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DISSERTATION

ENGINEERING STUDENTS' AND FACULTY PERCEPTIONS OF TEACHING METHODS AND THE LEVEL OF FACULTY INVOLVEMENT THAT PROMOTES ACADEMIC SUCCESS

Submitted by

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY LACY N. KARPILO ENTITLED ENGINEERING STUDENTS' AND FACULTY PERCEPTIONS OF TEACHING METHODS AND THE LEVEL OF FACULTY INVOLVEMENT THAT PROMOTES ACADEMIC SUCCESS BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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ABSTRACT OF DISSERTATION

ENGINEERING STUDENTS' AND FACULTY PERCEPTIONS OF TEACHING METHODS AND THE LEVEL OF FACULTY INVOLVEMENT THAT PROMOTES ACADEMIC SUCCESS

Student academic success is a top priority of higher education institutions in the United States and the trend of students leaving school prior to finishing their degree is a serious concern. Accountability has become a large part of university and college ratings and perceived success. Retention is one component of the accountability metrics used by accreditation agencies. In addition, there are an increasing number of states allocating funds based in part on retention (Seidman, 2005). Institutions have created initiatives, programs, and even entire departments to address issues related to student academic success to promote retention. Universities and colleges have responded by focusing on methods to retain and better serve students. Retention and student academic success is a primary concern for high education institutions; however, engineering education has unique retention issues. The National Science Board (2004) reports a significant decline in the number of individuals in the United States who are training to become engineers, despite the fact that the number of jobs that utilize an engineering background continues to increase. Engineering education has responded to academic success issues by changing curriculum and pedagogical methods (Sheppard, 2001).

This descriptive study investigates the perception of engineering students and faculty regarding teaching methods and faculty involvement to create a picture of what is occurring in engineering education. The population was the engineering students and faculty of Colorado State University's College of Engineering. Data from this research

suggests that engaging teaching methods are not being used as often as research indicates they should and that there is a lack of student-faculty interaction outside of the classroom. This research adds to the breadth of knowledge and understanding of the current environment of engineering education. Furthermore, the data allows engineering educators and other higher education professionals to gain insight into the teaching methods currently being utilized in engineering and reinforces the importance of student-faculty interaction and thus facilitating the creation of programs or initiatives to improve student academic success.

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DEDICATION

To Ron, the love of my life, who has also provided unrelenting support and encouragement to help me reach my goals no matter how big they may be.

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CHAPTER 1: INTRODUCTION

Student academic success is a top priority of higher education institutions in the United States and the trend of students leaving school prior to finishing their degree is a serious concern. The national retention rate (first year students returning for their second year) for higher education institutions in 2005 was 75.8% (National Center for Higher Education Management Systems, 2008). Accountability has become a large part of university and college ratings and perceived success. Retention is one component of the accountability metrics used by accreditation agencies. In addition, there are an increasing number of states allocating funds based in part on retention (Seidman, 2005). Institutions have created initiatives, programs, and even entire departments to address issues related to student academic success. Universities and colleges have responded by focusing on methods to retain and better serve students.

Retention and student academic success is a primary concern for higher education institutions; however, engineering education has unique retention issues. The National Science Board, or NSB (2004) has seen a significant decline in the number of individuals in the United States who are training to become engineers, despite the fact that the number of jobs that utilize an engineering background continues to increase. The number of jobs in the engineering and science fields has been growing 5% a year compared to other fields, which report a growth of only 1% (NSB). How can the number of engineering students be increased and retained? Engineering education has attempted to address these questions by utilizing many methods, particularly pedagogical changes in the classroom. In the past decade, major funding and national attention has focused on engineering education to address these concerns (Sheppard, 2001). New and innovative

programs are being developed to help students manage problems they might encounter in academic, personal, and social areas of the college experience. There is a paradigm shift to focus on the student from a holistic perspective with an emphasis on out-of-class experiences and interactions with faculty (Love, 1995). These supportive services and faculty interactions are part of the puzzle in student academic success and retention.

Retention, Academic Success, and the Role of Faculty

Many research studies have addressed student academic success and retention in the past three decades (Pascarella & Terenzini, 2005; Seidman, 2005; Braxton, 2000; York & Longden, 2004; Kuh, Kinzie, Schuh, & Whitt, 2005; Tinto, 1993; Astin, 1999). The research ranges from policy development (funding/accreditation) and institutional research, which focuses on the individual university (Kuh et al.), to individual student experiences (Bean, 2005; Astin). Researchers have found that positive student-faculty interaction (Kuh et al.; Braxton, Bray, & Berger, 2000; Tinto; Bean; Astin), active and collaborative teaching methods (Kuh et al.; Braxton; Terenzini, Cabrera, Colbeck, Parente, & Bjorklund, 2001), supportive campus environments (Kuh et al.), and a social and educational community (Tinto) leads to student academic success and retention.

Tinto (1993), one of the leading theorist and researchers in the field of student retention, with over 400 citations (Braxton et al. 2000), indicates that effective retention depends on a commitment to students and their education as well as developing a social and educational community at the school. Tinto states that:

> effective retention programs are committed to the students they serve, they put student welfare ahead of other institutional goals . . . committed to the education of all, not just some, of their students . . . committed to the development of supportive social and educational communities in which all students are integrated as competent members (p. 146-147).

An institution's commitment can be established by reaching out to students to determine what problems or struggles they are facing and by assisting them in building relationships with other students, faculty, and staff (Moxley, Najor-Durack, & Dumbrigue, 2001). Tinto (1993) further recommends that "incentives have to be structured as to allow faculty and staff to become active participants in the process through which programs are developed" in order to achieve successful implementation of retention and student academic success programs (p. 150). The above models of retention address the importance of faculty in facilitating student academic success.

Faculty play a pivotal role in student academic success and retention. Braxton et al. (2000) build on Tinto's model and examine students' perceptions of faculty teaching skills and the impact on student persistence. Faculty organization, preparation, instructional skills, and clarity had a positive impact on students' "social integration, subsequent institutional commitment, and intent to reenroll" (p. 222). This demonstrates the importance of the classroom experiences of students in relation to their persistence in school. Terenzini et al. (2001) found that by using active and collaborative teaching methods compared to traditional methods, students had statistically significant greater gains in learning. Faculty can have a significant impact inside the classroom through their teaching methods.

Yorke and Longden (2004) recommend when addressing the issue of retention, it is optimal to create a program for student academic success through teaching, learning, and support services, rather than focusing on the end goal of improving retention. Hence, the school should focus on student-faculty interaction and teaching methods to create a positive environment that promotes academic success.

Utilizing empirical and theoretical studies of college retention from 1976 to the present, Bean (2005) found nine themes that impact retention, which include "the student's background, money and finance, grades and academic performance, social factors, bureaucratic factors, the external environment, psychological and attitudinal factors, institutional fit and commitment, and intentions" (p. 216). Bean's themes are centered on attitude-behavior theory and create a series of experiences that lead to a student's decision to leave school. The model implies that a student's interaction with the school (peers, faculty, staff, etc) leads to particular attitudes about their experiences that can contribute to their departure. Through this model there is a point where interventions can be made. By creating a positive interaction, the student should develop a positive attitude; therefore, frameworks must be in place to create a positive experience for students.

As mentioned previously, students will not be successful if they are passive participants in their college experience. Astin's (1999) student involvement theory puts the concept of students as active participants in their education into the forefront. Student involvement theory utilizes a framework that incorporates other researchers and theorists to create a concise conceptualization of student academic success. Student involvement is defined as "the amount of physical and psychological energy that the students devote to the academic experience" (p. 518). Student involvement theory in relation to persistence allows, "that virtually every significant effect could be rationalized in terms of the involvement concept; that is, every positive factor was likely to increase student involvement in the undergraduate experience" (p. 523). Hence, student involvement is directly related to their persistence. In Astin's theory there are three significant factors:

student's place of residence, academic involvement, and student-faculty interaction. Student-faculty interaction, Astin argues, "is more strongly related to satisfaction with college than any other institutional characteristics" (p. 525). Thus, research demonstrates that faculty-student interaction and a student's active participation in school plays a critical role in academic success.

Retention and student academic success is a well-researched topic; however, most studies use the entire population of students including all majors. This research focuses on engineering students and faculty and the role that faculty and pedagogies play in a student's academic success. Much is known about student involvement, teaching methods, and other external and internal factors that impact academic success. However, there continues to be a large number of students leaving engineering programs and/or school completely. If we know what makes them successful, why are they still struggling? It has been shown that student-faculty interaction is critical to a student's academic success. Nevertheless, there is a lack of research related to teaching methods, faculty involvement, and students' attitudes about the impact of these constructs on their academic success. Few studies have involved engineering faculty and students, and even fewer have explored the attitudes of both students and faculty regarding the impact of teaching methods and faculty involvement on student academic success. This raises a series of questions: What are students' attitudes about teaching methods utilized by engineering faculty in promoting their academic success? What are the faculty and students perceptions about which teaching methods and level of faculty involvement promotes academic success? Are there similarities or differences in faculty and students responses? What are students doing in and outside of class to help them achieve academic success? What are faculty

members doing in and outside of the classroom to promote student academic success? Do faculty and students agree with which teaching methods and level of faculty involvement promotes student academic success?

Definition of Terms

University's Definition of Student Academic Success and Retention

Student academic success is defined as a combination of persistence and cumulative grade point average (cum GPA). Each university has certain standards set forth in regards to persistence and cum GPA. Persistence is categorized for an engineering student as graduating from the school with a degree in engineering. Colorado State University (CSU) requires all undergraduate students to have minimum cum GPA of 2.0 to graduate; therefore, a cum GPA of 2.0 or above is considered to be "successful." Grades will be accessible for the research; however, persistence will be difficult to track without a longitudinal study design. However, utilizing knowledge about factors that promote and predict student success, one can look at those factors to assess the likelihood of student persistence.

Teaching Methods

Teaching methods are divided into passive and active learning methods (Jacobsen, Eggen, & Kauchak, 2002; Jordan & Porath, 2006; National Research Council, 1997). Passive learning methods are defined as methods in which the student is given the information to be learned and is a passive receptor of that information. Passive learning methods include but are not limited to lecturing, homework problems, and demonstrations in class. Active learning methods are defined as methods that actively engage the student in the learning process. Active learning methods include but are not

limited to cooperative learning, problem-based learning, and collaborative learning (Jordan & Porath). Table 1 shows the teaching method activity or behavior in and outside the classroom in relation to passive and active learning.

Statement of the Research Problem

This research will contribute to the understanding of the impact of faculty involvement and teaching methods on engineering students' academic success. The current culture of engineering faculty and students will be investigated. Engineering educators are addressing student academic success issues with pedagogies (such as active teaching methods), tutoring, and other academic services. As higher education continues to funnel money and time into these efforts it is crucial to assess if students are responding positively and if they find value in the teaching techniques or methods utilized, as well as exploring the teaching methods and techniques engineering faculty are utilizing to promote student academic success. The purpose of this study is to investigate if there is a difference between each group's attitudes in relation to teaching methods and level of faculty involvement that promotes student academic success. This research will add to the breadth of knowledge and understanding about teaching methods utilized and student perceptions of these teaching methods in engineering majors. The results will allow engineering educators and other higher education professionals to gain an understanding of the teaching methods utilized in engineering, the importance of student and faculty involvement, and thus allow the creation of programs or incentives to improve student academic success.

Table 1

Teaching Methods		
Passive	Active	Passive or Active *Depending on Application*
Lecturing	Solving real world problems	Giving a quiz
Showing videos in class	Small student groups in class	Fieldtrips or visits
Lecture notes posted before class (entire or partial)	Discussion	In class reading
	Having students ask questions	Using visual aids
	Faculty asking the students questions	Classroom demonstration
	In class writing	Homework problems
	Study groups outside of class	
	Working on project outside of class	
	Graded as a group for a project or assignment	

References: Jacobsen, Eggen, Kauchak, 2002; Jordan & Porath, 2006; Chickering & Gamson, 1987; National Research Council, 1997.

Research Questions

The research will address the following questions: 1) How do engineering students and faculty responses compare in regards to their perceptions about teaching methods utilized and the level of student-faculty interaction in the college? 2) How do engineering students and faculty responses compare in regards to their perceptions about the importance of teaching methods and the level of faculty involvement that promotes student academic success? 3) How do students from different majors compare in regards

to their perceptions about teaching methods and the level of faculty involvement that promotes academic success? 4) How do students from different class levels (freshman, sophomore, etc.) compare in regards to their perceptions about teaching methods and the level of faculty involvement that promotes academic success?

Significance of the Study

This descriptive study investigated, through a survey instrument, the perceptions and behaviors of engineering students and faculty regarding teaching methods and the level of faculty involvement that impacts a student's academic success. Student success will continue to be a critical issue in higher education. Large studies have been conducted and there is a need for more specific and detailed research. The previous researchers and theorists have laid the foundation of what is needed for students to be successful. This research adds new insight about teaching methods and the level of faculty involvement in relation to student academic success and sheds light on the culture of engineering students and faculty.

Researcher's Perspective

This research is grounded in the postpositivist paradigm. Postpositivism moves away from naïve realism where there is one truth, one reality, that it is apprehensible to critical realism in which a reality does exists but with certain limitations to the apprehension of that truth (Lincoln & Guba, 2000; Mertens, 2005). John Dewey (1966) in his book *Logic: The Theory of Inquiry* states, "knowledge, as an abstract term, is a name for the product of competent inquires" (p. 8). In postpositivism those "competent inquires" are part of the researcher's duty to be accurate and objective in the research.

However, postpositivism acknowledges that there is always that unknown human element that can impact the truth even if objectivity is attempted.

The "knowledge" in this study will be investigated through quantitative research methods. In some circles quantitative and positivism are used interchangeable. However, a sound researcher should acknowledge that by simply utilizing quantitative research methods one is not removing all subjectivity, since simply choosing the problem to be explored creates subjectivity (Morgan, Gliner, & Harmon, 2006). Even with this lack of complete objectivity, through careful design one is able to get closer to a truth. This research is grounded in the idea that knowledge can be obtained about engineering students and faculty utilizing quantitative research methods.

Study Limitations

There are several limitations to this study. First, the methodology will only use quantitative measures. There are "purist" that believe that "paradigms and method should not be mixed" (Creswell, 1994, p. 176). However, a mixed-methodology design, which combines aspects of both qualitative and quantitative design in all aspects of the study could be utilized. Through this method, the researcher is able to use the advantages of each approach (Creswell). This study is rooted in a postpositivism paradigm; however, if one were going to take a pragmatic view, the research questions would be paramount and would drive the research methods (Mertens, 2005). With this pragmatic approach a mixed design could be appropriate. The mixed design could include interviews with faculty and students about student academic success. The interviews would add depth and complexity to the research, which would allow individual differences and experiences to be shared. The survey construction prevented a mixed design; however, it allowed for the survey to

be concise and easily distributed to the participants thus hopefully increasing the participation and completion rate.

Secondly, as a result of the focus of the research on one institution the generalizability to other schools with engineering majors is limited. To increase the generalizability it would be necessary to randomly sample from engineering faculty and students from other institutions. Thirdly, the survey has a few limitations based on its new design. Selecting a questionnaire already in use would allow for prior knowledge of reliability, validity, and a standard error of measurement. However, there were no measurements that addressed the necessary constructs of the proposed research. The self-reporting nature of the dependent variable could impact the responses of the students and faculty. The participants may not report realistic or honest responses about their attitude or behavior; however, this study will focus on the participants' perceptions.

CHAPTER 2: LITERATURE REVIEW

Teaching Methods

As mentioned previously, the retention and academic success of students is paramount in higher education. Researchers have found that the interaction between students and faculty has a positive impact on students (Braxton et al., 2000; Terenzini et al., 2001; Kuh et al., 2005; Tinto, 1993; Bean, 2005; Astin, 1999). The interaction can be both in and outside of the classroom. Outside the classroom faculty involvement can be attending a program in a residence hall or going to a campus wide event, while inside of the classroom involvement can consist of the teaching methods utilized. The following section will discuss teaching methods used in undergraduate education and the particular methods used in engineering education.

Undergraduate Teaching Methods

In the field of undergraduate education Chickering and Gamson (1999) suggest that the following seven principles represent good practice in undergraduate education (p. 76):

1. Encouraging student-faculty contact
2. Encouraging cooperation among students
3. Encouraging active learning
4. Giving prompt feedback
5. Emphasizing time on task
6. Communicating high expectations
7. Respecting diverse talents and ways of learning

These seven principles are centered on student interactions with their peers and faculty. Interaction between students and faculty create a supportive environment where students can get assistance when they struggle academically. Cooperation and reciprocity removes the competition and isolation from the learning process, which increases students'

involvement in their own learning (Chickering & Gamson). Active learning allows for students to be actively involved in the learning process, students have to move beyond just remembering and reciting back information. Through the use of prompt feedback, students are able to improve and learn from previous assignments or projects. Respecting and taking into consideration the diversity of student learning acknowledges individual skills and encourages students to "learn ways that work for them" (Chickering & Gamson, p. 6).

Chickering and Gamson's (1999) principles address some the issues or findings of the previously mentioned retention studies. The principles were created as a result of a task force of scholars who studied the impact of the college experience on students. Faculty members were the primary audience for the principles; however, they wanted to reach other constituents such as college administrators (Chickering & Gamson). The simplicity of the principles allows for easy transference into the classroom. Chickering and Gamson's (1987) seven principles of good practice correlate well with many of the modern teaching methods.

Traditional Method (Passive Learning Teaching Methods)

The term traditional methods commonly refers to passive learning teaching methods in which the teacher disseminates information and students become passive receivers of the information, this includes but is not limited to: lectures, closed ended questions, and/or the use of homework problems to apply previously presented information (Jacobsen, Eggen, & Kauchak, 2002). A common traditional method is instructor centered teaching where the teacher is the expert and decides what is to be taught and studied (National Research Council, 1997). Lecturing is the common method

for disseminating information particularly in large introductory classes. Discussions and laboratories can also be included in traditional methods; however, it is possible for faculty members to modify the way they utilize discussion and laboratories to engage the student in active learning.

Active Learning Teaching Methods

Active learning incorporates many methods and teaching styles in which students become active participants in their learning through problem solving, cooperative learning, and small group work (Jacobsen et al., 2002).

Problem-based learning. In problem-based learning (PBL) students are given real-world problems to address. Through PBL students are encouraged to identify the problem and the method or ways to solve the problem. PBL is unique in that it "begins with practice-based situations that facilitate the linking of theory to practice through consideration of the questions inherent in the problem" (Jordan & Porath, 2006, p. 10). Teachers utilizing PBL become facilitators and promote student learning by posing the problem and encouraging the students' own exploration rather then just disseminating information. When using PBL the students are given a problem and must identify the information needed to solve it, learn the material, and apply the learned knowledge to the solution of the problem. PBL helps students self-direct their learning and improve their ability to investigate a problem (Jacobsen et al., 2002).

PBL utilizes "interdisciplinary sets of complex problems that students learn to collaboratively solve" (Jonassen, Strobel, & Lee, 2006, p. 147). The goal of problem–based learning "is to help students develop their own problem-solving skills, rather than tell them how to solve a problem" (Steinemann, 2003, p. 218). Each of these methods,

facilitated by the professor, creates active rather than passive learning.

Cooperative learning. Cooperative learning incorporates many teaching methods; however, ultimately the goal of these methods is to provide an environment that promotes interaction and cooperation between students (Jacobsen et al., 2002). Small groups working towards the same goal are commonly used in this technique. Student groups can consists of in-class discussion groups, out-of-class study groups, and groups where students have assigned roles (National Research Council, 1997). The students are not only responsible for their own learning but they are now responsible for the learning of others in the group.

