noted that gender role socialization tend to provide experiences that limit self-efficacy in nontraditional career and academic domains such as Science, Technology, Engineering and Mathematics. Interest, consideration, and academic persistence in nontraditional choice options were found to be lower for women than men. Subsequent to the Betz and Hackett (1981) work, many other studies have applied SCCT and investigated socio-cognitive variables on diverse populations. Researchers have focused on the application of SCCT on student populations taking into account gender, race/ethnicity, culture, socioeconomic status, age, and disability.

Conceptual Model

Background, socio-cultural, college environment, and cognitive factors on the diverse populations in particular academic domains (such as STEM) have received growing attention from researchers. Few studies focus on the combined effects of the variables to Native Hawaiian students in general and none exist to the knowledge of the researcher focusing on Native Hawaiian STEM students in particular. The intent of this study is to examine the differences between Native Hawaiian and non-Hawaiian STEM students on various contextual and environmental factors and their impact on STEM self-efficacy and intention to persist.

This section describes the conceptual model used in this study based on the Inputs-Environments-Outcomes framework and SCCT. The selected input and environmental factors are presented based on relevant research as well as a review of the dependent variables. It was hypothesized that all variables will directly or indirectly mediate self-efficacy and intent to persist, but the level and nature of influences are yet to be determined. Furthermore, differences between Native Hawaiian and non-Hawaiian STEM students were explored.

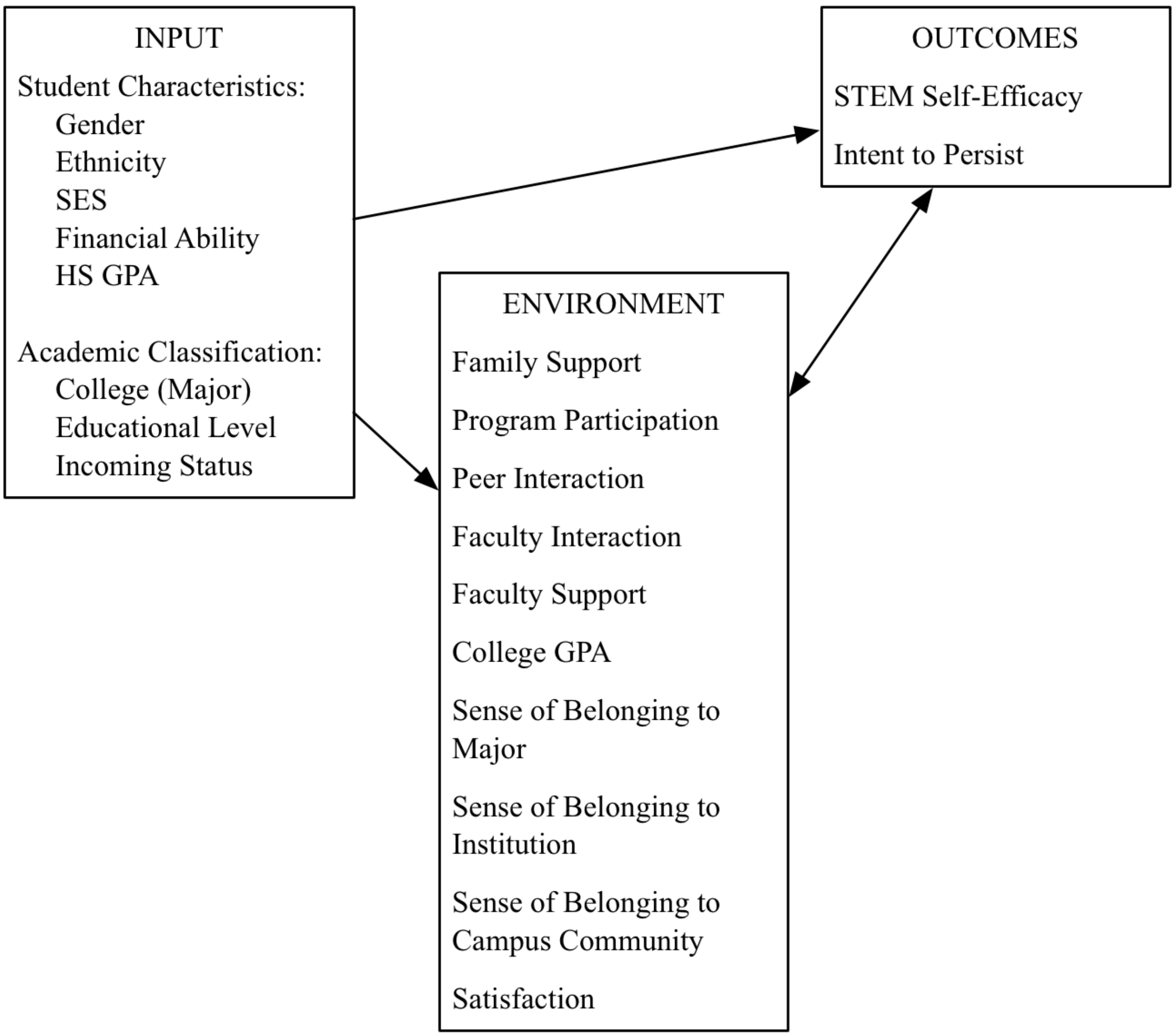

Figure 1. Conceptual Input – Environment – Outcomes (I-E-O) model for STEM self-efficacy and intent to persist. Adapted from Astin (1993).

Outcome Variables

The two dependent variables of interest in this study were STEM self-efficacy and intent to persist. Self-efficacy in STEM was measured to assess undergraduate STEM major's beliefs about their own *capabilities* to complete their Bachelor's degree in STEM. Intent to persist was measured to assess STEM major's beliefs about their *intentions* or commitment to complete their Bachelor's degree in STEM.

Self-Efficacy

In this study, self-efficacy in STEM will pertain to student's self-beliefs about their own capabilities to complete their intended STEM degree at their current institution. Self-efficacy has garnered increased attention from researchers due to its influence on choice goals, task performance, and motivation discussed prior in this chapter. STEM self-efficacy is modeled as a dependent variable based on the influences of the other personal input and environmental factors outlined in this study's conceptual model.

Intent to Persist

Although research has shown self-efficacy to be strongly directly related to task motivation and interest, capabilities do not directly measure intent or interest. For example one can have a high self-efficacy in washing dishes (high confidence in their capability to complete the task) but make no intention of washing the dishes. Similarly, one can feel confident and capable of flying a kite, but have little or no interest in kite flying. These examples highlight that self-efficacy beliefs are statements about what one *can do* and not what one *will do.* Bandura (1997) argues that individuals tend to avoid tasks that they do not feel capable of successfully completing, but the opposite may not be true. For these reasons, self-efficacy is often examined in concert with outcome expectations, interests, and choice goals. This study investigated self-efficacy for STEM degree completion along with intent to persist in STEM.

The use of intent to persist as an outcome in research is substantiated by prior studies showing a strong association between intentions to persist and actual persistence (Bean, 1980; Cabrera et al., 1992; Pascarella & Chapman, 1983, Hausmann et al., 2007). Tinto (1975, 1987, 1993) theorized students' integration into their social and academic environment were critical to student persistence. Commitments to finishing college (goal commitment) and to completing a degree at the college in which they are enrolled (institutional commitment) were also determined to be importance predictors of student persistence. Although research has shown intent to persist tends to overestimate actual persistence behavior, intent *not* to persist is an excellent indicator of student attrition.

It is important to note that this study defines intent to persist as intent to continue in a STEM major at their current institution to degree completion (goal commitment + institutional commitment). Persistence is often measured in other studies as year-to-year continuation, whereas this study is focused on graduation and degree attainment. Other definitions of persistence not applicable to this study are concerned with major or domain persistence, in which an science student is labeled as a persister in science after transferring to one or more institutions and maintain their focus on completing their science degree. Conversely, some studies of persistence are concerned with institutional persistence regardless of degree whereby institutional transfers, leavers, and stop-outs are labeled as non-persisters. Intent to persist in this study refers to the student's self-reported intention to complete a STEM degree at the current institution. This definition of persisters includes students that may switch between STEM majors at the institution but does not include STEM students that change majors from a STEM degree to a non-STEM degree.

Environment Factors

This study examined ten environment factors: family support, participation in a minority STEM program, peer interaction, faculty interaction, faculty support, sense of belonging to major, belonging to institution, belonging to campus community, and satisfaction. The ten environmental factors will be treated as independent variables. Although there is disagreement to the level and nature of influence, the extant literature has shown these factors to influence self-efficacy belief and intent to persist.

Family Support

Parents, family members, and caregivers provide experiences, role modeling, and persuasion that differentially influences individual's self-efficacy and intentions. Home influences can help children interact effectively with their environment, stimulate curiosity, gain mastery experiences, and positively affect self-efficacy (Bandura, 1997). Lack of family support has been shown to be a barrier to success in STEM, whereas ongoing encouragement from parents positively influenced persistence (Sandler, 1999; Swail & Perna, 2002). Family dynamics can positively and negatively influence self-efficacy and intention to persist.

Participation in Minority STEM Program

This factor identifies the involvement and potential influence of intervention activities at the institution to promote the academic development of Native Hawaiian and other minority students in the STEM disciplines. Minority STEM programs of interest in this study are the: (1) Native Hawaiian Science & Engineering Mentorship Program (NHSEMP), (2) Louis Stokes Alliance for Minority Participation (LSAMP) Scholars Program, (3) the Center for Microbial

Oceanography (CMORE) Scholars Program; (4) Na Pua No'eau Center for Gifted and Talented Native Hawaiian Children (NPN); (5) Hui Manawa Kupono Native Hawaiian Scholarship Program; (6) Minority Access to Research Careers; (7) Undergraduate Research at Mentoring (URM) in the Biological Sciences; (8) Pacific Internship Programs for Exploring Science (PIPES); (9) UH Manoa Honors Program; (10) Kua'ana Native Hawaiian Student Services Program; and the (11) UH Manoa Honors Program.

The extant literature analyzes interventions and promising programs at the undergraduate, graduate, and faculty level that address increasing the success of minority students in STEM. Jackson (2004) identified the Meyerhoff Scholars Program (MSP) at University of Maryland, Baltimore County (UMBC) as an exemplary program targeted to produce African American and other minority students to complete STEM BS degrees and continue to earn STEM doctorates. The MSP is largely research-based, utilizes residential intensive peer study groups, and focuses on the need to build a strong sense of community. MSP students achieved higher GPAs, graduated in STEM majors at higher rates, and gained acceptance to graduate schools at higher rates than current and historical samples. More so, faculty involvement and institutional commitment (the intervention will not disappear if external funding for MSP ends) are key components cited by evaluators and researchers.

Successful programs including MSP and LSAMP agree with Astin's (1993) theory of student involvement. Expectations are very high and holistic support systems including strong faculty mentoring and financial assistance are present. For Louis Stokes Alliance for Minority Participation (Clewell, de Cohen, Tsui, & Deterding, 2006; Leggon & Pearson, 2009) student participants, the four strategies most often cited (among national programs) are student research (82%), summer bridge academic preparation (67%), mentoring (60%), and stipends (48%).

Similar to MSP the program stresses an integrated approach to provide financial, academic, social, and professional support. Factors negatively affecting degree completion or continuation include lack of quality mentoring, poor academic preparation, and poor connection with campus or department culture. Although this study does not aim to directly investigate the activities and outcomes of indivudal minority STEM programs at the research setting, it is predicted that student participation has an effect on STEM self-efficacy and intent to persist.

Peer Interaction

The research evidence indicates that peer relationship and interaction is linked with identity development and social adjustment for college students. In a study of National Longitudinal Survey of Freshmen data (N=3,924), Fischer (2007) found a positive relationship between relatedness to peers and college persistence for on-campus peers, and a negative relationship off-campus peers. Bandura (1997) argues that self-efficacy development is, in part, dependent on an individual's social relations within their environment and culture. This study will focus on peer interaction with respect to its association with intent to persist and STEM self-efficacy.

Faculty Interaction and Support

Research has shown that student-faculty interaction is a strong predictor of student learning and persistence for all students, including minority students (Kuh & Hu, 2001; Pascarella & Terenzini, 1991, 2005; Tinto, 1993). In a study on 7,603 college students, Cole (2007) investigated student-faculty interaction as both an intermediate outcome variable from interracial interactions and an environmental variable to inform intellectual self-concept. In addition, Cole and Espinoza (2009) looked at support from faculty in terms of encouragement, feedback, and help in areas such as professional goals, intellectual challenge and stimulation, and respect. Faculty support was found to have positive influence on academic performance for URM STEM students and that the quality of faculty interaction was important than the quantity of faculty interaction (Cole & Espinoza, 2009). Through descriptive analysis, factor analysis, and regression analysis, this study investigated the effects of faculty interaction on self-efficacy and intent to persist as they apply to Hawaiian and non-Hawaiian STEM students.

College GPA

Cumulative college grade point average is measured in this study to represent academic achievement. While other indicators of academic achievement exist such as degree aspirations, degree attainment, degree attainment with honors, knowledge or skill based assessment, demonstration, and performance (Astin, 1993), grades and grade point average were found to predict completion of bachelor's degree even after controlling for other factors (Pascarella & Terenzini, 1991, 2005). In a meta-analytic review of 109 published studies including 279 correlations with cumulative GPA, Robbins et al. (2004) found the largest true score correlations of .50 between self-efficacy and cumulative GPA, and .45 between high school GPA and cumulative college GPA.

Sense of Belonging

Sense of belonging refers to the psychological sense that one is a valued member of the whole and was investigated in areas of belonging to major, belonging to institution, and belonging to the campus community. Due to its impact on student persistence and other academic outcomes, sense of belonging has been a closely examined construct. Tinto (1975, 1987, 1993) theorized students' *integration* into their social and academic environment as being critical to student persistence along with *institutional commitment*. Bean (1985) identified *institutional fit,* the extent in which students felt they "fit in" at the university, as a key element to successful socialization and student persistence. In a study focusing on sense of belonging as a predictor of intent to persist on a sample of first year African American and Caucasian students (N=365), Hausmann et al. (2007) found sense of belonging to be positively related to intent to persist and other environmental factors such as faculty interaction, peer support, and parental support. Sense of belonging was not related to race, gender, financial difficulty, or academic integration. Hausmann et al. (2007) also found sense of belonging to decrease with time over the students first year possibly due to the initial high expectations and excitement new college students bring with them to college. Commitment to the institution and intentions to persist also declined with time (Haussmann et al., 2007). This cross-sectional study assessed senses of belonging across educational levels to evaluate their relation to the research outcome variables.

Sense of belonging has additional importance for Native Hawaiians in STEM in terms of interpretations of acculturation and enculturation. Native Hawaiian individuals, like other groups, vary greatly in their sense of cultural identity, pride, cultural practice, and ability to manage potential differences and similarities in their sense of academic, cultural, and home community. Makuakane-Drechsel and Hagedorn (2000) postulated but did not explore the influence of Native Hawaiian culture, values, and traditions on Hawaiian student persistence. Matsumoto (2010) found that Hawaiian sense of belonging, gender, Hawaiian blood quantum, and residential boarding as a high school student were insignificant factors among Hawaiians in degree completion. Hagedorn and Tibbetts (2003) found high family responsibilities, high job responsibilities, cultural obligations, and starting out at a community college were negative factors to retention and completion, which relate to the inquiry of Native Hawaiian student cultural identity.

Native Hawaiian cultural identity, integration, and development and their associated impacts on STEM degree completion are interesting questions left unanswered. Some past studies and reports (Alu Like, 1988) have used anecdotal rather than empirical evidence to show the relationship between knowledge of and involvement in Hawaiian cultural traditions and college persistence. Further qualitative studies would add to the findings. Matsumoto (2010) also cautions that thinking of the institutional culture and Native Hawaiian culture as being in opposition (i.e. that one needs to subsume one's culture to integrate into the institution's culture) as a faulty assumption. Program administrators, educators, and stakeholders in Native Hawaiian education can incorporate cultural factors within strategies to support the student holistically. Similarly, Pacific Policy Research Center (PPRC, 2010) reviewed studies finding greater levels of learning for Native American students who attended institutions with a deep commitment to diversity. University of Hawaii campuses, departments, and programs seek to build an environment and culture that addresses Native Hawaiian student needs that reinforces their level of satisfaction and success (UoHVPAPP, 2002) but do not exactly know how to do so. Assessing sense of belonging among Native Hawaiian STEM students is an initial step in understanding this process.

Satisfaction

Research has shown student educational satisfaction to be a mediating concept positively associated with academic performance, persistence, and student development (Astin, 1993; Pascarella & Terenzini, 1991; Tinto, 1975). Astin (1993) found students reported highest levels of satisfaction with their major courses, opportunities to interact with faculty, opportunities to get involved in extracurricular activities, and overall college experience. Lowest levels of satisfaction were found to be related to university life policies and regulations and with student support services such as academic advising, financial aid, and housing (Astin, 1993). The environmental variable *satisfaction* was based on self-reported survey items focusing on student perceptions of quality of instruction, interactions with peers, satisfaction with STEM major and advising, and satisfaction with overall college environment.

Input Factors

This study examined eight background personal inputs and academic classification variables: gender, ethnicity, social economic status, financial ability, pre-college (high school) grade point average, STEM college, academic level, and incoming student status. These background variables were treated as independent variables as they influence two dependent variables: STEM self-efficacy and intent to persist in STEM.

Gender

Gender is a key personal input in this study of student development in STEM. Byars and Hackett (1998) reviewed the literature on academic development of women through the lens of SCCT describing the process through which gender as well as ethnicity, socioeconomic, and cultural factors influence social cognitive and academic outcomes. Racism, sexism, and gendered role orientation can influence environmental factors of social support, learning experiences, and perceived and encounters barriers (Lent et al., 1994; Flores & O'Brien, 2002). Research on the underrepresentation of females in certain disciplines such as Engineering, Computer Sciences, Physics, and Mathematics have shown gender to be an important variable in understanding college outcomes (Cole & Espinoza, 2008; Jackson, 2004; Leggon & Pearson, 2009).

Ethnicity

This study was more concerned with the socio-cultural constructs of ethnicity and gender that influence contextual, cultural, and cognitive effects, as opposed to the view of race and sex as categorical physical or biological factors. Ethnicity was measured based on University of Hawaii categories, with Native Hawaiian reported measure taking priority in instances of mixed Native Hawaiian measures. Ethnicity was a self-report measure assessing which of one or combination of 25 ethnic categories students self-identified.

National reports show that college outcomes vary significantly by ethnicity group (NSB, 2010). Research has shown Native Hawaiians perceive different barriers to college success than Non-Hawaiians (Hokoana, 2010; Hagedorn & Tibbetts, 2003). A central question to this study was to explore any differences of input, environment, or outcome variables between Native Hawaiians and non-Hawaiians.

Socioeconomic Status and Financial Ability

Socioeconomic status in this study was viewed as a personal input because it indirectly influences socio-cognitive variables (e.g. self-efficacy and intent to persist) due to its impact on choice behaviors, past experiences, and academic achievement, particularly with minority populations. For example, since many racial ethnic minority students have been found to be from low-income households, have parents with lower levels of education, and may have less exposure to high quality schools and learning experiences, they are at risk for lower academic achievement, entry, or completion of higher education (Sirin, 2005). Thus, socioeconomic status as an input can affect student's college access and choice not only directly, but also indirectly through the lack of social and cultural capital and the creation of poor signals sent to post-secondary education (Perna, 2000; PPRC, 2010). Social strata in which a person belongs continues to be a critical factor in the academic development of minority and non-minority students (Sirin, 2005).

Although financial-aid will not be directly measured in this study, it is noted that self-assessment of financial ability can provide some insight to potential barriers to college persistence. Given the lower socioeconomic status of Native Hawaiians in Hawaii (Benham, 2006; Hsu & Nielson, 2010; Makuakane-Drechsel & Hagedorn, 2000), it was expected that college financial assistance was a strong influence on college outcomes. Kumashiro (2006) elaborates that "Native Hawaiians and other Pacific Islanders are living in poverty at almost one-and-a-half times the national average" (p. 131). Hagedorn and Tibbetts (2003) found that receipt of financial assistance "clearly overshadowed other important variables such as high school grades and family responsibilities" (p. 15) as the leading factor increasing the likelihood that Native Hawaiian students will complete college. Financial support was also cited as the most significant factor contributing to recruitment and retention of Pacific Islander students (Ah Sam & Robinson, 1998) at the University of Hawaii at Manoa. This study investigated the association of SES and financial ability with STEM self-efficacy and intent to persist as well as explored significant difference between Native Hawaiian and non-Hawaiian groups.

High School Grade Point Average

High school grade point average was the variable selected to evaluate pre-college academic performance and preparation. Grade point average in high school (academic preparation) and cumulative college grade point average were strong indicators of success (degree completion) found in the literature for Native Hawaiians and other URM students. Researchers further note that while cognitive factors (including performance on standardized tests) are strong predictors of success, models that also incorporate non-cognitive factors (such as motivation, leadership, and self-efficacy) provide a more promising tool to identify students who may leave STEM or have potential in STEM (Besterfield-Sacre, Altman, & Shuman, 1997;

Zhang, Anderson, Ohland, Carter, & Thorndyke, 2002). Academic factors commonly found in successful URM STEM programs include academic engagement such as learning communities and involvement in research.

STEM College and Major

This variable referred to the particular STEM College or school to which a student was currently enrolled. In this single-institution study, there were four STEM colleges or schools that housed undergraduate academic STEM majors: the College of Engineering (Engineering), College of Natural Sciences (Natural Sciences), College of Tropical Agriculture and Human Resources (Agriculture), School of Ocean and Earth Science and Technology (Ocean). A full list of STEM academic majors is presented in Appendix C.

