THE RELATIONSHIP OF A LIVING-LEARNING COMMUNITY TO THE ACADEMIC SUCCESS AND RETENTION OF WOMEN IN ENGINEERING

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CHAPTER I

INTRODUCTION

With women earning more than half of the bachelor degrees awarded nationally (National Science Foundation, 2008), faculty, staff and students in the social sciences and humanities may not realize the gender disparity that exists in science and engineering fields on a college campus. These gender dynamics reveal a high ratio of men to women in science and engineering (S&E) majors. While female students have been an ever-increasing presence on university campuses from the middle of the twentieth century to the present day, their numbers in science and engineering fields has remained a distinct minority.

Represented in smaller numbers at the outset, the attrition of women from science and engineering majors can generate further gender imbalance in these academic disciplines. To offset this imbalance, colleges and universities have responded in a number of ways: creating outreach and mentoring programs for girls in high school, increasing recruitment efforts and creating programs to support women science and engineering students once they enter higher education.

This paper will provide an in-depth look at one program designed to help

limit the attrition of women engineering students: a living-learning community. An examination of the literature of both living-learning communities themselves and the issues women engineers typically face on a college campus will provide the foundation for this living-learning community. The relationship of the living-learning community to the academic success, retention and student satisfaction will be explored by comparing three groups of women engineering students in looking at grade point average and percentage of students retained and the women in engineering students will be asked to respond to an anonymous, online survey about their experience to look at student satisfaction with the program.

Statement of the Problem

While women at four-year institutions nationally earned more than half of all bachelor's degrees in the United States in 2005 (most recent year data are available), great variations of gender representation persist among fields of study. Men earned the majority of bachelor's degrees awarded nationally in engineering (80%), computer sciences (78%), and physics (79%) (National Science Foundation, 2008). Is there a reason for this disparity? It does not arise from natural ability as both men and women have the intrinsic ability to succeed at any academic discipline (ScienceDaily, 2005). There is a great deal of speculation that environmental and societal factors may contribute to the lack of women entering S&E (Science and Engineering) fields. Women have the intellectual ability to study in the fields of engineering and math at the post-secondary level and beyond, yet there is a disproportionately low number of women entering and graduating from these fields at all levels of academia as well as representation

among engineering faculty. Bystydzienski and Bird (2006) point out that while women typically hold fewer faculty positions than men in institutions of higher education, proportionally fewer women have faculty positions in Science & Engineering fields compared to other academic disciplines. “In four-year colleges and universities, women constitute 36 percent of the overall faculty, but only 22 percent of professors of physical sciences and 9 percent of Engineering faculty” (Bystydzienski & Bird, 2006).

With a much smaller percentage of women than men earning degrees in S&E fields, it stands to reason there would be fewer women than men becoming faculty in S&E fields. While there have been several studies with results showing that both men and women leave S&E majors at high rates (National Research Council (U.S.) Committee on the Guide to Recruiting and Advising Women Scientists and Engineers in Academia, 2006), there is a far greater wealth of literature indicating that women do not persist, from entrance to graduation, in S&E fields to the same extent as men. A review of the current literature suggests that not only do a smaller percentage of women (compared to men) enter engineering fields, an even smaller percentage of women (compared to men) graduate with bachelor degrees in engineering fields.

One problem the smaller number of women graduates in S&E majors presents is a less diverse workforce in companies whose work and mission uses graduates trained in these disciplines. Some believe that more women working in the field as engineers would augment engineering by providing a diversity of perspective and management styles. A study released in 2004 titled “The Bottom Line: Connecting the Corporate Performance and Gender Diversity,” sponsored

by the BMO Financial Group concluded financial outcomes were better for corporations and businesses when their senior level positions were comprised of a higher percentage of women (Society of Women Engineers, Fall 2004). The study examined companies remaining on the Fortune 500 between 1996 and 2000 through two measures of financial performance: Return on Equity (ROE) and Total Return to Shareholders (TRS). The results of this study showed "the group of companies with the highest representation of women on their senior management teams had a 35% higher ROE and a 34% higher TRS than companies with the lowest women's representation" (Society of Women Engineers, Fall 2004). Another study conducted by Dr. Theresa M. Welbourne of the University of Michigan Business School reported in the March/April 2001 issue of the Society of Women Engineers, suggested that companies with women in top management positions have better short-term performance in the post-IPO (Initial Public Offering), three year stock value and growth in earnings per share than companies with all male management teams.