Research by Terenzini et al. (2001) found that by using active teaching methods compared to traditional methods, students had statistically significant greater gains in learning. Students' perceptions of progress in learning were compared between courses utilizing traditional methods and courses taught with active teaching methods. Data were collected for a total of 480 students at 6 colleges. In the study, students reported three areas in which they had improved learning with active learning methods of instruction: design skills, communication skills, and group skills.

Other Teaching Methods

Humor in the Classroom

The use of humor in the classroom has been increasing over the years as faculty members have found that humor can create a more engaged interaction with students. With the shift towards more engaging methods of teaching; humor can find a home in the classroom. Torok, McMorris, and Lin (2004) found that faculty members most commonly used funny stories and funny comments to include humor in the classroom.

Students reported that the use of appropriate humor in the classroom helped to build a sense of community in the classroom. Furthermore, the students felt that the use of humor helped them to learn a concept or idea better. Overall, the use of appropriate humor in the classroom can be a way to engage students, build community, and help them learn material.

Learning Communities

Learning communities are a response to criticism that universities have not been focused on student learning (Inkelas & Weisman, 2003). The purpose of learning communities is to bridge academics and college life through learning opportunities. Through this bridge, learning communities move beyond passive learning and create active, engaged learning through collaboration and shared learning experiences (Pascarella & Terenzini, 2005).

Learning communities can be broken down into four categories; clustered courses, cohorts in large courses, team-taught courses, and residence based programs (Shapiro & Levine, 1999). By establishing a community of learners that moves beyond the classroom, the learning community creates students who are engaged in their educational experience. The concept of creating a learning community of students with similar interests or majors is not a new idea; yet, it continues to develop and evolve as the need of students change and higher education institutions attempt to address the issue of student success. Learning communities are defined by Gabelnick, MacGregor, Matthews, and Smith (1990) as restructuring "the curriculum to link together courses or course work so that students find greater coherence in what they are learning as well as increased intellectual interaction with faculty and fellow students" (p. 5). Schools across the United

States are using learning communities to address the issue of student academic success and create an environment that promotes relationship building with faculty and peers and encourages student involvement (Gabelnick et al.; Love & Tokuno, 1999).

Learning communities vary from college to college; yet all models attempt to assist students in their personal development and academic success. Learning communities create a supportive teaching environment for faculty and foster stronger connections between students, faculty, and the community (Bystrom, 1999). Learning communities provide an integrated learning experience in which individual classes and programs become unified by a theme (Shapiro & Levine, 1999). Schools can utilize learning communities to create smaller groups within a large institution. It is easy to feel overwhelmed and lost at a big school, and learning communities can create a mechanism to help students make connections with the larger campus in a smaller setting. These smaller groups create both academic and social networks in and outside of the classroom.

Learning communities are found to have a positive impact on student success by increasing attendance and participation in class (Shapiro & Levine, 1999). Research by Tinto (1998) also found that students in learning communities compared to students in traditional classrooms actually spend more time with their peers and faculty discussing educational material and more time involved in learning activities.

Student cohorts in large courses. The most common type of cohort course model is freshman interest groups (FIGs). As a cohort, the students enroll in up to three courses and meet weekly in a seminar, which is typically lead by a peer mentor (Gabelnick et al., 1990). Events outside of the classroom tend to be more social in the cohort model when compared to other learning community models (Shapiro & Levine, 1999).

Paired or clustered courses. The simplest learning community model is the paired courses model in which individual courses are linked (Shapiro & Levine, 1999). These courses tend to be existing courses and it is common to use basic writing or other basic skill courses as part of the pairing. The two courses can be combined based on a theme that links them together. The clustered course model expands on the paired course model by grouping up to four courses together. With the clustered courses the college adds a seminar that is able to create curriculum links to all the courses. The role of the faculty in the paired or clustered course model depends on the amount of time the faculty are able to invest and their desired level of involvement in the learning community. For successful learning, colleges can move beyond the practice of allowing students to simply register concurrently for classes by creating intentionality with the development of a unifying curriculum and syllabus that creates a cohesive unit of classes.

Team-taught programs. Team-taught programs are sometimes referred to as coordinated studies programs. In the team-taught model, faculty members team-teach an "integrated program of courses" (Love & Tokuno, 1999). Faculty involvement is most intensive in the team-taught model in which two to four instructors form a team to work collaboratively on the development of the community (Shapiro & Lavine, 1999) and create themes that will unite the courses into a cohesive program. As a result of the collaborative effort by the faculty, assignments can be integrated across the program of courses. The team of faculty are normally involved in all aspects of the community including but not limited to curriculum development and instruction of the courses. In this learning community model, students can be involved part-time and/or their participation can last an entire year.

Residential Programs/Living Learning Communities

Throughout the United States, residential based programs may be called by several different names including; living learning community (LLC), living learning center, or residential learning community, but the idea is the same. The concept of a creating a residential community of undergraduate students with similar interests or majors has continued to develop and evolve as student needs change. Inkelas and Weisman (2003) define a residential learning community as an integration of "in-class and out-of-class experiences by providing a community that fosters great faculty and peer interaction . . . an academically and socially supportive living environment" (p. 335). Residential learning communities add a unique component to the learning community through the student's shared living space, whether it is a floor or an entire hall, each student has a common academic interest; which creates a bridge between the academic and living/social environments. Residential programs are based on the common principles of residential colleges in which, "faculty commitment, students' learning from each other, and the intentional linkages between the academic and social components of the undergraduate experience" (Shapiro & Levin, 1999). As stated by Shapiro and Levin, one unique aspect of the LLC is the focus on the learning that happens outside the classroom. Multiple services can be provided in residential programs including tutoring, academic advising, and programs that bring in faculty and/or classes held in the residence hall.

Currently, there are over 200 LLCs in the Residential Learning Communities International Registry with 15 communities strictly for engineering students, which is up from 2006 when, there were only 8 (The Residential Learning Communities International

Registry, 2008). Schools across the United States have used LLCs to create an environment that promotes relationship building for students with faculty and peers.

Inkelas and Weisman (2003) found in their study of 4,269 students from a large public institution that "students in the living-learning programs were more integrated in key living-learning activities and perceived their environments more positively than non-participants" (p. 344). These results are supported by the study completed by Pike, Schroeder, and Berry (1997) in which 2,678 students living in residence halls were surveyed and data indicated that the residential learning community significantly increased the student-faculty interaction. In a second study by Pike (1999), he found that students in residential learning communities had significantly "higher levels of involvement, interaction, integration, and gains in learning and intellectual development" compared to students in traditional residence halls (p. 269). These studies demonstrate the positive impact of LLCs on the learning experience of students outside of the classroom and how they help create opportunities for student-faculty interaction.

Engineering Learning Communities

San Jose University has a learning community for freshman engineering students, called the Engineering Learning Community for Academic Success (San Jose University, 2008). A group of 10 to 20 students take the same classes, participate in study groups, and attend programs. Purdue University offers multiple learning communities for engineering students. Most of Purdue's learning communities include shared courses while some offer a residential option (Purdue University, 2008)

Virginia Polytechnic Institute and State University has two different freshman living learning communities, Hypatia for 75 females and Galileo for 180 males. Both

LLCs were placed within existing residence halls (Kampe, Edmister, Stimpson, Matanin, Martin, Brozina, & Watford, 2007). Hypatia houses not only first year students but also returning students who participated in the LLC the previous year. Both communities have course clustering around math, chemistry, and engineering so that each student is able to share the same class experience with their peers. The course clustering is coupled with a seminar course that brings both Hypatia and Galileo residents together. The seminar course focuses on the professional, social, and academic development of the students.

Southern Illinois University - Carbondale has an engineering residential college that houses peer mentors, resident assistants, and all freshman and sophomore engineering students (Mathais et al., 2007). Students take common engineering courses in classrooms located in the residential college. Texas A & M University has an engineering living learning community for first year students who are engineering majors. The students live in a co-ed hall and have access to peer mentors who were former participants of the living learning community (Texas A & M University, 2008).

Colorado State University has had a residential learning community for engineering majors for over 20 years; however, in fall 2007 an entire residence hall for engineering students opened as part of a two building complex called the Academic Village that also has a residence hall for a honors residential living community. The building was designed around the residential living learning community model. The engineering residential living learning community has electronic classrooms, designs studios, and engineering classes are taught in the building (Colorado State University, 2008).

Each of the engineering LLCs discussed add a component of either peer mentoring or courses taught in the hall. The engineering students in all of the above LLCs are getting the opportunity to create a community of engineers with a common goal and purpose. The positive impacts of living learning communities on student success are well documented (Pike, 1999; Pike, Schroeder, & Berry, 1997; Inkelas & Weisman, 2003). The increasing number of engineering living learning communities over the past 2 years demonstrates that creating a community of engineers is slowly becoming a method for engineering education to help promote the academic success of engineering students.

Engineering Education Criteria 2000

ABET, Inc. adopted new standards in 1996 for the accreditation of engineering programs called the EC2000, which changed the focus "from inputs, such as what is taught, to outputs, what is learned" (ABET, 2006, pg. 1). In the EC2000, engineering programs must demonstrate 11 student outcomes that include the following:

> (a) an ability to apply knowledge of mathematics, science, and engineering
> (b) an ability to design and conduct experiments, as well as to analyze and interpret data
> (c) an ability to design a system, component, or process to meet desired needs
> (d) an ability to function on multi-disciplinary teams
> (e) an ability to identify, formulate, and solve engineering problems
> (f) an understanding of professional and ethical responsibility
> (g) an ability to communicate effectively
> (h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
> (i) a recognition of the need for, and an ability to engage in life-long learning
> (j) knowledge of contemporary issues
> (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (ABET, 2006, p. 18-19)

A three-year study was conducted by the Center for the Study of Higher Education at Pennsylvania State University to investigate the EC2000 impact on engineering education (ABET, 2006). The key findings in the study found that changes and

improvements were made on the "emphasis on professional skills and active learning" and "high levels of faculty support for continuous improvement" (p. 3). The change in the accreditation process where student outcomes become critical, demonstrates how the field of engineering attempts to continually work towards the academic success of engineering students.

Engineering Education Pedagogies

As mentioned previously, the National Science Board (2004) has seen a significant decline of individuals in the United States training to become engineers despite the fact that the number of jobs that utilize an engineering background continues to increase. Engineering is not only facing a shortage but also criticism from the field of engineering that students are not prepared for the workforce. There needs to be a move towards "broaden engineering education so that those technically grounded graduates will be better prepared to work in a constantly changing global economy" (National Academy of Engineering, 2005, p. 1).

Engineering education has responded with changes in curricular and pedagogical methods (Sheppard, 2001). The challenges facing engineering education have remained constant over the years including: how to prepare students for the workforce, what should be part of the curriculum, how to address the engineering needs of society, and how long it should take to finish an engineering degree (Seely, 2005).

The Carnegie Foundation for the Advancement of Teaching is in the process of researching the "current state of education" (Sheppard & Silva, 2001). In this research, the following goals have been expressed in relation to the field of engineering: to create a description of teaching and learning in engineering, to discuss approaches utilized in

educating future engineers, and to offer suggestions for strengthening engineering education (Sheppard & Silva). Their research will help synthesize the current trends in engineering education to see where the field is heading and help decide where it should go in the future. This type of research is important when attempting to address the current issues in engineering education. Their research study is still in progress; however, there are a number of researchers investigating the current state of engineering education and how to address the current issues that the field of engineering is facing.

For years, engineering educators have attempted to improve student academic success through multiple techniques that move beyond the "pour it in" model of teaching where faculty simply pass on information to be learned by students (Smith, Sheppard, Johnson, & Johnson, 2005, Terenzini et al., 2001; Fink, Ambrose, & Wheeler, 2005). In this model there is no time left for contemplation for either faculty or students (Smith et al.). Faculty in engineering and other fields suggest that "the real challenge in college teaching is not covering the material for the students; it's uncovering the material with the students" (Smith et al.).

As engineering educators respond to the changing student, the emergence of pedagogies of engagement in the classroom has created a new conceptual model of the student. Students must move past being passive receptors in their own learning and become active learners. Faculty members can facilitate this change from passive to active learning through pedagogies of engagement. There are three principles that pedagogies of engagement address, "good practices encourage student-faculty contact, cooperation among students, and active learning" (Smith et al., 2005, p. 87). Two well-known pedagogies of engagement are cooperative and problem-based learning. As mentioned

earlier, these methods create an active learning process.

To address the rising concerns about the preparation of engineering students for the workforce, engineering educators must respond by preparing students to solve workplace problems (Jonassen et al., 2006). Jonassen et al. states that in order for students to solve problems that would arise in the workplace, "students must develop adequate conceptual frameworks (make meaning) and apply those frameworks in solving complex-ill structured problems" (p. 139). Problem-based learning is an important pedagogical innovation; although, the method is not able to address the "nature of workplace problems" (Jonassen et al., p. 147). When utilizing the problem-based learning method, faculty should attempt to address the complexities and ambiguities of workplace problems. Overall, to assist with student success in engineering education, pedagogies of engagement that incorporate workplace problems and transferability should be utilized.

Faculty Involvement

Faculty members play a critical role in student academic success through the teaching methods that they use in the classroom; however, students need more involvement with faculty beyond the traditional instructional interaction (Kuh et al., 2005; Braxton et al., 2000; Tinto, 1993; Bean, 2005; Austin, 1999). Pascarella and Terenzini (2005) found in their review of research that student-faculty interaction outside the classroom positively impacts students. Astin (1993) found that student-faculty interaction increased the following: degree attainment, grade point average, graduating with honors, and enrollment in graduate school. Interestingly, Pascarella and Terenzini noticed that persistence can be promoted through the perception that faculty are available and interested in the students' development; therefore, students simply need to perceive

that a connection exists. To increase student academic success positive student-faculty interactions need to be facilitated, promoted, and encouraged. Learning communities, events or programs, and faculty office hours are examples of methods that create opportunities for student-faculty interaction beyond the typical classroom setting.

Today's College Student

University campuses have experienced a shift in attitude and behavior in the students that are entering their classrooms (Howe & Strauss, 2007). In recent years, institutions have moved towards engaged pedagogies, increased faculty involvement, and the creation of unique learning environments (e.g., living learning communities). As universities modify the student's higher educational experience, it is helpful to discuss changes in current university students. While being cautious not to over-generalize, a generational approach can be utilized as a framework to better understand today's students. Strauss and Howe (1991) conceptualize generations as "people moving through time, each group or generation of people possessing a distinctive sense of self" (p. 32). A generation will share "peer personality" which is a collection of attributes that include "(1) common age location; (2) common beliefs and behaviors; and (3) perceived membership in a common generation" (Strauss & Howe, p. 64). Peer personality can impact the institutions that students attend greatly and it is myopic to assume that each generation is going to respond well to previously established methods of instruction and the level of faculty involvement.

In 2000 the next generation of students, most commonly called the millennials, started entering college. These students, born after 1980, have demonstrated a shift in the expectations of services delivered by universities and colleges to students. Coomes and

DeBard (2004) utilize the generational analyzes of Howe and Strauss to conceptualize the interaction between students and faculty. They address the four generations that currently co-exist on college campuses; silents (born 1925 to 1942), boomers (born 1943 to 1960), generation Xers (born 1961 to 1981), and the millennials (born 1982 to?) (Coomes & DeBard). In 2003, 18.3% of engineering faculty and staff (full and part-time) were from the silent generation, 46.1% from the boomer generation, 14.5% at the end of the boomer generation and beginning of the generation X (1959 – 1962), and 21.15% from generation X (National Center for Educational Statistics, 2007). Knowing that each generation has their own sense of self it is vital to compare the differences in the core traits of millennials to the other generations that are found at universities.

Some of the unique characteristics of the millennial generation include high technology use (Oblinger, 2003; Frand, 2000), ethnic and cultural diversity (Coomes & DeBard, 2004), and increased civic mindedness (Cress & Sax, 1998). The use of technology "is assumed to be a natural part of the environment" (Oblinger, p. 38) particularly in the classroom and other learning environments. Students are staying connected through the use of e-mail, text messaging, and online social networks. The Cooperative Institutional Research Program (CIRP) found that 6 out of 10 first-year students frequently use a computer (Cress & Sax). Students increased familiarity and skill using technology has impacted their learning environments. Students utilizing technological connectivity to communicate with faculty, peers, and family are slowly reshaping the way personal connections are built on campus. Blackboard, a common web based classroom management tool, allows faculty to create discussion boards as well as post syllabi and assignments online (Blackboard, 2008). These types of web based

classroom management tools can be utilized to create an online community that is centered on the classroom. As students technology use increases, institutions of higher education have responded by utilizing technology to respond quickly to students' needs through online chat tools, which allows the staff to respond in real time (Oblinger). Schools are moving forward and trying to keep in step with the students, and most institutions have websites that students can visit to gain more information about the institution. However, some move beyond websites to create web portals for current students. For example, Colorado State University utilizes a web based portal were students can register for classes, pay bills online, search student job postings, get transcripts, and login to the school's web based classroom management system.

Moving beyond characteristics of the millennial generation, Howe and Strauss (2007) describe the following seven core traits of the millennials: special, sheltered, team-oriented, conventional, pressured, confident, and achieving. Each of these traits impact how students interact in and outside of the classroom. Recent studies investigating current trends in today's college students utilize the CIRP, which has collected data from United States college students since 1966 on the following topics: "background characteristics, attitudes, values, educational achievements, and future goals" (Cress & Sax, 1998). Many of the researchers and authors discussed below utilized the CIRP to better understand today's college students.

Howe and Strauss (2007) use the example of the No Child Left Behind Act to show that both parents/guardians and institutions of learning value children and young adults. This sends the message to students that they have been special from the beginning of their lives. Often the concept of being special is coupled with the notion of protecting

and sheltering them from harm. Coomes (2004) utilizes the example of parental advisory initiatives in music and blocking software that regulates internet material to demonstrate how our society has been moving towards sheltering their youth.

Collaboration and connectivity is an essential part of the millennial generation's college experience. Current college students enjoy working in teams (DeBard, 2004) and often use technology to stay connected (e.g., cell phones, texting) and create virtual communities utilizing web pages such as Myspace or Facebook. Millennial students also are willing to move past virtual social networks and participate in living learning communities and group projects in the classroom (DeBard). Current students are more willing to accept social rules and there has been a movement in the past five years towards more "conservative leanings" (DeBard). As stated by DeBard, "millennial students have learned that one of the best ways of getting along is to go along" (p. 37).

The stress that students report feeling has been increasing over the years. The CIRP survey found an increase from 16% to 29% in students response to "feeling overwhelmed by all I have to do" since 1987 (Cress & Sax, 1998). As these students move away from their parents/guardians they can find that college is an extremely stressful experience since they feel pressure to perform (DeBard, 2004; Elam, Stratton, & Gibson, 2007) and are encouraged by schools to navigate themselves through their college experience.

When asked about their academic ability, more freshmen (when compared to previous generations) reported feeling confident and even rated themselves as above average in academic ability (Cress & Sax, 1998). When the college students of today were in secondary school, an increasing number of schools were reluctant to hold back

students in fear of negatively impacting their self-esteem. Hence, students would be passed to the next grade to help boost their confidence, also known as social promotion (Thompson & Cunningham, 2000). There also has been a rise in the number of "A" averages with an increase from 13% in 1969 to 32% in 1997 (Cress & Sax). Not only are students receiving higher grades but they are expecting to receive higher grades. As mentioned by DeBard (2004) when reporting on CIRP data, "more than twice as many college freshman . . . expect to earn at least a B average in college, compared to twenty years ago" (pg. 38). These students are not only achieving, but are quite confident in their ability to do well in their academic endeavors. However, as mentioned previously, this confidence is impacted by grade inflation and social promotion, which can create conflict when they enter the college system. A good example of this conflict is from a study conducted in 1995 that found that students felt well prepared for school; however, only a quarter of faculty (33,986 surveyed) believed students were well prepared (Cress & Sax). Furthermore, there has been a decline in the number of hours students spend studying and when they enter college they only study half the amount of time that faculty report is needed to be successful (Kuh, 2003).