The *STEM college* variable could be viewed as an input factor and an environmental factor. Upon enrollment into the institution of study, undergraduate students self-select and are admitted to their academic college/school of choice. An exception, however, is engineering in which self-selected students are granted admission based on criteria (high school Trigonometry, Chemistry, Physics, SAT-Quantitative, and high school GPA) in addition to institutional admission criterion. Students can also elect to change majors at any time during their academic journey thereby switching between departments, Non-STEM or STEM colleges, and/or institutions. *STEM college* was viewed as an input variable because it signifies a prior choice goal and choice action (major in particular academic domain).

Although STEM colleges are structured primarily due to organizational reasons, they certainly represent like academic domains based on STEM content areas. STEM colleges have their own academic leadership, faculty, curriculum requirements, student learning objectives, community of students, and culture(s). STEM college was hypothesized to influence other independent variables such as sense of belonging, faculty interaction, satisfaction, minority STEM program participation, and dependent variables self-efficacy and intent to persist.

STEM college and major were treated as academic classification input variables because of its proximal influence on the ongoing student experience (environment). In the model, they are conceptual inputted after background or personal input variables such as gender, ethnicity and SES that are pre-college factors. The influence of academic classification variables, STEM College, educational level and incoming student status, were analyzed after background inputs and before college environment variables such as peer and faculty interaction.

Educational Level and Incoming Student Status

Educational level refers to class standing in major such as freshmen, sophomore, junior, and senior. This factor is related to but different from total college credits completed or semesters in college because it is focused on degree completion in selected major. A student may have completed 100 credits and eight semesters of college but only have sophomore level class standing as a Biology major based on their degree curriculum. Higher academic level denotes persistence towards degree completion.

Educational level was of particular interest in this cross-sectional study. Self-efficacy and intent to persist may change as students progress along their curriculum and have more experiences at the college. Changes over time can also be inferred by looking at the progression from freshmen to senior levels.

A related academic status variable is *incoming student status.* This variable refers to the student's pre-institution experience directly before entrance into the University such as first-time clean freshmen, transfer from another four-year institution, transfer from a community college, and non-traditional or returning student. Research indicates that perceptions and experiences of students vary by incoming student status (Makuakane-Drechsel & Hagedorn, 2000; Kuh, 1993; Pascarella & Terrenzini, 1991, 2005). In this study, incoming student status was treated as an independent variable in predicting STEM self-efficacy and intent to persist.

Summary

The literature provides some empirical and theoretical foundation to guide this investigation of Native Hawaiian and Non-Hawaiian STEM majors. A conceptual model based on Astin's I-E-O framework, social cognitive theory, and social cognitive career theory was utilized to understand the complex influences of background and environmental factors on STEM self-efficacy and intent to persist in STEM. Limitations and voids in the literature warrant further research in self-beliefs and influential persistence factors for undergraduate Hawaiian and non-Hawaiian STEM undergraduate students. Few studies focus on the combined effects of the variables to Native Hawaiian students in general and none exist focusing on Native Hawaiian STEM students in particular. The intent of this study was to contribute to the literature in this regard.

CHAPTER 3

METHODOLOGY

The aim of this quantitative study was to extend the literature on Native Hawaiians by investigating factors associated with positive college outcomes. Using social cognitive career theory (Lent et al., 1994), this study explored the influence of input and environment factors on two college outcomes of interest: STEM self-efficacy and intent to persist. In addition, Native Hawaiian and non-Hawaiian groups were investigated for significant difference. The research questions for this study were:

1. What are the personal input and environmental factors associated with STEM self-efficacy beliefs of undergraduate STEM students?
2. What are the personal input and environmental factors associated with intent to persist in STEM of undergraduate STEM students?
3. How do these factors and outcomes differ, if at all, amongst Native Hawaiian and non-Hawaiian students?

Chapter 3 provides an overview of the research design, institutional context, population, and sample. Then, a description of the instrumentation and measures for all variables in the study is presented. A discussion of the data collection and quantitative analysis procedures concludes the chapter.

Research Design

This section describes the plans and procedures selected to best address the research questions given the scope, researcher's experience, and audiences for the study. The use of a quantitative approach, cross-sectional design, and self-reported survey research are discussed.

Quantitative Approach

To address the research questions, this study utilized a quantitative, non-experimental, survey design. A quantitative approach is often chosen as a means for isolating and measuring variables, investigating their relationships, and testing objective theories (Creswell, 2008). Consistent with prior studies investigating SCCT, this study gathered input, environmental, and outcome variable data to be analyzed with quantitative methods to seek trends and correlations among variables.

In addition, a quantitative approach was chosen (as opposed to qualitative or mixed-method approach) to address the three research questions to thereby inform a broader objective to improve the college outcomes of Native Hawaiians at the University of Hawaii. In terms of generalizability and grounds to inform policy or guidelines, it was important for the study to gather and analyze data from as many individuals as possible. The quantitative survey approach provided the researcher with efficient means to invite participation from the entire population of UH Manoa STEM majors.

Lastly, the quantitative approach was chosen in efforts to limit bias and perceptions of undue bias in the study. Given that the researcher works in Native Hawaiian STEM education at the institution, guidelines of a quantitative, objective approach were utilized to reduce systematic error and increase validity of results.

Cross-Sectional Design

A cross-sectional, single-administration survey was chosen to allow for the collection of current, self-reported data, in a single-point in time. Experimental and longitudinal designs, which are better suited for investigating claims of cause and effect or impacts of interventions, were not as appropriate for this study (Creswell, 2008). This study examined the relationships between variables and between groups. Cross-sectional designs are important and applicable in this study because they describe things as they are so that people can plan for change (Fink, 2013). More so, the measures of interest to this study, such as self-efficacy beliefs and sense of belonging, relate to dynamic, social psychological processes that change. A cross-sectional single-administration survey allowed the study to capture data on variables at the same point in time to allow for meaningful investigation of association and patterns.

Self-Reported Survey Research

The purpose of survey research is to collect information directly from people to describe, compare, or explain their knowledge, feelings, values, and behavior (Fink, 2013). Survey research can also be used to generalize from a sample to a population so that inferences can be made about some characteristic, attitude, or behavior of the population of study (Babbie, 1990; Creswell, 2008). This strategy of inquiry was the preferred type of data collection given this study's research questions, scope, and nature of what is being measured.

A self-administered, questionnaire survey instrument (presented in Appendix B) was utilized to collect self-reported input, environmental, and outcome variables including measures assessing beliefs and motivation such as satisfaction and intent to persist. These measures are not available in existing or historical data sources and are best derived from the subjects themselves. Although there are some concerns with truthfulness or accuracy of self-reported data, it is the only source for many variables of interest to this study.

Setting, Context, and Environment

The specific context of the study was the motivation to improve college outcomes for Native Hawaiian students at the University of Hawaii. This single-institution study was focused at the University of Hawaii at Manoa (UHM), the flagship campus of the state's sole public

University of Hawaii System, where most of the Baccalaureate degrees in STEM are conferred. UHM is classified by the Carnegie Foundation as "very high research activity," ranked in the top 30 public universities in federal research funding for engineering and science and 49th overall by the National Science Foundation. UHM is one of only 32 institutions nationwide to hold the distinction of being a land-, sea-, and space-grant research institution.

UHM can be compared to "peer institutions" of like characteristics such as urban city location (Honolulu), sector (Public, 4-year and above), basic Carnegie classification (research universities, very high research activity), and size by enrollment (20,400). The University of Hawaii at Manoa peer group listing, shown in Table 1 (UoHIRO, 2009), was determined by National Center for Higher Education Management Systems (NCHEMS) Information Service using variables including finance, degrees awarded, faculty, institutional characteristics, professional judgment, and other student and research data from the national Integrated Postsecondary Education Data System (IPEDS).

Institutional characteristics including undergraduate ethnic diversity, commitment to Native Hawaiians, STEM colleges and majors, and this study's sample are described in the following sections.

Table 1

University of Hawai'i at Manoa Peer Group

Institution	City	State
Colorado State University	Fort Collins	CO
Iowa State University	Ames	IA
Louisiana State University and Agricultural and Mechanical College	Baton Rouge	LA
Oregon State University	Corvallis	OR
The University of Utah	Salt Lake City	UT
University of California – Davis	Davis	CA
University of Georgia	Athens	GA
University of Kentucky	Lexington	KY
University of Missouri – Columbia	Columbia	MO
University of North Carolina at Chapel Hill	Chapel Hill	NC
University of Tennessee – Knoxville	Knoxville	TN
University of Virginia	Charlottesville	VA
University of Hawaii at Manoa	Honolulu	HI

Undergraduate Ethnic Diversity

The University of Hawaii at Manoa in many ways reflects the State of Hawaii's ethnic population with 71.2% of the undergraduate enrollment comprised of in-state students. Table 2 shows the Race/Ethnic Background of all undergraduate enrollments at UH Manoa in 2012 (UoHIRO, 2012). It is noted that UHM is a non-majority population, with similar proportions from Mixed, Caucasian, Native Hawaiian, Japanese, and Other Asian race/ethnicity groups.

Relative to national minority-serving institutions, UHM enrolls a low percentage of African American (1.6%), Hispanic (2.0%), and Native American or Alaskan Native (0.3%) students but a large percentage of Native Hawaiian and Pacific Islander students (17.4%).

Table 2

Ethnic Background of UHM Undergraduates, 2012

Ethnicity	*n*	%
Asian (Chinese, Filipino, Japanese, Korean, Other)	5,914	40.3
White	3,069	20.9
Native Hawaiian or Pacific Islander	2,556	17.4
Mixed	2,089	14.2
International	436	3.0
Hispanic	300	2.0
Black or African American	233	1.6
American Indian or Alaskan Native	46	0.3
Unknown	22	0.2
Total	14,665	100.0

Commitment to Native Hawaiians

Additional context for this study is that improved Native Hawaiian participation is a stated strategic initiative of the institution. Native Hawaiian educational attainment is a performance measure guiding the UH System in their 2008-2015 strategic plan to "position the University of Hawaii as one of the world's foremost indigenous-serving universities by supporting the access and success of Native Hawaiians" (UoHVPAPP, 2008, p. 2). Increasing degree attainment of Native Hawaiians (in STEM and non-STEM fields), is a performance goal of the campus and ten-member University system.

STEM Colleges and Majors

Roughly one-third of the undergraduate study body at UHM major in STEM. UH Manoa offers 93 Bachelor's programs including 35 STEM majors. Undergraduate STEM majors fall into academic departments within one of four STEM colleges shown in Table 3. Regarding transferability of this study's findings to other settings, it should be noted that the size (total STEM undergraduate enrollment) of STEM programs at UH Manoa is moderate compared to many other land-grant, public universities.

Table 3

Enrollment of UHM Undergraduates by STEM College, Spring 2014

College/School	All	Native Hawaiian
Natural Sciences	2170	226
Engineering	916	115
Tropical Agriculture	310	58
Ocean & Earth Sciences	117	12
Total	3,513	411

Sample

The population in this study was the undergraduate STEM majors at the University of Hawaii at Manoa. An inclusive subset of this population that is of particular interest in this study was Native Hawaiians in STEM. As shown in Table 3, for the Spring 2014, 411 Native Hawaiians represent 12% of the overall STEM population.

The sample in this study consisted of the 638 respondents the survey. All enrolled UHM undergraduate STEM majors were invited to participate in the study by completing an online, self-reported survey. Of the 953 students who started the online questionnaire, 241 did not submit their survey, 71 opted out of final participation, and 4 responses were excluded from the sample because they did not meet the study criterion (3 had graduated and were not current undergraduate STEM majors and one respondent had transferred to the business school, a non-STEM major). The total number of participants was 638 for a study response rate of 17.7%. Chapter 4 tests for differences between the sample and available information about the population to inform the generalizability of the findings.

Instrumentation

This study utilized a 63-item, closed-ended questionnaire to collect data on the 18 input, environment, and outcome variables (presented in Appendix B). No single existing instrument tool was found to cover the range of variables sought to answer this study's research questions, necessitating the motivation to merge and modify multiple scales. Many of the subscales utilized were from two source instruments in particular, the Academic Pathways of People Learning Engineering Survey (APPLES) (Sheppard et al., 2010) and the Longitudinal Assessment of Engineering Self-Efficacy (LAESE) (Marra & Bogue, 2006). The instrument was constructed by a combination of a subscales of tested and published instruments focusing on motivation, self-efficacy, and persistence of science or engineering students and a researcher-developed demographics survey. A discussion of all variables and their measurement items are presented.

Input Variables

Table 4 summarizes the background variables to be collected in the demographics section of the survey developed by the researcher.

Table 4

Input and Background Variables Collected

Variable	Items	Source
Gender	1	demographic
Ethnicity	2	demographic
Socioeconomic status	3	APPLES
Financial ability	1	APPLES
High School GPA	1	demographic
College	1	demographic
Major	1	demographic
Educational level	1	demographic
Incoming status	2	demographic

Gender was collected with a single dichotomous item on the demographics survey.

Ethnicity was collected with 2 items on the survey. Ethnicity response categories followed the UH System application for admissions allowing students to select one or more categories of African American, American Indian or Alaskan Native, Caucasian, Chinese, Filipino, Guamanian/Chamorro, Hawaiian, Hispanic, Indian, Japanese, Korean, Laotian, Micronesian, Other Asian, Other Pacific Islander, Samoan, Thai, Tongan, and Vietnamese. Consistent with the UH System application form, a second survey item queried, "were any of your ancestors Hawaiian?" As is consistent with UH Manoa race and ethnicity reporting procedures, student respondents with more than one ethnicity were derived into multiple ethnicity categories. For data analysis, ethnicity responses were hierarchically clustered into categories as follows: (1) Native Hawaiian (any); (2) Mixed Asian for multiple ethnicity reports that fall under the larger Asian grouping only (example: Japanese, Chinese, and Korean); (3) Mixed Pacific Islander for multiple ethnicity reports that fall under the larger Pacific Islander grouping only (example: Samoan and Tongan); (4) Mixed Race for multiple ethnicity reports that fall across several larger groupings (example: Japanese and White); (5) Reported ethnicity for single ethnicity reports; (6) Hispanic for self-indicated ethnicity report; and (7) Unknown for unreported ethnicity.

Socioeconomic status was measured using 3 items from the APPLES instrument querying: (1) Highest level of education mother completed; (2) Highest level of education father completed; and (3) Self-perceived family income (low, lower middle, middle, upper-middle, or high income). A fourth close-ended survey item taken from the APPLES instrument queried "Do you have any concerns about your ability to finance your college education?" In SES component analysis, the fourth item was found to load onto a separate construct, used in subsequent analysis as "financial ability."

Self-reported high school grade point average was reported by letter grade treated as a continuous scalar variable from 1.3 to 4.0. Two categorical input variables were reported for College and Major. Educational level was a single-item variable assessed self-reported

University class standing as: (1) Freshmen, (2) Sophomore, (3) Junior, (4) Senior, or (5) 5th year Senior. Two additional items related to academic status queried "when you first entered this institution, were you: (first-time, returning, transfer student from a two-year college, and transfer student from a four-year college)" and "are you a full-time/part-time student?" and "where were you immediately before starting at this institution used in analysis as "Pre-institution status."

Environment Variables

This study investigated ten environmental factors: family support, program participation, peer interaction, faculty interaction, faculty support, college GPA, sense of belonging to school, major, and campus community, and satisfaction. The survey items and scales from extant literature used to measure these independent variables are discussed.

Family support was measured with two-items taken from Cabrera et al. (1992) querying, "My family approves of my attending this university" and "my family encourages me to continue attending this university." Reliability analysis, further described in Chapter 4, found good internal consistency (α = .838) for this composite measure with respondent data.

Regarding program participation, one survey item prompted students to check any programs that they have participated in from a list eleven minority STEM programs at UH Manoa known to the researcher. Programs of interest include (1) C-MORE Scholars Program, (2) Hui Manawa Kupono Native Hawaiian Scholarship Program, (3) Kua'ana Native Hawaiian Student Services, (4) Minority Access to Research Careers, (5) Na Pua No'eau, (6) NHSEMP, (7) Pacific Internship Programs for Exploring Science, (8) Undergraduate Research and Mentoring in the Biological Sciences, (9) UH Manoa Honors Program, (10) Society for the Advancement of Chicanos and Native Americans in Science, (11) American Indian Science &

Engineering Society. An open-ended response was available for respondents to write in participation in other programs.

Interaction with peers was queried on frequency (not at all, occasionally, frequently) of three items: studied with other students, tutored another college student, and worked on a group project. Relationship with peers will be queried on frequency (not at all, occasionally, frequently) of four items: “I worked cooperatively with other students on course assignments”; “I discussed ideas with my classmates (individuals or groups)”; “I got feedback on my work or ideas from my classmates”; and “I interacted with classmates outside of class.” The subscale of peer interaction is used with permission from the Engineering – National Student Survey of Engagement (E-NSSE) (Cady, Fortenberry, Drewery, & Bjorkland, 2009). In a pilot study of the E-NSSE instrument, 261 students completed the test twice. Cady et al. (2009) found significant test-retest Pearson’s coefficients on the individual items and $\alpha = 0.918$ for relationships with peers. In this study, reliability analysis of the 7-item peer interaction measure found good internal consistency ($\alpha = .837$).

Capturing faculty interactions, three items from the APPLES survey will be used to query frequency (not at all, occasionally, frequently) of interaction with faculty and/or instructors during class, during office hours, and outside of class or office hours. Inter-item reliability measures for the faculty interaction construct for administration of APPLES to 4,266 students were acceptable (Cronbach’s alpha = 0.74). In the current study, internal consistency was found to be moderate (α=.609).

Cole and Ahmadi (2010) generated a factor “general faculty support” from 9 items (α = 0.90) including encouragement for graduate school, opportunity to work on research project, advice about educational program, respect, emotional support/development, letter of recommendation, intellectual challenge/stimulation, opportunity to discuss coursework outside of class, and help in achieving professional goals (p. 130). In the current study, good internal consistency was found for the composite 9-item measure ($\alpha = .826$).

Based on scales of prior research on the construct, the instrument contained a total of 9-items to measure sense of belonging to major, to the institution, and to the campus community. Smith, Wilson, Jones, Plett, Bates, and Veilleux (2012) studied sense of belonging for more than 900 engineering and science undergraduates in four different settings to assess sense of belonging to major and sense of belonging to the university as an institution. Analysis of the study demonstrated strong internal reliability (Cronbach's alphas ranged from 0.80 to 088). Sense of belonging *to major* consisted of 3 items including "I feel accepted in my major," "I feel comfortable in my major," "I feel that I am a part of my major." Sense of belonging *to the university as an institution* included three items: "I feel like I really belong at this school," "I really enjoy going to school here," and "I wish I had gone to another school instead of this one (reverse scoring)." Hurtado and Carter (1997) measured sense of belonging *to campus* subscale (3 items, $\alpha = 0.94$) measured "I see myself as a part of the campus community," "I feel that I am a member of the campus community," and "I feel a sense of belonging to the campus community." For this study, reliability analysis found strong internal consistency with Cronbach's α values to school, major, and campus community of .731, .885, and .952 respectively.

The environmental variable satisfaction was based on 6 survey items of student's ratings of their satisfaction with quality of instruction, amount of contact with faculty, interaction with peers, academic advising and student support, STEM major, and overall quality of their collegiate experience so far. These items are taken with permission from the Academic Pathways of People Learning Engineering Survey (APPLES). In this study, the 6-item scale demonstrated good internal consistency (α=.842). College grade point average was measured by self-report to letter grade ranging from D (1.3) to A (4.0).

Table 5 presents the ten environmental independent variables and two outcome variables highlighting source instrument and internal consistency found in this study.

Table 5

Environment and Outcome Variables Collected

Variable	Items	Source	Cronbach's α
Family support	2	Cabrera et al. (1992)	.838
Program participation	1	Researcher	-
Peer Interaction	7	Cady et al. (2009), (α = .92)	.837
Faculty Interaction	3	APPLES, (α =.70)	.609
Faculty Support	9	Cole and Ahmadi (2010), α = .90	.826
College GPA	1	Researcher	-
Belonging to Major	3	Smith et al. (2012), .80< α < .88	.885
Belonging to School	3	Smith et al. (2012), .80< α < .88	.731
Belonging to Campus	3	Hurtado & Carter (1997), α =.94	.952
Satisfaction	6	APPLES	.842
Intent to Persist	1	APPLES	-
STEM Self-Efficacy	8	LAESE, α = .82	.914

Outcome Variables

The purpose of this study was to investigate the associations between the input and environmental measures on two outcomes of interest – intent to persist and STEM self-efficacy. These two outcomes were chosen because of their influence on motivation, choice goals, and actual persistence (Lent, 2013; Cabrera et al., 1992). Intent to persist was a single-item measure queried students to rate their agreement on a 4-point scale (1 = strongly disagree and 4 = strongly agree) to the prompt "I intend to complete a STEM degree at UH Manoa."

Eight items from the Longitudinal Assessment of Engineering Self-Efficacy (LAESE) engineering self-efficacy subscale (11-item scale, $\alpha = 0.82$) to assess self-efficacy beliefs related to completing a STEM degree at the institution. Wording of the LAESE items was modified from 'Engineering' to 'STEM major' to include the science, technology, and mathematics domains of interest in this study. For example, the item "I can succeed in an engineering curriculum" was modified to "I can succeed in my *STEM major* curriculum." The STEM self-efficacy variable was comprised of eight items rating their agreement on a 4-point scale (1=strongly disagree and 4 = strongly agree) to the following prompts:

1. I can succeed in my STEM major curriculum;
2. I can succeed in my STEM major curriculum while not having to give up participation in my outside interests (e.g. extra curricular activities, family, sports);
3. I can complete the math requirements for my STEM major;
4. I can complete the science requirements for my STEM major;
5. I can excel in my current STEM major during the current academic year;
6. I can persist in my STEM major during the next year;

7. I can complete my STEM major at this institution;
8. I feel confident in my ability to complete a STEM degree at UH Manoa.

The survey instrument consisted of 63 items and gathered data found to load onto 21 factors. The median time for survey completion was 8 minutes.

