FACTORS THAT CONTRIBUTE TO SUCCESS IN A FIRST YEAR ENGINEERING SUMMER BRIDGE PROGRAM

By

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To my family, and all engineering educators

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LIST OF ABBREVIATIONS

AAU	The Association of American Universities is a nonprofit association of 59 U.S. and two Canadian preeminent public and private research universities.
AP	Represents advance placement college-level courses and exams, taught to high school students where they can earn college credit.
ASEE	The American Society for Engineering Education is committed to furthering education in engineering and engineering technology.
DE	Dual Enrollment involves students being enrolled in two separate, academically related institutions such as a high school and a college or university.
EDW	Engineering Data Warehouse is a storage center for multiple data that are stored for authorized access.
ETS	Educational Testing Service serves as the administrator of the yearly advance placement examinations.
IB	The International Baccalaureate is a two-year educational program for students aged 16–18 that provides an internationally accepted qualification for entry into higher education, and is recognized by universities worldwide.
NSF	The National Science Foundation is an independent U.S. government agency responsible for promoting science and engineering through research programs and education
SES	Socio-economic status is an economic and sociological combined total measure of a person's work experience and of an individual's or family’s economic and social position relative to others, based on income, education, and occupation.
STEM	Commonly used to represent the Science, Technology, Engineering, & Mathematics fields of study.
STEPUP	The Successful Transition through Enhanced Preparation for Undergraduates Program is an engineering summer bridge program focused on promoting academic excellence for underrepresented groups.
SUCCEED	The Southeastern University and College Coalition for Engineering Education is a multi-million dollar National Science Foundation program geared toward revitalizing undergraduate education.

Abstract of Dissertation Presented to the Graduate School
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This study explored the factors that contributed to the success of a first year engineering summer bridge program designed for all incoming engineering freshman at a southeastern large land-grant research university over the 2007-2010 years. A secondary data source from the College of Engineering's Data Warehouse was used to examine the effects of the engineering summer bridge program. Additionally, characteristics of participants of the engineering summer bridge program were compared with non-participants to investigate if any similarities existed. Moreover, predictors of retention between the participants and non-participants were explored. This study attempted to determine if there were relationships between this intervention and an increase on retention by utilizing predictive and descriptive statistics to explain the phenomena between the two groups.

Participation in the summer bridge program was voluntary with 415 students completing the program over the four year period (2007-2010). This data was compared with 3751 non-participants. Utilizing various quantitative methods including logistic regression, results indicated that the engineering summer bridge program was successful in retaining students at a higher rate than the non-participants. Additionally,

the students who decided to participate and completed the engineering summer bridge program were significantly different that the non-participants high school grade point average and SAT quantitative scores.

CHAPTER 1
INTRODUCTION

In the coming years, the engineering profession and engineering education are unlikely to produce enough engineers in the United States. The U.S. Bureau of Labor Statistics has projected a need for 12,200 more engineering positions over the 10-year period between 2008-2018. This 6.7% increase does not include the replacement of many retiring engineers. The number of engineering bachelor degrees awarded in the U.S is also contributing to this problem. According to the 2010 American Society of Engineering Education (ASEE) Profiles of Engineering and Engineering Technology Colleges, undergraduate engineering enrollment grew by 5.3% from 427,503 to 450,685 (during 2010 which is a notable improvement from the 1% growth from 2005-2009 (Gibbons, 2010). However, weakening interest in studying engineering among graduating high school students also continues. Furthermore, of the students entering U.S. universities as engineering majors and completing degree requirements, approximately only half matriculate (Wulf & Fisher, 2002; Frotenberry, Sullivan, Jordan, & Knight, 2007).

A recent report from the Institute for Higher Education Leadership & Policy and The Education Trust describes the United States becoming less globally competitive as our college completion rates stager (Offerstein, Moore, & Shulock, 2010) Currently, underrepresented populations continue to complete college at low rates however to regain our global competitiveness educational attainment must be a national goal. The College Board Advocacy and Policy Center recommends that the U.S. raise the number of 25-35 year olds with an associate in arts degrees or higher degree to 55% by the year 2025 so the U.S. can regain is dominance in educational attainment (Lee & Rawls,

2010). Previous reports support these initiatives, stating the workforce in the United States and the rest of the world will have demands for a more educated workforce with postsecondary skills and credentials (U.S. Department of Education, 2006; Kirsch, Braun, Yamamoto, & Sum, 2007). Demographic changes in the world economy and the United States suggests that an older, more diverse and a significant population of immigrants will make up our workforce. Further, a majority of the fastest growing jobs in the new information and service economy will require some postsecondary education (U.S. Department of Education, 2006). The Department of Labor projects that by 2018 there will be close to four million new job openings combined in health care, education, and computer and mathematical sciences. Compounding this issue is the completion rate for underrepresented and nontraditional students who continue to make up an increasing portion of those who attend colleges and universities. The nation will begin to rely on these students as major source of new employees as the demographic shifts in the population continues (Offerstein, Moore, & Shulock, 2010).

Raising degree production in the engineering disciplines is necessary to sustain and increase our competitiveness in the global market. Universities have played an essential role in producing talented and highly trained engineers. In 2010, the United States universities graduated approximately 79,000 new bachelor's level engineers (Gibbons, M. T., 2010). If U.S. universities continue to remain constant in degree production, as it has in the past 20 years, the U.S. will under produce bachelor level engineers (National Science Board, 2006). Retaining and graduating all students who are interested in the engineering field is essential to meeting the workforce needs.

Retention rates of undergraduates in engineering remain at 56% nationally (Frontenberry, Sullivan, Jordan, & Knight, 2007). Since studies have concluded that there is no difference in academic status between students staying in engineering and students that choose to leave for other majors (Besterfield-Sacre, Atman, & Shuman, 1997), the high student attrition rates cannot be attributed to lack of academic ability. Methods to combat this current situation are needed to improve the engineering retention rates and provide the nation with more engineers.

Loss of students majoring in engineering affects institutions in two primary areas: revenue and loss of human potential represented by student dropouts (Lenning, Beal, & Sauer, 1980; Pascrella & Terenzini, 1991; Tinto, 1993). This issue has been studied extensively and several initiatives have been launched to address the problem (Astin, 1993; Noel, Levitz, & Saluri, 1991; Seidman, 2005; Tinto, 1993). For example, engineering colleges and employers have partnered with universities to develop programs aimed at improving the diversity and retention of historically underrepresented students in engineering but significantly more work in retaining undergraduate engineering underrepresented students must be done to solve this issue (Lindner, et al., 2009).

Research regarding the loss of undergraduate engineering students has found that retention has not improved over time (Bernold, Spurlin, & Anson, 2007). However, studies do suggest factors surrounding this phenomenon including, among others, inadequate preparation, high school GPA, SAT Math score, misconceptions about the engineering profession, and classroom dynamics. Students who exit higher education voluntarily before receiving their degree usually leave for one of three reasons: (1) a

lack of psychological and social support (Austin, 1999); (2) a lack of institutional fit and campus integration (Swail, Redd, & Perna, 2003); and (3) financial hardships associated with increases in college tuition and fees (Orfield & Paul, 1988). In spite of current research on retaining engineering students and programmatic solutions, attrition remains stable. Evidence supports that pedagogies of engagement such as cooperative learning, problem-based learning, student feedback, and supplemental instruction may enhance student persistence and learning (Seidman, 2005).

Research on engineering undergraduate retention shows that a few programmatic solutions such as the summer bridge programs that focus primarily on underrepresented populations can improve college retention rates (Garcia, 1991). Although summer bridge programs are a common solution to engineering college's retention and diversity issues, there is little empirical evidence assessing their effectiveness (Ackerman, 1991, Gandara & Maxwell-Jolly, 1999, Garcia, 1991 Kluepfel, 1994; Pascarella & Terenzini, 2005, Rita & Bacote, 1997). Most studies offer details on the critical and non-critical factors surrounding retention or models and indicators for retention and lack solutions that can be institutionalized (Heckel, 1996; Besterfield-Sacre, Atman, Shuman 1997; French, Immekus, Oakes 2005; Felder, Forrest, Baker-Ward, Dietz & Mohr 1993). If successful retention solutions can be identified then these solutions could be institutionalized. This study will seek to investigate the factors that contribute to the outcomes of a first year engineering summer bridge program offered to all students entering engineering, to determine if it improves their retention rate.

Purpose of the Study

The purpose of this study was to explore the factors that contributed to the outcomes of a first year engineering summer bridge program designed for all incoming

engineering freshman at a southeastern large land-grant research university over the 2007-2010 years. Additionally, characteristics of participants of this summer bridge program were compared with non-participants to investigate if any similarities existed. Moreover, predictors of retention between the participants and non-participants were determined. This study will demonstrate if there is relationship between this intervention and an increase on retention by utilizing predictive and descriptive statistics to explain the phenomena between the two groups.

This study will focus on a summer bridge program that is offered to all incoming engineering students, not only underrepresented groups. This model includes review style sessions similar to supplemental instruction in a collaborative learning environment of quantitative gateway courses coupled with an engineering design course and a peer mentoring component. This summer bridge model incorporates processes to enhance student learning through the use of technology-based delivery systems (e.g. multimedia, electronic delivery, electronic advising and mentoring). One goal of the program is to help students become better acclimated to the rigor of the engineering curriculum before they begin their first semester. Findings from this study could be used to redesign or guide the development of a summer bridge program that benefits undergraduate engineering students.

Research Questions

By addressing issues that have been neglected in previous literature, this study aims to expand the knowledge base of information regarding summer bridge programs. Further, this study also aims to evaluate several factors that may prove to assist the summer bridge programs become successful in retaining students. Accordingly, the following research questions guide the focus of this empirical study:

1. What is the relationship between the students who completed the summer bridge program performance and their engineering peers who do not enroll in the summer bridge program in Calculus 1 and Chemistry 1 when compared by final course grades and withdrawal rates?

2. How did engineering summer bridge program participants and non-participants compare on high school GPA, SAT Quantitative scores, first year college GPA, and gender?

3. What is the relationship between engineering summer bridge program participants and non-participants, SAT Quantitative scores, first semester grades in calculus and high school GPA on retention?

These research questions will be studied using quantitative research methods. This study utilized a quasi-experimental retrospective research design using a secondary data source. The quasi-experimental design utilizing a static-group comparison will be employed because the two treatment groups were not randomly assigned. Additionally, this study utilized predictive and descriptive statistics to explain the phenomena between the two groups.

Research Hypotheses

The following research hypotheses were developed with the previous research questions in mind. These null hypotheses are all tested at the α .05 level and correspond with each research question respectively. Each hypothesis will be tested, analyzed and discussed in subsequent chapters.

1. **H_0:** No relationship exists between summer bridge participants and non-participants in calculus course grades and withdrawal rates at the α .05 level.

2. **H_0:** Summer bridge program participants have equivalent high school GPA, SAT Quantitative scores, first year college GPA and gender ratios when compared to non-participants at the α .05 level.

3. **H_0:** No relationship will exist between summer bridge participants and non-participants on SAT Quantitative scores, first semester grades in calculus and high school GPA on retention at the α .05 level.

Definition of Terms

The following alphabetized list contains definitions pertinent to this study.

- ATTRITION. Students who fail to reenroll at an institution in consecutive semesters, including summer semesters.
- DISMISSAL. A student who is not permitted by the institution to continue enrollment.
- DROPOUT. A student whose initial educational goal was to complete as least a bachelor's degree but did not obtain that goal.
- ENGINEERING DESIGN. The process of devising a system, component, or process to meet desired needs (Oakes, et al., 2000).
- ENGINEERING DESIGN COURSE. Course content designed to teach fundamentals of engineering design.
- PERSISTANCE. The desire and action of a student to stay within the system of higher education from beginning year through degree completion.
- RETENTION. The ability of an institution to retain a student from admission to the university through graduation.
- SUMMER BRIDGE PROGRAM. Program designed to expose and help newly admitted college students to make the transition to college level coursework and campus resources in the summer before they start their college careers (Kezar, 2000).
- WITHDRAWAL. The departure of a student from a college or university campus.

Limitations

There were several noteworthy limitations to this study concerning the structure. Using data from multiple academic years (2007-2010) made available through the Engineering Data Warehouse (EDW), this study specifically examined the retention and academic success of first year engineering students that completed an engineering summer bridge program. Data were used to measure student performance for students who complete the summer bridge program retention versus students who did not participate in an engineering summer bridge program

through first year college GPA, high school GPA, SAT Quantitative scores, retention, calculus and chemistry course grades and withdrawal rates. As with any study that conducts a secondary data analysis, this particular dataset has its own limitations. This study and its analyses relied exclusively on data collected by one institution and errors in data collection and extraction by EDW are very likely. These potential errors may have resulted in erroneous results and or findings.

Additionally, the sample of this study was limited to a southeastern large, land grant research university. Data were analyzed for this designated institution over a four year period. This reduces the generalizability of the findings to similar type and size institutions that have a college of engineering.

Further, the timing of data collected, with respect to retention could be premature. The retention points for this study consisted of the beginning matriculation date at the beginning of the second part of the summer session and ended at the end of their first spring semester, after spring grades were posted. It is realistic to consider students who performed poorly may have waited until after summer to change their major or that a student who left after the first semester may work over summer to correct some poor grades and reenroll in engineering.

Significance of the Study

Previous research has been conducted on summer bridge program models that focus on underrepresented populations including female students. One study found that, “innovations designed to help female students and underrepresented students of color actually benefitted all students and aligned the engineering undergraduate experience much closer to the ideals described in Education the Engineering of 2020” (Davis & Finelli, 2007). Other studies have found educators should increase their

emphasis on early success to beginning engineering students (Gilmer, 2007). Scholars have called for research on summer bridge programs but researchers have not adequately investigated the programs and their effects (Walpole, Simmerman, Mack, Mills, Scales, & Albano, 2008). This study will attempt to bridge this gap.

This present study makes a contribution for further practice, research and policy in higher education by providing a resource for first year engineering student success. The results will be useful for administrators and directors of engineering summer bridge programs, policymakers at the institutional, state and federal levels. Additionally, this study will have significance due to the broad nature of this summer bridge program model in that it is offered to all first year engineering students. If it can be determined that the outcomes of the calculus and chemistry primer courses within an engineering summer bridge program positively affects first attempt final grades versus non-participants and those grades were predictors of retention in engineering, then this would provide evidence that an engineering summer bridge programs possesses the ability to prepare first year engineering students in calculus and chemistry and can be used to predict student retention. This model could then be replicated at similar type size and type engineering schools to see if the findings are comparable.