The characteristics and traits of the millennial generation create unique expectations of higher education institutions, impact the way students respond to their college experience, and foster new methods of creating engaged learners through the modification and adaptation of pedagogies. Even the way students approach and understand technology is impacting what occurs in and outside of the classroom. Anything that existed before the students were born is not necessarily considered technology to them (Frand, 2000). Hence, many of the "progressive" technology faculty

are using in the classroom are considered disappointing, uninspiring, and the students report that they "see better ways to use technology then do their teachers" (Oblinger, 2003, p. 39). In response to the technology mindset of current students, schools can make pedagogical changes that use technology in a meaningful and beneficial way to students (Frand).

There is an intrinsic strength in collaborative and other active learning methods knowing that students of today are team-oriented and will create virtual and real communities/networks. However, Wilson (2004) warns that students may not prepare as much and rely on other group members to do the work. Hence, collaborative and cooperative teaching methods must be structured and carefully constructed to incorporate peer evaluations and individual graded portions of the activity or project (Kuh, 2003).

When looking at generational issues to study a group of individuals it is important to acknowledge the limits of generational analysis as mentioned by Wilson (2004) "general group characteristics do not describe accurately or well any individual student" (p. 69). It can create a framework for understanding but will not allow for a direct cause and effect analysis. Hence, the characteristic and traits of millennials students creates a framework for the exploration of pedagogical needs and the level of faculty involvement that current students desire in higher education.

Discussion

In examining the literature, it is clear that student academic success can be improved by utilizing active teaching methods, promoting positive student-faculty interaction, and creating learning communities (Kuh et al., 2005; Braxton, 2000; Terenzini et al., 2001; Chickering & Gamson, 1999; Torok et al., 2004; Inkelas &

Weisman, 2003). To help improve retention, engineering education has focused on engaging pedagogies and creating opportunities for student-faculty interaction. Cooperative and problem-based learning is being incorporated into the engineering classroom while living learning communities are creating a community of engineers outside of the classroom.

CHAPTER 3: METHOD

Research Design and Rationale

This descriptive study was designed to shed light on the opinions and attitudes of engineering faculty and students in order to gather a snapshot of engineering education. This research addresses the following questions: 1) How do engineering students and faculty responses compare in regards to their perceptions about teaching methods utilized and the level of student-faculty interaction in the college? 2) How do engineering students and faculty responses compare in regards to their perceptions about the importance of teaching methods and the level of faculty involvement that promotes student academic success? 3) How do students with different engineering majors compare in regards to their perceptions about teaching methods and the level of faculty involvement that promotes academic success? 4) How do students from different class levels compare in regards to their perceptions about teaching methods and the level of faculty involvement that promotes academic success? Two surveys were constructed to explore their perceptions and behaviors in relation to teaching methods and the level of faculty involvement, which allowed for a comparison between the two groups. The survey was designed to distinguish between active and passive teaching methods and the level of involvement of the faculty in and outside the classroom. The purpose of the research was to reveal patterns and connections to assess program needs and identify areas for future research in engineering education (Merriam & Simpson, 1995).

Participants and Site

The population for this study was focused on the College of Engineering at Colorado State University (CSU). CSU is a large public land grant institution, which has

an enrollment of 20,500 undergraduate students. The sample for this study was 1,463 students and 74 faculty members in the following College of Engineering majors: chemical and biological, civil, environmental, electrical, computer, engineering science, and mechanical.

Data Collection

Students

All engineering students at the college were invited to participate in the study. An electronic cover letter with a link to the online survey was sent to students through an e-mail from the College of Engineering through a list-serve. Appendix A is the electronic cover letter sent to the students. Students were entered into a drawing for a $25 gift card if they participated in the survey and provided their e-mail address. Four hundred twenty students completed the online survey for a completion rate of 28.9%.

Faculty

All faculty members who teach undergraduate engineering courses were invited to participate in the study. An invitation, consent form, and a link to the online survey were sent to faculty through an e-mail from the departmental head of each department. Appendix B is the electronic cover letter sent to faculty. Forty faculty members completed the survey for a completion rate of 54.05%.

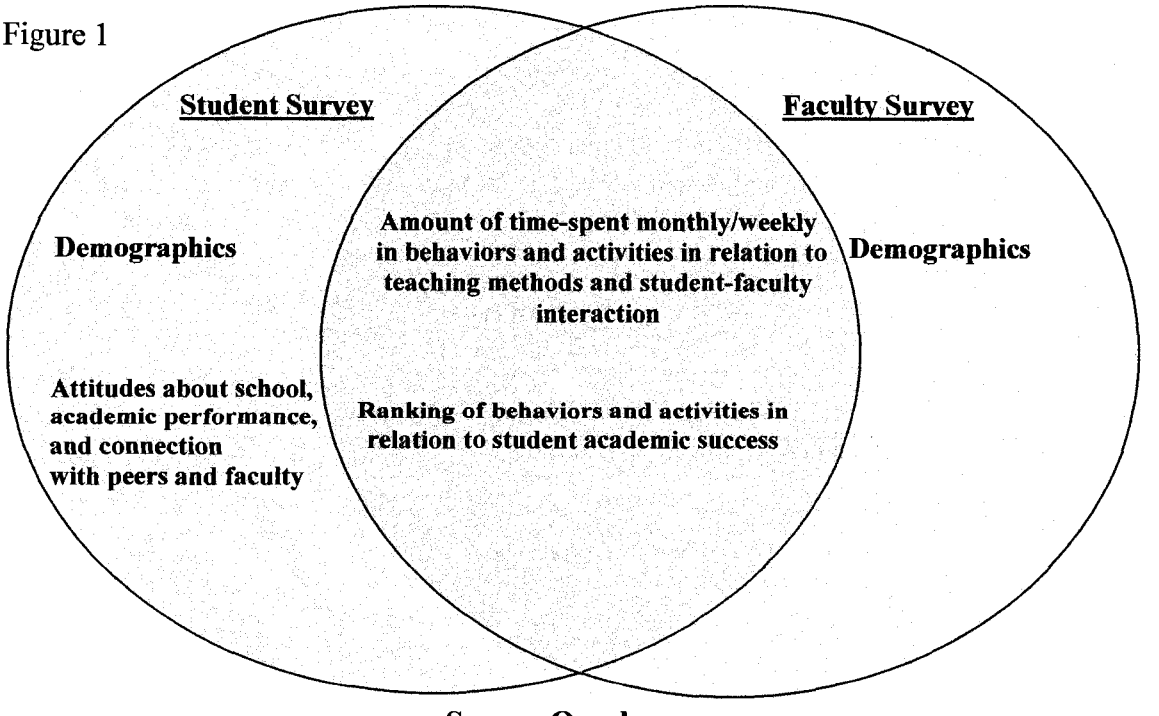
Measures

The surveys explored student and faculty behaviors and attitudes towards teaching methods and faculty involvement. The following constructs were studied: involvement inside the classroom (e.g., pedagogies, note taking), involvement outside classroom in academic endeavors (e.g., tutoring, faculty office hours), and involvement outside the

classroom in social activities and/or unique learning environments (e.g., LLC, social programs). Research about teaching methods (Jacobsen et al., 2002; Jordan & Porath, 2006; Chickering & Gamson, 1987; National Research Council, 1997), faculty involvement outside the classroom (Astin, 1999), and student academic/retention theories (Pascarella & Terenzini, 2005; Seidman, 2005; Tinto, 1993; Kuh et al., 2005) were utilized to create questions that would address the above constructs.

Figure 1 shows the overlap of the faculty and student survey. The participants responded to questions that asked how often the student or the faculty member engages in a particular activity or behavior. Other questions asked the participants to rate the importance of the behavior or activity to a student's academic success from very important to not at all important. Identifying the behaviors and activities that would represent a faculty member utilizing passive or active learning method helped guide the construction of the questions. Table 2 shows the teaching method, active or passive learning, and the behaviors associated with those methods used for the survey instrument.

Figure 1



Survey Overlap

Table 2 Active/Passive Teaching Methods & Activities

	Activity	Teaching Method
IN CLASS	Solving a real world problem*	Active Learning
	Small student groups**	
	Discussion	
	Have the students ask questions	
	Faculty asking the student questions	
	In-class writing	
	Give a quiz	Active Learning or Passive Learning *(depending on application)*
	Fieldtrips or visits	
	In class reading	
	Visual aids	
	Classroom demonstration	
	Videos shown in class	Passive Learning
	Lectures from textbook	
OUT OF CLASS	Study groups **	Active Learning
	Working on project	
	Graded as a group **	
	Study for test	Active Learning or Passive Learning *(depending on application)*
	Solving homework problem *	
	Do assigned reading	Passive Learning
	Lecture notes posted before class (entire or partial)	

* *Problem-Based Learning*
***Cooperative Learning*

Student and Faculty Survey

The student survey had a total of 89 questions with sections that addressed demographics, a Likert scale addressing attitudes toward their academics, satisfaction with the college of engineering, connection with faculty and peers, and questions that addressed the teaching methods utilized by faculty. Appendix C divides each question into the construct it addressed. Tables 1 and 2 show how each question addresses the activity that would indicate the use of passive or active teaching methods. In appendix D is a copy of the student survey instrument.

The faculty survey had a total of 55 questions that addressed demographics, their teaching methods, and involvement in and outside of the classroom. Appendix C divides each question into the construct it is addressing. In appendix E is a copy of the faculty survey instrument.

Pilot Study

Drafts of the surveys were pilot tested utilizing a small focus group of students and an individual interview with a faculty member. The focus group was utilized to better understand the reaction of the students and faculty to the survey questions (Fitzpatrick, Sanders, & Worthen, 2004) and to help refine and improve the survey instrument. Participants of the pilot test were observed as they took the survey. They were encouraged to write notes in the margins of the survey during the survey completion process. The following questions were asked to the participants: Were any of the questions unclear or confusing? What recommendations do you have to improve the survey? Questions that the participants felt were confusing or unclear were modified. The

pilot testing of the survey helps to reduce measurement and procedural errors (Newman & McNeil, 1998).

Four engineering students participated in the focus group. Appendix F shows the outline for the focus group. The focus group participants were first year students who lived in an engineering living learning community, and it was conducted in one of the study labs in the building. Three of the students were mechanical engineering majors and one student was a civil engineering major. There was one female participant in the focus group. Students were encouraged to take the survey and give feedback at any time (during or after taking the survey). Food was provided for the students while they completed the survey. The survey took the students between 10 to 15 minutes to complete. During the focus group the students made the following suggestions:

1. Indicate that the survey is just about their own engineering classes and experience in engineering at CSU.
2. In the portion about the number of classes, clarify what counts as a class (labs, etc).
3. Change the questions that ranked important from low to high to high to low, to match the order of the likert scales in the rest of the survey.

Overall feedback from the students regarding the survey was that it was easy to understand and that the amount of time would be reasonable for a student to spend on a survey.

One civil engineering faculty member participated in the individual interview to pilot test the survey. Appendix G shows the outline of the individual interview. During the individual interview the faculty member made the following suggestions:

1. Change the order of the questions (put the ranking questions first).
2. Collapse the years teaching from 13 categories into 5 categories.

The feedback was used to modify the survey and all the changes were made to the final survey. The surveys were also modified to work as online surveys.

Data Analysis

The research results will be reported utilizing descriptive statistics, which will consist of reporting and comparing frequencies, percentages, and means based on the faculty and student responses. The population was the engineering students and faculty at CSU and there was no inference to estimate the sample of participants to a larger population.

Method

The responses to the questions that asked the participants to rate the following in importance to a student's success in school were reduced from four categories (very important, somewhat important, not very important, and not all important) to two categories of high and low importance. *Very important* and *somewhat important* were combined to be *high importance*. *Not very important* and *not at all important* were combined to be *low importance*. Percentages were utilized to report the results so if it is reported that 80% of students ranked it as high that would mean 80% of students rated the activity or behavior as either very important or somewhat important. The responses to the questions that asked the participants to report the frequency of a behavior or activity were reduced from five categories (always, often, sometimes, rarely, and never) to three categories of often, sometimes, and rarely. *Always* and *often* were combined to be *often*, *rarely* and *never* were combined to be *rarely* while *sometimes* stayed the same. Percentages were utilized to report the results so if it is reported that 75% of faculty

report the activity as occurring often that would mean that 75% of faculty reported that the activity occurred always or often.

Students and faculty scores on questions that related to the level of importance to a student's success were ranked based on the percentages. The larger the percentage of faculty and students that rated the activity or behavior as highly importance the higher the behavior or activity was ranked. Hence, the activity or behavior that had the largest percentage of highly important responses was ranked first and conversely if the smallest percentage rated it as highly important it would be ranked last.

The pilot testing helped establish content validity and response processes (construct related) through the response and feedback from the participants. However, since the survey instrument will only be given to participants once, the research is unable to test for stability of the measurement through pre and post-testing.

CHAPTER 4: RESULTS

Demographic Data

Tables 3 and 4 show the demographic data for students and faculty. The demographic data collected for students included the following: age, sex, class, major, living arrangement, anticipated GPA, and ethnicity. The demographic data collected for faculty included the following: department, sex, years teaching, ethnicity, and faculty rank. The demographical information was asked during the first portion of the survey distributed to each group. All percentages will be rounded to the first decimal point in the following sections.

Students

The total population of the students in the College of Engineering for the fall 2007 semester was 1,463 with 420 students responding to the survey. The completion rate of the survey was 28.7%. Statistics that were available for the total population of students during the 2007 fall semester from the College of Engineering will be included in the following sections.

Age and sex. The age of the students ranged from under 18 to over 25. Most of the students were between the ages of 18 to 23 (81.7%). Only one student was under the age of 18 with 76 students above the age of 23. The sex of the students was 79% male and 21% female. Females are slightly more represented in this study then the gender distribution of the College of Engineering in fall 2007, which was 14.6% female and 85.4% male (Colorado State University Institutional Research, 2007).

Class. The class standings of the students who responded to the survey was 22.4% freshman, 17.1% sophomore, 26.7% junior, 32.1% senior, and 1.7% other. Those that identified as 'other' noted that they were on their fifth year, second bachelors, or transfer students. The study class distribution closely resembles the class distribution in the College of Engineering in fall 2007 which was 28% freshman, 18% sophomore, 17.4% junior, and 36.6% senior (Colorado State University Institutional Research, 2007).

Major. The major distribution of the students who responded to the survey was 12.9% chemical and biological, 31.4% civil and environmental, 11.7% electrical and computer, 38.8% mechanical, 5.2% other engineering. The major distribution of the study closely resembles the fall 2007 distribution of majors which was as follows: 10.5% chemical and biological, 25.6% civil and environmental, 17.6% electrical and computer, 39.2% mechanical, 7% other engineering (Colorado State University Institutional Research, 2007).

Living arrangement. More than half of the students lived off campus 69.5%, 3.1% lived in a campus apartment, 13.1% lived in a non-LLC residence hall, and 14.3% lived in a LLC.

Ethnicity. The ethnic distribution of the students who responded to the survey was 5.7% who choose not to disclose, 83.6% Caucasian, 1% African American/Black, 0.5% American Indian/Alaska Native, 3.8% Asian American/Asian, 0.2% Native Hawaiian/Pacific Islander, 1.2% Mexican, 0.2% Puerto Rican, 0.7% other Latino, and 3.1% stated other. The survey sample was representative of the ethnic make-up of the College of Engineering in fall 2007 with 77.9% Caucasian, 10.1% classified as a minority

(Asian, Black, Hispanic, and Native American), 6.2% International, and 5.8% other (Colorado State University Institutional Research, 2007).

Table 3

Student Demographics (N = 420)

	Percentage	N
Age		
Under 18	0.24	1
18 to 20	45.95	193
21 to 23	35.71	150
23 to 25	7.86	33
Over 25	10.24	43
Sex		
Male	79.05	332
Female	20.95	80
Class		
Freshman	22.38	94
Sophomore	17.14	72
Junior	26.67	112
Senior	32.14	135
Other	1.67	7
Major		
Civil	26.19	110
Mechanical	38.81	163
Chemical & Biological	12.86	54
Computer	3.81	16
Electrical	7.86	33
Environmental	5.24	22
Engineering Science	5.00	21
Engineering Open Option	0.24	1
Living Arrangement		
Residence hall	13.10	55
Campus apartments	3.10	13
Off campus with parents/family	11.43	48
Off campus with friends	58.10	244
Living learning community (Engineering)	14.29	60
Anticipated GPA		
Below 1.5	0.24	1
1.6-2.0	2.26	11
2.1-2.5	14.05	59
2.6-3.0	31.43	132
3.1-3.5	30.24	127
3.6-4.0	21.43	90
Ethnicity		
Choose not to disclose	5.71	24
African American/Black	0.95	4
American Indian/Alaska Native	0.48	2
Asian American/Asian	3.81	16

Caucasian/White	83.57	351
Native Hawaiian/Pacific Islander	0.24	1
Mexican	1.19	5
Puerto Rican	0.24	1
Other Latino	0.71	3
Other	3.10	13

Faculty

The total population of the faculty in the College of Engineering is 74 with 40 faculty members responding to the survey. The completion rate of the survey was 54.1%. The following demographics are representative of the survey participants. There were no demographics available for the total population of faculty of the College of Engineering in the fall 2007.

Department. The departmental breakdown of the faculty was as follows: 42.5% civil and environmental, 22.5% mechanical, 12.5% chemical and biological, and 22.5% computer and electrical.

Sex. The sex of the faculty was 92.5% male and 7.5% female.

Years teaching. The years of teaching ranged from one year to over 20 years with 17.5% 1-5 years, 17.5% 5-10 years, 5% 10-15 years, 20% 15-20 years, and 40% with more than 20 years of teaching experience.

Ethnicity. The ethnic distribution of the faculty that responded to the survey was 12.5% who choose not to disclose, 0% African American/Black, 0% American Indian/Alaska Native, 10% Asian American/Asian, 65% Caucasian/white, and 12.5% other Latino.

Faculty rank. The faculty ranged from instructor to full professor with the following percentages: 10% instructors, 12.5% assistant professors, 15% associate professors, 60% professor, and 2.5% other.

Table 4

Faculty Demographics (N =40)

	Percentage	N
Department		
Civil & Environmental	42.50	17
Mechanical	22.50	9
Chemical & Biological	12.50	5
Computer & Electrical	22.50	9
Sex		
Male	92.50	37
Female	7.50	3
Years		
1-5	17.50	7
5-10	17.50	7
10-15	5.00	2
15-20	20.00	8
More than 20	40.00	16
Ethnicity		
Choose not to disclose	12.50	5
African American/Black	0.00	0
American Indian/Alaska Native	0.00	0
Asian American/Asian	10.00	4
Caucasian/White	65.00	26
Native Hawaiian/Pacific Islander	0.00	0
Mexican	0.00	0
Puerto Rican	0.00	0
Other Latino	12.50	5
Other	0.00	0
Faculty Rank		
Instructor	10.00	4
Assistant Professor	12.50	5
Associate Professor	15.00	6
Professor	60.00	24
Other	2.50	1

Research Questions

In the following sections the results will be analyzed utilizing percentages, frequencies, and means to address each research question. To answer some of the research questions, the participants' responses will be ranked in order based on the reported frequency or level of importance. This allowed a comparison between the groups taking into consideration that some groups will respond to a survey with overall

lower or higher responses. All percentages will be rounded up to the first decimal point in the following sections.