Validity and Reliability Measures

Three procedures were utilized to enhance the ability of survey instrument to elicit valid responses. First, survey items were directly taken or modified from existing published tools that have been tested for reliability and validity. Then, aspects of the survey including directions that accompany the survey and the ordering and wording of questions were critiqued by the dissertation faculty chair. Expert review is a commonly accepted method for validating survey instruments (American Educational Research Association [AERA], 1999). Lastly, the web-based survey was tested with group of like individuals (graduate students and recent alumni) not in the intended study sample. Pilot testing is a highly regarded step to improve validity and quality of data collected (Suskie, 1996). Pilot participants (n=25) were instructed to interpret and complete the survey from the perspective of an undergraduate student, then provide feedback on the clarity of survey items and response options to the researcher. Modifications to survey language, response options, layout, and elimination of three items were made based on the pilot results and feedback.

Data Collection

This study utilized Qualtrics web-based software to create and administer the online survey instrument. Web-based data collection was the desired form of data collection in this study for many reasons. First, computer access, computer literacy, and online access was found to be high among the target population (University of Hawai'i Office of the Vice President for

Student Affairs [UoHVPSA], 1999) supporting the samples' candidacy survey completion. Second, the web-based option allowed for rapid turnaround, and economy of design (Fink, 2013) enabling a large sample size to be taken. Collection of data from the total population was desirable because it would potentially increase the utility of the data and was a feasible option for this study.

This study applied for and received Human Studies Program approval as exempt (presented in Appendix A) from the University of Hawaii Human Studies Program and the USC University Park Institutional Review Board. Email addresses for enrolled Spring 2014 STEM undergraduates were granted to the researcher by the College of Engineering, Natural Sciences, CTAHR, and SOEST for the purposes of this study. Students with more than one major were classified by primary major.

Data collection from participants took place in February 2014, coinciding with week 4 through week 7 of the Spring semester. Collecting data from Spring enrollment would allow first-year college students at least a semester to interpret their thoughts related to their college environment and might reduce the number of first semester STEM leavers from the sample. An initial email on February 6 was sent to all subjects (n=3,592) introducing the voluntary study and inviting them to participate in the web-based survey via a unique link to Qualtrics. A total of three reminder emails was sent to participants that did not complete the survey every six days. The study utilized unique links within the Qualtrics Mailer to prevent multiple responses from the same link. The intent was to collect data only from specific individuals (STEM undergraduates directly emailed).

Data Analysis

Data analyses, conducted using SPSS Statistics v.21 software, consisted of descriptive statistics, factor analysis, reliabilities, regression analysis, and analysis of variance techniques.

First, the data file of raw survey responses was prepared using Excel and SPSS software and SPSS. Data were screened for errors and scores out of range. Some data used for composite measures and reverse-scored data were recoded to provide for more meaningful and usable variables for analysis. New variables were derived from raw data such as mixed ethnicity as well as dichotomous variables such as intent to persist and program participation.

Preliminary analysis including frequencies and descriptives checked for mistakes due to recoding or data entry. Tests for normal behavior and investigation of outliers were conducted to ensure clean data. Principal factor analysis was conducted to confirm clustering effects leading to higher order factors as predicted in the scales used from prior research. It is noted reliability of a scale can vary depending on the sample (Pallant, 2013). Reliability tests investigated inter-item consistency by inter-item factor correlations as well as overall correlation. Descriptive statistics were utilized to organize, summarize, and describe the experiences of the sample in aggregate for each individual or composite variable.

Subsequent analysis involved logistic and multiple regression to explore relationships among input and environment variables with outcome variables STEM self-efficacy and intent to persist, respectively. Sequential (or hierarchical) regressions were chosen (as opposed to standard or step-wise) in order for the study to enter independent (input and environmental) variables based on the theoretical grounds outlined in Lent’s (2013) Social Cognitive Career Theory and Astin’s (1999) Inputs – Environment – Outcomes model and to interpret to contribution of independent variables after prior variables were controlled.

Analysis of variance (ANOVA) and multiple analysis of variance (MANOVA) were chosen to explore differences between the Native Hawaiian and non-Hawaiian groups. These were the ideal techniques to investigate whether the mean differences between groups were likely to have occurred by chance.

Summary

This chapter described the methodology of this quantitative study including an overview of the research design, approach, and context. Details of the instrumentation were provided with discussion of the validity and reliability of measures used to assess each variable. Finally, the data collection and data analysis were presented. Chapter 4 presents the analysis and results of the study as they relate to the three research questions.

CHAPTER 4

RESULTS AND ANALYSIS

The purpose of this study is to examine the factors associated with STEM self-efficacy and intent to persist for Native Hawaiian and non-Hawaiian students. The goal is to better understand the dynamics that correlate with student's beliefs about their own capabilities and commitment to complete a Bachelor's degree in STEM. Data was collected on a range of input/background, environment, and outcome measures from undergraduate STEM majors at the University of Hawaii at Manoa to answer the following research questions:

1. What are the personal input and environmental factors associated with STEM self-efficacy beliefs of undergraduate STEM students?
2. What are the personal input and environmental factors associated with intent to persist in STEM of undergraduate STEM students?
3. How do these factors and outcomes differ, if at all, amongst Native Hawaiian and non-Hawaiian students?

Chapter 4 will present the data analysis for the key variables and findings of the study as they relate to the three research questions.

The results and analysis are organized into two sections. The first section of this chapter describes the sample, data on variables collected, and construction of composite variables. Descriptive statistics are presented to also display similarities and differences between non-Hawaiian and Hawaiian groups. Results of factor analysis and reliability tests are presented on multi-item variables to be used in subsequent analysis. The second part of the chapter presents the analysis applied to answer the research questions. First, the results of sequential multiple regression and sequential logistic regression models used to explore relationships between the input and environmental variables to outcome variables STEM self-efficacy and intent to persist are discussed. Then, the results from a series of analysis of variance and multivariate analysis of variance used to explore the similarities and differences between non-Hawaiian and Hawaiian group are presented. A summary of the major results concludes the chapter.

Participant Characteristics

The entire population of UHM undergraduate STEM majors was invited to participate in the study (N=3592). Of the 953 students who started the online questionnaire, 241 did not submit their survey, 71 opted out of final participation, and 4 responses were excluded from the sample because they did not meet the study criterion (3 had graduated and were not current undergraduate STEM majors and one respondent had transferred to the business school, a non-STEM major). The total number of participants was 638 (N=638) for a study response rate of 17.7%. Sample characteristics are presented by gender, ethnicity, STEM college, and academic major and are evaluated via a chi-square goodness of fit to test for significant difference from existing demographic data on all UH Manoa STEM undergraduates. Environmental and outcome variables and construction of multi-item variables were utilized.

Gender

Table 6 displays frequency and percentage of students in the sample by gender as well as reference percentages derived from the total population of undergraduate STEM students at UH Manoa (N=3592). The majority of the respondents in the sample were female (54.9%) versus male (43.9%). A chi-square test for goodness of fit indicates that the sample was significantly different from the population χ^2 (2, n=638) = 67.76, p = 0.000) noting that the reference STEM undergraduate population has a higher percentage of males (59.4%) than found in the sample and lower percentage of females (40.1%) than found in the sample.

Table 6

Participant Gender (N = 638)

Gender	Frequency	%	Reference %
Female	350	54.9	40.1
Male	280	43.9	59.4
Prefer not to answer/No Data	8	1.2	0.5
Total	638	100.0	100.0

Gender representation of the all undergraduate STEM majors varies by College with the College of Engineering enrolling 80.2% male, College of Natural Sciences enrolling 53.6% male, and the College of Tropical Agriculture and Human Resources (CTAHR) enrolling 57.7% female. School of Ocean and Earth Sciences and Technology (SOEST) has a near balanced gender enrollment of 58 men and 57 women. Table 7 presents gender characteristics of the sample by College. The sample represents a greater percentage of females in all colleges than expected from population parameters. Therefore, it should be noted that the results of this study reflect a larger voice from females (+15% or 1.4x) when generalizing to the UHM population.

Table 7

Sample Gender (N = 638) by College

	Male		Female		Unreported	
College	Frequency	%	Frequency	%	Frequency	%
Natural Sciences	101	33.3	198	65.3	4	1.3
Engineering	150	70.8	59	27.8	3	1.4
Tropical Agriculture	18	21.4	65	77.4	1	1.2
Ocean & Earth Sciences	7	23.3	23	76.7	0	0
Prefer not to answer	4	44.4	5	55.6	0	0
Total	280	43.9	350	54.9	8	1.2

Ethnicity

Table 8 displays frequency and percentage of students in the sample by ethnic group as well as reference percentages of each ethnic group relative to the entire population of undergraduate STEM students (N=3592). A chi-square goodness of fit indicates significant difference in the ethnic composition of the sample as compared with Spring 2014 total STEM enrollment ethnicity data, $\chi^2(21, n = 637) = 14270.76$, $p = 0.000$). Hawaiian respondents (n=109) represent 17.1% of the sample, an overrepresentation of Hawaiians compared to the reference percentage. Other groups overrepresented in the sample include Unreported and Chinese. Groups underrepresented in the sample include White, Japanese, and Korean. Overrepresentation and a sufficient subsample of Native Hawaiians are desirable for this study to conduct statistically powerful analysis and investigation of the Native Hawaiian subgroup.

However, it should be noted that the results of this study reflect a larger voice from Native Hawaiians (1.5X) when generalizing to the UHM population.

Table 8

Participant Ethnicity (N = 638)

Ethnicity	Frequency	%	Reference %
White	112	17.6	21.7
Native Hawaiian	109	17.1	11.7
Mixed (2 or more ethnicities)	96	15.0	15.4
Mixed Asian	72	11.3	10.9
Filipino	67	10.5	10.7
Chinese	64	10.0	8.1
Japanese	51	8.0	11.1
Unreported	17	2.7	.2
Korean	12	1.9	3.1
Hispanic	8	1.3	1.7
Vietnamese	5	.8	1.7
Black or African American	5	.8	.9
Samoan	4	.6	.3
Micronesian	3	.5	.2
Other	3	.5	0
Laotian	2	.3	.1
Other Asian	2	.3	.6
Tongan	2	.3	.1
American Indian or Alaskan Native	1	.2	.4
Asian Indian	1	.2	.1
Chamorro/Guamanian	1	.2	.3
Other Pacific Islander	1	.2	.2
Thai	0	0	.1
Mixed Pacific Islander	0	0	.1
Total	638	100.0	100.0

STEM College and Academic Major

Table 9 presents the frequency and percentage of students by college for both the sample and population of all undergraduate STEM students. The sample was found to be significantly different than the population with an underrepresentation of Natural Science students and a larger than expected percentage of students from SOEST, CTAHR, and Engineering. Response rates from the four different STEM Colleges were 16.0% from the College of Natural Sciences, 18.4% from the College of Engineering, 19.7% from the College of Tropical Agriculture and Human Resources (CTAHR), and a high of 26% from the School of Ocean and Earth Sciences and Technology (SOEST).

Table 9

Sample and Population by STEM College

	Sample (N=638)		Population (N=3592)	
College	Frequency	%	Frequency	%
Natural Sciences	303	47.5	1896	52.8
Engineering	212	33.2	1154	32.1
Tropical Agriculture	84	13.2	427	11.9
Ocean & Earth Sciences	30	4.7	115	3.2
Prefer not to answer	9	1.4	0	0.0
Total	638	100.0	3592	100.0

Note. $\chi^2(3, n = 629) = 9.016$, $p = 0.029$).

This study invited participation from all enrolled students in any one of 34 undergraduate STEM majors offered at UH Manoa. The complete frequency and percentage of student by academic major for both the sample and population is presented in Appendix D: Table 40. Table 10 presents a reduced set of data for the highest enrolled and lowest enrolled majors. It is noted that Biology is the highest enrolled academic major representing 20.6% of the total STEM undergraduates followed by Mechanical Engineering (8.6%), Civil & Environmental Engineering (8.3%), Marine Biology (8.0%), and Electrical Engineering (6.1%). Similarly, the highest number of sample respondents came from 5 highest enrolled academic majors. There were less than 10 respondents in the sample for 12 of the smaller academic majors and no respondents from Geology, Environmental Studies/Interdisciplinary Studies, or Pre-Physical Therapy in the sample.

Table 10

Sample and Population by Highest and Lowest Enrolled STEM Academic Majors

	Sample (N=638)		Population (N=3592)	
Major	Frequency	%	Frequency	%
Biology	111	17.4	741	20.6
Civil & Environmental Engineering	71	11.1	298	8.3
Mechanical Engineering	69	10.8	309	8.6
Electrical Engineering	43	4.7	219	6.1
Marine Biology	35	5.5	286	8.0
Computer Engineering	9	1.4	76	2.1
Other	9	1.4	0	0
Biological Engineering	6	.9	41	1.1
Meteorology	6	.9	23	.6
PEPS	5	.8	21	.6
Geology & Geophysics	5	.8	35	1.0
Plant & Environmental Biotechnology	4	.6	18	.5
TPSS	4	.6	42	1.2
Pre-Medicine	4	.6	0	0
Botany	3	.5	25	.7
Ethnobotany	3	.5	20	.6
Molecular Biosciences & Biotechnology	2	.3	0	0
Geology	0	0	8	.2
Prefer not to answer	2	.3	0	0.0
Total	638	100.0	3592	100.0

Note. Students enrolled in one or more academic majors (double majors) were classified into their primary major for this study. GES = Global Environmental Sciences; ICS = Information & Computer Sciences; NREM = Natural Resources & Environmental Management; PEPS = Plant and Environmental Protection Sciences; TPSS = Tropical Plant and Soil Sciences.

Academic Level and Pre-UH Manoa Status

In addition to the gender, ethnicity, college, and major, the research model tested variation of self-efficacy and intentions to persist by academic level and pre-institution status. Frequency counts of the sample by academic level and pre-UH Manoa status are presented in the Appendix D: Table 41. Combined, Seniors and 5th year seniors represent the largest group (34.6%), followed by Juniors (30.4%), Sophomores (17.7%), and Freshmen (14.6%). The majority of the respondents (61.9%) defined themselves as first-time college students when they first entered UH Manoa. Regarding incoming students status, 22.1% of respondents classified themselves as transfer students from any 2-year college (although many students wrote in comments regarding their UH community college), 9.7% as transfers from a 4-year college, and 5.6% as returning or non-traditional students. The majority of the sample (61%) was classified as first-time clean freshmen enrolling at UHM from high school.

Input Characteristics by Native Hawaiian Status

Data for all variables are also presented by Hawaiian and non-Hawaiian groups. This will inform the analysis, results, and potentially recommendations. For example, the study may find some key differences that allow Native Hawaiian serving programs to better customize their approach, whereas similarities should be noted such that interventions to affect Native Hawaiians will affect all students. Table 11 presents counts and percentages of Native Hawaiian status by gender, college, educational level, and incoming student status (first-time clean freshmen, transfer student, etc.). Not shown in Table 11 are percentages within variable, however, data revealed highest percentages of NH respondents within College of Engineering (22.0%), followed by CTAHR (21.7%), SOEST (16.7%), and Natural Sciences (12.7%).

Table 11

Native Hawaiian Status Count and Frequency by Input Variable

	Non-HW		HW	
Variable	*n*	%	*n*	%
Gender (N=627)				
Female*	301	58.2	48	43.6
Male*	216	41.8	62	56.4
College (N=622)				
Engineering*	163	31.7	46	43.0
Natural Sciences*	262	50.9	38	35.5
Tropical Agriculture	65	12.6	18	16.8
SOEST	25	4.9	5	4.7
Level (N=615)				
Freshmen	82	16.1	11	10.3
Sophomore	93	18.3	2	18.7
Junior	162	31.9	31	29.0
Senior	106	20.9	26	24.3
5th year Senior	65	12.8	19	17.8
Incoming student status (N=628)				
First time college student	331	63.9	62	56.4
Community college transfer	107	20.7	32	29.1
4-year University transfer	50	9.7	11	10.0
Returning or non-traditional	30	5.8	5	4.5

Note. * column proportions differ from each other at the .05 level.

A Chi-square test for independence (with Yates Continuity Correction for gender) indicated a significant association between Native Hawaiian status and gender, χ^2 (1, n=627) = 7.237, p = 0.007, *phi* = .112, and for college, χ^2 (3, n=622) = 8.902, p = 0.031, *phi* = .120. In other words, there were more Hawaiian males than Hawaiian females represented in the sample compared to more females than males in the non-Hawaiian group. Similarly, Hawaiian respondents were found distributed in higher levels in Engineering than non-Hawaiians, and in lower levels in Natural Sciences than non-Hawaiians. No significant association was found for educational level, χ^2 (4, n=615) = 4.33, p = 0.363, *phi* = .084, or for incoming status, χ^2 (3, n=628) = 4.004, p = 0.261, *phi* = .080. It is noted that a higher percentage of Native Hawaiians as compared to Non-Hawaiians in the sample came from two-year community colleges.

High School and College GPA

Of the respondents 613 provided a cumulative high school GPA by category (A-, B+, B, etc.) and 25 (4.9%) did not provide a GPA. A value of 1.30 was assigned to one student who indicated a GPA of "D+ or lower (less than 1.4)." High school GPA of A- (3.5 – 3.8) was the most common response, followed by A/A+, and B+ categories. As is sometimes seen in research with self-reported GPA, this variable exhibited negative skew. Of the respondents, 618 provided a College GPA by category and 20 (3.1%) did not. Table 12 shows descriptive statistics for GPA items.

Table 12

Descriptive Statistics for GPA Items

GPA Item	Total *M (SD)*	Non-HW *M (SD)*	HW *M (SD)*
HS GPA* (N = 613)	3.55 (.46)	3.58 (.43)	3.44 (.58)
College GPA (N = 618)	3.18 (.52)	3.20 (.53)	3.10 (.53)

Note. * Non-HW and HW groups significantly differ at the p <0.05 level.

Independent t-tests were conducted to explore if GPA variables varied by Native Hawaiian status (non-Hawaiian vs. Hawaiian group). There was no significant difference found in College GPA t(612)=1.708, p = .088, two-tailed. There was, however, significant difference found in HS GPA t(609) = 2.309, p = .023, two-tailed. Inspection of means show Non-HW students reported a higher GPA than HW students. The magnitude of the differences in the means (mean difference = .14, 95% CI: .02 to .26) was very small (eta^2 = .009).

Participation in Program

The majority of the sample (66%) did not indicate participation in any academic preparation program, 21.2% participated in one program, 6.3% in two programs, and 6.6% or 52 students in 3 to 5 programs. Participation in the UHM Honors Program was identified by 105 respondents (16.5%) and 82 students (12.9%) indicated participation in the Native Hawaiian Science & Engineering Mentorship Program. Table 13 displays descriptive data for program participation by count and percentage. Thirty-one students (4.9%) indicated participation in a program not listed. Other programs identified by respondents included ACE learning communities (3), ASME (3), Marine Option Program (3), IKE (2), IEEE (2), Undergraduate

Research Opportunities Program (2), HNEI research, Hawaii Space Grant Consortium fellowship, College Opportunities Program, McNair Scholars Program, EPSCoR Hawaii Program, JABSOM DMEAP, TASSO, Trio, and INBRE.

Table 13

Frequency of Program Participation (N = 638)

Program	*n*	%
None or *prefer not to answer*	421	66.0
UHM Honors Program	105	16.5
NHSEMP	82	12.9
AISES	42	6.6
Other	31	4.9
Kuaana Native Hawaiian Student Services	29	4.5
SACNAS	22	3.4
Na Pua No'eau	22	3.4
Undergraduate Research and Mentoring (URM) in Biological Sciences	13	2.0
C-MORE Scholars Program	8	1.3
Hui Manawa Kupono Native Hawaiian Scholarship Program	7	1.1
MARC	5	.8
PIPES	4	.6

Note. NHSEMP = Native Hawaiian Science & Engineering Mentorship Program; AISES = American Indian Science & Engineering Society; SACNAS = Society for Advancement of Chicanos and Native Americans in Science; MARC = Minority Access to Research Careers; PIPES = Pacific Internship Program for Exploring Science.

Native Hawaiians participated in at least one program (67.9%) at a higher rate than non-Hawaiians (26.9%). This was found to be a significant difference, χ^2 (1, n=637) = 67.76, $p <$ 0.001.

Level of Parental Education, Self-Reported Family Income, and Financial Ability

Descriptive statistics for SES variables and financial ability are presented in Table 14. Level of parental education was recoded for analysis for less than high school (.14), graduated from high school (.29), some college (.43), Associates degree (.57), Bachelor's degree (.71), Master's degree (.86), or professional or doctoral degree (1.0). Self-reported family income was recoded as 0 for low income, .25 for lower-middle income, .50 for middle income, .75 for upper-middle income, and 1.0 for high income. Financial concern was reverse scored such that higher measures denote higher financial ability to allow for easier interpretation with the SES measures.

Table 14

Descriptive Statistics for SES Items

SES Item	Total *M (SD)*	Non-HW *M (SD)*	HW *M (SD)*
Mother's education (N=610)	.560 (.229)	.563 (.232)	.546 (.213)
Father's education (N=592)	.540 (.243)	.542 (.247)	.527 (.222)
Perceived family income (N = 607)	.433 (.233)	.433 (.234)	.416 (.233)
Financial ability (N=623)	2.51 (.878)	2.547 (.864)	2.373 (.937)
Composite SES (N=595)	.479 (.186)	.482 (.189)	.466 (.174)

No significant differences between non-HW and HW groups were found for perceived family income, level of parental education, the calculated SES scale (a composite of parental income and self-reported income), or financial ability. It is noted, however, that the non-HW group exhibited higher means relative to the HW group on all measured items of SES. As presented in Table 14, both non-HW and non-HW groups have some degree of financial concern with means of 2.55 and 2.37 respectively falling between 3 - "Some, I probably will have sufficient funds" and 2 – "Major, I have funds but will graduate with significant debt." 10.7% of Non-HW and 20.2% of HW students rate their concern, 1 – "Extreme – Not sure if I will have sufficient funds to complete college." Table 15 presents further descriptive analysis of SES data by NH status.