Leaky Pipeline Analogy

Whether it is the world of business or the world of academia, the smaller number of women in S&E fields has a potentially far-reaching impact. The "leaky pipeline" analogy (introduced in this study in the previously cited NSES study) is a fairly common descriptor used when describing the number of women leaving S&E majors in college (Bystydzienski & Bird, 2006; Burke & Mattis, 2007; Lane, 2000; Sheffield, 2004; Tang, 2006). The theory behind the analogy is that if enough women flow through "the pipeline," the numbers of women in

engineering fields will eventually increase to a point of equal gender representation, creating a what has been referred to as a "critical mass," which will generate gender equity and therefore solve the problem of the smaller percentage of women to men entering S&E disciplines. Then the number of women that "leak" out of the "pipeline" will not matter when examining the total number of women and men in S&E fields, as attrition certainly occurs in all academic disciplines. A critical difference, however, may lie in that while students leave engineering for other academic disciplines, students rarely leave other academic disciplines for engineering. This may cause the college of engineering's retention numbers to appear lower than the other colleges at the university.

Critics of the "leaky pipeline" theory believe that it oversimplifies the attrition of women in S&E disciplines by reducing it to a simple matter of numbers (number of students in, number of students retained and number of students graduated). The leaky pipeline theory does not account for the obstructions of culture and institutionalized behaviors which may overtly or subtly prevent women students from being equal members of science and engineering majors (Bystydzienski & Bird, 2006) which may contribute to the low numbers of women in S&E fields. Dean and Fleckenstein (2007) state

> The pipeline analogy is inadequate for conveying the scope, magnitude and potential causes of the lack of parity and equity for women across their careers. Indeed, most references to the 'leaky pipeline' are predicated on the view that the pipeline is linear, with one entry point (educational environment), and with one exit point

> (definition of a certain kind of career success). What has been missing from these simplistic views is the concept that pipelines have many entry points and many branch points, all of which provide value and integrity to the system as a whole" (Dean & Fleckenstein, 2007, p. 29).

By focusing on the "pipeline" as a singularly linear entity, higher education is doing women students and the S&E fields a disservice by reducing the focus to a matter of numbers and not examining potential reasons for those low numbers and therefore, possible solutions to increase the retention of women in S&E majors.

While retention of all S&E students is the goal, finding ways to retain the small number of women entering S&E fields is crucial so their numbers do not further dwindle in comparison to their male counterparts. Literature about women in engineering indicates that women typically do not leave engineering because they cannot handle the work. The Goodman Research Group (2002) and Seymour and Hewitt (1997) found that female S&E students leave due to isolation from female peers, lack of female role models, concerns about balancing their academic load with other responsibilities, difficulty in navigating the competitive culture of engineering classes, behavior of male peers, and culture, which is often referred to as "chilly climate," among other concerns.

Learning Communities

Universities cannot necessarily control academic curriculum prior to college, lack of pre-college exposure to S&E fields, which high school students are

mentored and encouraged towards those fields or what major students choose to study upon arriving for their post-secondary experience. However, today's institutions of higher education do exercise the ability to provide resources that can make a difference for students once students enter college and choose an S&E field of study. One way the support and resources manifest themselves is through various types of learning communities. On a college campus, learning communities are created from classrooms, student organizations and other programs designed to bring students together for cooperative learning experiences. Learning communities can serve as an excellent strategy to combat specific issues relating to attrition and student satisfaction of their college experience, such as those often cited by women students in S&E disciplines.