This study will assist in guiding future research in examining summer bridge programs. The current study examines the factors that contribute to success in a first year engineering summer bridge program designed for all incoming engineering students over four years, 2007-2010. Other methods could be explored to provide a richer evidence based data on summer bridge programs to allow practitioners more studies to draw from to develop in improve their particular summer bridge program.

Lastly, with these findings legislatures and administrators will become more informed on the outcomes of summer bridge programs and will be more likely to make data driven decisions regarding supporting colleges and universities. In particular, administrators such as deans who have financial resources and oversight responsibilities over student success, i.e. retention rates and graduation rates, will be better equipped to make knowledgeable assessments of summer bridge programs in terms of funding support, personal support, and recruitment and retention strategies.

At the state and federal level, governing bodies could use the results of this study to help pre-college students make informed decisions about entering and persisting in a large research engineering program. For example, the results could be disseminated to all public state high schools. Further, the governing bodies could use this study to assist in identifying the gaps in secondary education (K-12) chemistry and mathematics to improve curriculum development and instruction.

CHAPTER 2
REVIEW OF LITERATURE

This chapter begins with a review of the relevant literature surrounding summer bridge programs. Beginning with an overview of the development of summer bridge programs, discussed are the strategies that support successful summer bridge programs, including peer mentoring, living learning communities, commitment to career and educational goals, tutoring, faculty interaction and academic advising. Following these are components that challenge the success of summer bridge programs including gateway courses, engineering curriculum, financial needs and family issues are discussed. Lastly, the engineering studies and programs that have previously been designed and engineering summer bridge programs are discussed to explore previous methods of educational initiatives to support engineering education.

The review of the literature provided in this chapter was organized with two primary purposes in mind. First, to discover the issues surrounding summer bridge programs including when and why they were developed. Secondly, to explore the literature for significant factors that foster and challenge student success in summer bridge programs and how they are utilized in engineering education.

Summer Bridge Programs

The increase in African-American students attending institutions of higher education coincides with the Civil Rights Movement of the 1960s, a turbulent decade for U.S. public colleges and universities (Noel, Levitz, Saluri et al., 1985). This was a turning point decade for the entrance of African-Americans in institutions of higher education, facilitated in part by the passage of important pieces of legislation. The Civil Rights Act of 1964, for example, was a landmark act that outlawed discrimination in

public and private facilities based on race, color, religion, sex, national origin. This act had huge implications for colleges and universities that received federal funds because it mandated equal admission practices. This act facilitated the acceptance, at least on paper, of more African-Americans in higher education (Kaplin & Lee, 1997; Levin & Levin, 1991; Robert& Thomson, 1994; Swail, Redd, & Perna, 2003).

For the first time, institutions were forced to openly address equal opportunity for underrepresented students or disadvantaged groups. During the 1970s, the retention of African-American students, generally less academically prepared than White students, became a major issue. Therefore, early retention programs were created to avoid dropout and increase persistence by meeting the changing demands and needs of students to provide a staying environment for all students. Early programs sought to provide review style classes in basic mathematics, science and English courses along with peer mentoring from successful students.

One of the main strategies of many engineering institutions was to implement summer bridge programs for underrepresented minorities and women in Science, Technology, Engineering and Mathematics, (STEM) disciplines. These programs sought to provide a more inclusive workforce that draws on all available talent, and provide equal opportunity for minorities and women who traditionally have been excluded from STEM areas. These programs sought to provide entering freshman, within these minorities, with peer study groups, strong study habits, time management skills, analytic problem-solving capacity and the willingness to use available department and university resources (Maton, Harbowski III, & Schmitt, 2000). Simply, this strategy was aimed at combating the high attrition and dropout rates of the large quantitative gateway courses

that are part of a system within the STEM disciplines that limits access to degrees by "weeding out" those whose academic abilities are allegedly not equal to the challenge (Massey, 1992, Seymour & Hewitt, 1997).

Through the development of these summer bridge programs, students who have participated in summer bridge programs have found numerous positive benefits. These students have higher academic achievement and higher self-efficacy than similar students who were not involved in such programs (Strayhorn, 2011). Studies also report students who participated in bridge programs also persist in school longer and have higher college completion rates than similarly prepared non-participants. Furthermore, participants in bridge programs have an increased sense of control, increased confidence, and increased self-esteem, important factors related to meeting the social and academic challenges of the first year (Ackermann, 1991). Additionally, students who participate in bridge programs also have closer contact with other students and faculty during their first year and complete more core courses than non-program students (Ackermann, 1991). Moreover, students develop leadership ability, have more extensive involvement in the campus community, and are more likely to use tutoring and counseling during the academic year than their non-bridge peers (Fitts, 1989). Some concern about the lack of empirical evidence to support the efficacy of summer bridge programs improving GPA and achievement test scores, however there is substantial research in support for the effect of summer bridge programs on retention. (Ackermann, 1991, Balz & Esten, 1998, Buck, 1985, Garcia, 1991, Logan & Spence, 2000, McElryo & Armesto, 1998, Suhr, 1980, Valeri-Gold & Stone, 1992).

Given the success of the engineering summer bridge programs on retention, the poor engineering retention rate of freshman and scholars' call for more research on bridge programs, this study seeks to expand the current summer bridge program to all entering freshman regardless of gender, race, or socio-economic status. This program will run simultaneously along side the underrepresented minority based summer-bridge program and utilize a similar model of delivery.

Components That Foster Student Success in Summer Bridge Programs

The following section describes the strategies that support successful summer bridge programs including peer mentoring, living learning communities, commitment to career and educational goals, tutoring, faculty interaction and academic advising. These components are rooted in previous literature and provide support for inclusion in any summer bridge program. However, this list is not comprehensive as more research is has been called for on the components of summer bridge programs.

Peer Mentoring

Mentoring has been defined as "an intensive, one to one form of teaching in which the wise and experienced mentor inducts the aspiring protégé into a particular, usually professional, way of life" (Parkay, 1988). This definition fits well with this summer bridge program where relationships were encouraged between freshmen and upper-class students. Peer mentoring has gained popularity as an intervention over thirty years ago and continues to be a strategy to increase retention among women, minorities, first generation college students and at-risk students (Terrion, J.L.; Leonard, D. 2007). Because it appears to be a vital approach to providing role models and leadership within higher education, it has been adopted in university settings as a means to assist entering freshman students as they transition into the university

environment. For example, to improve retention the use of peer mentoring assists to develop social support networks among new students (Brawer, 1996). Additionally, the impact of mentoring on numerous outcome variables ranging from retention and graduation rates to comfort with the educational environment has been widely studied in recent years. Overall, findings have been positive and have indicated a positive relationship or an impact of mentoring on student persistence and/or grade point average of undergraduate students (Campbell and Campbell 1997; Freeman 1999; Kahveci et al. 2006;Mangold et al. 2003; Pagan and Edwards-Wilson 2003; Ross-Thomas and Bryant 1994;Salinitri 2005; Sorrentino 2007; Wallace et al. 2000).

Due to the past success of peer mentoring and its commonly wide use to improve retention it is important that it be included within this summer bridge program. This solution will provide academic and social support that has been theorized to retain students. Additionally, peer mentoring will provide each student with a model that exemplifies a pathway to success. This is particularly important to engineering students given the rigor and the rigidity of the curriculum.

Living Learning Communities

Living learning community programs have been introduced at postsecondary institutions across the United States to bridge the academic experiences with co-curricular experiences, to integrate learning across the curriculum. Prior research on living learning community programs indicate many positive outcomes such as increased persistence, stronger academic achievement, more faculty interaction, gains in student autonomy and personal independence, intellectual dispositions and orientations (Inkelas, Vogt, Longerbeam, Owen, & Johnson, 2006). Other studies reported significant positive student outcomes that also support student persistence. Some of the

outcomes included students in living learning programs are significantly more likely than students in traditional housing to be more involved on campus activities, show greater gains in or higher levels of intellectual development, use campus resources and seek assistance from peers, faculty and staff (Inkelas, 1999; Pike, 1999); experience a smoother transition to college and report their residence hall communities academically and socially supportive (Inkelas, 1999; Scholnick,1996).

Commitment to Career and Educational Goals

Commitment to the engineering curriculum is one of several essential factors for success in persistence in engineering (Burtner, 2004). Students beginning their engineering education who already are committed to the field should possess a higher motivation for persisting through to graduation. For example, in one study researchers found that students who had a high impression of engineering and liked engineering as a career path had higher freshman retention rates (Besterfield-Sacre, 1997). In another study, it was proven that there is a higher probability of a student graduating in engineering if their peers are also engineering majors (Astin & Astin, 1992). Through participating in an engineering summer bridge program students such as this one students are provided the opportunity to work through their level of commitment and discern whether engineering is appropriate for them or not.

Tutoring

Another method that is utilized to increase or support retention is tutoring, either by professional tutors or peers tutors. In nearly 94% of federal funded student support services grants awarded, tutoring was a strong part of the programs and close to 84% used peer-tutoring (Cahalan, Muraskin & Goodwin, 1994). Some studies indicate that tutoring and mentoring programs which encourage positive socially interactive

experiences, help address the problem of retention by increasing intentions and commitments both to degree completion and to the institution (Tinto, 1987). Previous studies also indicate that some peer tutoring experiences, which improved attitudes about subject matter and about college education involve peer tutoring programs (Cohen, Kulik, & Kulik 1982).One such study, went on to state that tutoring programs were observed to drastically increase mathematics achievements scores among tutees (Robinson, Schofield, & Steers-Wentzell, 2005).

Many studies have been conducted to assess the success of tutoring at the K-12 level however not many studies exist for assessing tutoring at the post-secondary level (Naidu, 2006). Some research indicates that tutoring helps students earn higher grades. One study indicated that if students were divided based on academic record into three groups and provided tutoring to half of each group, the students who received tutoring, regardless of academic record, earned significantly higher grades than did their non-tutored counterparts (Maxwell, 1990).

The literature clearly shows that postsecondary retention is problematic. However, while only limited research is available to validate the effectiveness of tutoring, some evidence exists that a support system of tutoring, especially peer tutoring may contribute to persistence and graduation rates of college students.

Faculty Interaction

Engineering faculty members may or may not realize the critical role they play in a student's decision to persist in engineering studies (Vogt, 2008). In one study, high attrition rates of engineering students were attributed to the intimidating nature of the classroom or chilly environment, the dullness of the lecture model, and inadequate faculty guidance (Seymour & Hewitt, 1997). However, when faculty understand the

significance of their student relationships and seriously undertake measures to be come personally available to students, increases in student self-efficacy, effort and critical thinking have been measured (Vogt, 2008).

Further, It has been proven in several higher education studies that one of the key college experiences associated with student development is interacting with faculty (Kim & Sax, 2009). This is further supported by two higher education studies that review student-faculty interaction and its relationship with college outcomes. With-in this review on effects of informal student-faculty interactions on various college student outcomes five categories were developed (Pascarella, 1980). The categories include: career plans and educational aspirations, satisfaction with college, intellectual and personal development, academic achievement and college persistence (Pascarella, 1980). In a more recent study, Pascarella's early findings were reinforced by adding a number of studies from the 1980 through 2000s by also finding including formal and informal student-faculty interaction to demonstrate that the amount and quality of student-faculty interaction positively affect various student outcomes, including subject competence, cognitive skills, and intellectual growth, attitudes and values, educational attainment, and career choice (Kim & Sax, 2009).

As previously stated, participating in a summer bridge program offers the opportuntiy for students to have closer contact with faculty during their first year and complete more core courses that non-program students thus providing further evidence that faculty interactions are key component to student retention.

Academic Advising

Academic advising supports retention of college students in a variety of ways. Most notably, through academic advising students learn to become members of their

higher education community, to think critically about their roles and responsibilities as students, and to prepare to be educated citizens of a democratic society and a global community (NACADA, 2003). Additionally, through advising students develop an educational plan, use information to set goals, assume responsibility for meeting their academic program requirements, cultivate intellectual habits that lead to a lifetime of learning, and act as citizens who engage in the wider world around them (NACADA, 2003).

Empirical studies on advising supporting or effecting retention are limited to only a handful of studies. Noel, Levitz, Saluri and Associates identified themes of attrition and the role of academic advising in retention efforts. The themes included: academic boredom, uncertainty about major and career goals, transition and adjustment difficulties, limited or unrealistic expectations of college, academic under preparedness, institution incompatibility, and course relevance. In a study of minority students on probation, identified eight factors that had implications for advising and retention. The factors included, inappropriate course selection, poor course scheduling, low use of support services, faculty members with limited familiarity with resources available on campus, external factors, inability to anticipate and adjust to the impact of personal life changes, lack a mandatory, comprehensive advising process (Ramirez & Evans 1988). In another study, on a national survey conducted by the American College Testing Program and the National Center for Higher Education Management Systems, noted that “inadequate academic advising” developed as the strongest negative factor in student retention, while “a caring attitude of faculty and staff” and “high quality of advising” emerged among the strongest positive factors (Beal & Noel 1980, p.44-45).

Further, developing a friendship with at least one faculty member along with effective academic and career advising were identified as campus factors associated with persistence (Webb, 1987). Additionally, many other researchers have described improved student retention as a result of better-quality advising.

Academic advising has been described as a corner stone of student retention, when provided effectively, it helps students develop better education and career goals, reinforces the relationship between academic preparation and industry, and contributes to the development of a increased positive attitude and academic performance (Crockett, 1978). This was best put by F. R. Kemerer, “Virtually every study of retention has shown that a well developed advising program is an important retention strategy. Advisors who are knowledgeable, enthusiastic, and like working with students can often make the difference between a potential dropout and a persister” (Kemerer, 1985, p.8).

Components That Challenge Student Success in Summer Bridge Programs

The following section describes the strategies that challenge successful summer bridge programs including gateway courses, engineering curriculum, financial needs, and family issues. These components are rooted in previous literature and provide an outline of challenges that need attention in summer bridge programs. However, this list is not comprehensive as more research is has been called for on the components of summer bridge programs.

Gateway Courses

Students aspiring to become scientists begin their post-secondary education in challenging, sequentially organized, quantitative courses including calculus, chemistry, physics and the like. Students usually take these courses in the first two years of study and then proceed through their chosen curriculum. However, these courses can open

doors or gates to the major specific courses or block admission to them if not completed successfully.