Table 15

SES Characteristics by Native Hawaiian Status

Variable	non-HW	HW
Mother's education, % reporting mother with Bachelor's or higher:	46.4	40.4
Father's education, % reporting father with Bachelor's or higher:	41.1	34.9
Financial ability, % who report extreme concern	10.7	20.2

SES Factor Analysis and Reliability Analysis

The grouping and reliability of the SES scale to be used in subsequent analysis was tested using SPSS version 22. Factor analysis was conducted on the three-items related to SES and 1-item financial concern as a technique to investigate any grouping or 'clumps' among the set of variables. A potential four-item SES scale was subjected to principal component analysis (PCA) using oblimin rotation. The Kaiser-Meyer-Olkin value of 0.615 met the recommended minimum value of .6 (Kaiser, 1970; Kaiser & Rice, 1974; Pallant, 2013), the correlation matrix found many coefficients of .3 and above, and the Bartlett's Test of Sphericity (Bartlett, 1954) reached statistical significance. Given that the sample size (n=638) and ratio of participants to items exceeded minimum recommendations in the literature (Nunnally, 1978; Tabachnick & Fidell, 2007), the researcher found the SES data suitable for factor analysis.

Two components were found with eigenvalues exceeding 1, explaining 47.5% and 25.5% of the variance respectively. Table 16 displays the component matrix for the 2-component solution showing strong unrotated loadings of 3 items for component 1 and a single item for component 2. A component correlation value of .248 suggests a weak correlation between the two components.

Table 16

Factor Analysis Component Matrix for SES

	Component	
Variables	1	2
Highest level of education completed by Mother	.728	-.481
Highest level of education completed by Father	.766	-.339
Self-reported family income	.730	.316
Concerns about ability to finance college	.501	.757

The factor analysis did not support the inclusion of the item financial ability into the SES scale given that it was loading onto a separate (r=.248) component from the 3-item SES scale. Thus, the study treated financial ability as a separate, single-item measure.

A reliability analysis of the 3-item SES scale found low to moderate internal consistency with a Cronbach's alpha = .649. A slightly higher alpha (.661) could be achieved if the self-reported family income item was deleted. Both respondent self-report and highest completed level of parent's education are considered acceptable proxies for SES of college students (Entwisle & Astone, 1994; Walpole, 2003). In this study, however, inter-item correlation between self-reported family income to mother's education and father's education was .325 and .323 respectively. Some researchers (Briggs & Cheek, 1986; Clark & Watson, 1995) advocate for an optimal level of homogeneity when the mean inter-item correlation falls in the .2 to .4 range if the items target diverse measures defining a latent construct rather than emerge from it. Donaldson, Lichtenstein, and Sheppard (2008) utilize a combined approach for approximating SES giving equal weight to respondent judgment and the traditional literature-grounded parent's education levels. This study retained the 3-item SES scale consistent with the method of prior studies (Cady et al., 2009; Donaldson et al., 2008) that believe a more reliable estimate of SES is obtained using measures based on research (parental education) and measures based on self-perception (self-reported income). Socio-economic status was determined using a composite measure ranging from 0 to 1.0.

Family Support

Respondents reported high levels of family support with mean response rates between 3 (agree) and 4 (strongly agree) to items 'my family approves of my attending this university' (M =3.45, SD = .57) and 'my family encourages me to continue attending this university' (M = 3.38, *SD* = .65). A reliability analysis showed good internal consistency (Cronbach's α = .838) for the 2-item composite measure. Inter-item correlation was 0.727 with N=622 following list wise deletion.

Table 17

Descriptive Statistics for Family Support Items

Family Support Item	Total *M (SD)*	Non-HW *M (SD)*	HW *M (SD)*
Approves of my attending this university**	3.45 (.57)	3.43 (.58)	3.63 (.51)
Encourages me to continue attending*	3.38 (.65)	3.36 (.67)	3.51 (.52)
Composite Family Support **	3.42 (.57)	3.34 (.58)	3.58 (.47)

Note. Non-HW and HW groups significantly differ at: * p <.05, **p <0.01 level.

A significant difference of means was found in scores for Family Support (a composite measure of items my family approves of my attending this university and my family encourages me to continue attending this university) between non-HW (*M*=3.398, *SD* = .580) and HW (*M*=3.576, *SD*=.474; t(616)=-3.362, p = .001, two-tailed. The magnitude of differences in the means (mean difference = -.18, 95% *CI*: -.282 to -.073) was a very small effect (eta squared = .018). It is noted that HW group exhibited higher mean scores on family approval to attend UHM and family encouragement to continue attending UHM.

Peer Interaction

Table 18 displays descriptive data related to peer interaction/support for responses to the prompt "how often do you do the following activities?" ranging from 1-not at all, 2-occasionally, and 3-frequently. Inspection of means show that HW group reported higher scores (more frequent peer interaction) than non-HW group on all seven items. Independent t-tests were conducted and found significant differences among groups for five items. The magnitudes of the differences in the means, however, were found to be very small with eta^2 values ranging from .006 to .009.

Table 18

Descriptive Statistics for Peer Interaction Items

Peer Interaction Item	Total *M (SD)*	Non-HW *M (SD)*	HW *M (SD)*
Discussed ideas	2.46 (.60)	2.44 (.60)	2.50 (.59)
Interacted outside of class*	2.44 (.62)	2.42 (.63)	2.55 (.58)
Worked cooperatively on assignments*	2.38 (.61)	2.35 (.61)	2.48 (.62)
Studied with other students*	2.30 (.68)	2.26 (.68)	2.42 (.66)
Got feedback on my work and ideas*	2.21 (.65)	2.18 (.65)	2.33 (.67)
Worked on a group project*	2.16 (.66)	2.14 (.67)	2.27 (.65)
Tutored another college student	1.67 (.71)	1.64 (.71)	1.72 (.71)

Note. * Significant at the $p < 0.05$ level.

A factor analysis (PCA method) was applied to the peer interaction data with the intent to confirm that the items were grouped appropriately. A Kaiser-Meyer-Olkin measure of .866 and statistical significance reached of Bartlett's test of sphericity showed the data was suitable for factorability. The component matrix is shown in Table 19. A single component was found with an eigenvalue of 3.672 explaining 52.5% of the variance. The results of the factor analysis confirmed the utility of all 7-items for a single peer interaction scale.

Table 19

Factor Analysis Component Matrix for Peer Interaction

Variables	Component #1
Discussed ideas with classmates	.844
Worked cooperatively with other students on course assignments	.804
Got feedback on my work and ideas from classmates	.769
Interacted with classmates outside of class	.747
Studied with other students	.728
Worked on a group project	.638
Tutored another college student	.477

A reliability analysis of the 7-item peer interaction scale was conducted. A list-wise deletion based on all variables in the procedure excluded 11 missing cases for an N of 627. A Cronbach's alpha of 0.837 for the 7-item scale demonstrated good internal consistency. The Cronbach's alpha would increase to 0.851 if item "tutored another student" were deleted, however, this study chose to keep the item in the overall scale to be consistent with the findings from the literature (Cady et al., 2009). A composite measure for Peer Interaction ranging from 7 to 21 consisted of a sum of the seven items (M=15.63, SD=3.226).

Faculty Interaction

Three items on the survey asked students to rate the frequency of interaction with instructors on 3-point likert scale ranging from not at all, occasionally, and frequently as well as the option "I prefer not to answer." Students reported higher than "occasional" interaction during class, less during office hours, and least outside of class and office hours. Students of the HW group were slightly more likely than non-HW group to interact with faculty during class and during office hours, but less likely to interact with faculty outside of class and office hours based on mean scores. However, analysis showed no statistical significance between groups of faculty interaction.

Table 20

Descriptive Statistics for Faculty Interaction Items

Faculty Interaction Item	All *M (SD)*	Non-HW *M (SD)*	HW *M (SD)*
During class	2.09 (.62)	2.08 (.64)	2.11 (.57)
During office hours	1.71 (.60)	1.70 (.60)	1.73 (.64)
Outside of class or office hours	1.59 (.64)	1.60 (.64)	1.59 (.61)

A direct oblimin principal components analysis (PCA) was conducted to check the underlying nature of the three faculty interaction items. The Kaiser-Meyer-Olkin value was .631 and Bartlett's test of sphericity reached statistical significance supporting the factorability of the items. A single component was found with an eigenvalue exceeding 1, explaining 56.4% of the variance. Table 21 revealed the three items loading onto a single component.

Table 21

Factor Analysis Component Matrix for Faculty Interaction

Variables	Component 1
During class	.708
During office hours	.791
Outside of class or office hours	.752

According to APPLES, the frequency of interaction with instructors scale demonstrated good internal consistency with a Cronbach's α of 0.74. In the current study, the Cronbach's alpha coefficient was .609. Ideally, a Cronbach's alpha greater than .7 is desired (DeVellis, 2012). Alpha values are sensitive to the number of items on a scale and with short scales (less than 10 items) it is common to find low Cronbach's alpha values. In short scales, a mean inter-item correlation for the items may be a more appropriate measure with an optimal range of inter-item correlation of .2 to .4 (Pallant, 2013; Briggs & Cheek, 1986). The inter-item correlation means for this study were, .284, .345 and .400.

Although reliability analysis showed moderate internal consistency (α = .609), no increase to Cronbach's α values would be achieved if any of the three items were deleted. The 3-items were retained giving a composite measure of faculty interaction ranging from 3 to 9, consistent with the use of the faculty interaction scale in prior studies (Sheppard et al., 2010).

Faculty Support

Table 22 displays the means and standard deviations for responses to the prompt "how often do you receive the following from your instructors?" ranging from 1-not at all, 2-occassionally, and 3-frequently.

Table 22

Descriptive Statistics for Faculty Support Items (N = 566)

Faculty Support Item	All *M (SD)*	non-HW *M (SD)*	HW *M (SD)*
Respect	2.55 (.58)	2.56 (.57)	2.56 (.60)
Intellectual challenge and stimulation	2.44 (.65)	2.45 (.65)	2.47 (.62)
Discuss coursework outside of class	2.25 (.73)	2.25 (.73)	2.29 (.72)
Help in achieving professional goals	1.84 (.71)	1.84 (.72)	1.81 (.67)
Emotional support/development	1.77 (.72)	1.81 (.71)	1.70 (.75)
Advice about educational program	1.66 (.68)	1.67 (.69)	1.61 (.62)
Opportunity to work on a research project	1.60 (.67)	1.62 (.68)	1.56 (.68)
Encouragement for graduate school	1.60 (.67)	1.60 (.68)	1.65 (.66)
Letter of recommendation*	1.59 (.67)	1.55 (.66)	1.71 (.71)

Note. * $p < .05$.

Students of the HW group were slightly more likely (by inspection of means) than non-HW group to report higher levels faculty support based on frequency of intellectual challenge and stimulation, opportunity to discuss coursework outside of class, encouragement for graduate school, and letter of recommendation. Students of the HW group were less likely to report higher levels of faculty support based on frequency of help in achieving professional goals, emotional support/development, advice about educational program, and opportunity to work on a research project. However, t-test analysis showed no statistical significance between groups on all items except for frequency of letter of recommendation. Receipt of letter of recommendation was rated lowest of all faculty support items (between '1- not at all' and '2 - occasionally') and significantly lower for Non-HW (M=1.55, SD = .664) than for HW (M=1.71, SD=.708; t(590)=-2.269, p = .024, two-tailed). The magnitude of differences in the means (mean difference = -.161, 95% *CI*: -.301 to -.022) was a very small effect (eta squared = .009). Both the non-HW and HW group reported equivalent and highest levels of faculty support in terms of "respect" of 2.55 ranging between 2-occasionally and 3-frequently.

Factor analysis (PCA with Oblimin rotation) revealed the potential to split scale into two subscales with one component grouped around academic support and the second component grouped around affective and emotional support. Table 23 displays the pattern matrix showing the loadings onto the two subscales.

Reliability analyses were conducted to evaluate the two faculty support subscales and a composite 9-item scale. A Cronbach's alpha of .797 was found for the 5-item subscale based on professional support demonstrating good internal consistency. A Cronbach's alpha of .687 was found for the 4-item subscale based on affective and personal support. No improvements to internal consistency for the two subscales would be made if any item were deleted. A list-wise deletion based on all variables in the procedure excluded 72 missing cases for an N of 566. A Cronbach's alpha of 0.826 for the 9-item scale demonstrated good internal consistency. To remain consistent with prior studies using the 9-item faculty support scale, the composite measure was chosen for overall faculty support measure.

Table 23

Factor Analysis Pattern Matrix for Faculty Support

	Component	
Variables	1	2
Opportunity to work on a research project	.836	-.138
Advice about educational program	.815	-.012
Encouragement for graduate school	.784	-.031
Help in achieving professional goals	.564	.393
Letter of recommendation	.489	.190
Intellectual challenge and stimulation	-.067	.789
Respect	-.063	.743
Opportunity to discuss coursework outside of class	.057	.716
Emotional support/development	.308	.481

Sense of Belonging

On measures of sense of belonging, respondents rated items, generally, in high agreement. Highest rated items were “enjoy going to school here” with 90.2% of the sample in agreement or strong agreement, followed by “feel accepted in my major” and “feel comfortable in my major” over 83% of the sample in agreement or strong agreement. Respondents felt highest sense of belonging to items dealing with major, lower sense of belonging to items dealing with school/institution, and the lowest sense of belonging to campus community. Approximately 45% of the respondents did not see themselves as a part of the campus community, did not feel they are a member of the campus community, and did not feel a sense of belonging to the campus community.

No significant differences were found for scores in sense of belonging between non-HW and HW groups. It is noted that the HW group exhibited higher mean scores for belonging to school, and belonging to major than the Non-HW group and a lower means score for sense of belonging to campus community than the Non-HW group.

Table 24

Descriptive Statistics for Sense of Belonging Items

	All	non-HW	HW
Sense of Belonging Item	% agree or agree strongly	*M (SD)*	*M (SD)*
Enjoy going to school here	90.2	3.14 (.60)	3.18 (.56)
Feel like I really belong at this school	77.8	2.92 (.72)	3.01 (.63)
Wish I had gone to a different school[a]	59.4	2.58 (.90)	2.65 (.88)
Feel accepted in my major	84.6	3.10 (.70)	3.16 (.65)
Feel comfortable in my major	83.0	3.10 (.70)	3.14 (.69)
Feel a part of my major	72.8	2.92 (.75)	2.92 (.78)
See myself as a part of the campus community	54.8	2.58 (.83)	2.51 (.78)
Feel I am a member of the campus community	54.0	2.56 (.83)	2.48 (.79)
Feel a sense of belonging to the campus community	54.5	2.56 (.83)	2.50 (.76)

Note. [a]item scores were reverse-coded.

The 9-item sense of belonging scale was subjected to principal component analysis (PCA) using SPSS version 22. Prior to performing PCA, the suitability of data for factor analysis was assessed by inspection of the correlation matrix for coefficients above .3, the Kaiser-Meyer-Olkin value (.835), and statistical significance of Bartlett's Test of Sphericity.

PCA found three components with eigenvalues above 1, explaining 50.4%, 18.0%, and 12.7% of the variance respectively. Inspection of the scree plot revealed a break after the third component. Parallel Analysis showed three components with eigenvalues above the corresponding criterion values for a randomly generated data matrix on the same size (9 variables x 560 subjects). Following the results of analysis, it was decided to extract three components.

The three-component solution explained a total of 81.2% of the total variance. The correlation coefficients for the three components were .331, .376, and .383 supporting the use of the Oblimin rotation solution. The pattern matrix is displayed in Table 25.

Consistent with the theoretical model, factor analysis revealed three, 3-item subscales consisting of a sense of belonging to school, to major, and to campus community. Reliability analysis found strong measures of internal consistency with Cronbach's α values to school, major, and campus community of .731, .885, and .952 respectively.

Table 25

Factor Analysis Pattern Matrix for Sense of Belonging

	Component		
Variables	1	2	3
Enjoy going to school here	.110	.182	.689
Feel like I really belong at this school	.316	.081	.638
Wish I had gone to a different school[a]	-.117	-.089	.915
Feel accepted in my major	.011	.899	-.017
Feel comfortable in my major	-.125	.951	.042
Feel a part of my major	.116	.847	-.023
See myself as a part of the campus community	.957	.020	-.024
Feel I am a member of the campus community	.984	-.050	-.014
Feel a sense of belonging to the campus community	.899	.035	.072

Note. [a]item scores were reverse-coded.

Satisfaction

Table 26 presents descriptive statistics for six satisfaction items and one composite item. Satisfaction, in general, was not very high or very low. Overall, the sample rated mean satisfaction levels between neutral (2), and satisfied (3) with mean scores ranking from highest for interaction with peers (2.83), STEM majors (2.64), overall quality of collegiate experience (2.63), academic advising and student support (2.49), quality of instruction (2.48) and amount of contact with faculty (2.44). Satisfaction with interaction with peers garnered the highest ratings with 70.0% of respondents satisfied or very satisfied. For items contact with faculty, academic advising/student support, STEM major, and quality of instruction only a little more than 50% were satisfied or very satisfied, the rest being neutral or dissatisfied. The highest percentages of dissatisfied respondents were with academic advising and student support (17.6%), quality of instruction (15.2%), and amount of contact with faculty (12.9%). A noticeable number of non-response/prefer not to answer responses came from "STEM major" prompt indicating a possible hesitation to rate satisfaction with STEM major or a misunderstanding of what was being asked. 46 participants did not respond to the STEM major item, where as five or less participants did not respond to the other five satisfaction items.

Table 26

Descriptive Statistics for Satisfaction Items

	All	non-HW	HW
Satisfaction Item	% satisfied or very satisfied	*M (SD)*	*M (SD)*
Academic advising and student support	53.9	2.49 (.92)	2.51 (.93)
Contact with faculty	48.7	2.46 (.81)	2.39 (.85)
Quality of instruction*	54.6	2.52 (.84)	2.33 (.90)
STEM major	53.3	2.62 (.79)	2.78 (.77)
Overall quality of experience	61.5	2.62 (.81)	2.72 (.77)
Interaction with peers*	70.0	2.80 (.78)	2.98 (.73)
Composite Satisfaction	-	15.57 (3.69)	15.74 (3.70)

Note. Non-HW and HW groups significantly differ at: * p <.05, ** p <0.01 level.

Students of the HW group were slightly more likely (by inspection of means) than non-HW group to report higher levels of satisfaction for items academic advising and student support, STEM major, overall quality of collegiate experience, interaction with peers, and the composite satisfaction variable (sum of all six items). Students of the HW group were less likely to report higher levels of satisfaction for amount of contact with faculty and quality of instruction. Significant difference was found by independent t-test between groups for quality of instruction ($t(630) = 2.156$, $p = .031$, two-tailed) and interaction with peers ($t(626) = -2.389$, $p = .018$, two-tailed). The magnitude of differences in the means for quality of instruction (mean difference = .192, 95% *CI*: .17 to .367) and interaction with peers (mean difference = -.185, 95% *CI*: -3.44 to -.26) were very small ($eta^2 = .007$ and .009, respectively).

A factor analysis (PCA method) was applied to the satisfaction data with the intent to confirm that the items were grouped appropriately. A Kaiser-Meyer-Olkin measure of .852 and statistical significance reached of Bartlett's test of sphericity showed the data was suitable for factorability. The component matrix is shown in Table 27. A single component was found with an eigenvalue of 3.359 explaining 56.0% of the variance. The results of the factor analysis confirmed the utility of all 6-items for a single satisfaction scale.

A reliability analysis for the scale followed a listwise deletion based on all variables in the procedure excluding 53 missing cases for an n of 585. A Cronbach's alpha of 0.842 for the 6-item scale demonstrated good internal consistency. A composite measure for Satisfaction ranging from 6 to 24 consisted of a sum of the six items (M=15.56, SD=3.698).

Table 27

Factor Analysis Component Matrix for Satisfaction

Variables	Component #1
Overall quality of collegiate experience so far	.823
STEM major	.772
Amount of faculty contact	.766
Quality of instruction	.755
Academic advising and student support	.700
Interaction with peers	.662

STEM Self-Efficacy

Table 28 displays descriptive data for eight STEM self-efficacy items and one intent to persist item. Overall, responses were very high with highest percentages of agreement or strong agreement to items 'succeed in major curriculum' (83.1%), 'can complete science requirements' (83.0%), 'can complete math requirements' (82.9%), and 'can complete major at this institution' (82.1%). It is noted that responses to item 'can excel this semester' should be interpreted with caution given that excelling in the current semester may describe a value judgment beyond that the intended scope of persisting in a STEM major. The lowest rated item was 'can succeed while not giving up outside interests' reflected 55.3% of the sample in agreement or strong agreement. A noticeable percentage of the sample (10.8% - 16.5%) did not provide an answer to the set of items related to persistence and ability to persist with a high of 102 respondents preferring not to answer to the item "I can persist in my STEM major during the next academic year." The intent to persist item was rated very high with 83.5% of respondents indicating agreement or strong agreement.

Table 28

Descriptive Statistics for STEM Self-Efficacy Items and Intent to Persist

STEM self-efficacy Item	All % agree or agree strongly	non-HW *M (SD)*	HW *M (SD)*
Succeed in major curriculum	83.1	3.37 (.63)	3.41 (.57)
Not giving up outside interests	55.3	2.73 (.92)	2.73 (.91)
Can complete math requirements	82.9	3.38 (.68)	3.41 (.69)
Can complete science requirements	83.0	3.35 (.65)	3.40 (.65)
Can excel this semester	73.7	3.12 (.76)	3.20 (.68)
Can persist next academic year	77.9	3.28 (.64)	3.30 (.62)
Can complete major at this institution	82.1	3.39 (.64)	3.43 (.63)
Confident in ability to complete	77.6	3.28 (.75)	3.29 (.74)
Composite Self-Efficacy	-	26.02 (4.67)	26.23 (4.03)
Intent to Persist**	83.5	3.48 (.69)	3.67 (.49)

Note. Non-HW and HW groups significantly differ at: * p <.05, **p <0.01 level.