Research Question # 1

How do engineering students and faculty responses compare in regards to their perceptions about teaching methods utilized and the level of student-faculty interaction in the college (table 5)?

Differences between students and faculty. There were large differences between students and faculty in their responses to the frequency of the five following activities and behaviors: faculty providing feedback to students on performance, students being asked questions in class, students given real world problems to solve, students encouraged to ask questions in class, and the use of humor in the classroom.

There was a 50.1 percentage point difference between students and faculty responses regarding the reported frequency of faculty providing feedback to students on performance with faculty (percentage wise) reporting that it occurs more often than students (77.5% faculty, 27.4% students). There was a 44.8 percentage point difference between students and faculty responses regarding the reported frequency of students being asked questions in class with faculty reporting it occurs more often than students (95% faculty, 50.2% students). Faculty members were twice as likely as students to report that students were given real world problems to solve (70% faculty, 35% students). There was a 33.6 percentage point difference between students and faculty responses regarding the reported frequency of students being encouraged to ask questions in class with more faculty reporting it occurs more often than students (85% faculty, 51.4% students).

Table 5 **Faculty and students compared by frequency of activity or behaviors**

Frequency of activity or behavior	Faculty (N=40) Often	Sometimes	Rarely			Students (N=420) Often	Sometimes	Rarely		
	%	%	%	M	SD	%	%	%	M	SD
Students encouraged to ask questions in class	85.00	15.00	0.00	4.45	0.75	51.43	31.19	17.38	3.49	1.04
Time spent in design studios by students	N/A	N/A	N/A	N/A	N/A	39.19	20.24	43.57	2.80	1.38
Time spent in computer labs by students	N/A	N/A	N/A	N/A	N/A	54.76	27.62	17.62	3.51	1.05
Students rereading notes	N/A	N/A	N/A	N/A	N/A	36.19	37.38	26.43	3.13	1.01
Faculty providing feedback to students on performance	77.50	17.50	5.00	4.15	0.89	27.38	31.90	40.71	2.79	1.09
Class divided into a small discussion group in class	15.00	12.50	75.50	1.88	1.26	4.29	11.19	84.52	1.60	0.89
Students who visited faculty office hours	15.00*	N/A	85.00	N/A	N/A	15.48	31.67	52.86	2.46	1.02
Students studying with a group	N/A	N/A	N/A	N/A	N/A	31.67	32.14	36.19	2.96	1.03
Students working in a study group outside of class	25.00	22.50	52.50	2.55	1.48	14.05	20.71	65.24	2.09	1.17
Spent time with each other outside of class	57.50	35.00	7.50	3.70	0.88	5.00	7.14	87.86	1.56	0.86
Student participation in student organization or event	N/A	N/A	N/A	N/A	N/A	24.52	17.62	57.86	2.41	1.37
Students attendance at an engineering program or event	N/A	N/A	N/A	N/A	N/A	10.24	27.14	62.62	2.27	0.95
Student time spent in tutoring	N/A	N/A	N/A	N/A	N/A	5.48	17.14	77.38	1.85	0.95
Humor used in the classroom	57.50	37.50	5.00	3.70	0.82	33.33	38.81	27.86	3.05	1.02
Faculty participate in an engineering event or program	47.50	37.50	15.00	3.45	0.99	7.86	15.24	76.90	1.90	0.98
Live in the engineering living learning community	N/A	N/A	N/A	N/A	N/A	11.43	N/A	88.57	N/A	N/A
Students working in a small group on a problem	22.50	15.00	62.50	2.28	0.40	6.43	15.00	78.57	1.76	0.97
Lectures posted before class	40.00	22.50	37.50	2.88	1.52	20.48	22.14	57.38	2.35	1.23
Lecturing for the majority of the class time	90.00	5.00	5.00	4.22	0.77	96.42	2.62	00.95	4.62	0.60
Gone to a TA's office hours	N/A	N/A	N/A	N/A	N/A	14.05	20.95	65.00	2.16	1.10
Send an email to a professor	27.50**	N/A	72.50	N/A	N/A	18.10	35.48	46.43	2.61	0.98

* Percentage of students that attend office hours. Above number represent the following: 100-51% equals often and 50-1% equals rarely.
** Percentage of students that send email. Above number represent the following: 100-51% equals often and 50-1% equals rarely

Faculty members were twice as likely as students to report that humor was used in the classroom (57.5% faculty, 33.3% students). Overall, faculty and students disagree the most with how often faculty provide students feedback about their performance with faculty reported that it occurs more often (77.5% faculty, 27.4% students).

Similarities between students and faculty. There were similarities between students and faculty in their responses to the frequency of the five following activities or behaviors: students visiting faculty office hours, students graded as a group, going on a field trip, assigned in-class writing, and assigned in-class reading.

Almost half of the faculty (42.5%) and half of the students (52.9%) reported that students rarely visit office hours. There was a 2.3 percentage point difference between students and faculty responses regarding the reported frequency of students being graded as a group with approximately three-fourths of faculty and students reporting that it sometimes to rarely occurs (75% faculty, 72.7% students). Almost all faculty and students reported that field trips rarely occur (90% faculty, 96.7% students). There was a 5.5 percentage point difference between students and faculty responses regarding the reported frequency of assigned in-class writing with almost all faculty and students reporting that it rarely occurs (95% faculty, 89.5% students). There was a 3.9 percentage point difference between students and faculty responses regarding the reported frequency of assigned in-class reading with roughly three-fourths of faculty and students reporting that it rarely occurs (67.5% faculty, 71.4% students). Overall, both students and faculty agreed that students rarely spend time in a faculty member's office hours (15% faculty report often, 15.5% of students report often).

Table 6 **Faculty and students compared by frequency of activity or behaviors in regards to teaching methods**

Frequency of activity or behavior	Faculty (N=40)					Students (N=420)				
	Often	Sometimes	Rarely			Often	Sometimes	Rarely		
Active Methods	%	%	%	M	SD	%	%	%	M	SD
Faculty providing feedback to students on their performance	77.50	17.50	5.00	4.15	0.89	27.38	31.90	40.71	2.79	1.09
Class divided into a small discussion group in class	15.00	12.50	75.50	1.88	1.26	4.29	11.19	84.52	1.60	0.89
Students encouraged to ask questions in class	85.00	15.00	0.00	4.45	0.75	51.43	31.19	17.38	3.49	1.04
Students working in a small group on a problem	22.50	15.00	62.50	2.28	1.40	6.43	15.00	78.57	1.76	0.97
Students working in a study group outside of class	25.00	22.50	52.50	2.55	1.48	14.05	20.71	65.24	2.09	1.17
Students studying with a group	N/A	N/A	N/A	N/A	N/A	31.67	32.14	36.19	2.96	1.03
Assign in-class writing	0.00	5.00	95.00	1.50	0.60	2.38	8.10	89.52	1.44	0.75
Students graded as a group	25.00	30.00	45.00	2.67	1.49	27.14	30.24	42.62	2.67	1.25
Students given real world problems to solve	70.00	20.00	10.00	3.75	0.93	35.00	37.86	27.14	3.08	1.07
Students given real world problems to solve as a group	37.50	25.00	37.50	2.83	1.38	17.62	25.95	56.43	2.33	1.16
Students asked questions in class	95.00	5.00	0.00	4.60	0.59	50.24	30.48	19.28	3.44	1.08
Humor used in the classroom	57.50	37.50	5.00	3.70	0.82	33.33	38.81	27.86	3.05	1.02
Passive Methods										
Shown a video in class	7.50	17.50	75.00	1.77	1.00	4.76	21.90	73.33	1.83	0.94
Faculty lectured from a textbook	45.00	20.00	35.00	3.03	1.40	36.67	24.76	38.57	2.95	1.25
Lectures posted before class	40.00	22.50	37.50	2.88	1.52	20.48	22.14	57.38	2.35	1.23
Lecturing for the majority of the class time	90.00	5.00	5.00	4.22	0.77	96.42	2.62	00.95	4.62	0.60
Active or Passive Methods										
Faculty using WebCt or other online resources	45.00	7.50	47.50	2.88	1.71	31.67	29.52	38.81	2.84	1.29
Students given a quiz	27.50	30.00	42.50	2.78	1.40	39.76	30.24	30.00	3.08	1.25
Faculty used PowerPoint or overheads in class	47.50	25.00	27.50	3.28	1.30	60.95	21.19	17.86	3.70	1.24
Assign in-class reading	12.50	20.00	67.50	2.08	1.19	15.00	13.57	71.43	1.97	1.20
Went on a field trip	2.50	7.50	90.00	1.42	0.75	0.23	3.10	96.67	1.22	0.50
Demonstrations in class	37.50	32.50	30.00	3.13	1.07	17.86	32.62	49.52	2.55	1.00

Teaching methods (Table 6). Faculty reported the following active teaching methods occurring most often: students asked questions in class (95%), students encouraged to ask questions in class (85%), faculty providing feedback to students on performance (77.5%), and student given real world problems to solve (70%). Students reported the following active teaching methods occurring most often: students encouraged to ask questions (51.4%), students asked questions in class (50.2%), students given real world problems to solve (35%), and the use of humor in the classroom (33.3%). Faculty and students reported that the following passive methods occurred most often: lecturing for the majority of the class time (90% faculty, 96.4% students) and lecturing from a textbook (45% faculty, 36.7% students). Overall, the most common teaching method utilized as reported by both faculty and students was lecturing for the majority of the class time (90% faculty, 96.4% students).

Student-faculty interaction. The following behaviors and/or activities that are related to student-faculty interaction were compared: amount of time spent by students in faculty office hours, faculty participation in engineering events for programs, and time faculty spend outside of class with students.

As mentioned previously, both faculty and students agree that students do not visit faculty member's office hours often (15% faculty, 15.5% students). Faculty were more than 11 times more likely than students to report spending time together often outside of the classroom (57.5% faculty, 5% students). There was a 39.6 percentage point difference between students and faculty responses regarding the amount of participation of faculty in engineering programs or events with 7.9% of students reporting that faculty participated often and 47.5% of faculty reporting they participated often. Overall, faculty

were more than six times more likely than students to report spending time with each other outside of the classroom in just time spent or involvement with programs or activities.

Importance compared to frequency of behaviors (Tables 7 and 8). Behaviors and/or activities that at least 75% of faculty and students rated as highly important to student academic success were compared to the reported frequency of those behaviors and/or activities.

Almost all (91.7%) students rated accessibility of design studios and computer labs as highly important; however, approximately one third of the students (36.2%) reported that they spent time often in design studios and half (54.8%) reported that they spent time often in computer labs. The majority of students (90.2%) rated note taking as highly important; however, roughly one third of students (36.2%) reported rereading their notes often. A large majority of students (89.3%) rated faculty members providing feedback regarding their performance as highly important; however, approximately one fourth (27.4%) reported that they received feedback often regarding their performance in class. A large majority of students (88.6%) rated ability for students to ask questions in class as highly important, while half of students (51.4%) report that faculty members encourage them to ask questions in class often. More than three quarters of students (78.8%) rated visiting instructors office hours as highly important, while a small minority of students went to a professors' office hours or teaching assistants' office hours often (15.4%, professors' office hours, 14.1% teaching assistants' office hours). Approximately three-fourths of students (78.3%) rated class discussion as highly important, while an extremely small minority of students (4.3%) reported that they were placed in discussion

groups in class often. Additionally, almost all students (96.4%) reported that faculty lectured for the majority of the class often, which could suggest a lack of discussion occurring in the classroom. Three-fourths of students (77.9%) rated the use of humor in the classroom as highly important, while one third (33.3%) reported that humor was used often in the classroom. Three-fourths of students (75%) rated the posting of class lectures online as highly important, while one-fifth of students (20.5%) reported that it occurs often. Three-fourths of students (75%) rated the accessibility of faculty outside of the classroom as highly important, while an extremely small minority of students (5%) report that they have spent time with faculty outside of class.

All faculty (100%) rated the ability for students to ask questions in class as highly important, while 85% of faculty reported that they encourage students to ask questions in class often. Almost all faculty (97.5%) reported that accessibility of design studios and computers labs was highly important, while half of the students (54.8%) reported spending time often in computer labs and one-third (36.2%) reported spending time in design studios often. Almost all faculty (95%) rated note taking as highly important, while one-third (36.2%) of students reported that they reread their notes often. Almost all faculty (92.5%) rated providing feedback to students regarding their performance as highly important, while three quarters of faculty (77.5%) reported that they provided students with feedback often. A large majority (87.5%) of faculty rated class discussion as highly important, while a small minority (15%) reported that they divide students into discussion groups often. Additionally, almost all faculty (90%) reported that they lecture for the majority of class time often, which could suggest a lack of discussion occurring in the classroom. Thirty-five faculty (87.5%) rated visiting instructors' office hours as

Table 7 **Importance to a student's academic success compared to frequency of activities or behaviors**

Level of importance	**High**	**Often**	**Frequency of activity or behavior**
	%	%	
Accessibility of design studios and computer labs	91.67	36.19	Time spent in design studios
		54.76	Time spent in computer labs
Note taking	90.24	36.19	Rereading notes
Providing feedback to students regarding their performance	89.29	27.38	Faculty providing feedback on performance
Ability for students to ask questions in class	88.57	51.43	Faculty encouraged you to ask questions in class
Visiting instructors office hours	78.81	15.48	Gone to a professor's office hours in a week
		14.05	Gone to a TA's office hours in a week
Class discussion	78.33	4.29	Faculty had you work in a small discussion group in class
		96.42	Faculty lectured for the majority of the class time*
Using humor in the classroom	77.86	33.33	Faculty using humor in the classroom
Class lectures available online	75.00	20.48	Faculty posting lectures before class
Accessibility of faculty outside of the classroom	75.00	5.00	Spent time with faculty outside of class
Study groups	67.62	31.67	Study with a group
Group work outside of class	66.90	14.05	Faculty had you work in a study group outside of class
Student participation in student organizations	48.33	24.52	Participate in student organization or event
		46.67	Percentage of students that belong to a student organization**
Having students with similar majors living together	45.48	11.43	Live in the engineering living learning community
Students attending engineering programming or events	43.57	10.24	Attend an engineering program or event
Group work in class	39.05	6.43	Faculty had your work in a small group on a problem
Tutoring	37.86	5.48	Time spent in tutoring
Faculty participation outside of the classroom in programs or events	37.14	7.86	An event or program with an engineering faculty member present

* Used inverse of response (i.e. if they lectured for most of the class time this would equal rarely had class discussion)

** Amount of students that said yes or no to participation in student organizations (46.67% said yes, 53.33% said no)

Table 8 **Importance to a student's academic success compared to frequency of activities or behaviors (faculty, N=40)**

Level of importance	**High** %	**Often** %	**Frequency of activity or behavior**
Ability for students to ask questions in class	100.0	85.00	Encouraged students to ask questions in class
Accessibility of design studios and computer labs	97.50	39.19	Time spent in design studios by students
		54.76	Time spent in computer labs by students
Note taking	95.00	36.19	Students rereading notes
Providing feedback to students regarding their performance	92.50	77.50	Providing feedback to students on performance
Class discussion	87.50	15.00	Divided class into a small discussion group in class
		90.00	Lectured for the majority of the class time*
Visiting instructors office hours	87.50	15.00	Students who visited faculty office hours
		14.05	Students who visited TA's office hours
Study groups	82.50	31.67	Students studying with a group
Group work outside of class	82.50	25.00	Had students work in a study group outside of class
Accessibility of faculty outside of the classroom (beyond office hours)	77.50	57.50	Spent time with a student outside of class
Student participation in student organizations	75.00	24.52	Student participation in student organization or event
		46.67	Percentage of students that belong to a student organization**
Students attending engineering programming or events	75.00	10.24	Students attendance at an engineering program or event
Tutoring	67.50	5.48	Student time spent in tutoring
Using humor in the classroom	62.50	57.50	Used humor in the classroom
Faculty participation outside of the classroom in programs or events	62.50	47.50	Participate in an engineering event or program
Having students with similar majors living together	47.50	11.43	Live in the engineering living learning community
Group work in class	47.50	22.50	Had students work in a small group on a problem
Class lectures available online	25.00	40.00	Posted lectures before class

* Used inverse of response (i.e. if they lectured for most of the class time this would equal rarely had class discussion)
** Amount of students that said yes or no to participation in student organizations (46.67% said yes, 53.33% said no)

highly important, while only six (15%) reported that students visited their office hours often. A large majority of faculty (82.5%) rated study groups as highly important, while close to one third of students (31.7%) reported study as a group often. More than three quarters of faculty (82.5%) rated group work outside of class as highly important, while only one quarter of faculty (25%) had students work as a group outside of class often. Three quarters of faculty (77.5%) rated accessibility of faculty outside of the classroom as highly important, while approximately half of faculty (57.5%) reported that they spend time with students outside of class often. Three quarters of faculty (75%) rated student participation in student organizations as highly important, while one quarter of students (24.5%) reported participating in student organizations or events often. However, roughly half of students (46.7%) reported that they belong to a student organization, which could suggest that students join organizations but may not attend events often or the organizations do not hold many events or meetings. Three quarters of faculty (75%) rated students attending engineering programming or events as highly important, while only one tenth of students (10.2%) reported spending time at an engineering event or program often.

Research Questions #2

How do engineering students and faculty responses compare in regards to their perceptions about the importance of teaching methods and the level of faculty involvement that promotes student academic success (Table 9)?

Differences between students and faculty. There were large differences between students and faculty on what they responded was important to a student's academic success in the following five activities or behaviors: lectures posted online, students

Table 9 **Students and faculty compared in importance to a student's academic success**

Level of importance	Students (N =420)				Faculty (N=40)			
	High	High			High	High		
	freq	%	M	SD	*freq*	%	M	SD
Study groups	284	67.62	2.91	0.95	33	82.50	3.12	0.69
Tutoring	159	37.86	2.23	0.96	27	67.50	2.73	0.64
Note taking	379	90.24	3.51	0.73	38	95.00	3.53	0.60
Group work in class	164	39.05	2.29	0.87	19	47.50	2.48	0.75
Group work outside of class	281	66.90	2.83	0.88	33	82.50	3.1	0.81
Class lectures available online	315	75.00	3.03	0.91	10	25.00	2.15	0.74
Class discussion	329	78.33	3.09	0.80	35	87.50	3.28	0.68
Ability for students to ask questions in class	372	88.57	3.45	0.75	40	100.0	3.8	0.41
Providing feedback to students regarding their performance	375	89.29	3.44	0.77	37	92.50	3.55	0.71
Using humor in the classroom	327	77.86	3.06	0.80	25	62.50	2.7	0.69
Having students with similar majors living together	191	45.48	2.38	1.05	19	47.50	2.38	0.81
Student participation in student organizations	203	48.33	2.42	0.92	30	75.00	2.95	0.81
Faculty participation outside of the classroom in programs or events	156	37.14	2.20	0.85	25	62.50	2.58	0.75
Accessibility of faculty outside of the classroom	315	75.00	3.00	0.87	31	77.50	3.03	0.95
Students attending engineering programming or events	183	43.57	2.34	0.84	30	75.00	3.03	0.86
Accessibility of design studios and computer labs	385	91.67	3.55	0.73	39	97.50	3.7	0.61
Visiting instructors office hours	331	78.81	3.08	0.83	35	87.50	3.28	0.75

attending engineering programming or events, tutoring, student participation in student organizations, and faculty participation outside of the classroom in programs or events.