What has become evident over many years is students switch out of majors that require these types of courses in disproportionately high numbers. For example, students who entered into a humanities degree programs remain at a total of 74% within that major, compared with just 56% in science, mathematics and engineering majors (Seymour & Hewitt, 1994). Similar patterns can be found amongst men and women. Approximately 60% of men remain in their selected science, mathematics and engineering majors where only 48% of women remain in science, mathematics and engineering majors (Gainen, J, & Willemsen E. 1995). It has been reported that the crucial experiences affecting students' decision to persist in or switch out of science, mathematics or engineering majors often occurs during the first year of study at the college level, when they must complete required gateway courses (Gainen, J, & Willemsen E. 1995).

The issue that arises out of this problem is students who have chosen science, math or engineering degree program are generally well prepared in mathematics and science (Rawls, 1991). Although success in these type course does not always come easy, evidence exist on factors that influences success in calculus and chemistry which are vital classes in the engineering curriculum. For these courses, previous research suggests that influential factors fall within three categories: demographic background, general education background and previous science learning experiences (Tai, R., Sadler, P, & Loehr, J. 2005). Researchers found that repeating chemistry labs for understanding, high school mathematics grades, course taking patterns, high

standardized test scores, enrollment in AP chemistry or calculus were associated with higher introductory chemistry grades in college (Tai, R., Sadler, P, & Loehr, J. 2005). Similarly, in a study of factors influencing first year students' success in mathematics, self motivation was reported by students and lecturers as being most likely to influence success. Other success factors included quality and availability of support and use of help services (Anthony, G. 2000).

Curriculum Design

Engineering colleges across the U.S. have been criticized for not including enough hands on, practical design courses especially at the freshman level. Thus, students were not sufficiently prepared in teamwork and team approached to problem solving. However, as early as the 1960, engineering educators began to notice the lack of understanding of design by their students. This spawned several studies which recommended the inclusion of an engineering design course back into the curriculum.

Since the late 1980s, there was a push to increase the amount of exposure undergraduate engineering students receive in design. This was particularly true of the freshman year as this year is critical for engineering students. In 1990, the National Science Foundation (NSF) established a small number of major coalitions of U.S. institutions in a multi-year effort to increase the quality of engineering education, develop new approached to deliver engineering education, create significant intellectual exchange and resources linkages among major U.S. engineering institutions (Engineering Education Coalitions, 1990). Other factors that contributed to enhancing the curriculum with a freshman design course included, the engineering industry and the Accrediting Board of Engineering and Technology (ABET). Industries that employed engineers were taking aggressive stands on the needs of industry, the state of current

education and what cooperative roles industry and academia play in making change (McMasters, J.H., Ford, S.D. 1990). ABET developed new guidelines in which the institutions were responsible for articulating the goals of the program, the logic used in the selection of engineering topics to meet goals and identify the major, meaningful design experiences and how they are integrated throughout the curriculum (ABET, 1995).

These new pressures to infuse engineering design developed a myriad of engineering freshman design programs. Today it is widely accepted that engineering design is expected in the freshman year not only to begin the understanding of the engineering design process but to also reduce freshman attrition. For example, at Purdue University Fort Wayne, Introduction to Engineering, Technology and Computer Science, a freshman success course, the main reported objective of the course was to increase retention (Pomalaza-Ráez, C., Groff, B. 2003). Further, at Purdue University in Indianapolis a design-oriented introduction to engineering course was developed to assist in major choice but also to increase retention (Yokomoto, C.F., Rizkalla, M.E., O'Loughlin, C.L., Lamm, N. 1998).

The success that freshman design programs have experienced over the past 15 years have shown that students have a better understanding for the engineering design process and that these courses contributed to increased retention (Pomalaza-Ráez, C., Groff, B. 2003). This provides support in providing a design project for our freshman students who participate in the summer bridge program. Additionally, this course will offer engineering faculty-student contact that has also been shown to improve retention in undergraduate engineering students.

Financial Needs

Today, fewer than four % of Americans can afford to pay the sticker price for four years of college (Levine, 2008). This is especially true for lower and lower-middle income students and their families (Perna & Li, 2006). The issues surrounding the ability to afford college are many and range from a growing income inequality, decline employer provided benefits, increased health care costs, increasing debt, declining personal savings to increasing college tuition, declining value of Pell grants, unmet financial need, increased borrowing among middle-income students etc. (Perna & Li, 2006).

What we know about the general effects of financial aid on college student achievement is that without need-based aid and merit based aid student experience negative effects on college GPA in the first year through the fourth year (Stater, 2009). Additionally, higher GPAs are correlated with higher retention, graduation and performance on standardized test (Stater, 2009). Further, it has been found that potential students from low socioeconomic-status (SES) families are significantly more responsive to the net price of college that those form more affluent families, holding all else equal. Given this, one can conclude that a bigger return per public dollar can be expected for support targeted toward student from low SES backgrounds.

Family Issues

Students leave college for a mix of individual and institutional reasons and included among the many reasons is family demands (Astin, Korn, & Green, 1987; Bean, 1990; Braxton, Hirschy, & McClendon, 2004; Cabrera, Nora, & Casteneda, 1992; Kuh, Kinzie, Buckley, Bridges, & Hayek, 2007; Pascarella, 1980; Peltier, Laden, & Matranga, 1999; Tinto, 1993). One study concluded that one of primary reasons

students leave college is lack of financial aid and holding a part-time job (Koirala, Davis & Cid, 2010). “These students come to college and are viewed as the family member with the most flexible schedule; they are family problem solvers and resources for the family. Because of this situation, they often are drawn off into family needs which in turn become a priority over academics. They also have problems creating boundaries and telling their families they are busy and can’t leave campus. “These students deal first with family issues and place academics issues second” (Koirala, Davis & Cid, 2010). Further, evidence suggest that families from lower socio-economic status tend to plan for one semester of finances and then leave it up to the student to figure out finances past the first semester (Koirala, Davis & Cid, 2010).

To increase the retention and graduation rate of students that have these issues many initiatives have been developed to combat this problem. These practices and policies include designated faculty and staff members who work as “first responders;” a high level of student engagement in campus activities and programs; well-developed first-year programs; efforts to improve instruction in “gate keeping” introductory courses particularly in mathematics; early warning and advising systems; and ample academic and social support services such as advisement and special programs for at-risk populations (Astin & Oseguera, 2005; Carey, 2004; Gansemer-Topf,& Schuh, 2004; The Pell Institute for the Study of Opportunity in Higher Education, n.d., 2004). Still, more work is needed to ensure the success of students with these family issues.

College Preparation

Success in college is related to the degree to which pervious educational and personal experiences have equipped students for the expectation and demands college will place upon them (Conley, 2008). Data has shown that first year student study less,

write less and read less than they thought they would. However, when institutions emphasize certain activities students are more likely to engage in them (Kuh, 2007). An emphasis of this summer bridge program is the development of student mastery of study skills because college courses require significant amounts of time out of class to study. Study skills must encompass active learning strategies that go far beyond reading and homework. Some of the most widely reported study skills include, time management, stress management, task prioritizing, using information resources, taking class notes, and communicating with faculty and advisors (Robbins et.al, 2004). Additionally, some have reported understanding the value of participating successfully in a study group and understanding its value (Conley, 2008).

Another issue regarding student success involves the growth of the Advanced Placement (AP) program over the past 50 years. The AP program has been accused of hindering student success in that public schools have adopted these courses as a barometer to enhance admission to colleges and universities but the courses have been reported to offer superficial coverage and waste student's senior year in preparing them for college (Hammond, 2008; AACU, 2002). Many colleges and universities are now encouraging more in-depth, investigative, or research-based learning even in the first year of college (AACU, 2002). Prior research on the predictive power of AP course experience on college success is not compelling. Studies from the College Board, owner of the AP trademark, and the Educational Testing Service (ETS), administrator of the yearly AP examinations, are frequently cited by AP Program proponents (Morgan and Maneckshana 2000; Willingham and Morris 1986). The descriptive nature of these studies, however, is insufficient for isolating the independent impact of the AP Program

given that the typical AP student is bright, motivated, and likely to experience positive college outcomes regardless of AP experience.

Given these circumstance in which incoming students are less prepared with study and academic skills the college must address these needs to improve student success. In this summer bridge program students are exposed to time management, study skills, note taking, stress management, task prioritizing, using information resources and communicating with faculty, administrators, and advisors. This exposure attempts to provide a solution for the deficiencies and supply participants with the needed skills to be successful students in engineering.

Engineering Education Retention Studies and Summer Bridge Programs

Engineering educators are interested in retention research because predictors for the engineering profession were beginning to report negative results for college freshman planning to major in a technical field. (Frotenberry, Sullivan, Jordan, & Knight, 2007). National engineering enrollment saw its peak in the early 1980s and has remained relatively flat for the past twenty five years (Moller-Wong & Eide, 1997). According to Kenneth Green's profile of undergraduates in the sciences, "Between 1966 and 1988 the proportion of college freshmen planning to major in a technical field fell by close to a factor of two" (Green, 1989). Additionally, the trend of attrition was continuing to increase. In 1975, attrition among engineering freshman was about 12%; by 1990, freshman attrition had doubled and was over 24% (Beaufait, 1991). With this knowledge the engineering education community began to look at retention of engineering students from various angles.

Early studies sought to learn and understand more about the predictors of success or failure in during the freshman year. Richard Fedler et al. studied 124 freshmen in an

introductory chemical engineering course. They correlated the assessment data (family and educational background, profile on the Myers-Briggs Type Indicator, the Learning and Study Strategies Inventory along with responses to a questionnaire regarding attitudes and expectations) to student performance in the course (Felder, Forrest, Baker-Ward, Dietz, & Mohr, 1993). Additionally, Cheryl Moller-Wong and Arvid Eide sought to establish descriptive data base that would allow continuous, longitudinal tracking of students through their college careers, develop a diagnostic tool that could identify students who are at risk of leaving the institution and the introduction of retention interventions to those students. They found that estimating the prediction of a student either staying in engineering or leaving is not completely accurate and should be designed by individual institutions based on their student characteristics. Other studies indicate the freshman year is critical. Lebold and Ward indicated the best predictors of engineering persistence were the first and second semester of college grades and cumulative GPA (Lebold & Ward, 1988). They also reported that students' self-perceptions of math, science and problem solving abilities were strong predictors of engineering persistence. Further, Brian French et al. also studied the non-cogitative and cognitive variables that effected student persistence and concluded that SAT math and high school rank were significant predictors of college GPA.

Most recently, a statistical retention model focused on the pre-college characteristics of freshman engineering students was proposed based on the prevalent engineering education empirical studies to better predict first year GPA and thus predict retention in engineering from the first year to the second year (Veenstra, Dey, & Herrin, 2009). In this study, the strongest predictors of success included high school

achievement, quantitative skills, commitment to career and educational goals and confidence in quantitative skills and they predicted student success (First Year college GPA). These results differed from general college education empirical studies in significant predictors of the GPA and retention. In the engineering education empirical studies, it was common, that the SAT Quantitative or ACT Quantitative scores were significant for predicting the GPA for the engineering students however, in the general college education empirical studies there were no cases where the SAT Quantitative score or the ACT Quantitative score significantly predicted the first year GPA. This suggests that the engineering curriculum is different from the general college education and should be studied with this difference in mind.

With this consideration, one must remember that the general engineering curriculum was originally developed from the practical base until the 1955 Grinter Report (Grinter, 1955). This report developed a focus to the scientific base with more emphasis on theoretical approaches and less emphasis on the “machinery” of engineering (Sheppard & Jennison, 1997). In the mid-1960s the curriculum shifted back to more design classes throughout the curriculum due to the lack of design fundamentals from students. As attrition gained more attention in the 1970s and early 1980s in the engineering educational community, a national movement began to increase the exposure of freshman to engineering design through various means (Sheppard & Jennison, 1997). Many engineering colleges and universities that were accredited by ABET formally the Accreditation Board for Engineering and Technology were introducing freshman design courses as a way to incorporate design throughout

the four year curriculum. Simultaneously, other strategies including engineering summer bridge programs were developing to combat the attrition issue.

Summary of Literature Review

This chapter began with a discussion on the development of summer bridge programs and the issues surrounding their initial goals and aims. Next, a discussion on the components that foster success in summer bridge programs was undertaken. These components included peer mentoring, living learning communities, facilitating commitment to career and educational goals, tutoring, faculty interaction, quality academic advising. Also discussed were some of the most common challenges for summer bridge programs to overcome. These challenges included gateway courses in mathematics, and science, the design of the engineering curriculum, financial needs of student and family issue that inhibit student success. Additionally, college preparation of high school students in the U.S. was discussed and continues to also inhibit college success and is also a challenge for summer bridge programs.

In sum, the literature suggests that a multi-faceted approach to increase engineering student success will provide an environment for possible increases to engineering degree completion. It also suggests, engineering summer bridge programs should possess this multi-faceted approach and should be utilized on a broad scale. This approach guides this study in the proper placement of components to ensure best results.

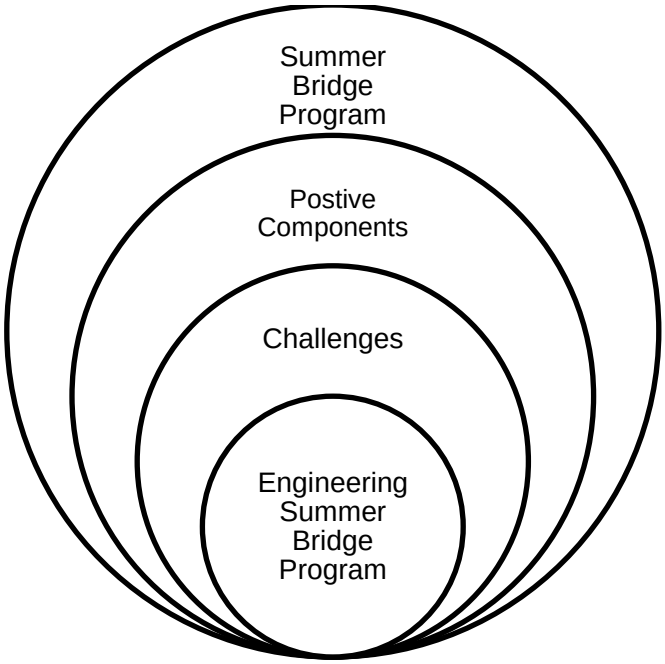

Figure 2-1. Literature review diagram

CHAPTER 3
METHODOLOGY

Chapter 3 describes the population and sample, subjectivity statement, dependent and independent variables design, data analysis and ethical considerations. Possible threats to validity are also discussed.

