

WOMEN IN ENGINEERING LEARNING COMMUNITY: WHAT WE LEARNED THE FIRST YEAR

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Abstract -- *The College of Engineering at Virginia Tech reflects national trends with respect to women in engineering. With first year enrollments hovering around 17%, the retention through graduation of these women is critical to increasing the number of women in the engineering profession. When examining year to year retention rates, it is observed that the largest percentage of women drop out of engineering during or immediately following their first year. It is therefore believed that efforts to increase the first to second year retention rate would have the greatest impact on graduation rates. The Office of Minority Engineering Programs conducts mentoring and other programs for underrepresented students. Hypatia, a residentially based learning community, was created to help foster success for first year women in the College of Engineering and to complement existing programs.*

Index Terms – adjustment, learning communities, women.

INTRODUCTION AND BACKGROUND

Over the last decade, learning communities have become common in United States higher education. Although learning communities have existed since the 1940s, colleges have only recently begun implementing them nationwide (Shapiro & Levine, 1999). Researchers believe this is primarily because of the challenges associated with meeting the needs of the current student population (Shapiro & Levine, 1999). Students attending colleges in the 21st Century possess a more sophisticated understanding of diversity and technology. Therefore, today's consumers of higher education tend to have greater expectations for college than students only five years ago. Colleges and universities must offer multiple programs to meet the needs of today's students. One way this need is met is through learning communities.

Defining Learning Communities

There is no universally accepted definition of a learning community. One definition commonly used when describing learning communities was proposed by Gabelnick, MacGregor, Matthews, and Smith (1990):

Any one of a variety of curricular structures that link together several existing courses – or actually restructure the material entirely – so that students have opportunities for deeper understanding and integration of the material they are learning, and more interaction with one another and their teachers as fellow participants in the learning enterprise (p.19).

Another perspective from Astin (1985) states:

Such communities can be organized along curricular lines, common career interests, avocational interests, residential living area, and so on. These can be used to build a sense of group identity, cohesiveness, and uniqueness; to encourage community and the integration of diverse curricular and co-curricular experiences; and to counteract the isolation that many students feel (p. 161).

Shapiro & Levine (1999) have described learning communities as models that allow learning to occur in a variety of settings. Similarly, Wenger (1998) views learning as “a process of becoming” (p. 215). The learning community, then, provides the context for developing new understandings of self or a place for individuals to develop identity.

Although these definitions reflect student learning, there are few similarities. However, learning communities typically have several features in common (Joyce & Weil, 1996). For example, many institutions define learning communities structurally. These structures include three models described by early writers: paired or clustered courses, cohorts or Freshmen Interest Groups (FIGs), and team-taught programs (Shapiro & Levine, 1999). In addition to the original three models Shapiro and Levine (1999) have added a fourth: residence-based learning communities.

Rather than defining learning communities according to a specific structure, Virginia Tech administrators have chosen to allow a broad definition of learning communities (Wildman, 1999). For that reason, Virginia Tech decided to focus on distinguishing characteristics of potential learning

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communities. These characteristics include: (a) a group of purposes, and values; (b) members of the community working together to accomplish tasks that require many talents, skills, and values; and (c) communities that feel a sense of place that can support and nurture the group's activities (Wildman, 1999).

Development of Hypatia

In 1998, Virginia Tech's Provost, Peggy Mezaros, identified seven cross-cutting initiatives as part of the university's academic agenda. One of these initiatives focused on leaning communities. A group formed to examine the best practices nationally in learning communities, study the state of learning communities at Virginia Tech, identify the gap between these two, and propose measures to bring Virginia Tech to national ranking of learning communities (personal communication, C. Turrentine, February 1, 2002).

Bevlee Watford and Keri Danna-Link of the Office of Minority Engineering Programs (OMEP) proposed a new community for women majoring in engineering shortly after Mezaros announced the initiative (Watford, 2000). This new community advanced the mission of OMEP, which is to help improve efforts to increase the number of under-represented minorities including women in the College of Engineering at Virginia Tech. Further, the proposed community would address a variety of needs for first-year women engineering students.

The successful proposal led to development of the community now called Hypatia. The mission of Hypatia is to bring together first-year women engineering students in a residential environment providing encouragement and support in pursuing engineering degrees. This is accomplished by uniting participants' academic and residential lives with special programming throughout the year to teach strategies and skills for academic success, professional and personal development.

In the first year of the program, forty women were selected for participation in the community. The fourth floor of Slusher Wing served as the residential location for the community. Another feature for participants in the women in engineering learning community is that they are clustered in several courses: Engineering Fundamentals, chemistry and math. Clustering the women in these courses insures none of them are isolated in courses. It is intended that these clusters of women would also form study groups and collaborate on projects and assignments.

The learning community featured a seminar course and programming designed to enhance and expand on lessons learned in classes. All members of the community were required to enroll in the three credit seminar during the fall semester. The seminar provided an advantage during the fall semester in that most activities were a part of the course. For example the ropes team building activity early in the semester provided a topic for discussion in class that centered on relationships and support for one another. Other activities during fall semester included attending a career fair, contests to

design the community t-shirt and logo, ice skating, bowling and a pre-holiday shopping trip.