It may take a village to raise a child, but does it take a learning community to teach a college student? As multiple adults come together to raise their children in cities, suburbs and rural municipalities, so do the faculty and staff combine their efforts in educating students on university campuses. In the Boyer Commission Report of 1998, the commission offers a suggestion for large, research universities regarding the sense of community they develop on campus, stating they should develop a "community of learners" which breaks down the large whole of the institution into smaller, more friendly and manageable student learning enclaves (Boyer Commission on Educating Undergraduates in the Research University, 1998, p. 34). While co-curricular student groups and organizations serve positive roles in developing relationships between students, the Boyer report stresses the importance of involving students in academically based learning communities to make a large university seem smaller. The report

focuses on large, research institutions and their unparalleled potential for educating undergraduate students due to their extensive, research-related resources, and details how these institutions fall short with students falling through the cracks through a lack of mentoring and faculty attention.

Learning communities of various types can be a way of making these large, research universities seem smaller and less isolating while providing increased mentoring and faculty attention—something that may be a key factor in supporting a minority population like women in engineering through their baccalaureate career. "Learning Community" can be a generic term on college campuses today. After all, the premise of attending a university is to learn and by default, a student then becomes a part of that campus's learning community. On every college and university campus, there exists a multitude of learning communities: a classroom, by definition, is a learning community. Student groups, whether religious, Greek, political, cultural or service-oriented are also learning communities.

With the term "learning community" having such a broad application in higher education, Shapiro and Levine (1999) tried to provide some structure by identifying four types of learning communities found on college campuses: (a) paired or clustered courses, (b) cohorts in large courses like Freshman Interest Groups (FIGs), (c) team taught courses and (d) residence based programs known as living-learning communities (LLC) (Inkelas & Weisman, 2003).

Within a large, research, institution, an academic college can serve as a general, learning community. However, the sheer size and diversity of the academic disciplines within such a college at a large research university can make

developing connections within that large of a community difficult. Other factors can be present in a college of engineering, which may further hinder female students in their efforts to establish relationships, feel welcome and learn. LLCs can specifically support women students who represent a distinct minority in their chosen field of study, such as S&E fields (typically less than 25%) by countering some of these factors (Goodman Research Group, 2002, p. 41).

Living-Learning Communities

In spite of Shapiro and Levine's (1999) categorization, no one definition exists concerning what features a living-learning community (LLC) should contain. Some LLCs are academically based, like an engineering LLC, while others are based on co-curricular interests such as a community based on Native American culture or one centering on "Outdoor Adventure." Specific common components of LLCs are linked courses (a group of courses taken at the same time by a set group of students), clustered courses (specialized versions of standard courses taken at the same time by the same group of students), intensive faculty/staff attention and involvement, peer mentoring and sharing planned activities outside the classroom including teambuilding and community service.

LLC elements (linked courses, clustered courses, study groups, peer mentors, increased faculty interaction, team development) may create an environment that can counteract the factors (isolation from female peers, lack of female role models, chilly climate) said to lead to attrition of women in engineering. Thus, it seems that a living-learning community for women in

engineering may be an ideal environment for fostering student success of women in engineering and increasing retention. Therefore, the focus of this study will be LLCs and the role they potentially play in the academic success, retention and student satisfaction of women students in engineering.

This paper will provide an examination of a living-learning community for women in engineering at a large, Midwestern, research university in three ways. The students in this LLC live together in groups of four women per unit in suite-style housing. Block-scheduling is used to keep the women in as many classes together as possible. This LLC has faculty and staff specifically assigned to work with the participants and peer mentors are also assigned. First, the study will assess the relationship of an LLC for women in engineering on academic achievement (GPA) when compared to the two other groups of women engineers. Second, the study will examine the percentage of women retained to the college of engineering and university when compared to two other groups of women engineers. Third, student satisfaction with participation in a living-learning community for women in engineering will be explored by asking women who have participated in the program to anonymously fill out a brief survey about their experience. If these programmatic elements show a positive relationship in supporting women in S&E fields through academic success (represented by GPA), retention (represented by continuous enrollment in the college of engineering and the university) and satisfaction of experience (represented through the survey) it may be possible for other institutions to adopt these programmatic elements in order to encourage similar results.