Inspection of means found HW students reported higher self-efficacy scores than non-HW students on all measures except for 'succeeding in STEM curriculum while not having to give up participation in outside interests' which was found equivalent for both groups. No statistically significant differences were found, however, for STEM self-efficacy scores.

Significant difference was found by t-test for intent to persist scores for non-HW (M = 3.48, SD = .693) and HW (M = 3.67, SD = .493; t (562) = -3.215, p = .002, two-tailed). The magnitude of the differences in the means (mean difference = -.189, 95% CI: -.306 to -.073) was small (eta squared = .018).

A factor analysis (PCA method) was applied to the STEM self-efficacy data to confirm like grouping and investigate any potential subscales present. Suitability for factor analysis was met (Kaiser-Meyer-Olkin measure = .908 and statistical significance of Bartlett's test of sphericity). The component matrix is shown in Table 29. A single component was found with an eigenvalue of 5.259 explaining 65.7% of the variance. The results of the factor analysis confirmed the utility of all 8-items for a single STEM Self-efficacy scale.

Table 29

Factor Analysis Component Matrix for STEM Self-Efficacy

Variables	Component #1
Can complete STEM major at this institution	.892
Feel confident in ability to complete a STEM degree at UH Manoa	.891
Can persist in STEM major during next academic year	.887
Can succeed in STEM major curriculum	.860
Can complete Science requirements for STEM major	.821
Can excel in current major this semester	.808
Can complete Math requirements for STEM major	.731
Can succeed in major curriculum while NOT giving up participation in outside interests	.531

A reliability analysis followed a listwise deletion based on all variables in the procedure excluded 144 missing cases for an n of 494. A Cronbach's alpha of 0.914 for the 8-item scale demonstrated very high internal consistency. The Cronbach's alpha if item "I can succeed in my STEM major curriculum while NOT having to give up participation in my outside interests" were deleted would increase to 0.933, however the item was kept in the scale to be consistent with the LAESE scale used in prior studies. A composite measure for STEM self-efficacy ranging from 8 to 32 consisted of a sum of the eight items (M=26.02, SD=3.226).

Summary of Reliability Tests for Multi-Item Variables

Ten multi-item variables were identified from the data using principal component analysis and reliability analysis. Existing literature discussing both theoretical rational and prior application of scales also supported composite measures. Table 30 displays a summary of the composite variables with the Cronbach's α measures for internal consistency. The composite variables were used in subsequent analysis as factors for regression to predict intent to persist, for multiple correlation to STEM self-efficacy, and for comparison between Native Hawaiian and non-Hawaiian groups to answer the overall research questions.

Table 30

Summary of Composite Variables and Reliability Analysis

Composite variable	Items	Cronbach's α
SES	3	.649
Family Support	2	.838
Peer Interaction	7	.837
Faculty Interaction	3	.609
Faculty Support	9	.826
Sense of belonging to school	3	.731
Sense of belonging to major	3	.885
Sense of belonging to campus community	3	.952
Satisfaction	6	.842
STEM self-efficacy	8	.914

Summary of Part One

The first part of the chapter highlighted the descriptive data for the items either by count and percentage or by mean and standard deviation. The sample was found to be different than the UHM STEM undergraduate population by having a larger percentage of females (by a factor of 1.4) and larger percentage of Native Hawaiians (by a factor of 1.5). The sample reflects underrepresentation of College of Natural Science students, White students, and Japanese students by factors of .9, .8, and .7 respectively. The researcher found that although the sample did not represent the exact characteristics of the population, differences were not substantial to limit the generalizability of the input of 638 students to the 3,592 students in the population.

Further, it is noted that the results are based on a slightly higher voice from females and Native Hawaiians.

The descriptive data set revealed a number of interesting results. The sample carried a 3.55 high school GPA (higher than the general UH Manoa freshmen class profile) and a college GPA of 3.18. The sample self-described their family income at a level between middle and lower-middle income with the majority reporting a mother's education below Bachelor's level and the majority reporting father's education below Bachelor's level. Highest agreements were to items of enjoying going to school here, sense of belonging to their major, family support, receiving respect and intellectual challenge from faculty, and satisfaction with interaction with peers. Lowest rated measures were to items related to sense of belonging to campus community, frequency of faculty interaction during office hours or outside of class, tutoring other students, faculty support related to advice, encouragement for graduate school, or research, satisfaction with amount of contact with faculty and satisfaction with academic advising and student support.

In general, the respondents indicated high agreement on measures of the two outcomes of interest in this study, their beliefs about their abilities to succeed in STEM and their intentions to complete their STEM degree at UH Manoa. Over 82% of respondents stated that they could complete their math, science, and major curriculum, could complete their major at UHM, and intended to graduate in STEM at UH Manoa.

Similarities and differences between Hawaiian and non-Hawaiian groups were discussed. Independent t-tests found significance difference on 12 items shown in Table 31, however the actual differences in mean scores between the two groups were very small.

Table 31

Significant t-test Results by Native Hawaiian Status

Variable	non-HW *M (SD)*	HW *M (SD)*	*t*	*p*	eta^2
HS GPA*	3.58 (.43)	3.44 (.58)	2.309	.023	.009
Family: Approves of my attending**	3.43 (.58)	3.63 (.51)	-3.504	.001	.020
Family: Encourages me to continue **	3.36 (.67)	3.51 (.52)	-2.617	.010	.011
Composite Family**	3.40 (.58)	3.58 (.47)	-3.362	.001	.018
Faculty: Recommendation*	1.55 (.66)	1.71 (.71)	-2.269	.024	.009
Peers: Outside of class*	2.44 (.62)	2.42 (.63)	-2.130	.034	.007
Peers: Cooperatively on assignments*	2.38 (.61)	2.35 (.61)	-1.967	.047	.006
Peers: Studied with others*	2.30 (.68)	2.26 (.68)	-2.175	.030	.008
Peers: Feedback from classmates*	2.21 (.65)	2.18 (.65)	-2.171	.030	.007
Peers: Group project*	2.16 (.66)	2.14 (.67)	-1.967	.050	.006
Composite Peer Interaction*	15.46 (3.22)	16.26 (3.16)	-2.367	.018	.009
Satisfaction, instruction*	2.52 (.84)	2.33 (.90)	2.156	.031	.007
Satisfaction, interaction with peers*	2.80 (.78)	2.98 (.73)	-2.389	.018	.009
Intent to persist**	3.48 (.69)	3.67 (.49)	-3.215	.002	.018

Note. * Significant at the p <0.05 level, ** Significant at the p <.01 level.

It is noted, however, that a series of t-tests may run the risk of inflated Type-I error, finding a significant difference between groups when there in fact is no difference. The t-test results will be further tested in the second part of this chapter by way of one-way analysis of variance and multiple analysis of variance.

The descriptive analysis presented in part one is important to situate the results that follow for three reasons. First, it provides a clearer picture of the sample and context to evaluate if interpretations of the results can be generalized by the researcher to provide implications for the UHM STEM population and if results can be transferred by readers to provide insight to their particular settings. Second, an initial comparison of Native Hawaiian and non-Hawaiian groups can be made to recognize areas of similarity and highlight key areas of difference that can be investigated further in subsequent analysis. Finally, the descriptive analysis, principal component analysis, and reliability tests lay the foundation for the multivariate techniques to follow, which in turn address the research questions.

Research Question 1: Correlation to STEM Self-Efficacy

Sequential multiple correlation was used to answer research question one, 'what are the personal input and environmental factors associated with STEM self-efficacy beliefs on undergraduate students?'

The terms *correlation* and *regression* are often used interchangeably although the term regression is used to denote that the intent of the analysis is prediction, and the term correlation is more often used when the goal is to assess the relationships between the DV and the IVs (Tabachnick & Fidell, 2007). Multiple correlation is the appropriate technique to answer this question given that the DV is continuous (composite scale of 8 self-efficacy items) and the model is interested in the relationships between a set of independent variables. Tabachnick and Fidell (2007) describe standard multiple regression as an atheoretical, shotgun approach, and step-wise/statistical regression as an exploratory, model-building (rather than a model-testing) procedure, both which are not fitting for this study. Sequential multiple correlation (rather than standard or step-wise correlation) is chosen in order for the researcher to enter and interpret IVs based on theoretical grounds from Lent's (2013) Social Cognitive Career Theory and Astin's (1977) Inputs – Environment – Outcomes model.

The aim of this sequential multiple regression is to evaluate how much variance in the desired outcome (STEM self-efficacy) can be explained by a function of inputs (entered into blocks 1 and 2) and environment (entered into blocks 3 and 4). Table 32 displays the blocks of IVs and order of entry used in analysis. A second objective, along with determining the overall predictive ability of conceptual model, is to determine the relative contribution of each independent variable. It should be noted that there are many other factors that may contribute to the variation in the DV (STEM self-efficacy) but the scope of this investigation is limited to the selected independent variables.

Block 1 consists of background, input variables: gender, ethnicity (recoded into five dichotomous variables for White, Asian, part-Hawaiian, Mixed, and non-Hawaiian underrepresented racial minorities), SES, and high-school GPA. They represent background, pre-college characteristics that Bean (1985) refers to as defining variables and Tinto (1987) describe as family background and individual attributes. These enter into the regression analysis prior to the college environment IVs so that the initial influence and additional influence of factors to the outcome can be evaluated. Conceptually, it makes sense when investigating college effects because students typically arrive at the University with ethnicity, gender, SES, and pre-college schooling set and college environmental factors build on their experience. Practically, it makes sense such that additional influence (variance on the outcome) can be determined on factors that the college may have more control over.

Table 32

Independent Variables Used for Self-Efficacy Sequential Multiple Correlation

Order	Variable	Block	Range	I-E-O
1	Gender: Male	1	0 = female, 1 = male	I
2	Ethnicity: White	1	0 = no, 1 = yes	I
3	Ethnicity: Hawaiian	1	0 = no, 1 = yes	I
4	Ethnicity: Asian	1	0 = no, 1 = yes	I
5	Ethnicity: Mixed	1	0 = no, 1 = yes	I
6	Ethnicity: URM (non-HW)	1	0 = no, 1 = yes	I
7	SES	1	0.00 (low) to 1.00 (high)	I
8	High School GPA (reflect log 10)	1	1.3 to 4.0	I
9	Incoming status: high school	2	0 = no, 1 = yes	I
10	Incoming status: 2-year transfer	2	0 = no, 1 = yes	I
11	Incoming status: 4-year transfer	2	0 = no, 1 = yes	I
12	Incoming status: Non-traditional	2	0 = no, 1 = yes	I
13	College: CTAHR	2	0 = no, 1 = yes	E
14	College: Engineering	2	0 = no, 1 = yes	E
15	College: Natural Sciences	2	0 = no, 1 = yes	E
16	College: SOEST	2	0 = no, 1 = yes	E
17	Educational level	2	1 = freshmen to 5 = 5^{th} year Senior	E
18	Family support	3	1 to 4	E
19	Program participation	3	0 = none, 1 = participation in one or more	E
20	Peer Interaction	3	7 to 21	E
21	Faculty Interaction	3	3 to 9	E
22	Faculty Support	3	9 to 27	E
23	College GPA	3	1.3 to 4.0	E
24	Belonging to School	4	3 to 12	E
25	Belonging to Major	4	3 to 12	E
26	Belonging to Campus Community	4	3 to 12	E
27	Satisfaction	4	6 to 24	E
28	Financial ability	4	1 to 4	E
DV	STEM self-efficacy	-	8 to 32	O

Block 2 consists of input academic classification variables: incoming student status (recoded into four dichotomous variables for first-time clean freshmen, community college transfers, four-year institution transfers, and returning or non-traditional students), College (recoded into four dichotomous variables for Engineering, Natural Science, CTAHR, and SOEST), and educational level (freshmen to 5^{th} year senior). These variables represent characteristics that define the student after college entry but prior to other environmental factors.

Blocks 3 and 4 consist of environment variables ordered based on a conceptual progression of student experience. For example, the model theorizes that a college student experiences levels of family support, peer-interaction, and faculty support prior to defining levels of sense of belonging and overall satisfaction. Financial ability (reverse scored item assessing levels of financial concern) fits into Lent's (2013) SCCT model as an environmental contextual variable proximal to choice behavior and was placed in block 4. This information will be used to assess each independent variable in terms of what it adds to the prediction of STEM self-efficacy after the previous variables have been controlled for.

Preliminary and post-analysis were conducted to test assumptions of normality, linearity, multicollinearity, and homoscedasticity. Univariate outliers were found in independent variables HS GPA, Family Support, and College GPA, and within dependent variable STEM Self-Efficacy. Outliers to HS GPA (very low GPA), College GPA (very low GPA), Family support (very low family support), and Self-efficacy were found to be true cases and kept in the sample. Independent variable HS GPA was transformed by reflection and log10 function to address substantial negative skewness and positive kurtosis. Multivariate outliers were inspected following regression using Mahalannobis distances and Cook's Distance. Pallant (2013) and Tabachnick and Fidell (2007) indicate that Cook's Distance values larger than 1 pose potential problems. In this analysis, the maximum Cook's Distance was 0.137 suggesting no undue influence from strange cases on the results of the model as a whole. Therefore, college GPA, family GPA, and Self-efficacy were not transformed and kept in the model.

Size of sample was found sufficient for generalizability with N=341 following listwise deletion for all missing values. Tabachnick and Fidell (2007) recommend a minimum sample size of $N > 50 + 8m$ (where m is the number of IVs) for testing multiple correlation and $N > 104 + m$ for testing individual predictors. In this analysis of 28 IVs, the sample size of 341 exceeded minimum requirements of 50 + 8(28) = 224 and 104 + 28 =132.

Table 33 displays the variance explained by the sequential multiple regression with the inclusion of independent variable blocks into each model. Input, background variables entered in block 1 explained 4.3% of the variance in STEM self-efficacy and input college status variables in block 2, explained an additional 6.6% of the variance. Environmental variables in block 3 explained an additional 23.3% of the variance and sense of belonging, satisfaction, and financial ability explained an additional 8% after controlling for prior measures. *R* was significantly different from zero at the end of each step. The total variance explained by the model as a whole was 42.2%, $F(25, 315) = 9.20$, $p < .001$.

Table 33

Sequential Multiple Regression Predicting Self-Efficacy

Model	*R*	R^2	Sig.	R^2 Change	F	Sig F Change
1	.208	.043	.037	.043	2.161	.037
2	.330	.109	.000	.066	2.851	.001
3	.585	.342	.000	.233	8.324	.000
4	.650	.422	.000	.080	9.196	.000

The statistical significance of the overall model indicate that the null hypothesis, that STEM self-efficacy is not affected by the set of independent variables, should be rejected. The research hypothesis, that the set of independent variables contribute to the prediction of STEM self-efficacy, was accepted. Table 34 displays the final model unstandardized regression coefficients (*B)* with standard errors (*SE B*), standardized coefficients (β), and significance for each variable demonstrate the relative contributions to the predictive ability of the model of STEM self-efficacy was assessed for each independent variable.

Model 1 tested background input variables alone and was found to be statistically significant in predicting 4.3% of the variance in STEM self-efficacy. In the final model, none of the background input variables reached statistical significance and Ethnicity: Native Hawaiian variable dropped out of the model. Negative β values for Gender: Male and Ethnicity: URM-nonHW suggest a prediction of lower STEM self-efficacy for males than females and a lower STEM self-efficacy for URM-nonHW relative to Hawaiians. The highest weighted standardized coefficient in Block 1 was Asian (.119) suggesting Asian ethnicity variable predicts a higher STEM self-efficacy than Hawaiians.

Table 34

Regression Coefficients Predicting STEM Self-Efficacy

Variable	*B*	*SE B*	*β*	*p*
Gender: Male	-.704	.444	-.078	.114
Ethnicity: White	.261	.713	.021	.714
Ethnicity: Asian	1.077	.590	.119	.069
Ethnicity: Mixed	.887	.666	.075	.184
Ethnicity: URM (non-HW)	-.256	1.031	-.012	.804
SES	2.109	1.184	.086	.076
High School GPA (reflect, log10)	-.075	1.826	-.002	9.67
Incoming status: 2-year transfer	.472	.569	.043	.408
Incoming status: 4-year transfer	.359	.718	.023	.618
Incoming status: Non-traditional or returning	1.852	.966	.090	.056
College: CTAHR	.627	.688	.043	.363
College: Engineering*	1.234	.498	.132	.014
College: SOEST	-.927	.955	-.045	.332
Educational level**	.472	.183	.129	.010
Family support***	1.438	.382	.186	.000
Program participation*	1.158	.465	.126	.013
Peer Interaction	-.024	.070	-.017	.734
Faculty Interaction	-.097	.169	-.030	.567
Faculty Support	.056	.070	.048	.422
College GPA***	2.302	.444	.267	.000
Belonging to School	.007	.146	.003	.960
Belonging to Major***	.625	.133	.268	.000
Belonging to Campus Community**	-.292	.110	-.151	.008
Satisfaction	.208	.248	.041	.403
Financial ability	.208	.248	.041	.403
(Constant)	2.563	2.162		.237

Note. Variables Ethnicity: Hawaiian, Incoming Status: High School, and College: Natural Sciences excluded from equation.
* $p < .05$, ** $p < .01$, *** $p < .001$.

Model 2 tested input academic classification variables added to the block 1 input variables. Model 2 was found to be statistically significant explaining a total of 10.9% of the variance in STEM self-efficacy. In the final model, incoming status: high school and College: Natural Sciences were excluded from the equation. Two factors, College: Engineering and educational level were found to be statistically significant. Positive standardized coefficients show that Engineering students relative to Natural Science students would predict higher STEM self-efficacy and that STEM self-efficacy would increase as students progress in educational level. Other variables did not reach statistical significance, which was unexpected, were SES and high school GPA cited as strong predictors of STEM self-efficacy (Cady et al., 2009; Perna, 2000).

Model 3 assessed the predictive ability of block 1 and block 2 variables with the addition of college environmental factors. Model 3 was found to be statistically significant contributing 23.3% of variance predictive ability for a total of 34.2%. In the final model, family support, program participation, and college GPA reached statistical significance. Positive β values suggest that increase in family approval and encouragement, participation in at least one program, and increase in college GPA contributes to increased STEM self-efficacy beliefs. College GPA was found to be one of the strongest factors with a standardized coefficient of .267. Although not found to be statistically significant, unexpected results were negative relationships for peer interaction and faculty interaction to the dependent variable. It should be noted that college environment factors in block 3 contributed the majority of the predictive ability of the overall self-efficacy model.

Model 4 added environmental variables sense of belonging, satisfaction, and financial ability to the previous factors and contributed an additional 8% to the predictive ability when controlling for other factors. It is noted these factors may have a larger influence on the dependent variable but given their order in the sequential multiple regression technique and the correlation with other independent variables, may be credited with a lesser, unique contribution. In block 4, only two variables, sense of belonging to major and sense of belonging to campus community, were found to be statistically significant. An unexpected result was that sense of belonging to campus community displayed a negative effect on self-efficacy in the model. This could be related to the distinction students make between sense of belonging to major and to school versus their views of the general campus community.

From the overall model, sense of belonging to major was found to be the most influential significant predictor ($\beta = .268$), followed by College GPA (.267), family support (.186), sense of belonging to campus community (-.151), College: Engineering (.132), educational level (.129) and program participation (.126). Many IVs unexpectedly did not reach statistical significance.

Research Question 2: Correlation to Intent to Persist

Logistic regression was used to answer research question two, 'what are the personal input and environmental factors associated with intent to persist on undergraduate students?' The outcome of interest in this analysis is intent to persist, which indirectly informs related outcomes including intent to leave, actual persistence, and actual dropout. Astin's I-E-O model framework, used to guide this study, views college outcomes as functions of inputs and environment. The aim of this analysis is to predict, from a set of 29 independent input and college environment variables, the students that report an interest in completing their STEM degree at UH Manoa as opposed to those that do not. Analysis should help investigate how well the complete set of IVs in the model explain the outcome as well as provide assessment for individual variables in terms of their likelihood of increasing, decreasing, or having no effect on the probability of the outcome.

The methods for answering question two (intent to persist) were very similar to the methods for answering question one (STEM self-efficacy). A sequential logistic regression was chosen (as opposed to standard or statistical) to allow for entry of independent variables in blocks in a manner consistent with the conceptual model. 29 independent variables were utilized, including all 28 IVs shown in Table 32 previously used for multiple correlation as predictors in blocks 1 through 4. STEM self-efficacy was tested as the 29^{th} independent variable, to predict intent to persist. The four point likert-like measure of intent to persist, was coded into a dichotomous measure of all respondents whom strongly disagree, disagree, or prefer not to answer into group “0” and all respondents whom indicated strongly agree or agree into group “1.” Logistic regression is the preferred technique to predict group membership given a set of independent variables (Pallant, 2013).

The full logistic regression model containing all predictors was statistically significant, $\chi^2(26, N = 341) = 61.24, p < .001$, indicating that the model was able to distinguish between respondents who reported and did not report an intent to persist. The model as a whole explained between 16.4% (Cox & Snell R Square) and 44.4% (Nagelkerke R Square) of the variance in intent to persist status and correctly classified 95.6% of cases.

Table 35 shows regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals for each of the independent variables. According to the Wald criterion, only two variables reliably predicted intent to persist status, educational level (p = .005) and STEM self-efficacy (p = .002). The stronger predictor of intent to persist was STEM self-efficacy recording an odds ratio of 1.27. Educational level recorded an odds ratio of 2.46. The odds ratio represents the change in the odds of being in one of the outcome categories when the value of the predictor increases by one unit (Tabachnick & Fidell, 2007). For every one-year increase in educational level (i.e. sophomore to junior) the odds of the student reporting intent to persist increases by a factor of 2.5. The significance of the relation makes sense, that students closer to completing their STEM degree will more likely indicate their intent to complete their STEM degree, but the magnitude of the difference appears very high. This finding supports the literature identifying the first three semesters of college as being critical to affect student retention.