Population Sample

The setting for this study was a four-year public research and doctoral degree-granting institution in the southeast between the 2007-2010 academic school years. It serves approximately 50,000 graduate and undergraduate students with approximately 6,500 incoming freshman each year. The university has a comprehensive curriculum that includes the liberal arts curriculum as well as science and engineering. The engineering college enrolls approximately 5,000 undergraduate students and 2,710 graduate students with approximately 1,100 incoming freshman each year.

The data were catalogued in the College of Engineering's Data Warehouse. Access to the data warehouse was granted to the researcher from the Associate Dean of Student Affairs whose responsibilities includes oversight of the engineering freshman programs facilitated by the Engineering Student Affairs office.

Subjectivity Statement

The researcher has conducted quantitative analyses utilizing a secondary data source in several studies investigating retention of undergraduate engineering students at a large four-year public institution. In prior research, the researcher has used t-test and chi-square analyses however has not run logistic regression analysis. The researcher has presented quantitative findings at relevant professional conferences. The researcher currently administers and has administered this summer bridge program

over the past eight years. Given the nature of this role, the findings of this study may not be as objective and forthcoming than an outside researcher studying this program.

Dependent Variables

The continuous dependent variables for this study included: high school GPA, SAT quantitative scores, SAT verbal scores and age. The dichotomous dependent variables included: 1st semester grades in calculus, 1st semester grade in chemistry, withdrawals from calculus, and withdrawals from chemistry, retention in engineering after the spring semester in the first year, gender, and race. Both numerical and categorical dependent variables were taken directly from the data provided from the college of engineering's data warehouse. Students who began enrollment in either summer b or fall semesters and had a final major listed with the university registrar as engineering after the spring semester of the first year of enrollment were considered retained in the engineering program.

Independent Variables

The independent variable for this study was the engineering summer bridge program. This program was developed as a spin-off of the Successful Transition through Enhanced Preparation for Undergraduates Program (STEPUP) which was created as part of the Southeastern University and College Coalition for Engineering Education (SUCCEED) initiative from the National Science Foundation's Education Coalitions. This program was introduced in 2003 as a one week program offered to all incoming engineering freshmen designed to offer support to incoming students in calculus, chemistry, design, student success, and career decisions. The program was offered again in this model the following year. The next two years the program was changed to a six-week program with components in calculus, chemistry, and design that

offered three academic credits. In 2007, the program added three more components to encompass a full six academic credit program that has continued through 2010. The data analyzed in this study considers data from the 2007 – 2010 summer bridge programs.

Engineering Summer Bridge Program: Over the past four years, the summer bridge program has been a six-week summer bridge program that introduces freshman to the college of engineering through six principal courses which include various levels of both calculus and chemistry, AutoCAD, computer programming, engineering design, student success seminar and introduction to engineering. Each student is assigned an upper division engineering student peer mentor who meets with them during the design class during the summer and on a weekly basis during the fall and spring semesters to provide tailored academic and professional support.

Peer mentors are selected during the spring semester prior to the summer program beginning. Peer mentor applicants apply through a web application that includes short essay on skill, attributes, and desire to work as a peer mentor. The current year peer mentors select approximately 20-25 applicants to interview. Applicants attend a panel interview of the director and the current year mentors that ask questions relevant to the position. After all applicants are interviewed the director and the current peer mentors select the top applicants and offer them a position in the program. After selection and position acceptance all peer mentors are required to attend five training sessions were they are trained on all aspects of the program including: history, philosophy, definition of a mentor, parts of the program, design project, computer programming, team building, university academic policies, student success,

and goal setting. After the trainings, mentors are expected to participate in the orientation and throughout the summer. Peer mentors are required to meet with their student's every day during the design course to facilitate the design project and build a relationship with the students assigned to them.

All incoming freshmen who have indicated engineering as their major on their application for admission are invited via letter from the Associate Dean of Student Affairs to participate in the program (Appendix B). Interested students complete an online web application (Appendix C) and are sent contract and release forms to compete with their parents. The contract (Appendix D) asks for them to participate in all of the summer bridge program activities during the summer, fall and spring semesters. The release form absolves the university of any law suit to sue the university arising out of any loss, damage or injury while the student is a part of the program (Appendix E) Once the contract and release forms are complete and returned to the program director, the student is accepted into the program. The open enrollment nature of the program is currently in place because demand has yet to exceed capacity limits. The program is currently designed to enroll up to approximately 120-130 students a year; however, it has only exceeded 120 students only once in the 2007-2010 study time period. Once accepted, the student is sent a letter of acceptance and details on how to sign up for the summer bridge program courses during orientation (Appendix F). Once the student registers for the courses they are sent a final letter with instructions to attend the summer bridge program orientation held the weekend before the summer B session begins (Appendix G). At the orientation, students are introduced to the staff, administration, instructors, their peer mentor, and are given an overview of the program.

Once the program begins the students attend courses throughout the summer b semester, see Table 3-1 for the course schedule.

Once the summer semester is completed the participants are required to meet with their peer mentors on a weekly basis throughout the fall and spring semesters. Mentors submit a weekly report on all assigned students to the program director. The weekly reports outline the student's progress on academics and social and professional integration. If any problems are reported the student receives additional attention from mentor and program director as needed. Additionally, fall and spring social events are held to reunite all students in the program and discuss registration for the following semester. The program concludes at the end of the spring semester after exams with the mentors working with their students to assist in the development of goal for the sophomore year.

Use of Secondary Data Source

Secondary data for this study was provided by the university's Engineering's Data Warehouse. This data warehouse utilizes data from the University Registrar's office which houses the official records for undergraduate education in a hierarchical database. This database allows interaction through the Conversational Interactive Content Systems known as CICS. Participants were identified through the completion of an online application. The data were also stored in the Engineering Data Warehouse. The data provided by the UF registrar's offices were used in aggregate form.

Data Analysis

Data analysis for this study was conducted in a preliminary analysis and advanced analysis. The preliminary analysis included descriptive analysis, *t*-test and chi-square test for student data. The data was analyzed using IBM SPSS 19® statistical software

package. For Hypothesis 1, mean calculus grades and withdrawal rates for the experimental and control groups were analyzed using *t*-tests and chi-square test to assess for statistical differences between the means for the different groups. For Hypothesis 2, the mean high school GPAs, SAT quantitative scores, first semester grades in calculus and gender were analyzed using *t*-test and chi-square test to assess for statistical differences between the means. For Hypothesis 3, the high school GPAs, SAT quantitative scores, first semester grades in calculus were analyzed using logistic regression analysis. Demographic and frequency data will also be analyzed for age, gender and ethnicity.

The data analyses conducted in the advanced stage of this study included the use of logistic regression. Logistic regression, (y) = a + bx, was used to explore the multiple pre-college and college student factors in predicting student retention. Early in retention research logistic regression was called for to study college student retention because of the “categorical nature of dropout as a dependent variable” (Tinto, 1975). Demographic and frequency data for age, gender, ethnicity, also analyzed between groups using tests for 2 independent samples (Mann Whitney U test).

Ethical Considerations

Permission to conduct this study was obtained from the investigator’s thesis committee, the College of Engineering and the Internal Review Board from the University. The benefit-risk ratio was assessed for this study, indicating minimal risk to participants. The benefits to the participants potentially include enhanced understanding of calculus and chemistry concepts, immersion in engineering topics, and mentoring by engineering professionals and peers. There are no other direct benefits for participation in this study.

Threats to Internal Validity

The main threat to internal validity in this design is whether differences between groups can be attributed to characteristics of the groups other than the experimental conditions to which they were assigned (Gall, Gall, & Borg, 2007). Additionally, uncontrolled threats to validity include mortality of experimental participants, instrumentation with respect to the intervention, and restricted generalizability outside of sample characteristics.

Table 3-1. Bridge program summer daily schedule

Period	Monday	Tuesday	Wednesday	Thursday	Friday
1(8:00-9:15)	Chemistry	Chemistry	Chemistry	Chemistry	Chemistry
2(9:30-10:45)	Calculus	Calculus	Calculus	Calculus	Calculus
3(11:00-12:15)	Succ. Skills	Comp.Prog.	AutoCAD	Comp. Prog.	AutoCAD
4(12:30-1:45)	Lunch	Lunch	Lunch	Lunch	Lunch
5(2:00-3:15)	Design	Design	Design	Design	Design
6(3:30-4:45)		Intro to EG		Intro to EG	
7(5:00-6:15)		Intro to EG		Intro to EG	

CHAPTER 4
DATA ANALYSIS AND RESULTS

This chapter begins with a presentation of results for the descriptive statistics (univariate and bivariate), *t*-tests, and chi-square analysis. The binary logistic regression models were constructed by using dependent variables which included pre-college and college characteristics that will be further described and discussed later in the chapter. The selected independent variables for the regression models were regressed against the dependent variables representing first year retention in engineering and pre-college and college characteristics. Chapter 4 concludes with a brief summary of significant results from the statistical analyses that were performed.

Preliminary Analysis

The preliminary analysis section of this study provides a foundation for the advanced statistical methods (binary logistic regressions) that were employed. The preliminary analysis section begins with a presentation of results from the descriptive analyses of the institutional sample, including the distribution of the students by cohort year. Additionally, this section describes a discussion of the average age, high school grade point average (HS GPA), SAT Quantitative scores, and first year in college GPA. The preliminary analysis is followed by a presentation of comparison results from the summer bridge program participants and non-participant groups. Results from the conducted t-tests and chi-square tests are presented and discussed. The final portion of the preliminary analysis includes an examination of predictor factors and retention (i.e., gender, summer bridge program participation, HS GPA).

Profile and Descriptive Statistics for the Institutional Sample

This study was performed at an Association of American Universities (AAU) designated university in the southeast at large, public, land grant institution. The engineering school serves approximately 5000 undergraduates and 2710 graduate students. Research funding for this engineering college reaches over 100 million dollars a year. In comparison to a similar AAU type and size institution, this university encompasses similar student body make up and size and procures similar research funding.

A total of 4,166 students were included in this study. Of the students included in the sample, the summer bridge program participants represented 9.9% (n=415) while the non-participating students included 90.1% (n=3751) (Table 4-1). Male students consisted of 74.5% (n=3104) while female students represented 25.5% of the sample. White students made up the largest percentage of the race/ethnicity with 65.8% (n=2728) while American Indian students represented the smallest percentage of race/ethnicity with .4% (n=15). The freshmen cohort years 2007-2010 range in size from 892 in 2007 to 1163 in 2010 with each year containing 21.4% to 27.9% of the sample size.

Using the data provided by the Engineering Data Warehouse (EDW) the, frequency of the mathematics and chemistry courses taken by beginning engineering students was explored (Table 4-2). Additionally, the frequency of retaining students that were summer bridge program completers and students who were non-participating students is explored.

In calculus, 43 % (n=1808) take calculus 1 and 15% (n=625) take calculus 2. Additionally, 13% (n=524) undertake pre-calculus and 12% (n=488) begin their

mathematics curriculum by taking calculus 2 for advance placements students. The combination of these four courses outlines 83% of the mathematics courses taken in the first full semester by incoming engineering students. The remaining 17% of students take the honors version of either calculus 1, 2 or 3.

In chemistry courses, 51% take chemistry 1 (n=2130). Further, 17% (n=696) undertake pre-chemistry and 15% (n=614) begin their chemistry curriculum by taking chemistry for engineers. Only 4% (n=153) undertake chemistry 2 during their first full semester. The combination of these four courses outlines 86% of the chemistry courses taken in the first full semester. An additional 12% (n=482) did not take a chemistry course in the first year either because they obtained advance placement (AP), dual enrollment (DE) or International Baccalaureate (IB) credit in high school for chemistry or have chosen an engineering major that does not require chemistry 2.

Examining frequency data on students that were retained as engineering majors after completing their first year in engineering showed a difference between the program participants and non-participants groups. Students who completed the summer bridge program retained at 88% (n = 365) while non-participants retained at 84.1% (n = 3154). A chi-square test of independence was performed to examine the relationship between the two student groups (participants and non-participants) and retention. The relationship between these variables was significant, $\chi^2(1, N=4164) = 4.17$, $p=.04$. Participants were more likely to be retained than non-participants students (Table 4-3).

Descriptive Statistics for Institutional Sample Continuous Dependent Variables

The following section examines the sample characteristics of mean age, high school grade point average, SAT quantitative scores, and the college grade point average at the end of the first year in the included samples (see Table 4-4). The results

from this descriptive analysis for the continuous variable revealed the mean age of incoming engineering students is 18.34 (SD = 0.51), the mean incoming HS GPA was a 4.13 (SD = .50) out of a 5.0 scale, the mean SAT Quantitative scores was a 679.5 (SD = 64.07) out of a possible 800 and the mean of the first year college GPA was 3.33 (SD = 0.57) out of a 4.0 scale.

An additional investigation into high school grade point average and its relationship to retention was undertaken. A *t*-test failed to reveal a statistically significant difference between the mean of the High School GPA of the entering engineering students and retention after the first year. Students not retained had the following results: (M = 4.1, SD = .4677) (see Table 4-5).

There was not a significant effect for HSGPA, $t(4135) = -1.76$, $p > .05$ (Table 4-6) for those students who were retained versus those who were not retained.

Descriptive Statistics for Student Classification and Categorical Variables

Using the data provided by the Engineering Data warehouse, the sample was divided into two classifications, the participant completers and the students who did not participate in the summer bridge program (non-participants). Chi-Square analyses were performed to understand if any differences existed between the groups on gender and race. Descriptive statistics for categorical variables were explored on both groups (see Table 4-7). Both groups had similar gender representation with 77.1% (n=320) male and 22.9% (n=95) female in the participant group compared to the 74.2% (n=2784) male and 25.8% (n=967) female in the non-participant group. Some notable differences existed between the two groups in the Race category. The participant group had 6.1% 5.1% Asian students (n=21) compared with the non-participant group which had 11.2% Asian students (n=421). Additionally, the participant group had 9.0% more white

students 71.8% (n=298) than the non-participant group 64.8% (n=2430). Most notable was a significant difference between the two group frequencies existed on race $\chi^2(6, N = 4166) = 26.75$, $p = .000$. Regarding gender, no significant difference was found between frequencies the groups with $\chi^2(1, N = 4166) = 1.64$, $p = .200$.

Investigation Differences between Participants and Non-Participants

Independent sample *t*-test were conducted to investigate group statistics and if differences between participants and non-participants student's age, HS GPA, SAT Quantitative scores and first year in college GPA were significantly different. Additionally, academic performance and course withdrawal rates are investigated to determine if any significant differences existed between participants and non-participants.