Three times more students than faculty responded that class lectures available online were highly important to a student's academic success (25% faculty, 75% students). There was a 31.4 percentage point difference between students and faculty responses regarding the importance of students attending engineering programming or events with more faculty (percentage wise) rating it higher than students (75% faculty, 43.6% students). There was a 29.6 percentage point difference between students and faculty responses regarding the importance of tutoring with more faculty rating it higher than students (67.5% faculty, 37.9% students). There was a 26.7 percentage point difference between students and faculty responses regarding the importance of student participation in student organizations with more faculty rating it higher than students (75% faculty, 48.3% students). There was a 25.4 percentage point difference between students and faculty responses regarding the importance of faculty participation outside of the classroom in programs or events with more faculty rating it higher than students (62.5% faculty, 37.1% students).

Similarities between students and faculty. There were similarities between students and faculty on what they responded was important to a student's academic success in the following four activities or behaviors: accessibility of faculty outside of the classroom, providing feedback to students regarding their performance, students with similar majors living together, and note taking.

Faculty and students were most similar in their response to the importance of having students with similar majors living together with 47.5% of faculty and 45.5% of

students reporting it as highly important. There was a 2.5 percentage point difference between students and faculty responses regarding the importance of accessibility of faculty outside of the classroom with both faculty and students rating it high (faculty 77.5%, students 75%). There was a 3.2 percentage point difference between students and faculty responses regarding the importance of providing feedback to students regarding their performance with both faculty and students rating it high (faculty 92.5%, students 89.3%). There was a 4.8 percentage point difference between students and faculty responses regarding the importance of note taking with both faculty and students rating it high (faculty 95%, students 90.2%).

Ranking of the activities or behaviors (Table 10). All the activities or behaviors were ranked in level of importance to a student's academic success by calculating faculty and students responses and ranking them using the percentage of high importance responses. The results show that faculty and students selected the following activities or behaviors as their top 6 that promote student academic success yet ranked them differently in importance: ability for students to ask questions in class, accessibility of design studios and computers, note taking, providing feedback to students regarding their performance, class discussion, and visiting instructors office hours.

Based on the activities and behaviors from the survey, students reported that the accessibility of design studios and computer labs were most important to a student's academic success with 91.7% of students rating this as highly important while faculty reported that the ability for students to ask questions in class was most important to a student's academic success with 100% of faculty rating this as highly important.

Table 10 **Ranking of importance to a student's academic success (students and faculty compared)**

Level of importance Students (N =420)	High %	Level of importance Faculty (N=40)	High %
Accessibility of design studios and computer labs	91.67	Ability for students to ask questions in class	100.00
Note taking	90.24	Accessibility of design studios and computer labs	97.50
Providing feedback to students regarding their performance	89.29	Note taking	95.00
Ability for students to ask questions in class	88.57	Providing feedback to students regarding their performance	92.50
Visiting instructors office hours	78.81	Visiting instructors office hours	87.50
Class discussion	78.33	Class discussion	87.50
Using humor in the classroom	77.86	Group work outside of class	82.50
Accessibility of faculty outside of the classroom	75.00	Study groups	82.50
Class lectures available online	75.00	Accessibility of faculty outside of the classroom	77.50
Study groups	67.62	Student participation in student organizations	75.00
Group work outside of class	66.90	Students attending engineering programming or events	75.00
Student participation in student organizations	48.33	Tutoring	67.50
Having students with similar majors living together	45.48	Faculty participation outside of the classroom in programs or events	62.50
Students attending engineering programming or events	43.57	Using humor in the classroom	62.50
Group work in class	39.05	Group work in class	47.50
Tutoring	37.86	Having students with similar majors living together	47.50
Faculty participation outside of the classroom in programs or events	37.14	Class lectures available online	25.00

Table 11 **Importance to a student's academic success students (N=420) compared by major (frequency)**

Level of importance	Major													
	Civil (n=110) High		Mech (n=163) High		Chem/Bio (n=54) High		Comp (n=16) High		Elect (n=33) High		Environ (n=22) High		Eng Sci (n=21) High	
	freq	%	*freq*	%	*freq*	%	*freq*	%	*freq*	%	*freq*	%	*freq*	%
Study groups	70	63.64	116	71.17	33	61.11	12	75.00	25	75.76	15	68.18	13	61.90
Tutoring	37	33.64	55	33.74	21	38.89	7	43.75	16	48.48	13	59.09	10	47.62
Note taking	102	92.73	146	89.57	52	96.30	14	87.50	27	81.82	19	86.36	19	90.48
Group work in class	37	33.64	67	41.10	29	53.70	1	6.25	14	42.42	8	36.36	7	33.33
Group work outside of class	69	62.73	120	73.62	31	57.41	9	56.25	24	72.73	14	63.64	14	66.67
Class lectures available online	88	80.00	122	74.85	34	62.96	14	87.50	26	78.79	15	68.18	15	71.43
Class discussion	85	77.27	127	77.91	45	83.33	11	68.75	29	87.88	15	68.18	16	76.19
Ability for students to ask questions in class	94	85.45	146	89.57	50	92.59	14	87.50	29	87.88	20	90.91	19	90.48
Providing feedback to students regarding their performance	98	89.09	147	90.18	51	94.44	14	87.50	27	81.82	20	90.91	17	80.95
Using humor in the classroom	83	75.45	123	75.46	46	85.19	13	81.25	29	87.88	18	81.82	14	66.67
Students with similar majors living together	44	40.00	74	45.40	28	51.85	5	43.75	20	60.61	7	31.82	11	52.38
Student participation in student organizations	50	45.45	79	48.47	26	48.15	5	31.25	16	48.48	14	63.64	13	61.90
Faculty participation in programs or events	42	38.18	58	35.58	23	42.59	1	6.25	13	39.39	7	31.82	12	57.14
Accessibility of faculty outside of the classroom	81	73.64	129	79.14	38	70.37	10	62.50	25	75.76	15	68.18	17	80.95
Students attending engineering programming or events	45	40.91	69	42.33	28	51.85	6	37.50	14	42.42	10	45.45	11	52.38
Accessibility of design studios and computer labs	99	90.00	154	94.48	47	87.04	15	93.75	31	93.94	19	86.36	20	95.24
Visiting instructors office hours	84	76.36	128	78.53	44	81.48	12	75.00	16	78.79	18	81.82	18	85.71

Table 12 **Importance to a student's academic success students (N=420) compared by major (Means)**

Level of importance	Major													
	Civil (n=110)		Mech (n=163)		Chem/Bio (n=54)		Comp (n=16)		Elect (n=33)		Environ (n=22)		Eng Sci (n=21)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Study groups	2.85	1.03	2.93	0.95	2.80	0.96	2.94	0.85	3.03	0.72	3.14	0.99	2.90	0.94
Tutoring	2.10	0.97	2.19	0.94	2.11	0.90	2.25	0.77	2.67	0.85	2.68	0.99	2.38	1.20
Note taking	3.56	0.63	3.49	0.75	3.59	0.57	3.44	0.89	3.33	0.92	3.59	0.85	3.52	0.81
Group work in class	2.19	0.98	2.28	0.83	2.46	0.79	1.88	0.50	2.42	0.92	2.41	0.85	2.33	0.80
Group work outside of class	2.76	0.97	2.96	0.83	2.57	0.88	2.63	0.81	2.94	0.85	2.77	0.92	2.81	0.81
Class lectures available online	3.11	0.85	3.0	0.93	2.83	0.93	3.13	0.81	3.30	0.94	2.91	1.06	3.00	0.89
Class discussion	3.10	0.83	3.04	0.79	3.24	0.82	2.81	0.83	3.24	0.67	2.91	0.75	3.14	0.79
Ability for students to ask questions in class	3.42	0.83	3.42	0.74	3.63	0.62	3.31	0.87	3.55	0.70	3.41	0.67	3.57	0.68
Providing feedback to students regarding their performance	3.42	0.78	3.42	0.77	3.56	0.60	3.38	0.89	3.39	0.86	3.45	0.80	3.48	0.81
Using humor in the classroom	2.88	0.81	3.07	0.81	3.24	0.75	3.00	0.82	3.33	0.68	3.18	0.85	2.86	0.85
Having students with similar majors living together	2.41	1.05	2.36	1.03	2.54	1.13	2.25	1.06	2.52	0.96	1.86	1.08	2.38	1.07
Student participation in student organizations	2.41	0.92	2.40	0.91	2.48	0.88	2.06	0.77	2.39	0.99	2.64	0.90	2.62	1.02
Faculty participation in programs or events	2.21	0.86	2.16	0.85	2.24	0.80	1.88	0.55	2.24	0.99	2.27	0.94	2.43	0.87
Accessibility of faculty outside of the classroom	3.05	0.92	3.02	0.88	2.91	0.85	2.81	0.91	2.91	0.79	2.86	0.83	3.19	0.75
Students attending engineering programming or events	2.28	0.80	2.33	0.85	2.39	0.76	2.19	0.75	2.42	0.99	2.41	0.96	2.43	0.93
Accessibility of design studios and computer labs	3.55	0.77	3.60	0.69	3.35	0.89	3.69	0.60	3.61	0.60	3.36	0.73	3.67	0.58
Visiting instructors office hours	3.04	0.86	3.03	0.84	3.15	0.81	2.81	0.75	3.15	0.83	3.36	0.79	3.38	0.74

Research Question #3

How do students from different engineering majors compare in regards to their perceptions about teaching methods and the level of faculty involvement that promotes academic success (Tables 11 and 12)? The following engineering majors were compared: civil, mechanical, chemical and biological, computer, electrical, environmental, and engineering science. Responses from engineering open option majors were excluded from the results because of the low number of participants (n=1).

Differences between engineering majors. There were large differences between engineering majors on what they responded was important to a student's academic success in the following five activities or behaviors: faculty participation outside of the classroom in programs or events, group work in class, student participation in student organizations, students with similar majors living together, and tutoring.

There was a 50.9 percentage point difference between majors in the importance of faculty participation outside of the classroom in programs or events with the largest percentage of engineering science majors (57.1%) rating it high and the smallest percentage of computer engineering majors (6.3%) rating it high. The other majors' ratings ranged from 42.6% to 31.8%. There was a 47.5 percentage point difference between majors in the importance of group work in class with the largest percentage of chemical and biological majors rating it high (53.7%) and the smallest percentage of computer engineering majors rating it high (6.3%). The other majors' ratings ranged from 42.4% to 33.3%. There was a 32.4 percentage point difference between majors in the importance of student participation in student organizations with the largest percentage of environmental engineering majors rating it high (63.6%) and the smallest percentage of

computer engineering majors rating it high (31.3%). The other majors' ratings ranged from 61.9% to 45.5%. There was a 28.8 percentage point difference between majors in the importance of having students with similar majors living together with the largest percentage of electrical engineering rating it high (60.6%) and the smallest percentage environmental engineering majors rating it high (31.8%). The other majors' ratings ranged from 52.4% to 40%. There was a 25.5 percentage point difference between majors in the importance of tutoring with the largest percentage of environmental engineering majors rating it high (59.1%) and the smallest percentage of civil engineering majors rating it high (33.6%). The other majors' ratings ranged from 48.5% to 33.7%.

Similarities between engineering majors. There were similarities between engineering majors on what they responded was important to academic success in the following activities or behaviors: ability for students to ask questions in class, accessibility of design studios and computer labs, visiting instructors office hours, providing feedback to students regarding their performance, study groups and students attending engineering programs or events.

There was a 7.1 percentage point difference between majors in the importance of the ability for students to ask questions in class with the majors' ratings ranging from 92.6% to 85.5%. Almost all of the students in each major rated the importance as high. There was an 8.9 percentage point difference between majors in the importance of accessibility of design studios and computer labs with the majors' ratings ranging from 95.2% to 86.4%. A large majority of the students in each major rated the importance as high. There was a 10.7 percentage point difference between majors in the importance of visiting instructor's office hours with the majors' ratings ranging from 85.7% to 75%. At

least three-fourths of students in each major rated the importance as high. There was a 13.5 percentage point difference between majors in the importance of faculty providing feedback to students regarding their performance with the majors' ratings ranging from 94.4% to 81%. The majority of students in each major rated the importance as high. There was a 14.7 percentage point difference between majors in the importance of study groups with the ratings ranging from 75.8% to 61.1%. More than half of the students in each major rated the importance as high. There was a 14.9 percentage point difference between majors in the importance of students attending engineering programming or events with the majors' ratings ranging from 52.4% to 31.2%. Between one-third and one-half of the students in each major rated the importance as low.

Research Question #4

How do students from different class levels compare in regards to their perceptions about teaching methods and the level of faculty involvement that promotes academic success (tables 13 and 14)? The following classes were compared: freshman, sophomore, junior, and senior. Responses from students who consider themselves other than the above classes were excluded from the result because of the low number of participants (n=7).

Differences between class standing. There were large differences between class standings on what they responded was important to academic success in the following activities or behaviors: group work in class, students with similar majors living together, and tutoring.

There was a 34.6 percentage point difference between class standings in the importance of group work in class with the class ratings ranging from 62.8% to 28.2%.

As the class standings increased (freshman to senior) a smaller percentage of students rated group work in class as important to academic success with fewer seniors rating it as high. There was a 30.4 percentage point difference between class standings in the importance of students with similar majors living together with the class ratings ranging from 67% to 35.6%. As the class standings increased (freshman to senior) a smaller percentage of students rated students living together with similar majors as important to academic success with fewer seniors rating it as high. There was a 22.3 percentage point difference between class standings in the importance of tutoring with the class ratings ranging from 49% to 26.7%. As the class standings increased (freshman to senior) a smaller percentage of students rated tutoring as important to academic success with the smallest percentage of seniors rating it has high. Overall, seniors when compared to other classes responded that the following activities or behaviors were less important to academic success: group work in class, students with similar majors living together, and tutoring.

Similarities between class standing. There were similarities between classes on what they responded was important to academic success in the following activities or behaviors: group work outside of class, study groups, and faculty participation outside of the classroom.

There was a 2.2 percentage point difference between class standings in the importance of group work outside of class with the class ratings ranging from 68.9% to 66.7%. More than half of students in all class standings rated group work as highly important. There was a 7.3 percentage point difference between class standings in the importance of study groups with the class ratings ranging from 73.2% to 66%. Between

two-thirds and three-fourths of the students in all class standings rated study groups as highly important. There was an 8.2 percentage point difference between class standings in the importance of faculty participation outside of the classroom in programs or events with the class ratings ranging from 41.5% to 33.3%. Over one-third of the students in all class standings rated faculty participation outside of the classroom in programs or events as being of high importance.

Table 13 **Importance to a student's academic success students (N=420) compared by class (frequency)**

Level of importance	Class									
	Fresh (n=94) High		Soph (n=72) High		Junior (n=112) High		Senior (n=135) High		Other (n=7) High	
	freq	%	*freq*	%	*freq*	%	*freq*	%	*freq*	%
Study groups	62	65.96	49	68.06	82	73.21	90	66.67	1	14.29
Tutoring	46	48.94	33	45.83	39	34.82	36	26.67	5	71.43
Note taking	90	95.74	65	90.28	100	89.29	117	86.67	7	100
Group work in class	59	62.77	26	36.11	40	35.71	38	28.15	1	14.29
Group work outside of class	63	67.02	48	66.67	75	66.96	93	68.89	2	28.57
Class lectures available online	75	79.79	47	65.28	88	78.57	100	74.07	5	71.43
Class discussion	83	88.30	58	80.56	89	79.46	94	69.63	5	71.43
Ability for students to ask questions in class	81	86.17	65	90.28	104	92.86	115	85.19	7	100
Providing feedback to students regarding their performance	81	86.17	68	94.44	102	91.07	117	86.67	7	100
Using humor in the classroom	76	80.85	59	81.94	89	79.46	98	72.59	5	71.43
Having students with similar majors living together	62	65.96	39	54.17	40	35.71	48	35.56	2	28.57
Student participation in student organizations	55	58.51	30	41.67	52	46.43	63	46.67	3	42.86
Faculty participation outside of the classroom in programs or events	39	41.49	28	38.89	42	37.50	45	33.33	2	28.57
Accessibility of faculty outside of the classroom	67	71.28	51	70.83	94	83.93	96	71.11	7	100
Students attending engineering programming or events	47	50.00	35	48.61	55	49.11	42	31.11	4	57.14
Accessibility of design studios and computer labs	82	87.23	64	88.89	103	91.96	129	95.56	7	100
Visiting instructors office hours	67	71.28	59	81.94	96	85.71	103	76.30	6	85.71

Table 14 **Importance to a student's academic success students (N=420) compared by class (Means)**

Level of importance	Class									
	Fresh (n=94)		Soph (n=72)		Junior (n=112)		Senior (n=135)		Other (n=7)	
	M	SD	M	SD	M	SD	M	SD	M	SD
Study groups	2.84	0.96	2.97	0.98	2.96	0.89	2.92	0.97	2.0	1.00
Tutoring	2.47	0.92	2.43	0.99	2.19	0.97	1.97	0.89	2.71	0.95
Note taking	3.67	0.59	3.56	0.71	3.5	0.76	3.39	0.79	3.57	0.53
Group work in class	2.67	0.86	2.21	0.73	2.29	0.88	2.06	0.88	2.14	0.38
Group work outside of class	2.85	0.82	2.74	0.79	2.80	0.87	2.91	0.97	2.14	1.07
Class lectures available online	3.14	0.88	2.86	1.00	3.13	0.88	2.97	0.91	2.86	1.07
Class discussion	3.33	0.79	3.03	0.73	3.17	0.77	2.9	0.82	2.86	0.69
Ability for students to ask questions in class	3.49	0.76	3.43	0.71	3.52	0.68	3.38	0.83	3.71	0.49
Providing feedback to students regarding their performance	3.43	0.79	3.5	0.69	3.51	0.71	3.33	0.84	3.71	0.49
Using humor in the classroom	3.17	0.78	3.13	0.77	3.0	0.72	2.99	0.90	3.0	0.82
Having students with similar majors living together	2.86	0.93	2.56	1.03	2.15	1.08	2.16	0.99	2.0	1.15
Student participation in student organizations	2.68	0.88	2.31	0.88	2.38	0.92	2.34	0.94	2.57	0.79
Faculty participation outside of the classroom in programs or events	2.31	0.79	2.15	0.82	2.23	0.87	2.11	0.89	2.29	0.95
Accessibility of faculty outside of the classroom	2.94	0.80	2.89	0.83	3.18	0.89	2.93	0.91	3.2	0.49
Students attending engineering programming or events	2.5	0.77	2.39	0.85	2.44	0.87	2.08	0.81	2.86	0.90
Accessibility of design studios and computer labs	3.30	0.82	3.42	0.76	3.62	0.74	3.72	0.59	3.71	0.49
Visiting instructors office hours	2.93	0.87	3.22	0.77	3.24	0.71	2.99	0.91	3.14	0.69

CHAPTER 5: DISCUSSION

Student success is paramount in higher education and this study was designed to focus on the expanded paradigm in which higher education now emphasizes the student's experience in and outside of the classroom (Love, 1995). Previous research has shown that the following promotes student academic success: positive student-faculty interaction, active teaching methods, supportive campus environments, and a social and educational community (Kuh et al., 2005; Braxton et al., 2000; Tinto, 1993; Bean, 2005; Astin, 1999; Terenzini et al., 2001). This research took into consideration student success research and generational analysis while shining the spotlight on the field of engineering. The field of engineering education is focused on creating successful students which in turn creates competent and qualified engineers. To enhance engineering education's efforts, it is important to explore the climate in and outside of the classroom as well as the students' and faculty perceptions about what promotes academic success.

This research investigated the perception of engineering students and faculty regarding teaching methods and faculty involvement to create a picture of what is occurring in engineering education. The results show some interesting patterns, similarities, and discrepancies between students and faculty. In this chapter, the patterns, similarities, and discrepancies will be discussed as well as recommendations for engineering education programs and future research. Each question will be explored individually and then all data will be brought together to create an overall picture of engineering students and faculty.