During the spring semester, activities included a speaker series, a book club, a movie project, and industrial plant visits. Women working in engineering industries visited the community to discuss their experiences. These conversations gave students the opportunity to learn what women in the field enjoy about their jobs as well as some of their frustrations. The author of *Hornet's Nest* (Cummings, 1999) led the end of the semester discussion for the book club. The movie project gave the community an opportunity to review movies that featured women in nontraditional roles. When visiting engineering plants, the students were able to talk with more women in the field while also observing them in their work environment.

Naming the Community

During the fall, there was a contest to name the community. After rejecting a list of acronyms that seemed inappropriate for the community, one student submitted Hypatia as the community name. She suggested Hypatia because she admired the work of this woman at a time when contributions of women to society were usually overlooked. Further, Hypatia was selected as the name of the community because "she was a pioneer in her fields of philosophy, mathematics, and astronomy as we are today as women in the field of engineering. Her incredible success encourages us to follow our dreams and reach for our goals" (http://www.eng.vt.edu/academic_affairs/mep/hypatia/index.htm).

Hypatia was an Egyptian philosopher, astronomer, and mathematician known for being a pioneer in her fields. Hypatia was trained by her father, Theon, who set out to create the perfect human. However, Hypatia soon surpassed her father's knowledge. Through her studies of mathematics, philosophy, and astronomy she became a well-known teacher and lecturer. Her work includes credit for annotating and editing the works of Diophantus and Ptolemy, as well as a commentary on The Conics of Apollonius (<http://cosmopolis.com/alexandria/hypatia-bio-suda.html>).

The work of Hypatia impacted the early survival of mathematics. In 400 AD, Hypatia became head of the Platonist's school at Alexandria, a monumental accomplishment for a woman of her time. Although people from far and wide came to hear her speak, her work was met with controversy. The Christians of that era labeled her a pagan because of her belief in Neo-Platonic philosophy. It is thought that this eventually led to her violent death when Christians killed her for teaching her beliefs (<http://www-groups.dcs.st-and.ac.uk/~history/Mathematicians/Hypatia.html>).

ASSESSMENT

At the end of the first semester three assessments were taken. The first assessment extended previous research which examined outcomes of Virginia Tech learning communities using the Learning Communities Assessment (Turrentine, 1999). Second, the course instructors assessed student satisfaction by having participants complete a course evaluation form. A final study compared the academic performance of Hypatia participants to those of a control group. This paper describes the results of each assessment as well as makes suggestions for future practices and policies.

Additional grade comparisons will be examined at the end of the year. Also, students will be asked to complete another survey to rate their overall satisfaction and experience with Hypatia. Finally, future assessments will examine participants' retention rate versus non-participants'.

Learning Communities Assessment

This study used the Learning Communities Assessment developed by the group of individuals who came together for the purpose of assessing the current state of learning communities on campus. This instrument measured the personal outcomes students gain when participating in a learning community.

Five learning communities were selected to participate in this study. These were (a) Hypatia community, (b) the Wing program (c) the Biological and Life Sciences Community, (d) the Residential Leadership Community, and (e) the Virginia Tech Corps of Cadets. Participants of each group completed the instrument which measures personal outcomes that result from involvement in a learning community.

The instrument consists of 46 items and is broken into five sections. Items were measured on a Likert-type scale ranging from 1- Strongly Disagree to 5- Strongly Agree with a sixth option of Not Applicable. The five sections are Active Engagement, Specific Learning Outcomes, Sense of Community, Sense of Identity, and Overall Impact. The language of the items on the instrument was modified for each group to ensure the students would understand each item as it related to their learning communities experience. No reliability or validity studies have been conducted yet with this instrument.

The groups participating in this study have several common features. First, all of the communities have a residential component and require participants to live in the hall designated for the community. Second, each program requires enrollment in specific courses. Third, the communities in the study all address the needs of first year students. Although two of the five communities surveyed include students with sophomore or higher standing to participate, only the first year students took part in the survey.

The results of the study revealed Hypatia demonstrated strong agreement for four of the five subscales: Active

Engagement, Learning, Sense of Community, and Overall Impact. The only subscale for which Hypatia did not report strong agreement was identity. This finding is consistent with the literature which states first year students do not have a strong sense of identity (Astin, 1999). This assessment indicates that Hypatia is fulfilling the mission of learning communities by meeting expected outcomes of learning communities (Gablenick, MacGregor, Matthews, and Smith, 1990; Love, 1999; Shapiro & Levine, 1999; Smith, 1991).

Course Evaluation

At the end of fall semester, Hypatia participants completed course evaluations to assess their level of satisfaction with this aspect of the community. Overall results indicate a high level of satisfaction with most aspects of the seminar. Twenty-six of 38 respondents agreed or strongly agreed that the seminar was a beneficial experience. Only five of the respondents disagreed or strongly disagreed that the seminar was a beneficial experience.