The group statistics of the average age, high school grade point average (HS GPA), SAT Quantitative scores and first year in college grade point average also conducted using the Engineering Data warehouse data comparing the participants and non-participant groups (Table 4-8). The results from the descriptive analysis for the continuous variables indicated that the mean age in years for students who completed the summer bridge program had a mean age of 18.34 (SD = 0.52) compared to students in the non-participant group who had a mean age of 18.34 (SD = 0.51). Further, the mean high school GPA for the participant students was 4.07 (SD = 0.35) and the mean high school GPA for the non-participant students was 4.13 (SD = 0.52). The mean SAT Quantitative score for the participant students was 656.46 (SD = 62.95) and the mean SAT Quantitative score for the non-participant students was 682.0. (SD = 63.69) The mean first year in college GPA for the participating students was 3.28 (SD =

0.55) and the mean first year in college GPA for the non-participating students was 3.33 (SD = 0.58).

Independent *t*-test were conducted on the principle that the assumptions of independent *t*-test (e.g., normal distribution of data, homogeneity of variance, data are independent) were not violated. The results supported that the equal assumptions had not be violated by returning p-values on Levene's Test of Equality of Variance that were not significant (Table 4-9).

From the conducted *t*-tests, significant differences were found for mean HSGPA between non-participanting students and participating students (Table 4-8). A difference in HSGPA .0665 was found between the non-participants and participating students. The differences between these two groups HSGPA were significant at the .05 alpha level $t(4137) = 2.51$, $p < .05$. Additionally, a difference in the SAT Q was found between non-participants and participating students. The differences between these two groups were significant at the .05 alpha level $t(4009) = 7.64$, $p < .001$. From the results for the *t*-test, conclusions can be drawn based on the sample for this study, that non-participants students have a significantly higher HSGPA and SAT Quantitative scores but not a significantly higher 1st year college GPA or age.

Using the data provided by the EDW the, frequency of the mathematics and chemistry courses taken by participants and non-participating students were explored (Table 4-10).

In calculus, the majority of the participating students and in the non-participating students began taking calculus 1, 53.7% (n=223) and 42.3% (n=1585) respectively. The second largest class percentage of students differed between participants and non-

participants. Participating students took pre-calculus as their second largest class at 16.4% (n=68) whereas the non-participating students took calculus 2 at their second largest mathematic course at 15.4% (n=578). However, if the calculus 2 class is combined with the calculus 2 for AP students for both groups calculus 2 becomes the second largest mathematics course at 17.8% for participating students and 27.7% for non-participating students. Additionally, pre-calculus becomes the third most frequently taken class by both groups at 16.4% (n=68) for participants and 12.2% (n=456) for non-participating students. The combination of these four courses outlines 87.9% for participating students and 82.2% for the non-participating students of the mathematics courses taken in the first full semester by incoming engineering students. The remaining 12.1% in participating and 17.8% in non-participating students take the honors version of either calculus 1, 2 or 3.

In chemistry courses, the majority of students in the participating and non-participating groups take chemistry 1, 62.2% (n=258) and 49.9% (n=1872) respectively. Further, the second largest course for the participants and non-participants was pre-chemistry at 17.1% (n=71) and 16.7% (n=625) respectively. Additionally, 12.5% (n=52) of the participating students undertook chemistry 1 for engineers course whereas 15.0% (n=562) of the non-participating students took the chemistry 1 for engineers course. Only 2.7% (n=11) of the participating students undertook chemistry 2 during their first full semester and only 3.8 (n=142) of the non-participating students also took chemistry 2. The combination of these five courses outlines 94.5% of the chemistry courses taken in the first full semester for the participating students and 85.4% for the non-participating students. An additional 5.1% (n=21) of the participating group and 12.3% (n=461) of the

non-participating group did not take a chemistry course in the first year either because they obtained advance placement (AP), dual enrollment (DE) or International Baccalaureate (IB) credit in high school for chemistry and have chosen an engineering major that does not require chemistry 2.

From the conducted *t*-tests, significant differences were not found for any of the comparisons between the participants and non- participants groups on course grade values (Table 4-11). For mathematics, the means from the calculus 1 course were closest to being significantly different at the .05 alpha level $t(1806) = -1.63$, $p>.05$. For chemistry, the means from the pre-chemistry course were closest to being significantly different at the .05 alpha level $t(694) = -1.70$, $p>.05$. This provides evidence that the students in both groups participants and non- participants are receiving relatively the same average grades in their first attempts at the mathematics and chemistry courses.

A descriptive analysis of the relationship in the participants and non- participants regarding withdrawal rates in calculus and chemistry was also conducted using the EDW data comparing the participants and non- participants groups (see Table 4-12). The participants withdrew at a higher rate than non- participants in Calculus 1 and pre-calculus with participants withdrawing 13.5% (n=30) in calculus and 13.2% (n=9) in pre-calculus. Whereas the non- participants withdrew 10.7% (n=169) in calculus 1 and 10.1% (n=46) in pre-calculus.

In chemistry 1, the participants withdrew at a lower rate than the non- participants at 8.5% (n=22) versus 9.3 (n=174) for the non- participants. Additionally, in pre-chemistry the participants withdrew at a lower rate than the non- participating students at 5.6% (n=4) versus 7.0% (n=44). Further investigation is needed to determine the

significance of the relationships between both the groups and their mathematics and chemistry withdrawal rates to understand group differences.

A *t*-test was conducted to determine if any differences existed amongst the participants and the non- participating groups on withdrawal rates from the mathematics and chemistry courses (Table 4-13). From the conducted *t*-test, significant differences were found for Honors calculus 1 with mean differences of -.100 was found between the participants and non- participant groups. This difference between the participants and non- participants groups was significant at the .05 alpha level $t(76) = -2.71$, $p<.05$. From these results, there was a significant effect for Honors Calculus 1 with the non-participant group withdrawing less than the participants group from this course.

Binary Logistic Regression

Binary logistic regression statistical methods were employed to better understand the factors that best predict the likelihood students will be retained or not retained in an engineering major after their first year of attendance. For this study, logistic regression was used to explore the multiple pre-college and college student factors in predicting student retention and participant inclusion. Early in retention research logistic regression was called for to study college student retention because of the “categorical nature of dropout as a dependent variable” (Tinto, 1975). Logistic regressions statistical procedures are also helpful when researchers are interested in estimating the probability that an event will occur (i.e. college retention, graduation, grade attainment etc.) for students with specific characteristics (Peng, Kee, & Ingersoll, 2002).

The following section will present and discuss significant findings from the conducted logistic regression analyses. Results are discussed in terms of odds-ratios (Exp (β)), which represents the odds change for a one-unit change in the predictor or

independent variable, when all other predictor variables in the equation are held at a constant value.

The presentation of results for the logistic regressions begin with the results for regressions Model 1 (characteristics of retention) followed by Model 2 (predictors of Summer Bridge Program inclusion).

Model 1: Characteristics of Retention

A significant *p* value of less than *p*<.001for Model 1 was found, which suggest that the regression equation including predictor variables were significantly improved, or a better fit, than the model with only the constant being considered. Model 1 held several factors that were significant in predicting a student's retention after the first year in an engineering major (Table 4-14). Four of the 12 predictor variables in the equation were found to be significant (see Table 4-15).

Gender, SAT quantitative scores, calculus grade values & program participation: For Model 1, gender, SAT Quantitative scores and Calculus Grade Values were all found to be significant factors in predicting retention of engineering students after their first year. Gender was a significant factor in predicting retention after the first year of engineering school. The results outlined that females were found to be 53.5% less likely (β= -.625, p<.001) than males to retain in an engineering major holding all other variables constant. Further, SAT quantitative scores were also a significant factor in predicting retention after the first year of engineering school. The results found that students with higher SAT Quantitative scores to be 1.003 times more likely to (β=.003, p<.000) retain in an engineering major holding all other variables constant. Furthermore, the first year calculus GPA was found to be a significant factor in prediction retention. Here the results showed that students with higher math GPAs are

1.613 more likely (β= .478, p<.000) to retain in an engineering major. Lastly, the results found the students in the summer bridge program to be 0.585 less likely (β= -.535, p<.05) to be retained in an engineering major after the first year.

Model 2: Predictors of Summer Bridge Program Inclusion

As with the first regression model, a significant *p* value of less than *p*<.001for Model 2 was found, which suggested that the regression equation including predictor variables were significantly improved, or a better fit, than the model with only the constant being considered. Model 2 held several factors that were significant in predicting students that would enroll in the summer bridge program (Table 4-16). Four of the 12 predictor variables in the equation were found to be significant (Table 4-17).

In Model 2, significant predictors for summer bridge program inclusion included gender, ethnicity, HS GPA, and SAT Quantitative scores (Table 4-17). Gender was a significant factor in predicting students who would enroll in the summer bridge program. The results outlined that females were found to be 77.2% less likely (β= -.259, p<.05) than males to participate in the summer bridge program holding all other variables constant. Under ethnicity, Asian students were also found to be a significant factor in predicting summer bridge program inclusion. The results showed that Asian students were 41.1% less likely (β= -.889, p<.05) to participate in the summer bridge program than other incoming engineering minority students. Students who possessed a higher high school GPA were found to have decreased odds of participating in the summer bridge program, compared to their inverse reference group. Students who had elevated high school GPAs were nearly 70% less likely (β= -.369, p≤.001) to enroll in the summer bridge program. Lastly, students who obtained high SAT quantitative scores

were less likely (β= -.007, p≤.000) by 99.4% to participate in the summer bridge program.

Chapter Summary and Conclusion

The preliminary and advanced analytic methods used in this study were designed to provide an overall view of the similarities and differences between Non-participating students and participating students. In review, the descriptive analyses provided further evidence to conclude that differences do exist in student's race, high school GPA, SAT Quantitative scores. The non-participants have higher high school GPAs and SAT Quantitative scores. Additionally, the results from the descriptive analysis indicate that students who participate in the summer bridge program retain at a significantly higher rate than non-participating students in the first year. This begins to underscore the importance and the effectiveness of a summer bridge program designed to incorporate more incoming engineering students to raise the overall retention rate and it also begins to develop a profile for students to be targeted for this type of program.

With regard to how students were similar in both groups, the analysis showed that both student groups were of similar age, had similar first year in college GPAs, took beginning math and chemistry courses at similar distributions and withdrew from these beginning math and chemistry courses at similar rates. This begins to show the students in the incoming engineering class ultimately are similar with regard to age, grade performance, course selection and withdrawal from math and chemistry courses. This begins the outline that the students in the participant group, with lower SAT Quantitative scores and high school GPAs are retained at a higher rate than the Non-participating students.

The primary purpose of this study was to explore the factors that contributed to the success of a first year engineering summer bridge program designed for all incoming engineering. The evidence supports the notion that significant differences are present between the participants and the non-participating students. Participating students have similar first year college GPAs, take the same math and chemistry courses and withdrawal at the same rates as the non-participating students. However participating student's SAT Quantitative scores, high school GPAs are lower but they retain at a higher rate than non-participating students. Results from the logistic regression suggest that higher SAT Quantitative scores, gender, and first semester math course grades are significant predictors of retention. Additionally, the second regression model found that female students along with students who possessed a lower high school GPA and SAT Quantitative scores were less likely to participate in the summer bridge program. The last chapter of this study will further discuss the results of the conducted preliminary and advanced analyses, considering the previous literature on this topic.

Table 4-1. Sample demographic description

Demographic Categories	Percentage	Frequency
Total	100	(4166)
Participants	9.9	(415)
Non-participants	90.1	(3751)
Gender		
Male	74.5	(3104)
Female	25.5	(1062)
Race/Ethnicity		
Asian	10.5	(442)
African American	4.6	(192)
Hispanic	15.8	(664)
American Indian	0.4	(15)
Non-Resident Alien	0.8	(35)
White	65.7	(2728)
Unknown	2.2	(90)
Cohort		
2007	21.4	(892)
2008	24.7	(1028)
2009	26.0	(1083)
2010	27.9	(1163)

Table 4-2. Frequency of mathematics and chemistry courses

Mathematics & Chemistry Courses	Frequency	Percentage
Pre-Calculus	524	12.6
Calculus 1	1808	43.4
Calculus 2	624	15.0
Calculus 2 for AP students	488	11.7
Calculus 3	303	7.3
Pre Chemistry	696	16.7
Chemistry 1	2130	51.1
Chemistry for Engineers	614	14.7
Chemistry 2	153	3.7

Table 4-3. Frequency of retention of engineering students after first year

Student Classification	Frequency	Percentage
Participants	365	88.0
Non-participants	3154	84.1

Table 4-4. Descriptive statistics for continuous independent variables

Sample Characteristics	Mean	(SD)
Age in Years	18.34	(0.518)
HS GPA (5.0 scale)	4.13	(0.5097)
SAT Quantitative	679.5	(64.077)
First Year College GPA	3.33	(0.578)

Table 4-5. Examination of high school GPA and retention

	Not Retained *M* (SD)	Retained *M* (SD)	p-value
H.S. G.P.A.	4.1 (0.47)	4.1 (0.52)	.078

Table 4-6. Analysis of means on high school GPA and retention

Comparisons	Levene's test of equal variance F	Sig	D*f*	*t*	Mean difference	Std. Error	*p*
Non-retained *vs. Retained*	.039	.844	4135	-1.76	-.038	.021	.078

Table 4-7. Comparison of participants & non-participants on categorical variables

	Participants Percentage	Count	Non-participants Percentage	Count	p-value
Gender					
Male	77.1	(320)	74.2	(2784)	0.200
Female	22.9	(95)	25.8	(967)	
Race					
Asian	5.1	(21)	11.2	(421)	0.000*
African American	6.5	(27)	4.4	(165)	
Hispanic	13.7	(57)	16.2	(607)	
American Indian	0.7	(3)	0.3	(12)	
White	71.8	(298)	64.8	(2430)	
Non-Resident Alien					
Unknown			2.2	(81)	

*Mean difference is significant at the p< .000 significance level

Table 4-8. Comparison of participants & non-participants on continuous variables

Sample Characteristics	Participants Mean (SD)	Non-participants Mean (SD)
Age in Years	18.34 (.528)	18.34 (.517)
HS GPA	4.07 (.354)	4.13 (.523)
SAT Quantitative	656.46 (62.95)	682 (63.69)
First Year College GPA	3.28 (.552)	3.33 (.581)

Table 4-9. Analysis of means on participants & non-participants on continuous variables