Data was collected by utilizing two surveys to address the following questions: 1) How do engineering students and faculty responses compare in regards to their

perceptions about teaching methods utilized and the level of student-faculty interaction in the college? 2) How do engineering students and faculty responses compare in regards to their perceptions about the importance of teaching methods and the level of faculty involvement that promotes student academic success? 3) How do students from different engineering majors compare in regards to their perceptions about teaching methods and the level of faculty involvement that promotes academic success? 4) How do students from different class levels compare in regards to their perceptions about teaching methods and the level of faculty involvement that promotes academic success? Survey construction allowed for a comparison between groups that explored perceptions and behaviors in relation to active and passive teaching methods and the level of faculty involvement in and outside of the classroom. Research about teaching methods (Jacobsen et al., 2002; Jordan & Porath, 2006; Chickering & Gamson, 1987; National Research Council, 1997), faculty involvement outside the classroom (Astin, 1999), and student academic and retention theories (Pascarella & Terenzini, 2005; Seidman, 2005; Tinto, 1993; Kuh et al., 2005) were utilized to create the survey questions. Data was analyzed utilizing descriptive statistics comparing frequencies, percentages, and means to reveal patterns and connections.

The data represents student and faculty perceptions about what is occurring in and outside of the classroom, as a result of the self-reporting nature of the survey the data represents perceptions not the actuality of frequency of behaviors; nevertheless, perceptions play an integral role in the student and faculty experience. Therefore, the findings do not necessarily show that the activities are occurring as frequently or infrequently as reported but rather that there are possibilities of different perceptions from

the participants. The discussion will include an analysis of what the discrepancies and similarities represent.

Summary of Results

Looking at the research results as a whole to gather insight into engineering education the data showed the following patterns: engaging teaching methods such as cooperative and problem-based learning are not used frequently in the classroom; instead a large percentage of faculty are spending the majority of class time lecturing, and there is a lack of student-faculty interaction outside of the classroom in events, office hours, or any other type of activity. When comparing the data it appears that faculty and students agree more with what is not happening than what is happening. In other words, it is easy to get a clear and consistent (agreed upon) picture of what is not happening in and outside of the classroom such as: students visiting office hours, students being graded as a group, field trips, in-class writing, and in-class reading.

When students were compared by class standing or major, there were interesting trends with computer engineering majors and seniors. Computer engineering students reported the following as being of low importance: faculty participation outside of the classroom, group work in class, and participation in student organizations. It appears based on the data that computer engineering students do not rate the level of importance for activities that would place them into groups or outside activities such as programming with faculty or student organizations as highly important for their success with their ratings being much lower than other majors. When comparing class standings, less importance was placed on tutoring, group work in class, and students with similar majors living together with seniors rating them as of low importance to academic success.

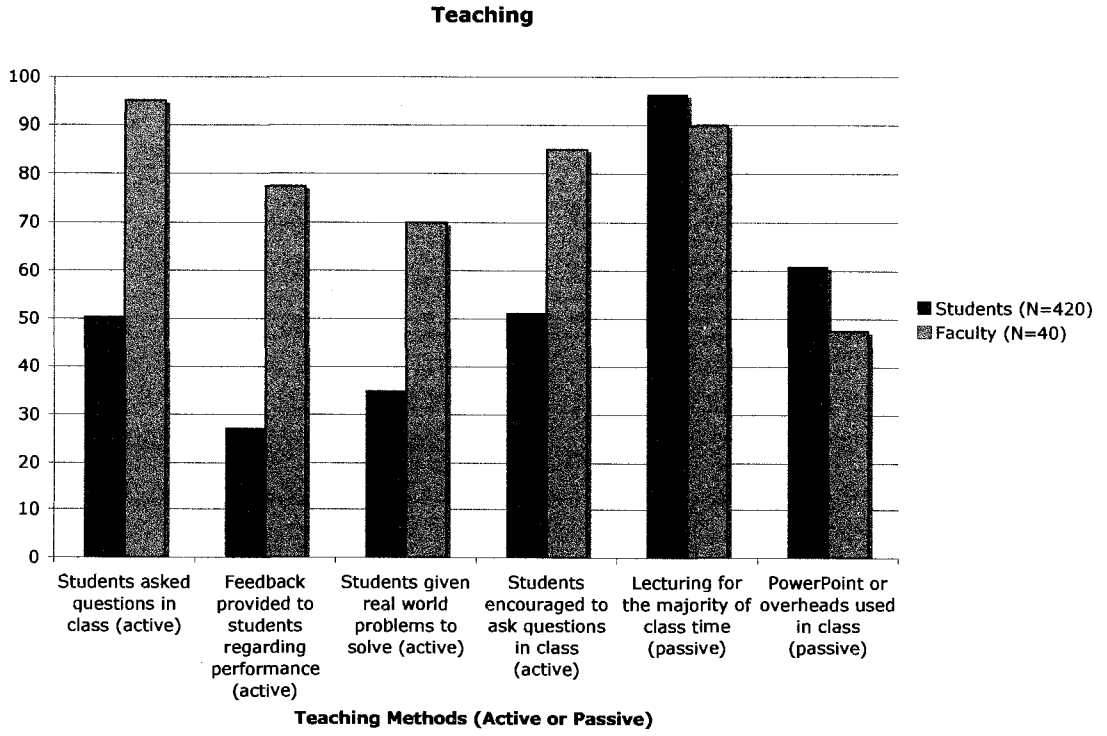
Research Question #1

The first research question asks: how do engineering students and faculty responses compare in regards to their perceptions about teaching methods utilized and the level of student-faculty interaction in the college? Students and faculty answers were explored to see the differences and similarities in their perceptions of the frequency of activities or behaviors. The more interesting results such as large differences or similarities will be discussed here. Overall, faculty reported that activities occurred more often than students reported for all activities and behaviors. This phenomenon was taken into consideration when comparing the two groups. The first question was explored in three different ways: 1) Students and faculty were compared by the reported frequency of activities or behaviors, 2) Faculty and students responses were viewed through the lens of teaching methods and faculty involvement, 3) The data was complied to see if there were any large differences or similarities in what faculty or students reported was important to a student's academic success verses what they perceived was occurring in and outside of the classroom.

Teaching methods (Graph 1). Table 6 shows the activities and behaviors associated with teaching methods both passive and active. Faculty reported that the following teaching methods were used most often: students asked questions in class (95%), lecturing for the majority of class time (90%), students encouraged to ask questions in class (85%), providing feedback to students on performance (77.50%), and students given real world problems to solve (70%). Students reported that the following teaching methods were used most often: lecturing for the majority of class time (96.4%), faculty using PowerPoint or overheads in class (61%), students encouraged to ask

questions (51.4%), and students asked questions in class (50.2%). The most commonly used teaching method reported in this study by both faculty and students was lecturing for the majority of class time (90% faculty, 96.4% student). Faculty report that active teaching methods occur more frequently than students report; however, overall students rated the frequency of all behaviors and activities as occurring less frequently. It is evident from the data that active teaching methods are not occurring as often as research suggests it should. As mentioned previously, almost all students and faculty agree that lecturing is the most common method and occurs during the majority of class time. This is not surprising since lecturing is the most common passive teaching method with instructor centered learning and is used frequently in large introductory classes (Jacobsen et al., 2002).

Graph 1



There were large differences in the perceived frequency of faculty providing feedback to students with faculty reporting that it occurs more frequently than students (77.5% faculty reported often, 27.4% students reported often). These differences raise some concern about the type and frequency of feedback provided to students as well as the way students perceive feedback when given by instructors. The difference could represent the following: faculty may not be giving students the type of feedback that they want, both (students and faculty) could perceive what constitutes feedback differently, faculty are truly not providing feedback to students as often as students want or perceive, or both are inaccurate and the frequency of feedback is somewhere in the middle. One of Chickering and Gamson's (1999) seven principles for good practice in undergraduate education is providing prompt feedback to students. Prompt feedback allows students to improve and learn from previous assignments (Weaver, 2006). Huxham (2007) found that the best approach to providing feedback to students is to employ a hybrid method that blends together model answers and personal comments. However, his research did lend itself to unique results, students reported that they preferred the personal feedback but they performed better when they had model answer feedback. Thus students' perceptions on what they need to be successful may vary from what actually promotes improved performance in class. Weaver found that students value feedback but that the feedback provided is often vague and unclear. The sample size for Weaver's research was small; however, it does shed some light on students' perspective about faculty providing feedback on their performance. Providing feedback to students is known (Terenzini et al., 2001) to help promote academic success; thus, the students' perceptions of the lack of receiving feedback could negativity impact their academic performance. Knowing that

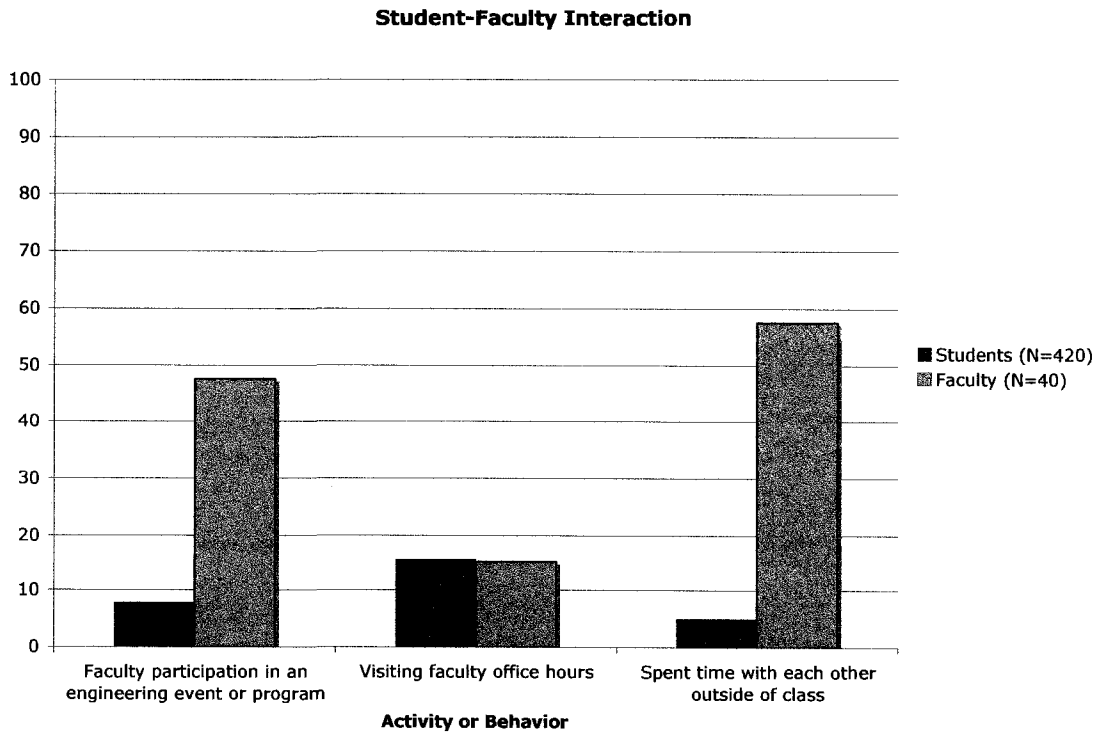
these discrepancies exist is the first step in understanding student success, and the next step in future research should be to explore why there are such large differences in perceptions.

Faculty and students report that students are asked questions in class often (95% faculty, 50.2% students), encouraged to ask questions in class often (85% faculty, 51.4% students), and giving real world problems often (70% faculty, 35% students), which are all active teaching methods. Accounting for the phenomenon that students reported the frequency of all activities and behaviors lower, it seems that faculty are attempting to create an engaged classroom even though both report that lecturing for the majority of the class time occurs often. There is some discrepancy between faculty and students with the reported frequency of real world problems given which represents a problem based learning method (70% faculty reported often, 35% students reported often). Even with the discrepancy it appears that real world problems are being utilized in classroom instruction. As mentioned previously, a large majority of students and faculty report that lecturing for the majority of class time occurs often which represents passive methods. Taking all of this into consideration it appears that faculty may be primarily utilizing passive teaching methods while incorporating active methods occasionally. There is not a complete void of active teaching methods; however, when compared to what research suggests and the push from engineering education, it appears that active teaching methods are not integrated often enough. Each engineering department will need to determine what active teaching methods would work well within their major. Some active teaching methods might not be appropriate or feasible for the engineering classroom such as in-class writing or reading. However, methods that are cooperative

such as students being graded as a group and problem based learning that incorporates real world problems could be easily implemented in the engineering classroom.

Student-faculty interaction (Graph 2). Student-faculty interaction in and outside of the classroom promotes persistence in school and higher grade point averages (Astin, 1993; Pascarella & Terenzini, 2005). Activities that would suggest that students and faculty would be interacting with each other were explored and compared based on the frequencies of the behaviors. The following behaviors and/or activities that are related to student faculty interaction were compared: faculty participation in engineering events for programs, amount of time spent by students in faculty office hours, and time spent outside of class with each other.

Graph 2



There were large discrepancies between the frequency of faculty attending engineering events or programs with 47.5% of faculty reported attending often and 7.9% of students reported that faculty attended often. However, only 10.2% (43) of students report attending engineering events or programs often and out of those 43 students only 17 (39.5%) reported that faculty attended the events often which matches closer to what faculty report. Thus, it seems that the discrepancies could be a result of a lack of students attending the events and relates more to their perception of the frequency of faculty attending engineering events rather than the actuality. Students' perceptions that faculty are available and engaged in and outside of the classroom helps to promote academic success thus their perception that faculty are not participating in the events can impact them negatively (Pascarella & Terenzini, 2005).

More than half the faculty report spending time often with students, but the percentage of faculty and students reporting spending time often is still low (57.5% faculty, 5% students). There was almost a complete agreement between students (15% reported often) and faculty (15.5% reported often) on how often students spend time in an instructor's office hours. Thus data suggests that both faculty and students agree that students do not visit instructor's office hours often. The lack of students spending time in an instructor's office does raise concern. Office hours are the most common and traditional method for faculty and students to interact outside of the classroom. Hence, faculty may overestimate or students underestimate but nevertheless they are not spending much time together outside of the classroom particularly in office hours. Another way that the data could be interpreted is that a small minority of students are

spending the majority of the time with the faculty. Hence, a small group of students are spending time with the faculty that are engaged outside of the classroom; thus, it may be the same students that keep interacting with faculty.

Importance compared to frequency of behaviors. The following had at least 75% of students deem as highly important activities: accessibility to design studios and computer labs, note taking, faculty providing feedback, ability for students to ask questions, visiting instructors' office hours, class discussion, using humor in the classroom, and posting lectures online. Overall these activities or behaviors that a majority of students (at least three-fourths) reported as important were not occurring or being utilized often.

The activities that faculty control such as class discussion, use of humor, lectures posted online, providing feedback were reported to not be occurring often by a majority of the students. For example, 89.3% of student indicated that they felt faculty providing feedback was highly important yet only 27.4% of students report that it occurs often. The activities that students control such as visiting offices hours and note taking were reported by the students to not be occurring often. For example 78.8% of students reported that visiting an instructor's office was very highly important yet only 15.4% reported visiting a professor's office hours often and only 14.1% reported visiting a teaching assistant's office hours often. Secondly, almost all students reported that taking notes is important; however, only 36.2% report rereading them. This could reflect that students value note taking during class but do not feel that the notes need to be used beyond the initial class in which they were written. In future research it would be important to find out what students do with their notes, if they take them at all.

Unlike students, there were similarities between what faculty felt was highly important and what they reported occurred in the classroom. However, the activities such as participation in student organizations, office hours, and attendance at engineering programs or events that relied on the student's behavior did have discrepancies between faculty importance and reported frequency of behavior. The biggest discrepancy was student participation in engineering programming or events with 75% of faculty rating it has highly important and only 10.2% of students reporting that they attend often. Students will not be successful if they are not active participants in their college experience. By facilitating students' involvement with their academics, peers, and faculty, colleges can increase the likelihood that the students will be academically successful (Astin, 1999). This raises the question on how universities can encourage students to attend events, student organizations, and faculty office hours. In future research, it would be helpful to ask students what events do they attend and what type of events would they be interested in attending.

Research Question #2

The second research question asks: how do engineering students and faculty responses compare in regards to their perceptions about the importance of teaching methods and the level of faculty involvement that promotes student academic success? Students and faculty answers were explored to see if there were differences and similarities in their responses.

Students and faculty vary the greatest on the importance of class lectures available online with three quarters of students (75%) responding that class lectures online are important to a student's academic success with only one quarter of faculty (25%)

reporting it as highly important. The availability of class lectures online would be a more recent occurrence in higher education with the increased use of web based course management systems such as Blackboard. These technologies allow instructors to create an online learning community that includes but is not limited to discussion boards, assessments, and surveys. The increased technology use by students will make it necessary for faculty and institutions of higher education to incorporate technologies that can create active learners. Schools can tap into the student's increased technological connectivity to create virtual communities to provide unique ways for faculty and students to interact.

Faculty and students were most similar in their response to the importance of accessibility of faculty outside of the classroom with 77.5% of faculty and 75% of students reporting it as highly important. The data suggests that both faculty and students agree that faculty being accessible to students is highly important to a student's success with three-fourths of the students and faculty rating it as highly important, which supports past research that student faculty interaction has a positive impact on a student's academic success (Pascarella & Terenzini, 2005; Astin, 1993).

Ranking of the activities or behaviors. Faculty and students had similar responses when activities or behaviors were ranked based on calculating the participants' score and ranking them using the percentage of high importance responses. Faculty and students have the following activities and behaviors as their top 6 that promote academic success yet they ranked them differently: ability for students to ask questions in class, accessibility of design studios and computer labs, note taking, providing feedback to students regarding their performance, class discussion, and visiting instructors' office

hours. This demonstrates that when the activities are ranked that there are similarities between faculty and students in what they report is important to a student's academic success. This takes into consideration the phenomenon that the students rated everything lower, their highest ranking (with 91% of students ranking it as highly important) was accessibility of design studios and computer labs.

Research Question #3 (Graph 3)

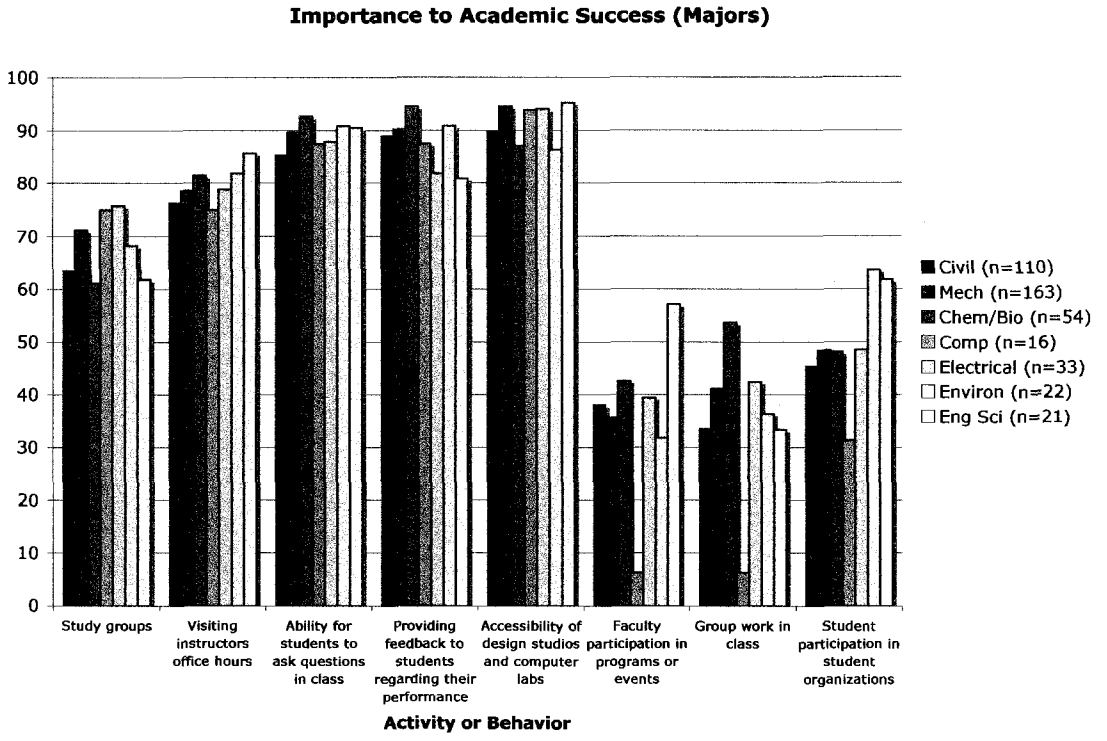
The third research question asks: how do students from different engineering majors compare in regards to their perceptions about teaching methods and the level of faculty involvement that promotes academic success? The following engineering majors were compared: civil, mechanical, chemical and biological, computer, electrical, environmental, and engineering science. Responses from engineering open option majors were excluded from the result because of the low number of participants (n=1).