The composite STEM self-efficacy measure was found to have the highest predictive ability on intent to persist. If a student increased their level of agreement by one unit (from disagree to agree or from agree to strongly agree) to any one of the eight STEM self-efficacy measures (i.e. I can complete the math requirements, I can excel this semester) then the probability of them belonging to the intent to persist group would increase by a factor of 1.27.

Although no significance was found in the predictive ability of the other variables in the model, the analysis provided some data that we expected in some areas, and unsupported by the literature in others. The parameter estimates showed negative coefficients for SES, financial ability, satisfaction, program participation, and sense of belonging to major indicating an indirect relationship between the independent variables and the predicted outcome group.

Table 35

Sequential Logistic Regression Predicting Intent to Persist

						95% *C.I.*	
Variable	*B*	*SE B*	Wald	*p*	Odds Ratio	Lower	Upper
Gender: Male	-.236	.693	.116	.733	.790	.203	3.069
Ethnicity: White	2.83	1.075	.069	.792	1.328	.161	10.919
Ethnicity: Hawaiian	1.645	1.402	1.377	.241	5.183	.332	80.945
Ethnicity: Asian	.312	1.104	.080	.777	1.367	.157	11.891
Ethnicity: Mixed	.197	1.291	.023	.879	1.218	.097	15.281
SES	-.566	1.796	.099	.753	.568	.017	19.193
High School GPA	-.689	.834	.684	.408	.502	.098	2.571
Incoming status: high school	2.420	1.412	2.937	.087	11.249	.706	179.197
Incoming status: 2-year transfer	1.547	1.451	1.137	.286	.213	.012	3.659
Incoming status: 4-year transfer	1.952	1.702	1.316	.251	7.043	.251	197.734
College: CTAHR	1.246	1.786	.487	.485	3.478	.105	115.142
College: Engineering	1.109	1.498	.548	.459	3.032	.161	57.116
College: Natural Sciences	.161	1.344	.014	.905	1.175	.084	16.359
Educational level**	.901	.322	7.839	.005	2.462	1.310	4.627
Family support	.810	.574	1.993	.158	2.247	.730	6.916
Program participation	-.015	.781	.000	.985	.985	.213	4.554
Peer Interaction	.068	.101	.457	.499	1.071	.878	1.305
Faculty Interaction	.167	.273	.374	.541	1.182	.692	2.016
Faculty Support	.003	.105	.001	.975	1.003	.817	1.233
College GPA	.679	.688	.972	.324	1.971	.511	7.598
Belonging to School	.031	.240	.017	.896	1.032	.644	1.653
Belonging to Major	-.011	.210	.003	.958	.989	.656	1.492
Belonging to Campus Community	.041	.174	.056	.813	1.042	.741	1.465
Satisfaction	-.042	.110	.146	.703	.959	.772	1.190
Financial ability	-.297	.410	.522	.470	.743	.333	1.661
Self-Efficacy**	.238	.077	9.465	.002	1.269	1.090	1.476
(Constant)	-.354	7.412	.002	.962	.702		

Note. Variables Ethnicity: URM non-HW, Incoming Status: Non-traditional, and College: SOEST excluded from the equation.
** $p < .01$.

Research Question 3: Native Hawaiian vs. Non-Hawaiian Respondents

Research question three asked, "how do the background, environmental, and outcome characteristics differ, if at all, among Native Hawaiian and non-Hawaiian students?" The related null hypothesis predicts that there are no differences for each variable between Native Hawaiian and non-Hawaiian respondents. To answer this question, multiple techniques were utilized. First, non-parametric Chi-Square tests were utilized to test for significant differences between Non-HW and HW groups across input categorical variables (gender, college, academic level, and incoming student status). A series of independent t-tests and one-way ANOVAs utilized as an screening prior to more sophisticated analysis to explore for significant differences across select input and environmental continuous variables (high school GPA, College GPA, level of parent education, self-reported income, and financial ability). Finally, multivariate analysis of variance was conducted on all variables.

Chi-square tests for independence (with Yates Continuity Correction for gender) were utilized to evaluate if the proportions of categorical variables varied significantly by Native Hawaiian status as seen in Table 11. Significant association between Native Hawaiian status was found for gender, Engineering, Natural Sciences, and participation in one or more programs. No significant difference was found for educational level and pre-UH Manoa student status. Relative to non-Hawaiians, Hawaiians were more highly enrolled in Engineering, fewer enrolled in Natural Sciences, higher percentage male, and higher participation in one or more programs.

A series of one-way between-groups analysis of variance was conducted to explore further if the significant variables found by t-test results between the non-Hawaiian and Hawaiian groups were due to Hawaiian grouping variability or due to chance. Table 36 displays results of the series of ANOVAs. Some of the variables tested did not pass the test for homogeneity of variance and are presented in a separate Table 37, Robust tests of equality of means.

Table 36

ANOVA of Select Characteristics by Native Hawaiian Status

Variable	non-HW *M (SD)*	HW *M (SD)*	*df2*	*F*	*p*	eta^2
Faculty support: letter of recommendation	1.55 (.66)	1.71 (.71)	593	5.787*	.016	.010
Peer: outside of class	2.42 (.63)	2.55 (.59)	633	3.959*	.047	.006
Peer: cooperate on assignments	2.36 (.61)	2.48 (.62)	631	3.267	.071	.006
Peer: Studied with others	2.27 (.68)	2.41 (.66)	631	3.893*	.049	.006
Peer: feedback from classmates	2.18 (.65)	2.32 (.67)	633	4.093*	.043	.006
Peer: group project	2.14 (.67)	2.27 (.65)	630	3.269	.071	.005
Composite Peer Interaction	15.49 (3.23)	16.23 (3.16)	624	4.727*	.030	.008
Satisfaction: quality of instruction	2.51 (.84)	2.34 (.90)	634	3.494	.062	.006

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 37

Robust Tests of Equality of Means of Select Characteristics by Native Hawaiian Status

Variable	non-HW *M (SD)*	HW *M (SD)*	*df2*	*Brown-Forsythe*	*p*
High school GPA	3.58 (.43)	3.44 (.58)	126.946	5.231*	.024
Family: approves of my attending	3.43 (.58)	3.62 (.51)	166.652	12.001**	.001
Family: encourages me to continue	3.35 (.67)	3.51 (.52)	177.968	6.929**	.009
Composite Family	3.39 (.58)	3.58 (.47)	171.313	11.301**	.001
Satisfaction: interaction with peers	2.80 (.78)	2.97 (.73)	164.694	4.996*	.027
Intent to persist	3.49 (.69)	3.68 (.49)	189.564	10.407**	.001

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Statistically significant differences were found on measures of peer interaction, faculty letter of recommendation, high school GPA, family approval and encouragement to continue, satisfaction with interaction with peers, and intent to persist. Three items found to be significantly different by t-test, satisfaction with quality of instruction, worked on group project, and worked cooperatively with other students on course assignments failed to reach significance in the ANOVA. The results revealed a theme around items of peer interaction frequency (with peers outside of class, studied with other students, get feedback from peers) and satisfaction with peer interaction found higher for Hawaiians than non-Hawaiians. It is noted that Hawaiians report higher levels of family approval and family encouragement to continue attending UH Manoa, and higher levels of intent to persist than non-Hawaiians.

Multivariate Analysis of Variance

Multivariate analysis of variance (MANOVA) is a technique to compare groups on a range of different characteristics. It is an ideal statistical technique to answer this research question to investigate the data based on two independent groups (Hawaiian and non-Hawaiian) against a set of variables. MANOVA is the preferred analysis technique over running a series of separate t-tests or ANOVAs testing each variable, the latter which runs the risk of an inflated Type 1 error (Pallant, 2013; Tabachnick & Fidell, 2007). However, Tabachnick and Fidell (2007) also note that often MANOVA is considerably less powerful than ANOVA, particularly in finding significant group differences for a particular DV, which risk Type 2 error. Therefore, the investigation of the data by way of ANOVA and MANOVA was used.

A one-way between-groups multivariate analysis of variance was performed to investigate if college environmental characteristics vary by Native Hawaiian or non-Hawaiian status. Fourteen dependent variables were selected for MANOVA testing dependent variable was Native Hawaiian status.

Table 38

MANOVA of Selected Characteristics by Hawaiian and Non-Hawaiian Groups (N = 345)

Dependent variable	*F*	*p*	partial eta^2
SES	.107	.744	.000
High School GPA (reflect and log10)	.553	.457	.002
Family support	3.742	.054	.011
Peer Interaction	.831	.363	.002
Faculty Interaction	.205	.651	.001
Faculty Support	.091	.763	.000
College GPA	.456	.500	.001
Belonging to School	.337	.562	.001
Belonging to Major	.074	.786	.000
Belonging to Campus Community	1.084	.299	.003
Satisfaction	.019	.892	.000
Financial ability	.593	.442	.002
STEM self-efficacy	.000	.993	.000
Intent to Persist	4.595	.033	.013

A statistically significant difference between non-Hawaiian and Hawaiian groups was not found on the overall MANOVA using linear combinations of dependent variables, $F(14, 345) = 1.108$, $p = .349$; Wilks' Lambda = .96; partial eta squared = .045. When the results for the dependent variables were considered separately, the only difference to reach statistical significance was intent to persist, $F\ (1, 343) = 4.595$, $p = .033$, partial eta squared = .013. An inspection of the mean scores indicated that Hawaiian students reported higher levels ($M = 3.69$, $SD = .50$) than non-Hawaiians ($M = 3.50$, $SD = .70$) indicating their agreement with the statement intend to complete a STEM degree at UH Manoa. A second independent variable in the model, family support, approached statistical significance, $F\ (1, 343) = 3.742$, $p = .054$, partial eta squared = .011. An inspection of the mean scores indicated that Hawaiian students reported higher levels ($M = 3.53$, $SD = .47$) than non-Hawaiians ($M = 3.38$, $SD = .60$) in agreement to statements that their family approves of their attending UH Manoa and encourages them to continue to attend UH Manoa.

The results of the MANOVA show that no significant differences between groups were found based on the set of 14 dependent college environment variables. Intent to persist was found to be significantly higher for Native Hawaiians than non-Hawaiians in both the MANOVA and ANOVA techniques. Composite family support approached significance (p=.054) and composite peer interaction and high school GPA failed to reach significance in the MANOVA, though variables were found to be significant in the one-way ANOVA. Differences in significant results could be due to increased family-wise error by ANOVA or increase in Type I-error by MANOVA due to correlations between a large set of dependent variables.

Summary of Results

The major results of the regression analyses were that the set of input and environment variables were successful in predicting 42.2% (F(25, 315) = 9.20, $p < .001$) of the variance in STEM self-efficacy and successful in predicting between 16.4% (Cox & Snell R Square) and 44.4% (Nagelkerke R Square) of the variance in intent to persist status correctly classifying 95.6% of cases ($\chi^2(26, N = 341) = 61.24, p < .001$). Native Hawaiian and non-Hawaiian groups were found to vary by measures of intent to persist, family support, program participation, and frequency and satisfaction with peer interaction. The major results are presented in Table 39.

Table 39

Significant Predictors and Native Hawaiian Differences

STEM Self-efficacy	Intent to Persist	Native Hawaiian vs. Non-Hawaiian
Belonging to major	STEM self-efficacy	Intent to persist
College GPA	Educational level	Family support
Family support		Program participation
College: Engineering[a]		Frequency of peer interaction
Belonging to campus community[b]		Satisfaction with peer interaction
Educational level		
Program participation		

Note. [a]Relative to reference college Natural Science
[b]Negative predictor

For STEM self-efficacy, sense of belonging to major was found to be the strongest significant predictor (β = .268), followed by College GPA (.267), family support (.186), sense of belonging to campus community (-.151), College: Engineering (.132), and program participation (.126). For Intent to Persist, the strongest significant predictor was STEM self-efficacy ($p = .002$) recording an odds ratio of 1.27. The only other significant predictor of intent to persist found was educational level ($p = .005$) with an odds ratio of 2.46.

Significant difference between Native Hawaiian and non-Hawaiian groups were found on only one item, intent to persist ($p = .033$) by MANOVA and on an additional 7 items related to family support, frequency and satisfaction of peer interaction, and faculty letter of recommendation by ANOVA. Program participation was also found to be significantly higher, by Chi-square test, for Hawaiians.

Discussion of these results as they relate to the literature and to future research and practice will be presented in Chapter 5. A synthesis of the results of the three research questions will attempt to address an overarching research question: How can the University of Hawaii at Manoa increase the persistence and degree completion of undergraduate STEM majors as a whole and Native Hawaiian undergraduate STEM majors in particular.

CHAPTER 5

DISCUSSION

The broader context for the motivation of this study is that the U.S. educational system is failing to keep pace with global competitors to produce a citizenship literate in STEM and a STEM workforce that is well-trained and well-educated. The National Academies (NRC, 2007, 2010) strategize that part of the solution lies in improving college outcomes for underrepresented minority and indigenous student in STEM. The challenge then falls to local educational systems to address areas of improvement in a leaky STEM pipeline. The specific context for the motivation of this study is the goal of improving college outcomes for Native Hawaiian STEM majors at the University of Hawaii at Manoa.

The purpose of this study was to investigate two outcomes of interest — self-efficacy beliefs and intentions to persist — for Native Hawaiian and non-Hawaiian STEM majors at the University of Hawaii at Manoa. These two outcomes were chosen because of their influence on choice goals, motivation, and actual persistence (Bandura, 1997; Lent, 2013; Cabrera et al., 1992; Bean, 1980). It was important to study Native Hawaiians because they have historically been an underserved group in post-secondary education and, as the indigenous people of Hawaii, are the subject of commitment for improved educational attainment and participation at the University of Hawaii, the only provider of public higher education in Hawaii (UoHBR, 2012). It was also important to study non-Hawaiian STEM majors in order to provide a reference group to understand differences from Native Hawaiian STEM majors, and in order derive meaningful recommendations for all students and STEM programs.

This single-institution, cross-sectional study gathered survey data from 638 undergraduate STEM majors (17% response rate of all STEM majors at UHM) on measures of pre-college, college environment, and outcome variables. Using the framework of Lent's (2013) Social Cognitive Career Theory and Astin's (1999) Inputs – Environment – Outcomes model, descriptive, multiple regression, logistics regression, and MANOVA techniques were used to answer this study's three research questions:

1. What are the personal input and environmental factors associated with STEM self-efficacy beliefs of undergraduate STEM students?
2. What are the personal input and environmental factors associated with intent to persist in STEM of undergraduate STEM students?
3. How do these factors and outcomes differ, if at all, amongst Native Hawaiian and non-Hawaiian students?

Discussion of Findings

The major results of the study (presented in Table 39) are organized into seven overall findings, three addressing STEM self-efficacy, two addressing intent to persist, and two addressing differences for Native Hawaiian students. First, STEM self-efficacy beliefs increased with higher sense of belonging to major but decreased with higher sense of belonging to campus community. Second, STEM self-efficacy increased with positive past performance including higher College GPA and higher educational level. Third, environmental factors of family support, program participation, and engineering college were found to increase STEM self-efficacy. Fourth, higher STEM self-efficacy explained higher intent to persist. Fifth, higher education level predicted higher intent to persist. Sixth, Native Hawaiians were found to report higher levels relative to non-Hawaiians of commitment to completing their STEM major at UH Manoa as shown by intent to persist and family support. Finally, Native Hawaiian STEM majors exhibited higher levels of peer interaction and program involvement. Discussion of these seven findings are presented by research question.

Research Question 1 Findings: Predictors of STEM Self-Efficacy

The complete set of background input, academic classification, and college environment variables was found to be significant in predicting STEM self-efficacy explaining 42.2% of total variance ($F(25, 315) = 9.20$, $p < .001$). The study found seven significant predictors for STEM self-efficacy out of the set of 28 tested. Sense of belonging to major was found to be the strongest significant predictor ($\beta = .268$), followed by College GPA (.267), family support (.186), sense of belonging to campus community (-.151), College: Engineering (.132), educational level (.129), and program participation (.126). Many IVs unexpectedly did not reach statistical significance.

The results in response to question one highlight three major findings. First, STEM self-efficacy beliefs increased with higher sense of belonging to major but decreased with higher sense of belonging to campus community. Second, STEM self-efficacy increased with positive past performance including higher College GPA and higher educational level. Third, environmental factors of family support, program participation, and engineering college were found to increase STEM self-efficacy.

The first finding is that for UHM students' sense of belonging to major was found to be the strongest predictor for STEM self-efficacy ($\beta = .268$, $p < .001$) while sense of belonging to campus community ($\beta = -.151$, $p = .008$) was the only significant negative predictor found. Existing research supports the positive relationship between sense of belonging to major to self-efficacy but the indirect relationship between sense of belonging to campus community to self-efficacy was unusual.

Possible interpretation of these results are that students with high STEM self-efficacy have a stronger identity in STEM (relating to their major peers, faculty, and academic study), but do not connect, frequently interact, of feel a part of the non-STEM or overall community. They may be expressing their perception of a STEM and non-STEM cultural division found at many large public universities. Or highly effacious students could be expressing a disappointment in the level of or longing to get involved in general campus community activities, school spirit, and extracurricular activities outside of their major. When surveyed if students think they can be successful in their STEM major without giving up their participation in outside interests almost half did not agree. Similarly, the interpretation is that students with low STEM self-efficacy do not strongly connect with their STEM major community and have a stronger sense of being a part of the general campus community. Cole and Espinoza (2008) suggest active campus involvement outside of STEM can have negative effects on the persistence of URM students within STEM majors due to a conflict between the values within their STEM major and the respective disciplines of their peers.

The findings reinforce the notion that different senses of belonging exist for students and they can relate to outcomes in different ways. Descriptive data showed that this sample reported sense of belonging to major highest, slightly lower on sense of belonging to school (which did not reach statistical significance in the regression analysis), and lowest on belonging to campus community. The implication for researchers is that different senses of belonging exist for students and unique analysis can provide clearer detail on the dynamics of college effects. The findings support Hurtado and Carter's (1997) assessment that sense of belonging is an important but under studied variable.

Second, STEM self-efficacy increased with positive past performance including higher College GPA and higher educational level. College GPA was found to be the second strongest ($\beta = .267$, $p < .001$) predictor of STEM self-efficacy. Positive association with College GPA and self-efficacy were consistent with the research (Bandura, 1977; Lent, 2013; Pajares, 1996) as self-efficacy beliefs are, for most people, based on the interpreted result of one's own past performance. Those with higher GPAs reported higher self-abilities in completing their STEM degree. Moreso, those with lower GPAs who may need to most help, may exhibit behaviors associated with lower self-efficacy beliefs such as reduced effort and commitment to future tasks such as seeking tutorial support and studying and preparation for coursework.

Educational level was found to be the sixth strongest factor in predicting student beliefs about their ability to complete a STEM degree at their current institution. The results indicate that student's level of STEM self-efficacy increase as they progress from first-year to second-year and so on. This is consistent with the theoretical research (Bandura, 1997; Lent, 2013) suggesting an increase in self-efficacy beliefs from mastery experiences or prior, personal success at a similar task. The assumption here is that students at higher education levels, have had some prior personal success, and have persisted onto the next educational level. Empirical research on academic level and Mathematics self-efficacy (Jordan, Sorby, & Amato-Henderson, 2012) also found consistent results.

Finally, environment factors of family support, program participation, and engineering college were found to increase STEM self-efficacy. Classification in Engineering was found significant in the regression model (whereas Tropical Agriculture, Ocean & Earth Sciences, and reference college Natural Sciences did not reach statistically significant findings). The results indicate that Engineering students ($\beta = .132$) show higher levels of STEM self-efficacy than reference college Natural Sciences. The researcher did not have an initial hypothesis in testing College associations with the outcomes variable, though the finding for Engineering was unexpected. The National Center for Education Statistics (U.S. Government Accountability Office, 2012) indicate a lower degree completion rates (in any STEM degree) and a higher rate of leaving college without earning a degree for students entering engineering/engineering technologies and computer sciences compared to students who entered physical sciences, natural sciences, and biological/agricultural sciences. In other words, the national data show persistence in engineering to be lower relative to other STEM fields. In this study at UH Manoa, respondents in were found to be have higher levels of self-beliefs about completing their engineering degree relative to other STEM fields.

Family support ($\beta = .186$, $p < .001$) was found to be another environmental predictor for STEM self-efficacy. This finding supported the literature that found lack of family support to be a barrier to success in STEM, whereas ongoing encouragement from parents positively influenced self-efficacy (Sandler, 1999; Swail & Perna, 2002). Bandura (1977, 1997) identifies social persuasion as a key source of self-efficacy beliefs, especially when feedback comes from influential others. Family approval and encouragement to continue was found to be the third strongest factor in explaining STEM self-efficacy beliefs after sense of belonging to major and GPA.

Participation in at least one academic/student support program was found to explain higher levels of STEM self-efficacy. Of the study sample, 217 students (34%) identified participation in one or more programs, the most frequent being the UHM Honors Program (105), the Native Hawaiian Science & Engineering Mentorship Program (82), and the American Indian Science & Engineering Society (42). It is noted that this study listed primarily minority support programs in the survey (with the option of selecting "other" and an open response category) because an interest was in investigating college effects especially for Native Hawaiian STEM students. The positive relationship between program participation and STEM self-efficacy was consistent with the theoretical research, such as Astin's theory of student involvement, and empirical review (Clewell et al., 2006; Leggon & Pearson, 2009). This result demonstrated consistency between the positive influence of Native Hawaiian-serving programs and minority support programs.

Research Question 2 Findings: Predictors of Intent to Persist

Research on self-efficacy is often examined in concert with outcome expectations, interest, or choice goals to connect the beliefs of what one can do with what one will do. In research question two, this study investigated the same conceptual model of background input, academic classification, and college environment variables with the addition of independent variable STEM self-efficacy to predict intent to persist. The full logistic regression model containing all predictors was statistically significant, $\chi^2(26, N = 341) = 61.24, p < .001$, indicating that the model was able to distinguish between respondents who reported and did not report an intent to persist. The model as a whole explained between 16.4% (Cox & Snell R Square) and 44.4% (Nagelkerke R Square) of the variance in intent to persist status and correctly classified 95.6% of cases.