Research Questions

The following research questions will be addressed in this study:

1. How does the academic success (as represented by GPA) of the living-learning community participants compare to the other two groups of engineering women living in other communities on campus? Potential differences in GPA will be examined by comparing the GPA between these three groups.
2. Did a greater percentage of the LLC women remain enrolled in the college of engineering, semester to semester, when compared to their cohorts?
3. What is the level of student satisfaction of the living-learning community participants as examined through an anonymous, online survey inquiring about students' academic experiences and social interaction facilitated by the LLC?

Definitions

The LLC referenced in this study will be one that has the following elements:

1. Linked courses
2. Students in the LLC are housed in a residence hall comprised of suites with four, single-occupancy bedrooms, two bathrooms and a living room per unit
3. Mentoring and job shadowing from women who have chosen a career in engineering
4. Increased academic support from peer mentors, faculty and staff.

5. Specially selected RA, always an engineering major
6. Application process in addition to being admitted to the university/college of engineering.

Limitations of the Study

While there are components often common to LLCs, there is no set standard for elements that make up an LLC. Therefore, research and results based on GPA and semester-to-semester retention from one institution may not apply to another school where LLCs are structured differently. LLCs often require an additional application process, which may indicate that students choosing to participate in an LLC may have greater motivation and investment in achieving an engineering degree than their non-LLC peers. Tinto (1993) finds that sense of investment, or intent to complete a degree, is integral to student persistence. Therefore, students in an LLC may be more likely to graduate than non-LLC students.

Another limitation may be the residence hall facilities where the LLC is located. The LLC facility has a higher level of student privacy, study space and more amenities (access to computer labs), which makes it more expensive than other residence halls at the study site (based on the room choice of the student, this space can be over $500 more per month over other, non-LLC buildings). Residence halls, such as the deluxe suite environments where the LLC in the study in located, providing ready access to technology, space for study sessions and common area lounge to facilitate student contact may be an environment more conducive to academic success and social integration than those that offer

more independent living and no or limited common area lounge space, such as apartment-style facilities. This brings a socio-economic factor into the study, which would serve as a limitation as those students with less financial means would not be able to afford the LLC.

An additional limitation may be that this study does not involve major choice, career choice, graduate preparation, career success, faculty representation in S&E fields or any issues beyond academic success, college retention and student satisfaction with their LLC experience. In looking at the relationship of academic success, retention and student satisfaction to a living-learning community for women in engineering, this study only examines a part of the puzzle of the proportionally lower numbers of women to men in S&E fields, it cannot completely account for all secondary preparation issues, nor does it address graduate or faculty preparation and retention.

Significance of the Study

Women constitute a small percentage of students entering and persisting in S&E fields at the post-secondary level. A living-learning community with features specifically designed to foster academic success and student engagement may lead to greater academic success and retention as well as student satisfaction. While programs rarely translate as a whole from one institution to another, programmatic elements found to be successful at the study site could be adapted by other institutions to suit the needs of their campus and students to positively impact the academic success, retention and student satisfaction of their women students in engineering disciplines (and potentially students in any

academic discipline). Thus, if a positive relationship is seen, this LLC can serve as a guide to other institutions, if not an exact blueprint.

Organization of the Study

The next chapter, chapter two, will contain a review of literature, which will include: a history of living-learning communities, including research of their positive impact on student development and retention, and a history of the issues faced by women in engineering, which lays out a deeper view of the retention issues of women in engineering and how living-learning communities may help address some of those issues. Chapter three will explain in detail the methodology of the study, chapter four will reveal the data and the results obtained from the analysis. The final chapter will analyze the data, conclude the findings and provide recommendations for future study.