Comparisons	Levene's test of equal variance F	Sig	D*f*	*t*	Mean difference	Std. Error	*p*
Non-Participants *vs.* Participants Age	0.115	0.73	4164	0.95	0.003	0.027	0.924
Non-Participants *vs.* Participants HSGPA	1.938	0.164	4137	2.514	0.0665	0.026	0.012*
Non-Participants *vs.* Participants SAT Q	0.328	0.567	4009	7.644	25.59	3.349	0.000*
Non-Participants *vs.* Participants 1st Year College GPA	0.671	0.413	4142	1.556	0.04655	0.029	0.120

*Significant at the p< .05 level

Table 4-10. Frequency of mathematics and chemistry courses

	Participants (n=415)		Non-Participants (n=3751)	
Courses	Frequency	(%)	Frequency	(%)
Pre-Calculus	68	(16.4)	456	(12.2)
Calculus 1	223	(53.7)	1585	(42.3)
Calculus 2	46	(11.1)	578	(15.4)
Honors Calculus 1	10	(2.4)	68	(1.8)
Honors Calculus 2	6	(1.4)	85	(2.3)
Calculus 2 /AP students	28	(6.7)	460	(12.3)
Pre-Chemistry	71	(17.1)	625	(16.7)
Chemistry 1	258	(62.2)	1872	(49.9)
Chemistry for Engineers	52	(12.5)	562	(15.0)
Chemistry 2	11	(2.7)	142	(3.8)

Table 4-11. Analysis of means for participants & non-participants on math & chemistry courses

Comparisons	Levene's test of equal variance F	Sig	D*f*	*t*	Mean difference	Std. Error	*p*
Non-Participants *vs.* Participants Pre-Calculus	1.597	0.207	522	-.585	-.099	.176	.570
Non- Participants *vs.* Participants Calculus 1	4.375	0.037	1806	-1.63	-.156	.096	.103
Non- Participants *vs.* Participants Calculus 2	4.187	0.041	622	.704	.13210	.187	.481
Non- Participants *vs.* Participants Honors Calculus 1	3.629	0.061	76	-.781	-.20147	.257	.437
Non- Participants *vs.* Participants Honors Calculus 2	0.019	0.891	89	-.406	-.16927	.416	.686
Non- Participants *vs.* Participants Calculus 2 for AP Stu.	.548	.459	486	-.934	-.1989	.213	.351
Non- Participants *vs.* Participants Pre-chemistry	1.249	.264	694	-1.70	-.272	.159	.088
Non- Participants *vs.* Participants Chemistry 1	1.687	.194	2128	-1.08	-.093	.086	.278
Non- Participants *vs.* Participants Chemistry for Engineers	1.237	.266	612	-1.125	-.218	.194	.261
Non- Participants *vs.* Participants Chemistry 2	0.072	0.788	151	-.157	-.0583	.371	.875

*Mean difference is significant at the p< .05 significance level

Table 4-12. Relationship of participation in the summer bridge program and withdrawal rate

Course	Participants		Non-Participants	
	Percentage	Frequency	Percentage	Frequency
Pre-Calculus	13.2	(9)	10.1	(46)
Calculus 1	13.5	(30)	10.7	(169)
Calculus 2	6.5	(3)	7.8	(45)
Honors Calculus 1	10.0	(1)	0.0	(0)
Honors Calculus 2	0.0	(0)	4.7	(4)
Calculus 2 for AP students	7.1	(2)	5.4	(25)
Pre-Chemistry	5.6	(4)	7.0	(44)
Chemistry 1	8.5	(22)	9.3	(174)
Chemistry 2	9.1	(1)	5.6	(8)

Table 4-13. Analysis of means withdrawal rates for participants & non- participant groups

Comparisons	Levene's test of equal variance F	Sig	D*f*	*t*	Mean difference	Std. Error	*p*
Non- Participants *vs.* Participants Pre-Calculus	2.354	0.126	522	-.789	-.031	.040	.431
Non- Participants *vs.* Participants Calculus 1	5.90	0.015	1806	-1.246	-.028	.022	.213
Non- Participants *vs.* Participants Calculus 2	.392	0.531	622	.309	.013	.041	.757
Non- Participants *vs.* Participants Honors Calculus 1	37.2	0.00*	76	-2.71	-.100	.037	.008*
Non- Participants *vs.* Participants Honors Calculus 2	1.28	0.26	89	-.538	.047	.087	.592
Non- Participants *vs.* Participants Calculus 2 for AP Stu.	.568	.451	486	-.383	-.017	.045	.702
Non- Participants *vs.* Participants Pre-chemistry	.805	.370	694	.433	.014	.032	.658
Non- Participants *vs.* Participants Chemistry 1	.649	.421	2128	.400	.008	.019	.689
Non- Participants *vs.* Participants Chemistry for Engineers	.192	.661	612	.216	.012	.054	.829
Non- Participants *vs.* Participants Chemistry 2	.818	.367	151	-.467	-.035	.074	.641

*Significant at the p< .05 level

Table 4-14. Logistic regression model measures model 1: characteristics of retention

	Chi-square	df	Sig.	Nagelkerke R Square	% predicted correctly
Probability of retention	327.479	12	.000***	.142	85.2

***Significant at the p<.001 level

Table 4-15. Results for binary logistic regression model 1: characteristics of retention

Variable	*Beta*	*Exp* (β)	Std. Error	Wald
Gender	-.625***	.535	.104	36.039
Ethnicity				
Asian	.483	1.621	.349	1.913
African American	.314	1.369	.376	.699
Hispanic	.296	1.345	.332	.795
American Indian	-.803	.448	.695	1.335
Other	2.055	7.086	1.140	3.248
White	.045	1.047	.313	.021
HS GPA	.078	1.081	.123	.401
SAT Quantitative	.003***	1.003	.001	15.324
First Year College GPA	.032	1.032	.093	.115
Calculus GPA	.478***	1.613	.041	135.131
Summer Bridge Program	-.535**	.585	.173	9.568

**p<.01, ***p<.001.

Table 4-16. Logistic regression model measures model 2: summer bridge program inclusion

	Chi-square	df	Sig.	Nagelkerke R Square	% predicted correctly
Probability of retention	104.180	10	.000***	.054	90.0

***Significant at the p<.001 level

Table 4-17. Results for binary logistic regression model 2: summer bridge program inclusion

Variable	*Beta*	*Exp* (β)	Std. Error	Wald
Gender	-.259*	.772	.129	4.043
Ethnicity				
Asian	-.889*	.411	.424	4.402
African American	-.255	.798	.424	.283
Hispanic	-.418	.658	.384	1.189
American Indian	.653	1.922	.754	.751
Other	-20.477	.000	7095.08	.000
White	.054	1.055	.361	.022
HS GPA	-.369**	.692	.110	11.238
SAT Quantitative	-.007***	.994	.001	55.477

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

CHAPTER 5
DISCUSSION AND CONCLUSIONS

Summer bridge programs were born out of the Civil Rights Movement the 1960s in an effort to address the retention issue of African-American students in higher education (Noel, Levitz, Saluri et al., 1985). As summer bridge programs evolved over time, the benefits of these programs became apparent to college administrators as a tool for increasing retention and providing a more inclusive workforce. Engineering schools across the nation began to implement summer bridge programs for underrepresented minorities and women. While the retention of underrepresented minorities and women in engineering majors did increase, the overall retention of engineering colleges has remained steady over the past 20 years (National Science Board, 2006). This suggests that a large portion, approximately 44% nationally, of students were not being retained and could possibly benefit from participating in a summer bridge program as well. The findings, for this empirical study, reveal that students who participated in the summer bridge program did retain through their first year at a higher rate than non-participants and at a statistically significant rate. More specifically, findings strongly suggest that SAT quantitative scores and the first college calculus course grades are strong predictors of student retention for the first two semesters.

This analysis extends the previous literature on summer bridge programs and brings further awareness to the academic performance and outcomes of engineering students. This chapter begins with a focus on the preliminary analysis of the summer bridge program participants and the non-participating students. Next, the focus of the discussion includes the advanced analysis where models were utilized to understand the characteristics of retention and the predictors of summer bridge program inclusion.

In this final chapter of study, previous literature was drawn upon to interpret and contextualize the empirical results and to propose implications of the findings to engineering practitioners. As the study closes, Chapter 5 is concluded with a discussion of the contribution of this body of work to the engineering community; provide suggestions for new policies for improved retention and success of engineering students. Finally, suggestions are made for future research regarding summer bridge programs offered at engineering colleges and schools.

Purpose of Study Revisited

This study extends the current literature on summer bridge programs by exploring the factors that contribute to the success of a first-year engineering summer bridge program designed for all incoming engineering freshman by challenging the assumptions that there are no differences in students who completed the summer bridge programs and non-participating students in High School GPA, SAT Quantitative scores, first semester calculus grades withdrawal rates and retention in engineering. Through this study, there are three main issues that emerge regarding the differences between participants and non-participants. First, this study addresses the idea that participation in a summer bridge program is a major factor for increased rates in retention after the first year of college as engineering student. In earlier chapters, it was proposed that no differences would be found when examining the retention rates when the participant and non-participant groups were compared on SAT Quantitative scores, first semester grades in calculus and high school GPA.

Secondly, this study addresses the pre-college performance and performance factors of the first year in college of the students within the participant and non-participant groups. The hypothesis was proposed that the students would have

equivalent high school GPA, SAT Quantitative scores, first semester grades in calculus and gender ratios.

Lastly, this study addresses the relationship between participants and non-participants in calculus course grades and withdrawal rates. It was proposed that no relationship will exist between participants and non-participants with respect to calculus course grades and withdrawal rates.

Retention of Participants and Non-Participants

What is the relationship between participating and non-participating engineering students SAT Quantitative scores, first semester grades in calculus and high school GPA on retention?

Retention: The results from this study disputes the hypothesis that a relationship exists between participants and non-participating students between SAT Quantitative scores, first semester grades in calculus and high school GPA and retention in engineering. A previous study found the average first year GPA for students who returned to engineering was significantly higher than student who left for other majors (Burtner, 2004). Further, another study also found that within three semesters, most students with low GPAs leave engineering (Zhang, 2004). Specifically, the results of this study suggest that students who enroll in and complete the summer bridge program are more likely to be retained in engineering after their first year than non-participants. However, the summer bridge program along with gender were both found not to be predictors of engineering retention after applying the regression Model 1. While female engineering students have always been a minority population in engineering it is not surprising that being a female engineering student is not a predictor of retention in engineering. The poor impression that many female students have about their ability to

perform well in technical subjects is exacerbated by the traditional unfriendly engineering curriculum and instruction, with continuing emphasis on individual work and competitive grading, (Felder, Felder, Mauney, Hamrin, & Dietz, 1995). Moreover, the gender populations of both participants and non-participating students were not significantly different, which explains obtaining these results similar to the same result of previous studies where gender was found not to be a significant factor in retention (Felder, Felder, Mauney, Hamrin, & Dietz, 1995; Astin & Astin, 1992).

Furthermore, participating in the summer bridge program not proving to be a predictor of being retained in engineering is, on the surface, a negative result for the program; however, at a deeper look we can ascertain what causes this result by looking at the characteristics of the students who participate from regression Model 2: Predictors of Summer Bridge Program Inclusion. This model found that gender, ethnicity, high school GPA and SAT Quantitative scores were significant factors in predicting students who would enroll in the summer bridge program. Specifically, the model found that females and Asian students were less likely to enroll. This can be interpreted that males were more likely to enroll in summer bridge programs than females. More importantly, students with elevated high school GPAs and SAT quantitative scores were less likely to participate in the summer bridge program. Asian students were less likely to enroll than other ethnicities. Students with lower SAT quantitative scores and high school GPAs were more likely to enroll. Given these results it could be suggested that the summer bridge program has enrolled lesser academically prepared students (i.e. students with lower high school GPA and lower SAT quantitative scores than the non-participating students). However, the students who complete the

first year summer bridge program retain at a higher rate than the non-participating students. As a result, students that are male, non-Asian, with lower SAT Quantitative scores and high school GPAs benefit the most from the summer bridge program because they retain at a higher rate after going through the summer bridge program.

This result is in line with previous studies on summer bridge programs that found numerous positive benefits such as higher academic achievement than similar students who were not involved in summer bridge programs (Ackerman, 1991). At Bowling Green State University, the Academic Investment in Math and Science program (AIMS) reported that students who participated in the AIMS program held a higher GPA than students who did not participate in the program after seven semesters (Gilmer, 2007). Further, The Program for Women in Science, Engineering, and Mathematics (PWISEM) found that after one year students who participated in the program significantly remained in the STEM fields than students who did not participate (Kahveci, Southerland, & Gilmer, 2006). Additionally, another study of a summer bridge program found the program participants academic and social engagement increased over the first two years of the program, and the retention rate after eight semesters was higher than the non-participants (Walpole, Simmerman, Mack, Mills, Scales, & Albano, 2008). Given the results of these previous studies, the result of this study adds to the previous literature and corroborates the effects summer bridge programs have on retention.

Academic Performance and Gender of Participants and Non-Participants

How do participants and non-participating engineering students compare on high school GPA, SAT Quantitative scores, first year college GPA and gender?

Academic Performance

The results from this study are mixed considering the hypothesis that participating students will have equivalent high school GPAs, SAT Quantitative scores, first year in college GPA and gender ratios when compared to non-participating students. In particular, the results show that the non-participating students outperform the participating students in high school GPA and SAT quantitative scores however there was no significant difference found between the groups on first year college GPA. These results provide positive support for this summer bridge program. Since the summer bridge program is a self-selected program, where students who are interested in the program select themselves in order to participate, we can only speculate that students who enroll feel they will benefit from the program. The data show that the non-participating students hold higher high school GPAs and SAT Quantitative scores; however, they don't have a statistically higher first year college GPA than the students who completed the summer bridge program. From these data we can conclude again that students who enroll in the summer bridge program are lesser prepared students; however, after going through the summer bridge program they perform similarly to the non-participating students on first year college GPA providing evidence that the summer bridge program is effective in assisting lesser prepared students to perform similarly to students with higher GPAs and SAT quantitative scores. This is also consistent with previous literature that found that success in college is related to the degree to which previous educational and personal experiences have equipped students for the expectations and demands college will place upon them (Conley, 2008; Kahveci, Southerland, & Gilmer, 2006; Walpole, Simmerman, Mack, Mills, Scales, & Albano, 2008). Given that a summer bridge program is undertaken during the first semester of a

student's college career it can be characterized as a previous educational and personal experience that equips students for college demands and expectations. Thus, the summer bridge program can be considered to be a positive influence on a student's college success.