There were two major findings in response to research question two. First, increased STEM self-efficacy and higher education levels explained higher intent to persist. Second, higher education levels explained higher commitment to degree completion. These findings are discussed in order of predictive strength.

Consistent with the research literature, this study found STEM self-efficacy significant ($p = .002$) in explaining Intent to Persist. The interpretation is that students that report high self-beliefs in their ability to complete their STEM degree at the institution also report intent to do so. If they think that they can do it, then they are more likely to pursue it. Conversely, students with low self-efficacy are less likely to attempt to engage in future task related activity and are less likely to expend as much energy. This confirms the literature (Lent, 2013; Pajares, 1996; Zimmerman, 2000) arguing the importance of self-efficacy as a central construct in mediating choice goal, motivation, and behavior outcomes.

Educational level was the only other factor found significant ($p = .005$) in the model. An odds ratio of 2.46 implies that students at higher levels are much more likely to have positive intent to complete their STEM major at the institution. Sophomores are about 2.5 times more likely than freshmen and Juniors are about 6 times more likely than freshmen to be found in the intent to persist group. It is noted that this result is derived from cross-sectional data where the sample of upperclassmen are past persisters as opposed to longitudinal data that tracks all students, including stop-outs and leavers, as they increase in educational level.

Educational level was found to be significant in predicting both STEM self-efficacy and intent to persist. Although this study makes no claims regarding causality, the “chicken-or-egg” (which came first?) question is relevant in trying to better understand the dynamics of increased educational level (indicating successful year to year persistence), STEM self-efficacy, and intent to persist. Do students have a higher commitment to continue on to graduation because they have made it to a certain educational level, or have they made it this far because they have a higher commitment to continue on to graduation? Do students have a higher commitment to graduation because they think they have the ability to do it or has their level of commitment influenced their choice activities, past performance (such as year to year persistence), and their perceptions of their abilities? Due to the reciprocal nature of human motivation and behavior, researchers (Pajares, 1996; Bandura, 1997) believe such questions are unlikely to be resolved.

Research Question 3 Findings: Differences by Native Hawaiian Ethnicity

There were two major findings in response to research questions three. First, Native Hawaiians were found to report higher levels relative to non-Hawaiians of commitment to completing their STEM major at UH Manoa as shown by intent to persist and family support. Second, Native Hawaiian STEM majors exhibited higher levels of peer interaction and program involvement.

This study found Native Hawaiians to report high levels of commitment and family support to complete their STEM degree at the institution. First, Native Hawaiians reported higher agreement than non-Hawaiians on the query ‘I intend to complete a STEM degree at UH Manoa.’ This variable was found statistically significant when analyzed independently by ANOVA ($p = .001$) and when analyzed collectively by MANOVA ($p = .033$), however the effect size (partial $eta^2 = .013$) was small.

The intent to persist result sheds new light on the beliefs of Native Hawaiian students. Because of the scarcity of literature investigating beliefs of Native Hawaiian students on college outcomes relative to other ethnicities, the researcher did not have a hypothesis on the potential findings. However, studies have shown that Hawaiians students face higher barriers than majority students on measures of pre-college achievement, high school graduation, college enrollment, and financial ability (KSP, 2009; Hokoana, 2010; Oliveira, 2005). By Lent’s conceptual model, a lower intent to persist finding for Native Hawaiians than non-Hawaiians would be expected.

In addition, family support, specifically a student's feeling that their family approves of their attending the institution and encourages them to continue attending, was found to be a statistically significant difference by ANOVA ($p = .001$) and approached significance by MANOVA ($F = 3.742$, $p = .054$). Although the relative effect was found to be small (partial $eta^2 = .011$), Native Hawaiians reported higher levels than non-Hawaiians to both items.

This result was, in part, supported by literature finding resilience, as enabled by parental support, particularly important for minority and indigenous students who may possess less social and cultural capital than others (Speck & Keahiola-Karasuda, 2011). Much of the literature on Native Hawaiians identify the importance of building the learning process inclusive of home, family, and broader community (Benham, 2006) and in situating learning in connection with family members (Kawakami, 1999).

Much of the conceptual literature focused on the influence of family support on academic outcomes, however it was unclear as to how family support varied by ethnicity and for Hawaiians in particular. Family responsibilities, job responsibilities, and lack of financial ability were identified by college administrators (PPRC, 2010) as prevalent obstacles for minority students and it has been shown that these factors are high among the Native Hawaiian population (Hagedorn & Tibbetts, 2003). Therefore, it was unexpected and encouraging to find sense of family encouragement higher for Native Hawaiians than their non-Hawaiian counterparts. Despite individual and family barriers that have been found to disadvantage Native Hawaiian students, this study found higher commitment to completing a STEM degree and support from family among Native Hawaiians relative to non-Hawaiians.

The second major finding in response to differences between Native Hawaiian and non-Hawaiian STEM students was higher levels of program involvement and peer interaction. Native

Hawaiians were found to be twice as likely (67.9% to 26.9%) to participate in at least one program than non-Hawaiians (χ^2 (1, n=637) = 67.76, $p < 0.001$). It is encouraging to recognize that two out of three Native Hawaiian STEM students participate in some form of STEM support program.

Measures of peer interaction (satisfaction with interaction with peers (p = .027), frequency of peer interaction outside of class (p = .047), studying with other students (p = .049), getting feedback from classmates (p = .043)) were found significantly higher for Native Hawaiians. The statistical claim on this finding is not as high (found significant by ANOVA, but not by MANOVA) as others discussed, but presented for discussion and future investigation. These findings are supported by the literature on Native Hawaiians as social-cultural learners that make meaning out of the relevance to community.

In addition, Native Hawaiians were found significantly different than non-Hawaiians in that their STEM majors were more male (56% to 42%), more likely to be found in engineering (43% to 32%), and less likely to be found in natural sciences (36% to 51%). These differences were found for the study sample and could be further explored using total enrollment data available to verify if the differences found in the sample are true to differences found in the population. This initial findings leads to further questions including, do Native Hawaiians enroll in and pursue STEM fields differently than non-Hawaiians? Are Native Hawaiian females less likely than non-Hawaiian females to pursue STEM fields? and if so, why?

Limitations

There are a number of limitations to this single-institution, quantitative study. Creswell (2008) defines a limitation as a design weakness that could potentially reduce the study's scope and validity. Limitations regarding external validity, internal validity, and bias were identified.

First, the sample was found to differ from the total UHM STEM population by way of higher representations of females and Hawaiians. It should be noted that the results of this study reflect a larger voice from females (1.4X) and Native Hawaiians (1.5X) and threatens the external validity of generalizing findings for the intended (UHM STEM) population. The sample was derived from a single, public four-year institution primarily serving residents of the state of Hawaii and was limited to Bachelor's degree seeking students in academic disciplines of Natural Science, Ocean & Earth Sciences, Engineering, and Tropical Agriculture. Therefore, this study is not claimed to be generalized to out-of-state institutions that may serve different student demographics or for non-stem or community college populations.

Second, limitations regarding the internal validity of the research should be noted. The data was collected via a close-ended, self-report questionnaire. The researcher had to rely on the assumption of truthful and honest responses, which may threaten the internal validity. While honest self-report data had the advantage of gathering respondents' perceptions of themselves and their environment, the data may not be accurate to "reality" or as seen by others. Additional assumptions were made that the respondents understood the questions and interpreted the close-ended response categories in the same way. Due to the complex, reciprocal nature of human behavior, motivation, and environmental effects, in this study no claims of causality are made.

Finally, limitations regarding bias affected this study. Bias describes systematic and unknown error in results or inferences (Creswell, 2008). The study employed close-ended survey responses and quantitative design and analysis in attempt to minimize bias although it is acknowledged that completely eliminating bias is unlikely or even impossible. Efforts were made to reduce the effects of researcher bias, given that the researcher is employed at the institution in the capacity of Minority Engineering Program coordinator and NHSEMP director.

In efforts to stem influence on potential study participants, the researcher took sabbatical leave over the semester that data collection took place and had little to no contact via email, phone, course instruction, or face-to-face interaction with potential participants.

Response bias, if students reported higher or lower measures consciously or subconsciously based on their expectations of the study, are a limitation. Overrepresentation of Native Hawaiians in the sample may have been a result of awareness of the researcher or it may be the case that more Native Hawaiians were drawn to the study given that the title identified Native Hawaiian students as a particular group of interest. Different levels of participation among Native Hawaiians and non-Hawaiians could influence the results such as if the Native Hawaiian sample included more students that normally would not complete the survey or if Native Hawaiians exhibited a more pronounced response bias. The study attempted to minimize bias, where possible, by research design and approach.

Ho'okahua Conceptual Framework

Based on the major findings of this study, a conceptual framework is proposed to inform policy, practice, and research discussions in Native Hawaiian education, especially in regard to NH STEM post-secondary education. The ho'okahua, or foundation building, framework is modeled after Native Hawaiian construction of dry-stacking volcanic rock to form walls retaining soil platforms as kahua or foundations. The traditional foundations provided space for residential, religious, agricultural, and recreational purposes. Likewise, the proposed ho'okahua framework provides a method to support future activities, practices, and action items.

Educational initiatives or action items should be based on sound theory or data. Likewise, dry-stacking volcanic rock upon each other without mortar or joints requires different pieces to fit and for each successive stone to rest by gravity on at least three points of contact.

The analogy follows that the recommendations are built on three overarching findings of the study. First, STEM self-efficacy leads to intention and motivation to persist in STEM. Second, student self-beliefs about their abilities in STEM are derived from their sense of belonging in STEM. Third, Native Hawaiian STEM students engage in high levels of involvement and interaction with family, peers, and STEM programs. Figure 2 displays the Ho'okahua framework.

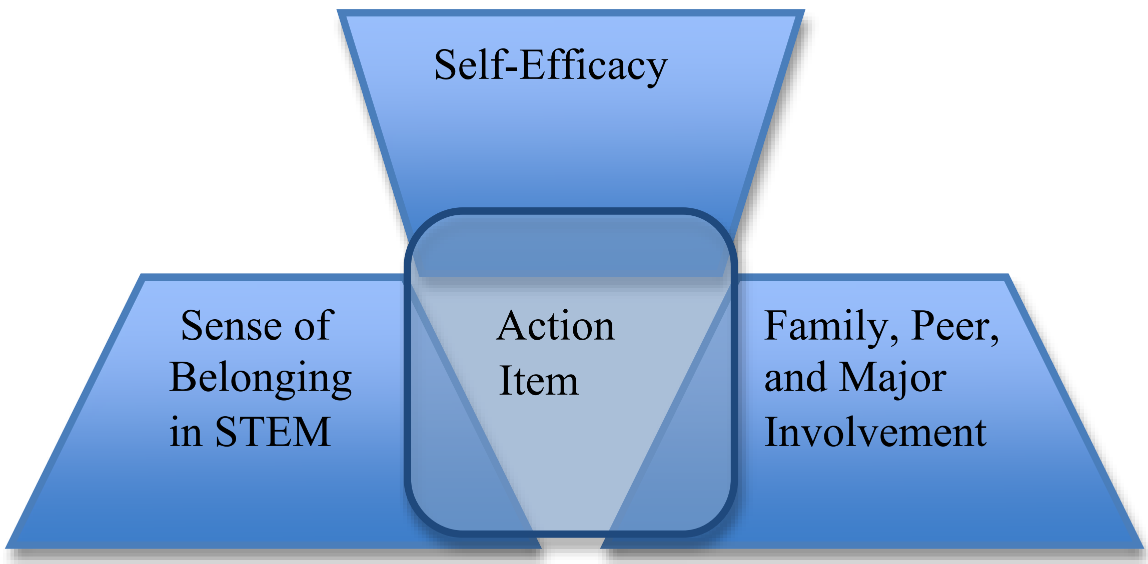

Figure 2. Ho'okahua conceptual framework

Action items at the center of the Ho'okahua model are akin to a stone placed on the second level of the wall. The three points of contact proposed for each successive stone selected are the three overarching ideas derived from this study describing key beliefs and behaviors of Native Hawaiian STEM undergraduate majors. This framework guides the successive recommendations for practice and future research.

Implications for Practice

The findings provide insight for four implications for practice. As the specific motivation of this study was the goal of improving college outcomes for Native Hawaiian STEM majors, the recommendations will focus on implications for the University of Hawaii with potential for transferability to other settings to be determined by the reader. The four recommendations relate to academic community, first-year learning communities, Native Hawaiian STEM programs, and decentralized advising and student support.

Academic Community

The first implication is that the institution and STEM departments should strive to build academic communities for students. Although GPA was a close second, the strongest determinant of a student's self-perceived ability to complete their degree was if they felt a part of their major. More so, sense of belonging to major was the strongest determinant for STEM major self-efficacy, which in turn was the strongest determinant for decision to persist at the institution in their STEM major. This was found true for both Native Hawaiian and non-Hawaiian students.

Academic community is built around relationships and communication between students, a supportive peer network, faculty, staff, and academic themes or goals. Good, Rattan, and Dweck (2012) describe sense of belonging in an academic domain as viewing oneself as being inside a discipline rather than on the fringes of it and a sense of being valued and accepted by fellow members of the discipline. Although early research on sense of belonging focused on campus climate (Hurtado & Carter, 1997) and social integration to the institution (Tinto, 1993), this study argues that academic community at the major or department level is most important for undergraduate STEM students. The overall recommendation is to promote student involvement in the major. This recommendation follows the ho'okahua framework considering the impact of self-efficacy, sense of belonging, and involvement.

First Year Learning Communities

Specific academic community should be encouraged at the first-year, academic major level. Co-registration or block scheduling that enables students to take courses together can change the way students experience the curriculum, their sense of belonging to a major, common theme, and academic community. Tinto (2003) identifies three things that all variations of learning communities have in common: shared knowledge; shared knowing; and shared responsibility. This is particularly important for first-year students given this study's findings that the first year students are likely to have the lowest levels of STEM self-efficacy and lowest levels of intentions to persist. More so, existing curricula are structured such that many STEM students have limited or no courses or contact with their STEM major in their first year.

The recommendation is for the institution to offer and encourage first-year students to participate in structured learning communities including designated learning communities for Native Hawaiian, high-risk students, and advanced students. The UHM College Opportunities Program (COP), a state-funded program that serves primarily Native Hawaiian, Filipino, first-generation, and other students with low admissions credentials but high potential, co-enrolls cohorts of students the summer prior to freshmen year and requires students to meet with staff and program mentors to during throughout their freshmen year. The federally funded Native Hawaiian Science & Engineering Mentorship Program (NHSEMP) requires co-enrollment (in Math, Chemistry, Hawaiian Studies, and Introduction to Engineering) for their first-year Native Hawaiian engineering students. Both programs have reported successful outcomes related to student involvement and in-major persistence. Bridge programs, learning communities, and first year student services support are recommended strategies for improving Native Hawaiian STEM outcomes.

Native Hawaiian STEM Programs

The University can improve college outcomes by supporting and implementing Native Hawaiian STEM programs. Program participation was found to be significant in higher STEM self-efficacy (which in turn predicted higher persistence) and significantly higher among Native Hawaiians. The programs that support undergraduate research, such as the Honors Program, NHSEMP, C-MORE Scholars Program, and Undergraduate research and mentoring, promote faculty interaction and provide students an important view of their academic discipline beyond a provider of classroom instruction. Ethnic enclaves in STEM higher education were found to be important for URM students to find support within unknown or chilly climates (Cole & Espinoza, 2008; Hurtado & Carter, 1997). Ortiz and Santos (2009) found ethnic membership identity (sense of worth derived from one's ability to contribute to the ethnic group) significantly correlated to college efficacy, social efficacy, academic efficacy, and self-esteem.

Native Hawaiian programs should place particular emphasis on the social-cultural aspects of learning given the finding that Native Hawaiian STEM students display higher levels of interaction with their peers and in promoting behavior that encourages sense of belonging to their academic discipline. This can be achieved through mentoring programs (by faculty, upperclassmen, or role models), collaborative learning experiences such as projects or research, and in clarifying the values of the discipline and its connection to the Native Hawaiian and broader community.

At UHM, Native Hawaiian underrepresentation persists in all STEM colleges but has particular opportunity for improvement in Natural Sciences where Native Hawaiians in this study were found to be lower enrolled. As Engineering was found to be a positive indicator of STEM self-efficacy and higher enrolled among Native Hawaiians, there may be an emerging critical mass. SOEST, which relative to the other STEM colleges, has a low overall undergraduate enrollment are challenged to grow a Native Hawaiian community of peers with low numbers of students.

Decentralized Advising, Student Support, and STEM Curriculum

The recommendation, for increasing self-beliefs of ability, involvement, and sense of belonging, is for each STEM college or department to provide regular or mandatory advising and student services for their majors and pre-majors. In addition, staff and faculty should receive the training and support necessary to be effective in developing a connection with students. Hovland et al. (1997) argues the best way to keep students stimulated, challenged, and progressing toward a meaningful goal is through informed academic advising.

Student services support, via Native Hawaiian programs or other, at the college or departmental level can also enhance the student's network and sense of community in their STEM major. Enrollment management tools can be used to better facilitate communication with between majors and departments for purposes such as advising, scheduling tutors or other interventions, tracking, and two-way communication. For example, enrollment management software utilized at the UHM Athletics department allows for regular email, text messaging, and group conversation between advisors, faculty, tutors, and scholar athletes that changes the style and frequency of communication, involvement, and engagement at the University.

Additional conversation regarding common STEM curriculum is recommended. This study choose to investigate intent to persist and self-efficacy on a general STEM level such that for a student that start as a mathematics major but changes to physics major were considered a persisting STEM student. Some researchers (Ohland, Sheppard, Lichtenstein, Eris, Chachra, & Layton, 2008) argue that institutional retention rates in STEM majors can be improved by better aligning student migration between like majors. For example, Ohland et al. (2008) found that engineering majors persisted at or above the same rate as all other majors studied, but the field suffered from the lowest rate of inward migration. Common STEM curriculum between like majors could benefit the overall persistence of undergraduate students in the STEM pathways.

Future Research

There exists a limited number of studies focusing on Native Hawaiians in post-secondary education and less so in STEM education. Future research is needed to provide a better understanding of the dynamics of Native Hawaiian education and outcomes. Based on the findings and limitations of this study, future research is proposed in varying research design, non-Hawaii students, pre-college Native Hawaiian STEM education, interaction effects, community college STEM pathways, Native Hawaiian identity in STEM, and post-baccalaureate transition and training. The importance of self-efficacy, sense of belonging, and involvement has been derived from NH undergraduate STEM students, but further research is needed to evaluate the applicability of the ho’okahua framework for other populations.

Interaction Effects and Assessment of Findings

College behaviors, beliefs, and school outcomes operate in an interdependent, complex manner. Future research can explore interaction effects or structure variables to investigate a range of important and interesting questions. For example, what factors best contribute to STEM self-efficacy for females in engineering, physics, and computer sciences? How do the dynamics of behaviors, attitudes, and outcomes for Native Hawaiians differ for Engineering, Ocean and

Earth Science, Natural Science, and Tropical Agriculture majors? What input or environmental factors explain sense of belonging?

Three results of this study in particular warrant further investigation: a higher amount of family support among Native Hawaiians; program participation; and sense of belonging. Are these findings consistent with Native Hawaiians in non-STEM majors? If Native Hawaiian families show higher approval and encouragement of student's post-secondary goals and completion, then how can educational institutions utilize this information? How does sense of belonging to campus community interact with sense of belonging to major? These questions, for example, offer potential for intriguing research.

Qualitative, Mixed-Method, and Longitudinal Design

This study chose to approach the research topic from a quantitative method. Future qualitative or mixed-method research is needed to provide more vivid description and understanding of the issues facing Native Hawaiians in STEM. For example, family support and program participation were found significant in increasing STEM self-efficacy and higher for Native Hawaiians. Qualitative study could further investigate how Native Hawaiian students experience these factors.

In addition, longitudinal research that tracks individuals or cohorts can provide a valuable perspective and understanding of changes over time. How and why do internal (motivation, satisfaction, self-efficacy) and external (peer/faculty interaction, involvement) factors change as a student experiences college? Educational level was found significant in this cross-sectional study and assumptions had to be made to interpret past and future events as well as comparison between students at different educational levels. Longitudinal research has the opportunity to provide more conclusive results by investigating the same students or cohorts over time and utilizing data from confirmed events such as actual persistence and actual leavers.

Native Hawaiian Education in the Continental U.S.

To better inform Native Hawaiian education, further research is needed investigating Native Hawaiian education in the continental U.S. The majority (88.7%) of Native Hawaiian college and graduate students in the state of Hawaii attend the University of Hawaii (KSP, 2005). Therefore, the University of Hawaii is a logical setting to research Native Hawaiian college outcomes for a large percentage of the Native Hawaiian college-going population. However, many Native Hawaiian residents chose to attend post-secondary institutions out of state. In addition, the 2010 U.S. Census data show that 45% of the domestic Native Hawaiian population resides in Alaska or the continental U.S. Studies that can capture findings for this understudied group will address a void in the research.

There are challenges for researchers in Native Hawaiian education. Many post-secondary institutions on the continental U.S. do not have enough Native Hawaiian STEM student enrollments to provide adequate sample sizes to make powerful statistical claims. Studies that focus on the experience of URM students in general may not easily transfer to indigenous or Native Hawaiian students. It is important, however, that Native Hawaiian education and policy be informed by the best data available.

The Pre-College STEM Pipeline

Research focusing on existing Native Hawaiian college students is similar to fishing with a broken throw net. Even with improved technique, only a fraction of the potential outcomes can be realized. Improvements to Native Hawaiian education at the pre-college level especially within math and science education are foundational to improve the quantity and quality of Native Hawaiian college-going students.