Although the majority expressed satisfaction with the course, the students had a lot of advice to offer about improvements for the course. Most of the comments suggested including more engineering content. For example, they would like opportunities to have more engineers and engineering faculty speak to the class. The comments which reflected this include "bring in more engineer guest speakers" and "make it more ... geared to help us in engineering."

Several comments were made about the focus that was placed on the meaning associated with being a woman in a male-dominated field. The respondents thought too much attention focused on the role of women in engineering. For example, "the assignments were more about empowering women, while they needed to be about the engineering courses," "don't make engineering seem too feminist," and the speaker "did nothing but turn the group into a bunch of feminists ..."

Grade Comparison

This assessment examined Grade Point Average (GPA) during the first semester. In comparison to the control group and compared to other women first year students in the College of Engineering, Hypatia's grades were higher. The average of individual GPAs for all women first year students in the College for fall 2001 was 2.872.

The final assessment compared grades of Hypatia's participants to a control group. The control group was matched on several characteristics to the women in Hypatia including gender, academic level, college, on-campus residence, and SATTOTAL score. Grade point averages, weighted by credit, revealed significantly higher grades for participants in Hypatia. The average first semester grade

point average for Hypatia was 3.14 compared to 2.67 for the control group (i.e., $t = 4.573$, $df = 535$, $p = .000$).

While it is too early to make comments about the retention rates of women participating in Hypatia, all of the women returned for the second semester. In addition, they all continued in engineering (as indicated by enrollment in engineering courses). To the contrary, three of the women from the control group were not enrolled at the university at the end of the first semester (as indicated by course enrollment).

IMPLICATIONS

Researchers have discovered several outcomes associated with participation in learning communities. For example, students participating in learning communities benefit from increased intellectual interactions among students and between faculty and students (Gabelnick et al., 1990; Love, 1999; Shapiro & Levine, 1999; Smith, 1991), are more involved in their education than other students (Love, 1999; Smith, 1991), perform at higher levels than those not in learning communities (Gabelnick et al., 1990), and tend to have greater retention rates (Tinto, 1997).

Initial assessment indicates that the women of Hypatia also experience similar outcomes. When examining involvement with faculty, peers, and campus activities, community participants differ from most first year students.

For example, the seminar course and community activities provide a venue for developing dialogue surrounding a variety of topics, especially those related to being a woman in engineering. These activities often result in intellectual interactions among students and between faculty and students. Moreover, community activities include events where faculty are present in proportionately higher numbers than in classrooms. For example, Hypatia students were able to have lunch with the Associate Dean of Engineering in small groups of 8-10 students.

One topic that continues to surface in various settings and discussions is the role of "feminism." It seems they equate discussions about the dual roles of women and men in the workplace with feminist ideology. Program administrators have had to devote special conversations to discuss the difference between the two. Bringing these women to an intentional awareness of the role of women in the workforce, especially in a male dominated field, has been an underlying goal of the program.

Currently, no assessment of involvement has been taken. This will be an addition to future assessments. Despite the lack of a formal assessment with respect to involvement, a journal question regarding maintaining a balance between their social and academic lives addressed the issue. In response to question, the women commented they were involved in activities such as marching band, engineering competition teams, working on campus, intercollegiate and intramural athletics, performance groups, service learning projects, and a variety of other activities.

In terms of academic performance, Hypatia performed significantly better than other women in their first semester of engineering as well as the control group. While some have attributed higher academic performance of learning community participants to internal factors rather than the experience of the community, the fact remains that these students' grades on average exceed students' grades who are not participating in a community. Although faculty often expect more of students participating in learning communities, students meet and exceed their expectations (Gabelnick et al., 1990).

The fact that none of the students in Hypatia withdrew from engineering may be related to two issues. First, the strong relationships developed among this cohort of women may have contributed to their decisions to remain. The program administrators hope that the bonds developed helped to alleviate feelings of isolation that often precede withdrawing from the College. Knowing that they have a support system and others around them experiencing similar successes and failures may contribute to students persisting.

Second, participants may have avoided withdrawing because doing so would result in exclusion from Hypatia. When selected to participate in Hypatia students were informed that if at any time they withdrew from engineering or the seminar course, they would be removed from the community. A few may have considered leaving engineering; however, the benefits did not outweigh the drawbacks. The drawbacks include having to develop a new niche in the university, breaking ties with the community, and having to make another transition.

This article examined the first year of a learning community developed for women in engineering. A study which explored the outcomes of learning communities revealed that several of the outcomes described in the literature were realized. Also, participants' satisfaction was examined utilizing a course evaluation and by reviewing journal reflections. Finally, grade comparisons to a control group showed a significant difference from the grades of Hypatia's participants.

The information derived from these assessments has been used to plan for the second year of the program. Some of the planned changes include expanding the community and redesigning the seminar course. Plans beyond the next year include incorporating upper class students in the community to serve as peer facilitators and role models.

In conclusion, Hypatia has helped a cohort of forty women begin their development as engineers. After the first semester, this group has a strong start in comparison to other communities and other first year women majoring in engineering. The Office of Minority Engineering Programs intends to continue expanding the program so that all interested women will have an opportunity to benefit.

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