Gender

The second part of the above hypothesis states that participating students will have equivalent gender ratios when compared to non-participating students. The results found this part of the hypothesis to be true. When the groups were tested to see if any differences were statistically significant with regard to gender no evidence was found to support any differences existed. However, the descriptive statistics show that slight differences existed between the groups. The participating group was comprised of 77.1% male and 22.9% female where the non-participating group was contained 74.2% male and 25.8% female. This is in line with current studies that show females make up approximately 18 – 20% of engineering majors (Noeth, Cruce, & Harmston, 2003).

Although the previous results of this study the regression Model 2 showed that females were less likely to enroll in the summer bridge program female students were enrolling at similar rates as non-participating female students. This suggests that both genders enrolling in engineering majors find the offering of a summer bridge program proportionally appealing. Additionally, this could suggest that female engineering students have similar intentions to persist in engineering as males engineering students. This has been found in previous studies where researchers were examining undergraduate engineering majors' intentions to persist in their degree programs (Concannon & Barrow, 2009).

Impact on Quantitative Gateway Courses and Withdrawal rates

What is the relationship between the participating and non-participating students in calculus and chemistry when compared by final grades and withdrawal rates?

Quantitative Gateway Courses

Students who aspire to become scientist or engineers begin their college careers by taking challenging sequentially organized, quantitative course including calculus and chemistry physics and the like. Due to the challenging nature of these courses, they can open doors to the upper-division course work, or they can block any future enrollment if they are not completed successfully. Previous studies have reported that the students who decided on a science or engineering majors already have a good background in mathematics and science and performed well on the SAT and had good high school GPAs (Rawls, 1991; Zhang, 2004). The results of this study are similar by showing that no significant differences were found for any of the calculus or chemistry final course grades between the participants and non-participating students. Further, the results from this study also suggest those students who have chosen engineering as they major have some or a good background experience in mathematics and science and were not statistically different between the participants and non-participants.

An explanation of this result could suggest, that the participating students who are academically lesser prepared and are just as successful as the students who did not go through the summer bridge program, that the two groups were both equivalent in their preparation in chemistry and calculus since the two group were not significantly different in their grade performance in either course. This provides some evidence that suggest that the calculus and chemistry review sessions included in the summer bridge

program were effective at preparing lesser prepared students to perform at the same level as better prepared students who did not participate.

Withdrawal Rates from Quantitative Gateway Courses

Quantitative Gateway course such as calculus, chemistry and physics are reported as foundational courses for engineering. However, according to the Mathematics Association of America, college freshmen that enroll in calculus courses are being filtered out of majors such as engineering, science and mathematics because of lack of success in entry level mathematic courses (Olsen, Knott, & Currie, 2009). Further, the authors stated that lack of success in these courses was due to lack of pre-college preparation. Another study found similar results at the University of Alabama where they report that 60%-70% of engineering freshmen are not calculus ready (Gleason, et al., 2010).

The results of this study support the hypothesis that participants and non-participants student's withdrawal from calculus and chemistry courses at similar rates. Specifically, the results show that the participating student's withdrawal rates were not statistically significant when compared to the non-participating students in all courses chemistry and calculus courses except Honors Calculus 1. However, this difference can be explained by looking closer at the frequency data. The frequency data in Table 4-12 shows only one participating student withdrew from Honors Calculus 1 and zero non-participating students withdrew from Honors Calculus 1 over the span of the study. Although a significant result, it only accounts for one student withdraw over a span of four freshman cohorts. Additionally, the nature of honors courses, being comprised of honors students, lends itself to students who are high performing student and seldom withdrawal from courses.

The results provide some evidence that the summer bridge program is effective in preparing students to take on quantitative gateway courses and perform similarly, with respect to withdrawal rates, to non-participating students.

Contributions to Engineering Summer Bridge Programs

This study makes a contribution to the engineering summer bridge programs by providing a study on students that completed an engineering summer bridge program designed for all incoming engineering students. Utilizing a longitudinal methodology to emphasize the importance of tracking the academic performance and the explanation of important factors that affect engineering student's decisions to either stay in engineering or leave for other majors. Further, this study provides a standard for future comparative studies of students who participate in an engineering summer bridge program and students who do not participate in an engineering summer bridge program. Additionally, this study makes a contribution to the study of higher education by providing a model and rationale for continued study of the academic performance and factors associated with the retention of engineering students who participate in summer bridge programs.

This study further seeks to advance awareness of the impact student participation in summer bridge programs. Engineering summer bridge programs have the ability to make a difference with students' decision whether to stay in engineering or select another major. This study highlights the barriers and opportunities that an engineering summer bridge open to all students can benefit from in hopes that engineering colleges will utilize such data to develop larger summer bridge programs to benefit both the success of the student and the engineering colleges.

Finally, this study provides governing bodies and institutional administrators vital information on the outcomes of engineering summer bridge programs. This information

suggests areas where more human and financial resources should be directed in the future to grow the return on investment made by the state through and institutions toward increased student retention in engineering.

Implications for Practice

Since the 1970s institutions of higher education have been challenged to retain students to meet the changing demands of society. One of the most common solutions utilized to retain students in higher education has been the summer bridge programs. Initially, the engineering community within higher education used summer bridge programs to retain underrepresented students in engineering. However, over time the success of these engineering summer bridge programs has not raised the engineering colleges overall retention rate. From this result, it was thought by replicating the success of the former summer bridge programs but open enrollment to all incoming engineering students would positively impact the overall retention rate of engineering schools. From this study, it has become clear that aims for increased retention rates can be attained through rigorous development of summer bridge programs designed for all incoming engineering students. Based on the results from this study, I present three recommendations that institutions and practitioners at engineering colleges can better support retentions efforts of engineering students at their institutions.

First, this study begins to outline a profile of a student that might benefit more from completing a summer bridge program. The development of a target profile that includes their high school GPA and SAT Quantitative scores could provide a more persuasive argument for enticing students who would benefit most from the program to enroll and further increase the overall retention rate. Additionally, through this profile,

students and parents could have more data to make an informed decision on whether to participate in engineering summer bridge program or not.

Second, given that first semester grades in calculus were found to be a predictor of retention, additional attention should be given to calculus. This could be accomplished either during the summer bridge program or by extending the summer bridge program to include the fall semester. Since the summer bridge program at the study site's schedule is already full, adding additional attention to calculus would require removing another topic or alternatively carrying over these sessions into the fall semester. During the fall semester, students could attend cooperative, active learning sessions in calculus to further improve their calculus skills and ultimately their success which could translate into higher retention of engineering students.

Lastly, practitioners should consider sharing the profile of students, including SAT Quantitative scores and high school GPA, who are interested in studying engineering and would benefit most from participating in an engineering summer bridge program with high school officials such as guidance counselors. This would allow K-12 school officials to share this information with interested students and parents so they could adequately recommend additional or advanced track of mathematics that would benefit the student. Additionally, students would have some benchmarks to aim for earlier in their high school career. This would also allow students to begin to understand the expectations of considering a major in engineering and other science related majors.

National, State and Institution Policy Recommendations

Since the early 1960s several colleges saw massive expansion in enrollment due to many governmental initiatives that made a college education desirable. The National

Youth Administration in an effort to lessen the effects of the Depression funded postsecondary educational opportunities to thousands of students, the GI Bill was introduced to help returning soldiers gain skills to reenter the workforce, finally the National Defense Education Act of 1958 and the Higher Education Act of 1965 were also passed in an effort to encourage college enrollment (Berger & Lyon, 2005). As enrollments rose, institutions began to think about retention and began to monitor enrollments; however, only several attempts were made to systematically assess patterns of retention.

The past four decades in engineering education, many attempts have been made to increase enrollment and graduation rates of students obtaining Bachelors of Science in engineering degrees. Nearly, every campus in the U.S. has at least one program designed to foster minority retention (Ohland & Crockett, 2002). This is mainly due to the poor retention rate of engineering students which continues to hover around 50% nationally. However, it has been reported that many of the initiatives put in place to improve retention have not been studied to determine if they are effective (Ohland & Crockett, 2002; Walpole, Simmerman, Mack, Mills, Scales, & Albano, 2008). Accordingly, proposed here are three possible national, state and institutional policies to enhance the probability of success of engineering summer bridge programs and students pursuing engineering degrees.

First, continued national funding not only to produce summer bridge programs but new funding initiatives to also research them vigorously is paramount. Some results have been produced with respect to summer bridge programs; however, they are not comprehensive and leave out the study of the program components themselves

(Ohland & Crockett, 2002; Walpole, Simmerman, Mack, Mills, Scales, & Albano, 2008). Further, studies of the components could provide evidence of what works in summer bridge programs. This will allow other programs to make adjustments to their program if necessary and provide them with better overall results, mainly higher retention rates.

Additionally, summer bridge programs provide volumes of necessary support for incoming students; however, after the first year support wanes students are left to their own devices to complete the rest of their college career. Engineering colleges should consider developing an inter-curriculum program where support can be continued for students throughout their college career until graduation. Since strides are being made in the freshman year, advantage should be made of this success for the remaining years. Attention must be given to the interweaving of the academic support with respect to curriculum demands and dwindling resources; however, the summer bridge program model could provide the outline for this type of needed program.

Lastly, institutions should consider supplementary mathematics and science instruction reviews as part of the required curriculum to capture those students who cannot attend summer bridge programs and have scores below the profile of successful students. Although the engineering curriculum is already full with little room for electives or extra classes many students come to college with Advance Placement, International Baccalaureate, or Dual Enrollment credit that eliminates some college curriculum requirements. Given this situation, engineering colleges should considering requiring additional supplementary mathematics and science review sessions for students that do not have adequate SAT Quantitative scores or high school GPAs. This initiative would allow students who did not participate in the engineering summer bridge program to

experience the benefits of the mathematics and science reviews. This effort would allow students to simultaneously take their first college mathematics and science course while also obtaining additional instruction that would enhance their success and ultimately lead to increased retention.

Suggestions for Future Research

Through this study, it is anticipated that additional empirical research will be conducted on the factors that contribute to the success of engineering summer bridge programs in order to develop best practices and best components. To address these issues, the direction of future research could take on many different shapes. Based on the findings of this study, I provide several areas where future research may be important to expand the current literature on the successful factors of engineering summer bridge programs and the outcomes of students participating in engineering summer bridge programs.

More research on the factors included in a summer bridge program, that contribute to the retention and graduation of an engineering students is warranted. Further understanding of the components that contribute the retention and overall graduation rates would be beneficial in designing and redesigning summer bridge programs to become more effective in reaching their goals.

Further, additional study on the demographic factors from students that participate in summer bridge programs is needed. A richer picture of students that benefit most from summer bridge programs would illuminate a better profile and target for potential participation. Possible demographic factors that should be considered include socio-economic status, first generation in college, high school ranking, house hold size, cost/benefit, etc. Additionally, researchers could consider the draw of the

reputation of an institution as a factor. For example, the reputation of a public state university versus the reputation of a public flagship university might provide insight on what students attend and participate in retention programs. These factors would offer a greater understanding of students who would not only benefit the most from a summer bridge program but also allow the development of other programs and services to assist students continue in their engineering programs. These factors could also reveal themselves to be inhibitors to participation or predictors of exclusion which could inform program directors.

Additionally, increased quantitative and qualitative research of factors that enhance retention through the second year of engineering school is needed. Current retention efforts in engineering focus primarily on the first semester and first year. However, during the second year of engineering school approximately 25% of the sophomore level students leave the discipline for other majors, other institutions or higher education altogether. This research would allow for the development of effective programmatic solutions and services would extend retention efforts and ultimately graduation rates.

A longitudinal study that compares participants and non-participants over a longer period of time is appropriate. Other types of summer bridge programs that assist students in non-engineering majors such as mathematics, chemistry, physics, biology, should be developed and examined. Additionally, a study across several types of different institutions that employ summer bridge programs could provide new insights. These types of studies hold the potential to expand the small body of evidence on the

effectiveness of summer bridge programs and provide solutions to our need for a highly skilled diverse workforce.

Lastly, future quantitative and qualitative research on the lack of female participation in engineering summer bridge programs is suggested. Females are already a minority population in engineering programs and increasing their participation in engineering summer programs could prove beneficial in retaining and graduating more female engineers. A greater understanding of why or why they do not participate will increase awareness of their decision making process. This research could prove beneficial to addressing female concerns and provide a more effective summer bridge program.

Closing Summary

If we observe what the past 20 years in engineering education has produced and glance at the future of engineering education, one can easily that the potential for improvements is vast. Over the past four decades, engineering summer bridge programs have proven their worth in several development areas and have made impacts on retention (Garcia, 1991). These programs in support of the institutional and college missions provide an opportunity in which institutions can further support the personal academic goals of its students. This approach of providing academic support to further the academic goals of student in areas where evidence based practices are proven to provide positive results is a standard worthy of action.

This study was intended to explore the factors that contributed to the success of a first year engineering summer bridge program designed for all incoming engineering freshman. This study compared participants of a summer bridge program and non-participants to investigate if any similarities existed. Moreover, predictors of retention

between the participants and non-participants were explored. Additionally, this study attempted to demonstrate if relationships between this intervention and an increase on retention by utilizing predictive and descriptive statistics to explain the phenomena between the two groups.

Utilizing various quantitative methods including logistic regression, results indicated that the engineering summer bridge program was successful in retaining students at a higher rate than the non-participants. Additionally, the students who decided to participate and completed the engineering summer bridge program were significantly different that the non-participants on several variables. As shown through this study, summer bridge programs serve an increasing need and a foundation on which increased human potential and effective use of resources creates benefits that are felt by many.

APPENDIX A
INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL LETTER

UF Institutional Review Board
UNIVERSITY of FLORIDA

PO Box 112250
Gainesville, Fl32611-2250
352-392-0433 (Phone)
352-392-9234 (Fax)
irb2@ufl.edu

August 24, 2010

TO: Jeffrey M. Citty
PO Box 116550
Campus

FROM: Ira S. Fischler, PhD; Chair
University of Florida
Institutional Review Board 02

SUBJECT: **Exemption of Protocol #2010-U-0752**
The Effectiveness of an Engineering Summer Bridge Program: A Study of the Past Four Years

SPONSOR: None

Because this protocol does not involve the use of human participants in research, it is exempt from further review by this Board in accordance with 45 CFR 46. Human participants are defined by the Federal Regulations as living individual(s) about whom an investigator conducting research obtains (1) data through intervention or interaction with the individual; or (2) identifiable private information. The Board has also exempted the study based on the following category:

> *45 CFR 46.101(b(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.*

Should the nature of your study change or if you need to revise this protocol in any manner, please contact this office before implementing the changes.