This study offers some potential direction for research at the pre-college level. Peer interaction, family support, and intent to persist were found to significantly higher for Native Hawaiians than their non-Hawaiian counterparts. Do these findings translate into elementary or secondary settings? How can these findings inform potential STEM majors?

The key elements of the ho'okahua framework related to self-efficacy, sense of belonging, and involvement can be vetted at the pre-college level. Outside of the scope of this study are critical questions needed to address the shortage of Native Hawaiians (and others) in the STEM pipeline. What influences the motivations of pre-college Native Hawaiian students to pursue STEM? What influences STEM self-efficacy at the Pre-college levels?

Community College Pathways

Although this study focused on students enrolled the University of Hawaii's four-year campus, a large and growing percentage of the Native Hawaiians college-going population are found at the University of Hawaii community college system. Many Native Hawaiians earn certificates and associates degrees at the community colleges that prepare them for technology jobs and many begin at the community colleges, earn pre-STEM college credits, transfer, and graduate with a bachelors degree in STEM. Future research can test or extend this study's findings with the community college and/or transfer student population to better understand the matriculation and persistence of the community college to workforce and community college to BS degree pathways.

Native Hawaiian Congruence

Cultural congruence of Native Hawaiian identity in STEM is certainly an exciting area of research (Kanaʻiaupuni, Ledward, & Keohokalole, 2012). The premise is that education is a cultural process. When educational institutions are rooted in a cultural worldview in which mainstream Western values, knowledge, and practices are the norm, then non-Western and indigenous students are disadvantaged and educational disparities may result. Native Hawaiian identity and cultural congruence were not investigated in this study though it is likely to be associated with key factors of the ho'okahua framework such as sense of belonging, self-efficacy, and family and peer interaction. Future research on Native Hawaiian cultural congruence at all levels (early childhood, math and science primary and secondary education, higher education, and informal education) may provide insight into teaching, learning, and outcomes.

Post-Baccalaureate Transition and Preparation

Completing a STEM major does not, by itself, lead to persistence into the STEM workforce. Similarly, STEM education and STEM employment does not always lead to innovation or economic benefit as is desired to increase the nation's competitiveness. Future research can address questions such as what factors lead to STEM employment? Why do STEM graduates pursue certain career and life trajectories such as teaching, graduate education, industry, entrepreneurship, or non-STEM careers? What skills, knowledge, and preparation do STEM graduates need for these trajectories and how well are educational institutions aligned with providing them? What is the role of industry, non-profit sector, and informal education in meeting the needs of the STEM workforce? These questions relate the broader problem to address national competitiveness and workforce outcomes that extend beyond the scope of this study.

Conclusion

The National Research Council (2007, 2010) argues that if U.S. educational institutions improved the recruitment, retention and success rates of minority students in STEM, then the country would be better equipped to innovate, compete, and problem solve. Beyond international competitiveness, many of the world's current and future challenges such as energy dependence, climate change, and scarcity of natural resources will require STEM solutions. To address these global issues on a local scale, the educational system plays a leading role in developing the talent of all students. Indeed, educators are as vital to future opportunity as the scientist or the engineer.

This study attempted to address the broad challenge of America's 'quiet crisis' by examining college outcomes for Native Hawaiian and non-Hawaiian STEM majors at the University of Hawaii at Manoa. Significant predictors of STEM self-efficacy and intent to persist were found for all students and the significant differences between Native Hawaiian and non-Hawaiian students were presented. The ho'okahua framework presents the key concepts of the findings of STEM self-efficacy, sense of belonging, and involvement. It is hoped that this study makes some contribution to the literature supporting educational policy, practice, and future research especially in regard to Native Hawaiian education. The additional translations of ho'okahua refer to the community and values that are needed to build a firm foundation as well as a degree of commitment to settle down to a task with determination to see it through (Pukui & Elbert, 1986). Native Hawaiians come from a system of beliefs, values, and traditions that demonstrate excellence in science, engineering, and education and can no longer be underserved or underperform. The charge to educators and the kuleana (responsibility) to Native Hawaiians are to effect a positive change in the readiness, self-efficacy, and achievement of Native Hawaiians in the STEM pathways.

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APPENDIX A

UH HUMAN STUDIES PROGRAM APPROVAL

Office of Research Compliance
Human Studies Program

UNIVERSITY of HAWAI'I
MĀNOA

January 9, 2014

TO: Joshua Kaakua
Principal Investigator
College of Engineering

FROM: Denise A. Lin-DeShetler, MPH, MA
Director

SUBJECT: CHS #21810- "Self-Efficacy and Intentions to Persist of Native Hawaiian and Non-Hawaiian Science, Technology, Engineering, and Mathematics Majors"

This letter is your record of the Human Studies Program approval of this study as exempt.

On January 9, 2014, the University of Hawai'i (UH) Human Studies Program approved this study as exempt from federal regulations pertaining to the protection of human research participants. The authority for the exemption applicable to your study is documented in the Code of Federal Regulations at 45CFR 46.101(b)(Exempt Category 2).

Exempt studies are subject to the ethical principles articulated in The Belmont Report, found at http://www.hawaii.edu/irb/html/manual/appendices/A/belmont.html.

Exempt studies do not require regular continuing review by the Human Studies Program. However, if you propose to modify your study, you must receive approval from the Human Studies Program prior to implementing any changes. You can submit your proposed changes via email at uhirb@hawaii.edu. (The subject line should read: Exempt Study Modification,) The Human Studies Program may review the exempt status at that time and request an application for approval as non-exempt research.

In order to protect the confidentiality of research participants, we encourage you to destroy private information which can be linked to the identities of individuals as soon as it is reasonable to do so. Signed consent forms, as applicable to your study, should be maintained for at least the duration of your project.

This approval does not expire. However, please notify the Human Studies Program when your study is complete. Upon notification, we will close our files pertaining to your study.

If you have any questions relating to the protection of human research participants, please contact the Human Studies Program at 956-5007 or uhirb@hawaii.edu. We wish you success in carrying out your research project.

1960 East-West Road
Biomedical Sciences Building B104
Honolulu, Hawai'i 96822
Telephone: (808) 956-5007
Fax: (808) 956-8683

APPENDIX B

INFORMED CONSENT AND SURVEY INSTRUMENT

Introduction and Informed Consent

University of Southern California
Consent to Participate in Research

Self-Efficacy and Intentions to Persist of Native Hawaiian and Non-Hawaiian Science, Technology, Engineering, and Mathematics Majors

Introduction

The purpose of this study is to assess how students feel about completing a STEM degree at UH Manoa. You are invited to participate in a research study conducted by graduate student Joshua Kaakua and faculty advisor Darnell Cole of the University of Southern California. You are eligible to participate in this project because you are at least 18 years old and enrolled as a student at UH Manoa in a STEM college/school. Your participation is voluntary. You should read the information below, and ask questions about anything you do not understand, before deciding whether to participate.

Your relationship with USC or UH will not be affected, whether or not you participate in this study.

Procedures

If you decide to take part in this study, you will be asked to fill out an online survey. The survey questions are mainly multiple choice. However, there will be a few questions where you may add an open-ended response. You do not have to answer any questions that you don't want to, click "prefer not to answer" to move to the next question. Completing the survey will take approximately 10-15 minutes.

Benefits

There are no direct benefits for participants. However, the findings from this study may help create a better understanding of the wishes and needs of current and future UH Manoa STEM students.

Risks

There are no anticipated risks for participants.

Confidentiality and Privacy

All data obtained from participants will be kept confidential and will only be reported in an aggregate format (by reporting only combined results and never reporting individual ones). The data collected will be stored in the HIPPA-compliant, Qualtrics-secure database until it has been deleted by the primary investigator. The responses will be kept in a locked office for the duration of the study. All information will be destroyed upon completion of the research study anticipated in July 2014. Several public agencies with responsibility for research oversight, including the University of Hawaii

Human Studies Program (UH HSP) and the University of Southern California's Human Subjects Protection Program (USC HSPP), may access the data. The HSPP reviews and monitors research studies to protect the rights and welfare of research subjects.

Questions

If you have any questions or concerns about this study, please feel free to contact the research team: Joshua Kaakua at (808) 956-2289, jkaakua@hawaii.edu or Dr. Darnell Cole at (213) 821-4363, darnellc@usc.edu. If you have questions about your rights as a research participant in general or if you want to talk to someone independent of the research team, please contact the UH Human Studies Program at (808) 956-5007 or uhirb@hawaii.edu or the USC University Park Institutional Review Board (UPIRB), 3720 South Flower Street #301, Los Angeles, CA 90089-0702, (213) 821-5272 or upirb@usc.edu.

Voluntary Participation

You can freely choose to take part or to not take part in this survey. There will be no penalty or loss of benefits for either decision. If you do agree to participate, you can stop at any time.

- ◯ Yes, I would like to continue onto the survey.
- ◯ No, I do not want to participate.

Block 1

Which academic College/School are you enrolled in?

- ◯ UHM College of Engineering
- ◯ UHM College of Natural Sciences
- ◯ UHM College of Tropical Agriculture and Human Resources (CTAHR)
- ◯ UHM School of Ocean and Earth Science & Technology (SOEST)
- ◯ Other: ____________
- ◯ I prefer not to answer

What is your current major?

College of Engineering

- ◯ Civil & Environmental Engineering
- ◯ Computer Engineering
- ◯ Electrical Engineering
- ◯ Mechanical Engineering
- ◯

- Pre-Engineering

College of Natural Sciences

- Biology
- Biochemistry
- Botany
- Chemistry
- Computer Science
- Ethnobotany
- Information & Computer Sciences
- Marine Biology
- Mathematics
- Microbiology
- Molecular Cell Biology
- Physics
- Zoology

CTAHR

- Animal Sciences
- Biological Engineering
- Food Science & Human Nutrition
- Molecular Biosciences and Biotechnology
- NREM
- Plant & Environmental Biotechnology
- Plant and Environmental Protection Sciences
- Tropical Plant and Soil Sciences

SOEST

- Geology and Geophysics
- Geology (BA)
- Global Environmental Science
- Meteorology

Other

- Environmental Studies
- Interdisciplinary Studies
- Pre-Medicine
- Pre-Physical Therapy
- Other

- I prefer not to answer

What is your current academic standing?

- Freshmen
- Sophomore
- Junior
- Senior
- 5th year Senior
- Alumni
- *I prefer not to answer*

Where were you immediately before starting at this institution?

- High School
- Two-year college
- Four-year college
- Vocational/Technical school
- Military
- Working a full-time job
- Other
- *I prefer not to answer*

When you first entered this institution, were you: (Mark one)

- First-time college student
- Returning or non-traditional college student
- Transfer student from a two-year college
- Transfer student from a four-year college
- *I prefer not to answer*

Sense of Belonging

Please indicate your agreement or disagreement with the following statements:

	Disagree Strongly	Disagree	Agree	Agree Strongly	*I prefer not to answer*
"I enjoy going to school here"	○	○	○	○	○
"I feel like I really belong at this school"	○	○	○	○	○
"I wish I had gone to a different school"	○	○	○	○	○
"I feel accepted in my major"	○	○	○	○	○
"I feel comfortable in my major"	○	○	○	○	○
"I feel that I am a part of my major"	○	○	○	○	○
"I see myself as a part of the campus community"	○	○	○	○	○
"I feel that I am a member of the campus community"	○	○	○	○	○
"I feel a sense of belonging to the campus community"	○	○	○	○	○

fac-student interaction

How often do you interact with your instructors (faculty, teaching assistants) e.g. by phone, email, in person, or other)?

	Not at all	Occasionally	Frequently	*I prefer not to answer*
Instructors during class	○	○	○	○
Instructors during office hours	○	○	○	○
Instructors outside of class or office hours	○	○	○	○

How often do you receive the following from your instructors?

	Not at all	Occasionally	Frequently	*I prefer not to answer*
Encouragement for graduate school	○	○	○	○
Opportunity to work on a research project	○	○	○	○
Advice about educational program	○	○	○	○
Respect	○	○	○	○
Emotional support/development	○	○	○	○
Letter of recommendation	○	○	○	○
Intellectual challenge and stimulation	○	○	○	○

Opportunity to discuss coursework outside of class	◯	◯	◯	◯
Help in achieving professional goals	◯	◯	◯	◯

How often do you do the following activities?

	Not at all	Occasionally	Frequently	*I prefer not to answer*
Studied with other students	◯	◯	◯	◯
Tutored another college student	◯	◯	◯	◯
Worked on a group project	◯	◯	◯	◯
Worked cooperatively with other students on course assignments	◯	◯	◯	◯
Discussed ideas with classmates (individuals or groups)	◯	◯	◯	◯
Got feedback on my work and ideas from classmates	◯	◯	◯	◯
Interacted with classmates outside of class	◯	◯	◯	◯

family approval, satisfaction, programs, GPA

Rate your agreement to the following statements:

	Disagree strongly	Disagree	Agree	Agree Strongly	*I prefer not the answer*
"My family approves of my attending this university"	◯	◯	◯	◯	◯
"My family encourages me to continue attending this university"	◯	◯	◯	◯	◯

Rate your satisfaction with this institution on each aspect of campus life listed below:

	Dissatisfied	Neutral	Satisfied	Very Satisfied	*I prefer not to answer*
Quality of instruction	◯	◯	◯	◯	◯
Amount of contact with faculty	◯	◯	◯	◯	◯

Interaction with peers	○	○	○	○	○
Academic advising and student support	○	○	○	○	○
STEM Major	○	○	○	○	○
Overall quality of your collegiate experience so far	○	○	○	○	○

The following is a list of academic and/or academic preparation programs. Check all the activities that you have participated in:

- ☐ None
- ☐ C-MORE Scholars Program
- ☐ Hui Manawa Kupono Native Hawaiian Scholarship Program
- ☐ Kuaana Native Hawaiian Student Services
- ☐ MARC
- ☐ Na Pua No'eau
- ☐ NHSEMP
- ☐ PIPES
- ☐ Undergraduate Research and Mentoring (URM) in the Biological Sciences
- ☐ UH Manoa Honors Program
- ☐ SACNAS
- ☐ AISES
- ☐ Other: __________
- ☐ *I prefer not to answer*

What is your approximate cumulative grade point average?

- ○ A or A+ (i.e. 3.9 or above on a 4.0 scale)
- ○ A- (3.5 - 3.8)
- ○ B+ (3.2 - 3.4)
- ○ B (2.9 - 3.1)
- ○ B- (2.5 - 2.8)
- ○ C+ (2.2 - 2.4)
- ○ C (1.9 - 2.1)
- ○ C- (1.5 - 1.8)
- ○ D+ or lower (less than 1.4)

I prefer not to answer

STEM self-efficacy / Intent to persist

Rate your agreement to the following statements:

	Disagree Strongly	Disagree	Agree	Agree Strongly	*I prefer not to answer*/ Not applicable
I intend to complete a STEM degree at UH Manoa	○	○	○	○	○
I can succeed in my STEM major curriculum	○	○	○	○	○
I can succeed in my STEM major curriculum while NOT having to give up participation in my outside interests (e.g. extracurricular activities, family, sports, etc.)	○	○	○	○	○
I can complete the math requirements for my STEM major	○	○	○	○	○
I can complete the science requirements for my STEM major	○	○	○	○	○
I can excel in my current STEM major this semester	○	○	○	○	○
I can persist in my STEM major during the next academic year	○	○	○	○	○
I can complete my STEM major at this institution	○	○	○	○	○
I feel confident in my ability to complete a STEM degree at UH Manoa	○	○	○	○	○

Demographics

Ethnicity (select one or more):

- ☐ American Indian or Alaskan Native

Asian

- ☐ Chinese
- ☐ Filipino
- ☐ Asian Indian
- ☐ Japanese
- ☐

Korean

- Laotian
- Other Asian
- Thai
- Vietnamese
- Black or African America
- Caucasian or White

Native Hawaiian or Pacific Islander

- Guamanian or Chamorro
- Native Hawaiian or part-Hawaiian
- Micronesian
- Samoan
- Tongan
- Other Pacific Islander
- Other
- *I prefer not to answer*

Were any of your ancestors Hawaiian?

- Yes
- No
- *I prefer not to answer*

Gender:

- Male
- Female
- *I prefer not to answer*

Would you describe your family as: (mark one)

- High income
- Upper-middle income
-

- Middle income
- Lower-middle income
- Low income
- *I prefer not to answer*

What was the highest level of education completed by your Mother?

- Less than high school
- Graduated from high school
- Attended college but did not complete degree
- Completed an Associate degree (AA, AS, etc.)
- Completed a Bachelor degree (BA, BS, etc.)
- Completed a Master degree (MA, MS, etc.)
- Completed a Professional or Doctoral degree (JD, MD, PhD, etc.)
- Unsure or not applicable
- *I prefer not to answer*

What was the highest level of education completed by your Father?

- Less than high school
- Graduated from high school
- Attended college but did not complete degree
- Completed an Associate degree (AA, AS, etc.)
- Completed a Bachelor degree (BA, BS, etc.)
- Completed a Master degree (MA, MS, etc.)
- Completed a Professional or Doctoral degree (JD, MD, PhD, etc.)
- Unsure or not applicable
- *I prefer not to answer*

Do you have any concerns about your ability to finance your college education?

- None (I am confident that I will have sufficient funds)

- Some (I probably will have sufficient funds)
- Major (I have funds but will graduate with significant debt)
- Extreme (Not sure if I will have sufficient funds to complete college)
- *I prefer not to answer*

What was your approximate high school grade point average?

- A or A+ (i.e. 3.9 or above on a 4.0 scale)
- A- (3.5 - 3.8)
- B+ (3.2 - 3.4)
- B (2.9 - 3.1)
- B- (2.5 - 2.8)
- C+ (2.2 - 2.4)
- C (1.9 - 2.1)
- C- (1.5 - 1.8)
- D+ or lower (less than 1.4)
- *I prefer not to answer*

Debrief

Is there anything you want to tell us about your experiences in college that we haven't already asked about?

Would you like a summary of this study's results when they become available?

- No, I do not want a summary of the study's results
- Yes, please send me a summary of the study's results to this email address (optional):
- *I prefer not to answer*

Mahalo. Thank you for completing this survey! Your time and input are greatly appreciated.

APPENDIX C

UNIVERSITY OF HAWAII AT MANOA STEM MAJORS

College of Engineering
Civil & Environmental Engineering
Computer Engineering
Electrical Engineering
Mechanical Engineering
Pre-Engineering

College of Natural Sciences
Biology
Biochemistry
Botany
Chemistry
Computer Science
Ethnobotany
Information & Computer Sciences
Marine Biology
Mathematics
Microbiology
Molecular Cell Biology
Physics
Zoology

College of Tropical Agriculture & Human Resources (CTAHR)
Animal Sciences
Biological Engineering
Food Science & Human Nutrition
Molecular Biosciences and Biotechnology
Natural Resources and Environmental Management
Plant & Environmental Biotechnology
Plant and Environmental Protection Sciences
Tropical Plant and Soil Sciences

School of Ocean and Earth Science & Technology (SOEST)
Geology and Geophysics
Geology (BA)
Global Environmental Science
Meteorology

APPENDIX D

DESCRIPTIVE STATISTICS BY MAJOR, LEVEL, AND PRE-INSTITUTION STATUS

Table 40

Sample and Population by STEM Academic Major

	Sample (N=638)		Population (N=3592)	
Major	Frequency	%	Frequency	%
Biology	111	17.4	741	20.6
Civil & Environmental Engineering	71	11.1	298	8.3
Mechanical Engineering	69	10.8	309	8.6
Electrical Engineering	43	4.7	219	6.1
Marine Biology	35	5.5	286	8.0
Computer Science	24	3.8	216	6.0
Animal Science	24	3.8	122	3.4
Food Sciences & Nutrition	24	3.8	110	3.1
Microbiology	23	3.6	85	2.4
Chemistry	19	3.0	97	2.7
Mathematics	19	3.0	77	2.1
GES	18	2.8	49	1.4
Pre-Engineering	17	2.7	252	7.0
ICS	16	2.5	126	3.5
Biochemistry	13	2.0	52	1.4
Molecular Cell Biology	13	2.0	59	1.6
Physics	13	2.0	54	1.5
NREM	13	2.0	73	2.1
Zoology	11	1.7	58	1.6
Computer Engineering	9	1.4	76	2.1
Other	9	1.4	0	0
Biological Engineering	6	.9	41	1.1
Meteorology	6	.9	23	.6
PEPS	5	.8	21	.6

Table 40, continued

	Sample (N=638)		Population (N=3592)	
Major	Frequency	%	Frequency	%
Geology & Geophysics	5	.8	35	1.0
Plant & Environmental Biotechnology	4	.6	18	.5
TPSS	4	.6	42	1.2
Pre-Medicine	4	.6	0	0
Botany	3	.5	25	.7
Ethnobotany	3	.5	20	.6
Molecular Biosciences & Biotechnology	2	.3	0	0
Geology	0	0	8	.2
Prefer not to answer	2	.3	0	0.0
Total	638	100.0	3592	100.0

Note. Students enrolled in one or more academic majors (double majors) were classified into their primary major for this study. GES = Global Environmental Sciences; ICS = Information & Computer Sciences; NREM = Natural Resources & Environmental Management; PEPS = Plant and Environmental Protection Sciences; TPSS = Tropical Plant and Soil Sciences.

Table 41

Frequency Counts by Educational Level and Pre-Institution Status (N = 638)

Variable	Category	*n*	%
Educational Level			
	Freshmen	93	14.6
	Sophomore	113	17.7
	Junior	194	30.4
	Senior	134	21.0
	5th year Senior	87	13.6
	Prefer not to answer	17	2.6
Incoming Student Status			
	First-time college student	395	61.9
	Returning or non-traditional	36	5.6
	Transfer: 4-year college	62	9.7
	Transfer: 2-year college	141	22.1
	Prefer not to answer	4	0.6
Prior Institution			
	High School	390	61.1
	2-year college	141	22.1
	4-year college	57	8.9
	Full-time employment	32	5.0
	Military	4	.6
	Vocational or technical school	2	.3
	Other	6	.9
	Prefer not to answer	6	.9