There were large differences between engineering majors on what they responded was important to academic success in the following five activities or behaviors: faculty participation outside of the classroom in programs or events, group work in class, student participation in student organizations, students with similar majors living together, and tutoring.

Computer engineering majors have the largest differences when compared to other majors and rated the following as low importance to academic success: faculty participation in programs or events, group work in class, and student participation in student organizations. There were similarities between engineering majors on what they responded was important to academic success in the following five activities or behaviors: ability for students to ask questions in class, accessibility of design studios and

computer labs, visiting instructors' office hours, providing feedback to students regarding their performance, and study groups.

Graph 3



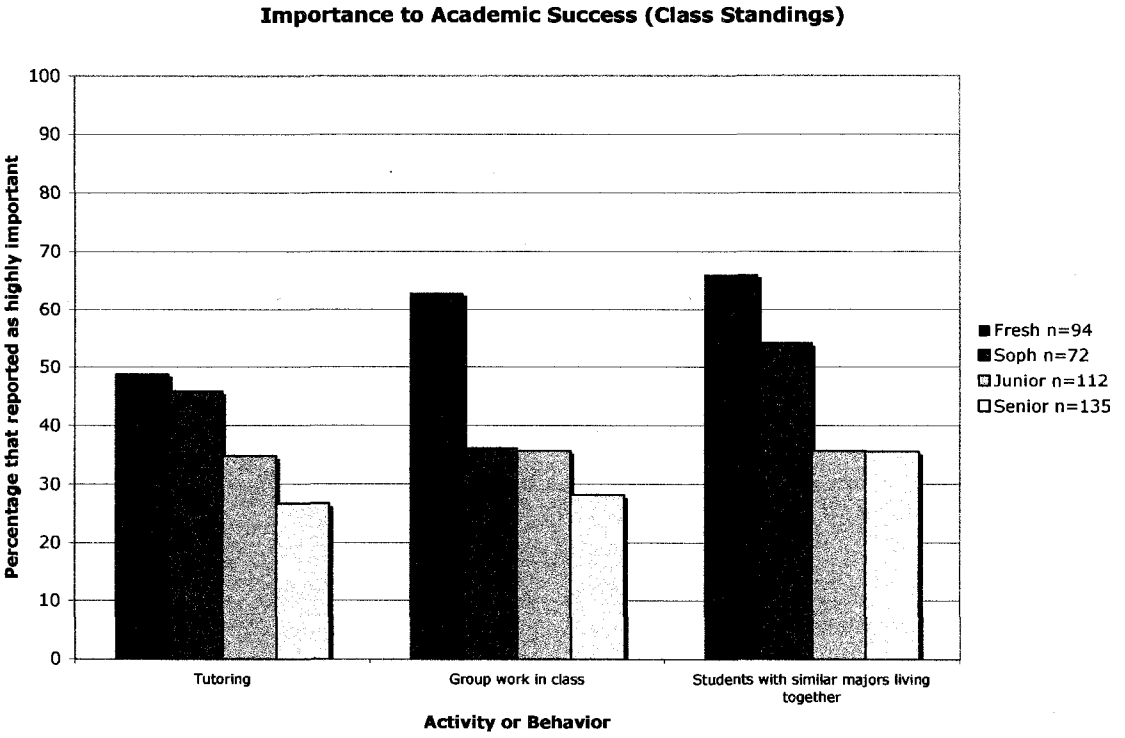
Research Question #4 (Graph 4)

The fourth research question asks: how do students in different class levels compare in regards to their perceptions about teaching methods and the level of faculty involvement that promotes academic success? The following classes were compared: freshman, sophomore, junior, and senior. Responses from students who consider themselves other than the above classes were excluded from the result because of the low number of participants (n=7).

Overall, seniors when compared to other classes responded that the following

activities were less important to academic success: group work in class, students with similar majors living together, and tutoring.

Graph 4



Recommendations for Engineering Education

The purpose of this research is to explore patterns in engineering education and provide insight to what is perceived by faculty and students as being important to a student's academic success in school. The following recommendations are made to undergraduate engineering education programs based on past research and the current study's findings:

- Increase faculty and student interaction both formally and informally
- Use engaging teaching methods often in class
- Utilize technology to improve learning and give students access to computer labs and design studios
- Respond to the new generation of students appropriately

Interaction Between Students and Faculty

The data suggests that the amount of time faculty and students are spending together are limited particularly during faculty office hours. This lack of student-faculty interaction is a concern with the known positive impact that it has on student's academic performance. To help increase student faculty involvement unique learning environments can be created that will allow students to interact with their peers and faculty outside of the classroom. Examples of unique learning environments include, residential learning communities (particularly with faculty in residence programs), learning communities, programs/events, and the use of networking technologies.

Learning communities, particularly living learning communities develop students who have a higher level of involvement and help to facilitate interaction between faculty and students (Inkelas & Weisman, 2003; Shapiro & Levin, 1999); thus, keeping the students connected and engaged in their educational experience. Efforts towards creating living learning communities might be more effective in the beginning of a student's college career since undergraduate students report that they value LLCs more than their upper-class peers (with seniors reporting it of low importance to academic success).

Engaging Teaching Methods

The current research findings suggest that engaging teaching methods are not occurring as frequently as research suggests it should. Depending on the program or major, appropriate engaging teaching methods should be incorporated into the classroom. Each department will need to decide what is feasible and appropriate for their program. With a large percentage of faculty and students reporting that lecturing occurs the majority of class time, moving beyond lecturing (particularly in the first few years of a

students college experience) would help to promote retention during the most important time of a student's academic career. Whatever the program or pedagogy that is used the goal should be to create engaged learners.

Use of Technology

As mentioned previously, students are becoming proficient in using technology (computers, online networking, etc) and there is a call for institutions to use newer technologies to engage the students (Oblinger, 2003). However, it is not just about using technologies but using sound methods to keep students engaged in their college experience. Whether it is using Blackboard or other technologies there needs to be a focus on engaging the student and creating opportunities for students and faculty to interact. In the field of engineering there are endless types of technology to get and keep students active and engaged in the learning process. Faculty should find a way to stay engaged with students outside of the classroom as well. Students agree and they expressed in this study that they place high importance on having contact with faculty outside of the classroom. In the current research, students rated having access to computer labs and design studios as highly important to a student's academic success. Thus, technology must be incorporated in three ways; to improve and enhance active teaching methods, create interaction between students and faculty, and to provide students access to technology such as computer labs and designs studios, which will give them the tools to progress and complete assignments and projects.

Respond to New Generation of Students

Generational analysis can create a framework for understanding today's college students. Engineering education can nurture the current college students' collaborative nature and desire to be connected through learning communities and active teaching methods; however, this must be balanced by acknowledging possible limitations such as students not being well prepared and relying on others to do the work (Wilson, 2004). For example, when using collaborative or cooperative teaching methods there should be measurable accountability such as peer evaluations and individual grading (Kuh, 2003). Taking into consideration current students needs, wants, and strengths when creating learning environments, programs, or pedagogies one can improve the likelihood that students will be engaged and therefore improve their academic success.

Recommendations for Future Research

One purpose of this research was to identify future areas of research. A few questions arose from the results that future research could help clarify on what is occurring in and outside of the engineering classroom.

Students report that receiving feedback from faculty was highly important to their success. However, it is unclear about what type of feedback the students would prefer model answers or personal comments. Students and faculty reported that students visiting office hours is highly important to academic success, but students rarely use them. More insight could be gained by exploring what type of interaction with faculty is most desired and/or is there a way to get students to go to office hours. The ability to ask questions was rated highly important by faculty and students; however, it is unclear since it was not

asked in the survey if the ability to ask questions is being interpreted by the participants as faculty providing an opportunity to ask questions in class or the cognitive ability of students to ask questions. Taking notes was reported by both faculty and students as being highly important; however, there were no follow-up questions in the survey, besides asking students if they reread their notes. Possible follow-up questions could ask students if they take notes and if so, what do they use them for after the initial notes are taken.

There is a limit in the study based on the paucity of questions addressing the issue of technology use, besides questions that asked about the accessibility of computer labs, design studios, and lectures posted online. Further research should address the types of technology that students and faculty would be interested in using in and outside of the classroom for networking, class management, and projects/homework.

Other research methods could help gain more insight as to what is occurring in engineering education. The current study utilized self-reporting of behaviors and activities; thus, the results are based on the perceptions rather than the actual frequencies of the behaviors. Utilizing qualitative research methods such as personal interviews or open-ended survey questions would enable faculty and students to expand on their answers and clarify anything that was unclear such as type of feedback desired, cognitive ability to ask questions, etc. Other qualitative research methods such as naturalistic observation would allow students and faculty to be observed in the classroom to assess what types of teaching methods are being used. When employing naturalist observation the purpose is to "prove a complete and accurate picture rather than to test hypotheses formed prior to the study" (Cozby, 1997, p. 79). To better understand how involved

students and faculty are with each other and the college as a whole, structural analysis can be used to gather data regarding the social networks of students and faculty within the college setting. Structural analysis is when one explores "the ordered arrangements of relations that are contingent upon exchange among members of social systems" and then maps "these structures, describe their patterns (often using a set of tools derived from mathematical graph theory) and seeks to uncover the effects of these patterns on the behaviors of the individual members of these structures – whether people, groups, or organizations" (Wellman & Berkowitz, 1988, p. 3).

Study Limitations

Lack of random sampling prevents the findings from being generalized beyond CSU to all engineering students and faculty. The next step would be to collect random samples from a variety of higher education institutions that have engineering majors. Adding more universities and colleges would help to examine if there is a larger pattern of behavior occurring in undergraduate engineering education. Furthermore, there could also be limitations to the survey based on possible definitional differences between faculty and students in the way they define and interpreted the questions.

Limitations on the quantitative nature of the research prevent the ability to clarify the patterns that developed and the participants are not able to elaborate or expand on their answers to the research questions. Since the survey was newly constructed, there are limitations based on the reliability of the survey instrument. To help establish reliability, future research could include test-retests of the instrument, survey questions could be added that would allow for Cronbachs Alpha to be run, and/or standard error of measurement could be established.

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APPENDIXES

APPENDIX A

Cover Letter to Students

You are invited to complete an Engineering Teaching Methods Survey. Only a select number of students have been asked to participate, so your responses are very important!

At the end of the survey all participants who provide an email address will be entered into a drawing for one of four $25 gift cards to Best Buy.

The survey should take about 15 minutes to complete. Your participation is voluntary and your responses will be completely confidential. Your responses will be combined with all other data for statistical analysis. The results of the survey will be used to assist the researchers with information about the Engineering Program at Colorado State University.

No identifiers, email addresses or names, will be attached to the survey responses unless you choose to provide that information. If you provide an email address and/or your name, all identifiers will be removed from the data and this information will be kept separately from your responses.

To take the survey click on this imbedded link (*imbedded link*) or go to (*Survey URL*).

Thank you for your participation.

Consent to Participate in a Research Study
Colorado State University

TITLE OF STUDY: *The perceptions and behaviors of engineering students and faculty in relation to teaching methods and faculty involvement.*

PRINCIPAL INVESTIGATOR: *Tom Siller, PhD - Associate Dean of Academic and Student Affairs, College of Engineering. Email: tjs@engr.colostate.edu Phone: (970) 491-6220*

CO-PRINCIPAL INVESTIGATOR: *Lacy Karpilo, PhD candidate - School of Education. Email: Karpilo@gmail.com. Phone: (720) 987-4038.*

WHY AM I BEING INVITED TO TAKE PART IN THIS RESEARCH? *We are interested in surveying students who are studying engineering at Colorado State University and their experience inside and outside of the classroom.*

WHO IS DOING THE STUDY? *The study is being conducted by Tom Siller, Associate Dean and Professor in Civil Engineering and Lacy Karpilo a graduate student in the School of Education.*

WHAT IS THE PURPOSE OF THIS STUDY? *The purpose of this study is to learn about the experience of students inside and outside of the classroom. We want to explore what are the faculty doing in the classroom and what you feel is important to your academic success.*

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST? *The study will take place during the 2007 fall semester and it will take approximately 15 minutes to complete the survey. The survey will be distributed during one of your classes.*

WHAT WILL I BE ASKED TO DO? *You will be asked to complete an electronic survey that will take approximately 15 minutes to complete.*

ARE THERE REASONS WHY I SHOULD NOT TAKE PART IN THIS STUDY?
You should not take part in this study if you are not studying engineering at CSU. All engineering majors including open option and engineering seeking are welcome to participate.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

- *There are no known risks associated with participating in this study.*
- It is not possible to identify all potential risks in research procedures, but the researcher(s) have taken reasonable safeguards to minimize any known and potential, but unknown, risks.

ARE THERE ANY BENEFITS FROM TAKING PART IN THIS STUDY? There are no direct benefits from participating in this research but we hope to improve student academic success and the experience of students in and outside the classroom.

DO I HAVE TO TAKE PART IN THE STUDY? Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participating at any time without penalty or loss of benefits to which you are otherwise entitled.

WHAT WILL IT COST ME TO PARTICIPATE? *There are no costs to participate.*

WHO WILL SEE THE INFORMATION THAT I GIVE?
We will keep private all research records that identify you to the extent allowed by law.

Your information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered. You will not be identified in these written materials. We may publish the results of this study; however, we will keep you name and other identifying information private.

We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information, or what that information is. For example, your name will be kept separate from your research records and these two things will be stored in different places under lock and key. You should know, however, that there are some circumstances in which we may have to show your information to other people. For example, the law may require us to show your information to a court.

CAN MY TAKING PART IN THE STUDY END EARLY? *A participant would be removed from the study if it were discovered that he or she is not studying engineering.*

WILL I RECEIVE ANY COMPENSATION FOR TAKING PART IN THIS STUDY? *All participants who provide email addresses will be entered into a drawing for one of four $25 gift cards to Best Buy.*

WHAT HAPPENS IF I AM INJURED BECAUSE OF THE RESEARCH? The Colorado Governmental Immunity Act determines and may limit Colorado State University's legal responsibility if an injury happens because of this study. Claims against the University must be filed within 180 days of the injury.

WHAT IF I HAVE QUESTIONS?
Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions about the study, you can contact the investigator, Tom Siller at (970) 491-6220. If you have any questions about your rights as a volunteer in this research, contact Janell Meldrem, Human Research Administrator at 970-491-1655. We will give you a copy of this consent form to take with you.

WHAT ELSE DO I NEED TO KNOW? *Your completion of the survey acknowledges that you have read the information stated and willingly have participated in this survey. You may print off a copy of this cover page email.*

For more information, relevant research, and results of this research (when completed) you may visit www.karpilo.com/research/lacykarpilo.html.

If you have questions, please feel free to contact me at 491-6220 or tjs@engr.colostate.edu.

Thank you for taking the time to complete the survey.

Sincerely,

Tom Siller
Associate Dean for Academic and Student Affairs
Associate Professor of Civil Engineering
College of Engineering

APPENDIX B

Cover Letter to Faculty

You are invited to complete a brief survey investigating engineering teaching methods. The purpose of the research is to gain a better understanding of the effects of faculty involvement and teaching methods on engineering students' academic success.

The survey should take approximately 5 minutes to complete. Your participation is voluntary and your responses will be completely confidential. Your responses will be combined with all other data for statistical analysis. The results of the survey will be used to gather information about the teaching methods used in the Engineering Program at Colorado State University.

No identifiers, email addresses or names, will be attached to the survey responses unless you choose to provide that information. If you provide an email address and/or your name, all identifiers will be removed from the data and this information will be kept separately from your responses.

To take the survey please go to the following link (*Survey URL*).

Thank you for your participation.

Consent to Participate in a Research Study
Colorado State University

TITLE OF STUDY: *The perceptions and behaviors of engineering students and faculty in relation to teaching methods and faculty involvement.*

PRINCIPAL INVESTIGATOR: *Tom Siller, PhD - Associate Dean of Academic and Student Affairs, College of Engineering. Email: tjs@engr.colostate.edu Phone: (970) 491-6220*

CO-PRINCIPAL INVESTIGATOR: *Lacy Karpilo, PhD candidate - School of Education. Email: karpilo@gmail.com. Phone: (720) 987-4038.*

WHY AM I BEING INVITED TO TAKE PART IN THIS RESEARCH? *We are interested in surveying engineering faculty who are teaching undergraduate engineering classes at Colorado State University.*

WHO IS DOING THE STUDY? *The study is being conducted by Tom Siller, Associate Dean and Professor in Civil Engineering and Lacy Karpilo a graduate student in the School of Education.*

WHAT IS THE PURPOSE OF THIS STUDY? *The purpose of this survey is to learn about the experience of engineering students inside and outside of the classroom. We want to explore with the survey what are the teaching methods that are being used in the classroom and what faculty feel is important to promote student academic success.*

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST? *The study will take place during the 2007 fall semester and it will take approximately 5 minutes to complete the survey. The survey will be distributed through email.*

WHAT WILL I BE ASKED TO DO? *You will be asked to complete an electronic survey that will take approximately 5 minutes to complete.*

ARE THERE REASONS WHY I SHOULD NOT TAKE PART IN THIS STUDY?
You should not take part in this study if you are not teaching undergraduate engineering classes at CSU. All engineering departments are included.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

- *There are no known risks associated with participating in this study.*
- It is not possible to identify all potential risks in research procedures, but the researcher(s) have taken reasonable safeguards to minimize any known and potential, but unknown, risks.

ARE THERE ANY BENEFITS FROM TAKING PART IN THIS STUDY? There are no direct benefits from participating in this research but we hope to improve student academic success and the experience of students in and outside the classroom.

DO I HAVE TO TAKE PART IN THE STUDY? Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participating at any time without penalty or loss of benefits to which you are otherwise entitled.

WHAT WILL IT COST ME TO PARTICIPATE? *There are no costs to participate.*

WHO WILL SEE THE INFORMATION THAT I GIVE?
We will keep private all research records that identify you to the extent allowed by law.

Your information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered. You will not be identified in these written materials. We may publish the results of this study; however, we will keep you name and other identifying information private. Results of the research will be shared with the College of Engineering. Steps will be taken to protect any identifying information when results will be shared. If particular demographic information would create the possibility that a participant could be identified, it will be removed from the results shared with the college (ex. ethnicity, total years teaching).