IF:dl

APPENDIX B
SUMMER BRIDGE PROGRAM INVITATION LETTER

March 1, 2010

To the parent(s) of:

Dear Parent/Guardian(s) of:

On behalf of the University of Florida (UF) College of Engineering, I congratulate you on the distinction of your admission into our great university and thank you for your desire to join us in the Community of Gator Scholars. While you ponder the important decisions about your future, do not hesitate to visit our College of Engineering web site at http://www.eng.ufl.edu, and feel free to contact the dedicated staff of professional advisors and program assistants in Engineering Student Affairs at 352-392-0944.

Let me also encourage you to strongly consider participating in one of our two "bridge" programs for first-year students, Successful Transition through Enhanced Preparation for Undergraduate Programs (STEPUP) and the Engineering Freshman Transition Program (EFTP). Students who have participated in these programs in the past fifteen years of STEPUP and seven years of EFTP have shown greater success in their first-year classes and overall retention in engineering compared to students who have not. You will find more details and contact information for these programs in the enclosed brochures.

The National Academy of Engineering recently defined fourteen Grand Challenges of Engineering that will shape the future of the field of engineering and will become the Great Work of our discipline (http://www.engineeringchallenges.org). Never before has engineering been more important to improving the quality of life throughout the world. I assure you that Gator Engineering faculty and students in all of our eleven departments that grant B.S. degrees are actively engaged in solving these Grand Challenges. We hope that you join us in this Great Work!

Sincerely,

Angela S. Lindner, Ph.D.
Associate Dean for Student Affairs

APPENDIX C
SUMMER BRIDGE PROGRAM WEB APPLICATION

EFTP Application

Applicant Information

First Name: | Middle Name: | Last Name: | UFID: -

Birthday (mm/dd/yyyy): / / | E-mail Address: | Gatorlink Username: | Phone: - -

Local Address: | City: | State: | Zip:

Gender: | T-Shirt Size: | Citizenship: | If other country, specify: | Ethnicity: | If other, specify:

Disabled? | If yes, specify disability: (Reasonable accommodations will be provided. Contact our office for more information.)

Household Income: | Household Size: | Guardian Name: | Guardian E-mail:

Are you the first member of your family to attend college? | Term Admitted:

I understand that if I selected Fall as my "Term Admitted" that my registration will be changed to Summer B and it will not be changed back. Please take this decision seriously. (You must check this box regardless of term selected to verify that you have read these terms.)

Academic Background

High School Attended: | HS Class Ranking: | FCAT High School Ranking: (e.g. A,B,C, etc):

Unweighted HS GPA: | Weighted HS GPA: | Are you receiving Bright Futures? | If so, what level:

Check all that apply:
Florida Prepaid | National Merit Finalist | National Achievement Scholar | National Hispanic Scholar

List other Scholarships:

Has the University of Florida Honors Program invited you to participate in the honors program?

College Entrance Exam Scores (Best Scores)

SAT: Math: | Verbal:

SAT II: Math:

ACT: Math: | Verbal:English

The engineering curriculum requires strong interest and demonstrated ability in math and science. In the list below, indicate the grades you earned in the courses that you have completed in high school. If you are currently enrolled in a course and have not received a grade, please enter "IP" (for "In Progress"). **If you have more than one grade for a course, enter each grade separated by a space. Example: B+ A.**

Algebra II: | Calc (Honors): | Physics: | Chem:

Trigonometry: | Calc (AP-AB): | Physics (Honors): | Chem (Honors):

Geometry: | Calc (AP-BC): | Physics (AP): | Chem (AP):

Calc (IB): | Physics (IB): | Chem (IB):

Calc (Dual Enroll): | Physics (Dual-Enroll): | Chem (Dual-Enroll):

AICE Math: | AICE Physics: | AICE Chem:

Submit Application

APPENDIX D
SUMMER BRIDGE PROGAM CONTRACT

University of Florida College of Engineering
Engineering Student Affairs

Engineering Freshman Transition Program 2010

EFTP Student Acceptance of Admission & Contract

This acceptance form and contract must be signed by student and parent and returned to:

Mr. Jeff Citty
UF College of Engineering
PO Box 116550/204 Weil Hall
Gainesville, FL 32611-6550

Signed contracts must be received no later than June 11, 2010.

PROGRAM DESCRIPTION AND LENGTH OF CONTRACT

EFTP is an academic enhancement program that is designed to prepare engineering students for college success. The residential component of the program which takes place during the Summer B term June 28 – August 6, and program support continues through Fall and Spring semester of the student's first year. Students are expected to participate in the EFTP for a period of 11 months: June 28, 2010 - May 2, 2011.

Part I: Summer B June 28, 2010 - August 6, 2010

Check-in Residence Halls/Apts.

If you accept this offer to participate in EFTP, you can check in to your residence halls as early as Wednesday, June 23 beginning at noon. If you have difficulty locating your residence hall, contact the Housing Department at (352) 392-2161.

If you will be renting an apartment, you should make arrangements to move in prior to EFTP Orientation.

Orientation/EFTP Check-in

On Saturday, **June 26 at 1:30 P.M. in the Reitz Union Rion Ballroom** we will be holding an afternoon orientation program which is designed to provide EFTP participants and their parents with information on EFTP, the College of Engineering, and the University of Florida. Students are required to attend the orientation. Parents are strongly encouraged to attend the afternoon orientation.

EFTP "Freshmen Engineering" Course

All students participating in EFTP **must** be enrolled in our EFTP courses for a total of 5 Credits. Additionally, students **must** sign up for EGN1002 for 1 credit. During day two of your Preview session you will complete your EFTP registration by signing up for the following courses: **TBA**

University of Florida College of Engineering
Engineering Student Affairs

Engineering Freshman Transition Program 2010

Complete and return this page only

Student Conduct Code

EFTP participants must actively participate in all scheduled academic, counseling, team building, and panel/presentation activities. Participants must also be on time for all scheduled events as attendance will be closely monitored.

Part II: Fall and Spring Component

August 23, 2010 – May 2, 2011

In addition to the Summer B program, EFTP participants are expected to maintain contact with mentors on a weekly basis and attend functions offered by mentors and/or College of Engineering, Engineering Student Affairs.

CONTRACT

I, _____, accept the University of Florida College of Engineering's invitation to participate in EFTP, I have read and understand the rules and regulations of the EFTP, and I agree to abide by them.

_____ _____

Student Signature Date

I have read and understand the rules and regulations of the EFTP.

_____ _____

Parent Signature Date

APPENDIX E
SUMMER BRIDGE PROGRAM RELEASE AND HOLD HARMLESS AGREEMENT

University of Florida College of Engineering
Engineering Student Affairs

Engineering Freshman Transition Program 2010

EFTP RELEASE AND HOLD HARMLESS AGREEMENT

In consideration of being allowed to participate in the University of Florida College of Engineering's Engineering Freshman Transition Program (EFTP) program, and the educational benefits to be derived therefrom, we (hereinafter "RELEASORS") hereby **RELEASE, WAIVE, DISCHARGE AND COVENANT NOT TO SUE**, the University of Florida, the Board of Trustees, the State of Florida, their officers, employees, or agents (hereinafter "RELEASEES") from or for any and all liability, claim, demands, actions or causes actions arising out of or relating to any loss, damage, or injury that may be sustained or incurred by student unless such loss, injury or damage is caused solely by negligence of the RELEASEES. Further, RELEASORS hereby indemnifies and hold harmless RELEASEES from any and all liabilities, including judgements, damages, settlements, costs of defense and attorneys' fees which RELEASEES may incur as a result of a third party's claim, demands, or action for damages or compensation for injuries to person or property, to the extent such injuries result from the negligent or deliberate act or omission of student.

RELEASORS:

_____ _____
Student Date

_____ _____
Parent or Legal Guardian Date

_____ _____
Parent or Legal Guardian Date

EFTP
Release Form

APPENDIX F
SUMMER BRIDGE PROGRAM LETTER OF ACCEPTANCE

UF Engineering Student,

Congratulations! You have been conditionally admitted to participate in the College of Engineering's *Engineering Freshman Transition Program (EFTP)* from June 28 – August 6, 2010. This program is designed to equip you with essential skills for engineering success.

In order to participate and complete your enrollment in EFTP, several requirements must be accomplished. First, you must go to the following web links and print out each form, complete them with your parents and return them to our office by the deadline of **JUNE 11**.

a) Acceptance form & contract: http://engnet.ufl.edu/students/files/contract.pdf
b) Release form http://engnet.ufl.edu/students/files/release_form.pdf
c) Information guide http://engnet.ufl.edu/students/files/info_guide.pdf

Second, if you have not registered for orientation (Preview), you must do so ASAP. Please go to http://www.dso.ufl.edu/nsp/orientation/ to register online or call the Dean of Students Office for assistance at (352) 392-1261. Please remember to sign up for one of the orientations offered for summer B entering students.

Finally, you will need to register for the EFTP courses that will be given to you at your orientation (Preview) session. Upon completion of all three of these tasks you will be fully registered for EFTP and ready to attend our orientation session on June 26. Details of the orientation will be sent out after the June 11 deadline.

If your student has a fall admission date we are currently working to have it switched to summer B. Once this is accomplished and you are notified by the admission office, you can obtain housing and register for a summer B preview session.

Once again, congratulations on your selection for EFTP. My staff and I look forward to working with you as you make this very important transition to college. If you have any questions or concerns, please contact me Mr. Jeff Citty at (352) 392-0944 or jcitt@eng.ufl.edu.

Sincerely,

EFTP Director

APPENDIX G
SUMMER BRIDGE PROGRAM FINAL LETTER

To the Parent(s) of:

Dear Parent(s) of:

Congratulations! Your student's application for EFTP program has been completed! We are excited to meet you and your student on Saturday June 26, 2010 at the EFTP student welcome & orientation session.

The Welcome and Orientation session will be held in the Reitz Union Rion Ballroom. We have enclosed a campus map to help familiarize you with the campus. There is one parking garage that is attached to the Reitz Union / Welcome Center and is free of charge during weekend hours. On your campus map it is labeled parking garage 12. Check-in will begin at 12:45 p.m. and the program will begin at 1:30 p.m. For your enjoyment, we also will have refreshments and hors d'oeuvres served between 12:45 p.m. – 1:30 p.m. **The welcome and orientation session for the parents will last until approximately 2:30 p.m.; however the students will stay until approximately 5:30 p.m.** During this time parents can go purchase books, run errands, or enjoy the campus. If for some extenuating circumstance your student cannot attend orientation they must meet with me in WEIL 204 at 7:30 A.M. on Monday June 28th to receive their EFTP schedule and information missed during orientation.

At check-in your student will receive an EFTP folder with their personal schedule with room assignments that will cover courses not covered on ISIS, summer B event calendar, exam schedule, orientation program and contact information. We have enclosed an overview schedule to help familiarize your student with the EFTP activities.

Please feel free to purchase your text books and LEGO NXT before or after the EFTP orientation. Each student is required to have access to a laptop computer during the EFTP program as AutoCAD and LabVIEW courses will require in-class use. Additionally, all students will be required to purchase the LEGO Mindstorm NXT Base Set from the UF bookstore to participate in the program. This kit will serve as the textbook for the Design course. The UF bookstore has a special reduced price for our students. Once you purchase your kit you will receive only a receipt. The kits will be delivered to students with their receipt during the first week of this course. These kits are **NON-REFUNDABLE** once you purchase them you cannot return them to the bookstore. Please contact the bookstore directly at (352) 392-0194 or email ufl@bkstr.com with any questions or concerns regarding these materials.

Please note that the students will be expected to participate in a formal presentation regarding their design project and should include business casual clothes when packing clothes for this semester.

EFTP mentoring will continue throughout the fall and spring semesters of the students first year and students are expected to participate. Below is a description of the expectation of EFTP students during the fall and spring semesters:

The EFTP program is designed to foster relationship building between upper and lower division students in the College of Engineering. During EFTP, each student will be assigned a Student Mentor who will serve as a resource for each student. With this in mind, we have asked each student, through their EFTP contract, to commit to continuous communication with their assigned Mentor throughout the fall and spring semesters. The minimum requirement asks that each student contact their Mentor at least once a week via email, telephone, or through a meeting. This should only require ½ hour to 1 hour a week of EFTP student's time to assist them in achieving their academic goals. This is designed to allow the Mentors to point out resources and provide support that is tailored to each individual student.

Congratulations again and welcome! I look forward to meeting you and your student. Please feel free to contact me at (352) 392-0944 or jcitt@eng.ufl.edu if you have any additional questions or concerns.

Very Best Regards,

Assistant Director, Engineering Student Affairs
/Enclosures

LIST OF REFERENCES

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BIOGRAPHICAL SKETCH

Jeffrey M. Citty was born to Robert and Libby Citty in April of 1975, in Tampa, Florida. The younger of two children, Jeff grew up in Tampa and graduated from T.R. Robinson High School in 1993. Upon completing high school, he attended Hillsborough Community College and earned his associate's degree during the summer of 1995. Jeff moved to Gainesville to continue his academic studies at the University of Florida (UF). At UF, he earned his Bachelor of Science (B.S.) degree in Recreation, Parks and Tourism in 1997.

After his graduation, Jeff completed a nine month extended internship with the Walt Disney World Company in Orlando Florida. Following Jeff's senior internship he held positions in the non-profit and for profit sectors where he gained experience in management, sales, and data analysis. Through these experiences Jeff felt the desire to return to UF to complete an advanced degree.

In 2001, Jeff began working on his master's degree in education, while simultaneously working full time as a Coordinator for Student Financial Affairs. Once he completed his master's degree in December of 2003, he continued his student affairs career at UF by accepting a Coordinator position in the Engineering Student Affairs office with dual responsibilities of advising and administering an engineering summer bridge program designed for all incoming engineering students.

After four years of full-time student affairs work, Jeff decided to return to the College of Education to pursue his doctoral degree in Higher Education Administration. Again, Jeff worked simultaneously as a Coordinator in the Engineering Student Affairs office while pursuing his terminal degree. During his pursuit of his terminal degree Jeff was promoted to Assistant Director in the Engineering Student Affairs office and was

also recognized by the National Academic Advising Association with a certificate of merit for Outstanding Advising during the 2009 national conference. In the fall of 2011, he received his Ed.D. from the University of Florida.