We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information, or what that information is. For example, your name will be kept separate from your research records and these two things will be stored in different places under lock and key. You should know, however, that there are some circumstances in which we may have to show your information to other people. For example, the law may require us to show your information to a court.

CAN MY TAKING PART IN THE STUDY END EARLY? *A participant would be removed from the study if it were discovered that he or she is not or has not taught undergraduate engineering courses.*

WILL I RECEIVE ANY COMPENSATION FOR TAKING PART IN THIS STUDY? *All participants who provide email address will be entered into a drawing for a gift card to the CSU Bookstore.*

WHAT HAPPENS IF I AM INJURED BECAUSE OF THE RESEARCH? The Colorado Governmental Immunity Act determines and may limit Colorado State University's legal responsibility if an injury happens because of this study. Claims against the University must be filed within 180 days of the injury.

WHAT IF I HAVE QUESTIONS?
Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions about the study, you can contact the investigator, Tom Siller at (970) 491-6220. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator at 970-491-1655. Please print out a copy of this consent form to take with you.

WHAT ELSE DO I NEED TO KNOW? *Your completion of the survey acknowledges that you have read the information stated and willingly have participated in this survey. You may print off a copy of this cover page email.*

For more information, relevant research, and results of this research (when completed) you may visit www.karpilo.com/lacy-karpilo.htm.

If you have questions, please feel free to contact me at 491-6220 or tjs@engr.colostate.edu.

Thank you for taking the time to complete the survey.

Sincerely,

Tom Siller
Associate Dean for Academic and Student Affairs
Associate Professor of Civil Engineering
College of Engineering

APPENDIX C

Constructs and Questions (Students and Faculty)

Student Survey - *Constructs and Questions*

Demographic Questions
Age
Class
Major
Living arrangements (LLC, off campus, etc.)
Anticipated graduation date
Hometown
GPA
Sex
Ethnicity
Student organizations participation
Satisfaction with School Questions
Change Major
Plan to transfer or leave CSU prior to graduation
Satisfied with my experience at the College of Engineering
Have teacher that I feel I can talk to if I am struggling in class
Have at least one teacher who has made an effort to get to know me
Satisfaction with my academic performance so far this semester
Feel comfortable approaching professors
Feel connected with peers inside and/or outside major
Student Behavior Questions
Studying with a group or alone
Studying for tests
Completing assignments
Homework problems
Rereading notes
Tutoring (Academic Village, Ingersoll, other)
Computer lab/design studio
Spending time with engineering or non engineering friends
Off or on campus job
Visiting office hours/emailing a professor
Missed a class
Gone to an advisor
Attended programming engineering or non engineering programs
Spent time with faculty outside of the classroom
Faculty Behavior Questions
Asking questions
Had students ask questions
Posted lectures notes
Gave quiz
Demonstration in class
Do in-class reading
Do in-class writing
Lecture
Provided feedback on performance
Shown video in class
Went on field trip
Small work groups
Gave real world problems to solve
Used Webct
Used humor

Faculty Survey - *Constructs and Questions*

Demographics Questions
Classes taught
Years at CSU
Department
Sex
Faculty rank
Total years teaching
Ethnicity
Faculty Behavior Questions
Asked students questions
Encourage students to ask questions
Gave a quiz
Used demonstrations in class
Posted lecture notes
Have students do in-class writing
Have student do in-class reading
Lecture
Divide students into discussion groups
Show a video in class
Went on Field trip
Graded students as a group
Gave students real world problems
Used Webct
Used humor
Provided feedback to students
Provided academic advising
Attended program or event
Spent time with a student outside of class
Professional development

APPENDIX D

Student Survey

Engineering Teaching Methods Survey (Student)

Directions: This survey will take about 15 minutes to complete. As you complete this survey please think about the classes that you are taking towards your engineering major. Thank you for your participation!

1. Age
☐ Under 18 ☐ 18 to 20 ☐ 21 to 23 ☐ 23 to 25 ☐ Over 25

2. Class
☐ Freshman ☐ Sophomore ☐ Junior ☐ Senior
☐ Other (please specify _____)

3. Major
☐ Civil ☐ Mechanical ☐ Chemical & Biological ☐ Computer
☐Electrical ☐ Environmental ☐ Engineering Science
☐ Open Option Seeking ☐ Engineering Open Option

4. Where do you live?
☐ Residence hall (jump to #5) ☐ Campus apartments (jump to #7)
☐ Off Campus with parents/family (jump to #7)
☐ Off campus with friends (jump to #7)

5. If you live in a residence hall, which hall do you live in?
☐Not Applicable ☐Academic Village ☐Allison Hall ☐Braiden Hall
☐Corbett Hall ☐Durward Hall ☐Edwards Hall ☐Ingersoll Hall
☐Newsom Hall ☐Parmelee Hall ☐Summit Hall ☐Westfall Hall

6. If you live in a living learning community, which one do you live in?
☐Not Applicable ☐Engineering ☐Honors ☐Key Service
☐Key Academic ☐Ingersoll Residential College
☐Leadership Development Floor ☐Living Substance Free
☐ Other (please specify _____)

7. Anticipated graduation date (please print)
Semester (ex. Fall) _____ Year (ex. 2000) _____

8. What is your hometown state or country if outside of the US (please print)?
_____

9. GPA (if this is your 1st semester mark your anticipated GPA)
☐ Below 1.5 ☐1.6-2.0 ☐2.1-2.5 ☐2.6-3.0 ☐3.1-3.5
☐3.6-4.0

10. Sex
☐Male ☐Female

11. Ethnicity

☐Choose not to disclose ☐African American/Black
☐American Indian/Alaska Native ☐Asian American/Asian ☐Caucasian/White
☐Native Hawaiian/Pacific Islander ☐Mexican ☐Puerto Rican
☐Other Latino ☐Other (please specify_____)

12. Do you plan to change your major to something other than an engineering major?

☐No ☐Yes (which major _____) ☐Unsure

13. Do you belong to any student organizations?

☐No ☐Yes (which ones _____)

14. How many engineering classes are you currently taking (including labs)?

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7

15. Please indicate which offices or departments you have visited this semester.
(*Please mark all that apply*)

- ☐ Writing Center
- ☐ Academic Advising
- ☐ University of Counseling Center
- ☐ Recreation Center (gym, etc).
- ☐ Advocacy offices (e.g. BSS, GLBT, El Centro, APASS)
- ☐ Resources for Disabled Students
- ☐ Career Center
- ☐ Center for Advising and Student Achievement (CASA)

16. Please estimate how often you do the following outside of class:

Study by myself	☐	☐	☐	☐	☐
Study with a group	☐	☐	☐	☐	☐
Study for a test	☐	☐	☐	☐	☐
Complete assigned reading	☐	☐	☐	☐	☐
Work on homework problems	☐	☐	☐	☐	☐
Rereading notes	☐	☐	☐	☐	☐
Spend in tutoring	☐	☐	☐	☐	☐
Spend in computer lab	☐	☐	☐	☐	☐
In a design studio	☐	☐	☐	☐	☐
Spend time with engineering friends	☐	☐	☐	☐	☐
Spend time with non-engineering friends	☐	☐	☐	☐	☐
Off campus job	☐	☐	☐	☐	☐
On campus job	☐	☐	☐	☐	☐

17. Please estimate how often in a typical WEEK you do the following:

Go to a professor's office hours	☐	☐	☐	☐	☐
Go to tutoring at the Academic Village	☐	☐	☐	☐	☐
Go to tutoring at Ingersoll	☐	☐	☐	☐	☐
Send an email to a professor	☐	☐	☐	☐	☐
Go to a teaching assistant's office hours	☐	☐	☐	☐	☐
Other tutoring	☐	☐	☐	☐	☐
Private tutoring	☐	☐	☐	☐	☐
Miss a class	☐	☐	☐	☐	☐

18. Please estimate how often in a typical MONTH you do the following out of class:

See an advisor from the College of Engineering	☐	☐	☐	☐	☐
Attend an engineering program or event	☐	☐	☐	☐	☐
Attend a non-engineering program or event	☐	☐	☐	☐	☐
Attend a Global Leadership workshop	☐	☐	☐	☐	☐
Participate in student organization programs or meetings	☐	☐	☐	☐	☐
Participate in an event or program that has a engineering faculty member present	☐	☐	☐	☐	☐
Spend time with faculty member outside of class	☐	☐	☐	☐	☐

19. Please estimate how often in a typical WEEK your engineering instructors do the following:

Ask you and other students questions in class	☐	☐	☐	☐	☐
Encourage you and other students to ask questions in class	☐	☐	☐	☐	☐
Post lectures notes before class (partial or full)	☐	☐	☐	☐	☐
Use demonstrations in class	☐	☐	☐	☐	☐
Assign in-class reading	☐	☐	☐	☐	☐
Assign in-class writing (ex. journaling)	☐	☐	☐	☐	☐
Lecture for the majority of the class time	☐	☐	☐	☐	☐
Provide feedback on performance (ex. written feedback on test)	☐	☐	☐	☐	☐
Use humor in the classroom (jokes, storytelling, cartoons, etc.)	☐	☐	☐	☐	☐

20. Please estimate in the past MONTH how often your engineering instructors have done the following:

Divided you into small discussion groups in class	☐	☐	☐	☐	☐
Shown a video in class	☐	☐	☐	☐	☐
Went on a field trip	☐	☐	☐	☐	☐
Had you work in a small group on a problem in class	☐	☐	☐	☐	☐
Had you work in a study group outside of class	☐	☐	☐	☐	☐
Graded you as a group for a group project	☐	☐	☐	☐	☐
Lectured from a textbook	☐	☐	☐	☐	☐
Gave you real world problems to solve	☐	☐	☐	☐	☐
Gave you real world problems to solve as a group	☐	☐	☐	☐	☐
Utilized Webct or other online resources	☐	☐	☐	☐	☐
Give a quiz	☐	☐	☐	☐	☐
Used PowerPoint or overheads in class	☐	☐	☐	☐	☐

21. Please rate the following in importance to your success in school:

Study Groups	☐	☐	☐	☐
Tutoring	☐	☐	☐	☐
Note Taking	☐	☐	☐	☐
Group work in class	☐	☐	☐	☐
Group work outside of class	☐	☐	☐	☐
Class lectures available online	☐	☐	☐	☐
Class discussion	☐	☐	☐	☐
Ability to ask questions in class	☐	☐	☐	☐
Instructors providing feedback on performance (ex. written feedback on tests)	☐	☐	☐	☐
Professors using humor in the classroom	☐	☐	☐	☐
Living with students with a similar major	☐	☐	☐	☐
Participation in student organizations	☐	☐	☐	☐
Instructor participation outside of the classroom in programs or events	☐	☐	☐	☐
Accessibility of faculty outside of the classroom (beyond office hours)	☐	☐	☐	☐
Engineering programming or events	☐	☐	☐	☐
Accessibility of design studios and computer labs	☐	☐	☐	☐
Visiting instructors' office hours	☐	☐	☐	☐

Please rate your level of agreement for the following questions:

22. I plan to transfer or leave CSU prior to graduation.
☐Strongly Agree ☐Agree ☐Neutral ☐Disagree ☐Strongly Disagree

23. I am satisfied with my experience at the College of Engineering.
☐Strongly Agree ☐Agree ☐Neutral ☐Disagree ☐Strongly Disagree

24. I have an engineering teacher that I feel I can talk to if I am struggling in class.
☐Strongly Agree ☐Agree ☐Neutral ☐Disagree ☐Strongly Disagree

25. I have at least one engineering teacher who has made an effort to get to know me.
☐Strongly Agree ☐Agree ☐Neutral ☐Disagree ☐Strongly Disagree

26. I am satisfied with my academic performance so far this semester.
☐Strongly Agree ☐Agree ☐Neutral ☐Disagree ☐Strongly Disagree

27. I feel comfortable approaching my engineering professors.
☐Strongly Agree ☐Agree ☐Neutral ☐Disagree ☐Strongly Disagree

28. I feel connected with peers who have an engineering related major.
☐Strongly Agree ☐Agree ☐Neutral ☐Disagree ☐Strongly Disagree

29. I feel connected with peers with non-engineering majors.
☐Strongly Agree ☐Agree ☐Neutral ☐Disagree ☐Strongly Disagree

30. If you would like to be entered into the drawing for one of the four $25 Best Buy gift cards, please fill in your email address. Your email address will be kept separate from the data in this research and will be deleted once the drawing is completed and the gift cards are awarded. _____ (fill in)

APPENDIX E

Faculty Survey

Engineering Teaching Methods Survey (Faculty)

1. Department

☐ Civil & Environmental ☐ Mechanical
☐ Chemical & Biological ☐ Computer & Electrical

2. Sex

☐Male ☐Female

3. Total years teaching

☐1-5 ☐ 5-10 ☐10-15 ☐15-20 ☐ More than 20

4. Ethnicity

☐Choose not to disclose ☐African American/Black
☐American Indian/Alaska Native ☐Asian American/Asian ☐Caucasian/White
☐Native Hawaiian/Pacific Islander ☐Mexican ☐Puerto Rican
☐Other Latino ☐Other (please specify _____

5. How many different undergraduate classes you have taught in the past five years (please print)

_____

6. Years at CSU (please print)

_____

7. Faculty rank (please print)

_____

8. Please rate the following in importance to a student's success in school:

Study Groups	☐	☐	☐	☐
Tutoring	☐	☐	☐	☐
Note Taking	☐	☐	☐	☐
Group work in class	☐	☐	☐	☐
Group work outside of class	☐	☐	☐	☐
Class lectures available online	☐	☐	☐	☐
Class discussion	☐	☐	☐	☐
Ability for students to ask questions in class	☐	☐	☐	☐
Providing feedback to students regarding their performance (ex. written feedback on tests)	☐	☐	☐	☐
Using humor in the classroom	☐	☐	☐	☐
Having students with similar majors living together	☐	☐	☐	☐

Student participation in student organizations	☐	☐	☐	☐
Faculty participation outside of the classroom in programs or events	☐	☐	☐	☐
Accessibility of faculty outside of the classroom (beyond office hours)	☐	☐	☐	☐
Students attending engineering programming or events	☐	☐	☐	☐
Accessibility of design studios and computer labs	☐	☐	☐	☐
Visiting instructors office hours	☐	☐	☐	☐

9. Please indicate which offices or departments you have referred students to during the past year.

(*please mark all that apply*)

- ☐ Writing Center
- ☐ Academic Advising
- ☐ University of Counseling Center
- ☐ Advocacy offices (e.g. BSS, GLBT, El Centro, APASS)
- ☐ Resources for Disabled Students
- ☐ Career Center
- ☐ Center for Advising and Student Achievement (CASA)

10. Please estimate what percentage of your students do the following during a semester:

Visit your office hours	☐	☐	☐	☐	☐
Send you an email regarding class	☐	☐	☐	☐	☐

11. Please estimate how often in a typical WEEK you do the following:

Ask students questions in class	☐	☐	☐	☐	☐
Encourage students to ask questions in class	☐	☐	☐	☐	☐
Post lectures notes before class (partial or full)	☐	☐	☐	☐	☐
Use demonstrations in class	☐	☐	☐	☐	☐
Assign in-class reading	☐	☐	☐	☐	☐
Assign in-class writing (ex. journaling)	☐	☐	☐	☐	☐
Lecture for the majority of the class time	☐	☐	☐	☐	☐
Provide feedback on performance (ex. written feedback on test)	☐	☐	☐	☐	☐
Use humor in the classroom (jokes, storytelling, cartoons, etc.)	☐	☐	☐	☐	☐

12. Please estimate in the past MONTH how often you have done the following:

Gave a quiz	☐	☐	☐	☐	☐
Divided your class into small discussion groups	☐	☐	☐	☐	☐
Shown a video in class	☐	☐	☐	☐	☐
Gone on a field trip	☐	☐	☐	☐	☐
Divided students into a small group to work on a problem in class	☐	☐	☐	☐	☐
Had students work in a study group outside of class	☐	☐	☐	☐	☐
Graded students as a group for a group project	☐	☐	☐	☐	☐
Used textbook for lectures	☐	☐	☐	☐	☐
Gave students real world problems to solve	☐	☐	☐	☐	☐
Gave students real world problems to solve as a group	☐	☐	☐	☐	☐
Utilized Webct or other online resources	☐	☐	☐	☐	☐
Used PowerPoint or overheads in class	☐	☐	☐	☐	☐

13. Please estimate how often in a typical MONTH you do the following out of class:

Provide informal academic advising to students	☐	☐	☐	☐	☐
Attend a engineering program or event	☐	☐	☐	☐	☐
Attend a non-engineering program or event	☐	☐	☐	☐	☐
Participate in student organization programs or meetings	☐	☐	☐	☐	☐
Spend time with a student outside of class (besides office hours)	☐	☐	☐	☐	☐
Attend a program or an event at the Academic Village or Allison hall	☐	☐	☐	☐	☐
Professional development (your own)	☐	☐	☐	☐	☐

APPENDIX F

Focus Group (Student)

Engineering Student Survey

Pilot Testing Focus Group

Population

1 session with up to 4 engineering students

Structure of Focus Group

The focus group will begin with students taking the survey. They will be encouraged to write notes in the margins. Once the survey is completed the mediator will go though each part of the survey to discuss with the participants the intent of the questions to see if the questions were interpreted correctly. After each section is discussed the mediator ask the following questions:

Were any of the questions unclear or confusing?
Is there anything that you would change about the survey?
Do you have any recommendations on how to improve the survey?

The focus group will be informally structured and driven by the participants. The session should last for about 60 minutes. The mediator's role will be to encourage participation, discuss each section of the survey and ask the above questions about the survey; otherwise, the participants will guide the session. Pizza will be provided to the group.

To be read aloud to participants

"Thank you for your participation. We are here to pilot test a survey that was created to explore the engineering program in regards to teaching methods and student/faculty participation outside and inside the classroom. The session should last for about an hour. During this session please have only one person talking at a time and try not to have any side conversations. After you take the survey, I will ask you a few questions about the survey; however, the group will guide the session. I will take notes on what is discussed but I will not record any identifies such as your name or where you live. I will collect your surveys at the end of the focus group. Please fill out the survey and in the margins write any thoughts or comments about the survey's construction, design, and questions. If a question is confusing or if you think it is a good question please mark it. Once you have completed the survey and are done taking notes please put down your pencil and turn over your survey so that I know that you are done. Does anyone have any questions before we start?"

APPENDIX G

Individual Interview (Faculty)

Engineering Faculty Survey

Pilot Testing Sessions

Population

1 session individual sessions with one engineering faculty member.

Structure of the sessions

The individual session will begin with the faculty member taking the survey. He/she will be encouraged to write notes in the margins. Once the survey is completed the mediator will go though each part of the survey to discuss with the participant the intent of the questions to see if the questions were interpreted correctly. After each section is discussed the mediator ask the following questions:

Were any of the questions unclear or confusing?
Is there anything that you would change about the survey?
Do you have any recommendations on how to improve the survey?

The individual session will be informally structured and driven by the participant. The sessions should last for about 45 minutes. The mediator's role will be to encourage participation, discuss each section of the survey and ask the above questions about the survey; otherwise, the participant will guide the session.

To be read aloud to participant

"Thank you for your participation. You are here to pilot test a survey that was created to explore the engineering program in regards to teaching methods and student/faculty participation outside and inside the classroom. The session should last for about an hour. After you take the survey, I will ask you a few questions about the survey. I will take notes on what is discussed but I will not record any identifies such as your name. I will collect your survey at the end of the session. Please fill out the survey and in the margins write any thoughts or comments about the survey's construction, design, and questions. If a question is confusing or if you think it is a good question please mark it. Once you have completed the survey and are done taking notes please put down your pencil and turn over your survey so that I know that you are done. Do you have any questions before you start?"