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**Hypatia
A Residential Program for Freshman Women in Engineering**

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Abstract

In 2001, Virginia Tech implemented a residentially based program for women students enrolling as freshman in the College of Engineering. Hypatia, named after an ancient Egyptian philosopher, currently has 52 residents representing approximately 30% of the freshmen engineering women. These students reside on one floor of a residence hall, enroll in the Hypatia Seminar during the fall semester, and participate in programmatic activities during the spring semester.

Women in Engineering programs exist in many colleges of engineering, some for 20 years or more. With women representing approximately 19% of students enrolled in undergraduate engineering programs¹, these programs create a supportive and welcoming environment for the students fostering academic success. Virginia Tech has been providing support programs for the undergraduate women in engineering since 1996. One of the more recent activities implemented at Virginia Tech is a residentially based learning community. Hypatia allows female freshmen engineering students to form a living and learning environment that promotes academic success.

This paper addresses two issues. First, to detail the characteristics (both academic and personal life experiences) that describes the typical Hypatia participant. Second, it is desired to determine the impact of the Hypatia Seminar on student perceptions and development.

Introduction

Over the past several years Virginia Tech, like many other institutions of higher education, has experienced substantial budget reductions. While every effort is made to reduce costs, tuition increases have been implemented. With the existence of numerous lower cost alternatives to undergraduate education, Virginia Tech continually looks to implement new programs that provide improved services to students, services that exist beyond the traditional classroom. University wide honors programs, study abroad opportunities, and nationally recognized student activities are a means for institutions to differentiate themselves from each other and influence decisions of both parents and students. In a sense, the perception is that excellent academic programs are often not enough to sustain the enrollment of academically talented students.

Additionally, undergraduate engineering programs have dealt with ever increasing pressures from industry to increase the numbers of under-represented students¹ earning degrees. Offices that provide targeted support to women and under-represented students of color have existed for decades within many colleges of engineering. Parents and students alike see these efforts as a means of providing additional services designed to support undergraduate education. The Center for the Enhancement of Engineering Diversity (CEED) in the College of Engineering at Virginia Tech is one such program. Designed to provide services to enhance the recruitment and graduation rates of under-represented students, CEED implements undergraduate mentoring, pre-college enrichment and numerous additional programs.

In 2001, CEED implemented Hypatia, a residentially based learning community for freshmen women in engineering. Learning communities have become common in United States higher education. In existence since the 1940s, institutions have only recently begun implementing them on a nationwide basis.² 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: 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.³ Another perspective from Astin states: Such communities can be organized along curricular lines, common career interests, vocational 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.⁴

Rather than defining learning communities according to a specific structure, Virginia Tech administrators have chosen to allow a broad definition of learning communities.⁵ For that reason, Virginia Tech decided to focus on distinguishing characteristics of potential learning 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.

Hypatia

Hypatia is essential to advancing the mission of CEED, which is to increase the number of under-represented students in the College of Engineering at Virginia Tech. The mission of Hypatia is to bring together first-year women engineering students in a residential environment designed to provide 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. Currently in its third year, fifty-two (52) women reside on the fourth floor of Slusher Wing.

¹ The College of Engineering at Virginia Tech considers the following groups to be under-represented: women, African Americans, Latino/a, and American Indians.

Several features of Hypatia are designed to assist in creating a cohesive, supportive community. The women are block scheduled in the first semester required courses for freshmen engineers. This includes engineering chemistry and the associated laboratory, calculus, engineering explorations (an introductory engineering course) and linear algebra. In addition to addressing the isolation the students may feel in an environment where they represent less than 20% of the engineering freshman, it also facilitates the formation of study groups as well as collaboration on course assignments and projects.

Throughout the academic year, various activities are implemented to provide professional and personal development for the Hypatians. For example a ropes team building activity early in the semester provides a topic for discussion in class that centers on relationships and support for one another. Other activities include attending a career fair, ice skating, bowling, a speaker series, a book club, a movie project, and industrial plant visits. Women working in engineering industries visit the community to discuss their experiences. These conversations give students the opportunity to learn what women in the field enjoy about their jobs as well as some of their frustrations.

A primary component of the program is the Hypatia Seminar, a required first semester course for all students living in the community.

Hypatia Seminar

All Hypatia residents are required to take a three credit seminar during their fall first semester of enrollment. The seminar does not count for credit towards the students' degree requirements. Currently in its third year of implementation, the seminar has been subject to substantial revisions since its first inception. Evaluations from both course instructors and students have resulted in the creation of a course that satisfies the specified design and outcome goals. This section will detail course content and implementation.

The students are divided into two sections of twenty-six as greater class participation is found with smaller class size. One section meets on Monday, and the class is then repeated on Tuesday for the second section. On Thursdays the entire group meets as one. Each class period is fifty minutes in length. The course topics are provided in Table 1.

As stated in the course syllabi, the course is designed to assist students in their efforts to become a successful engineering student at Virginia Tech, including providing the information necessary to become successful both academically and professionally. From an academic viewpoint, the course is built around the theme that learning is both an individual and a collaborative process. A student must determine what works best for them while learning how to utilize the skills and minds of others. Students are reminded that the learning skills taught in this course will not be beneficial unless they decide to use them daily. Additionally, students are informed that the professional development skills taught in this course are provided for a basic reason: all the engineering education and book knowledge in the world will not guarantee employment on a career path of their choice. Students must learn to select what they want to do professionally, and then determine how to go after it.

Table 1: Hypatia Seminar Topics

WEEK	DATE	TOPIC
1	8/25 & 8/27	Introductions, Course Overview
	8/28	Ropes Course Discussion & Team Dynamics
2	9/1 & 9/3	Resume Writing Interviewing Skills
	9/4	How to Work a Career Fair
3	9/8 & 9/10	Ware Lab
	9/11	Assistive Technology Presentation
4	9/15 & 9/17	Study Skills/Time Management
	9/18	McGyver Box Exercise
5	9/22 & 9/24	Women in Industry Panel Discussion
	9/25	Math and Science Elementary School Project
6	9/29 & 10/1	Web Development
	10/2	Learning Styles/Teaching Styles
7	10/6 & 10/8	True Colors
	10/9	Planning Your Academic Timetable; College Catalog; Academic Advising
8	10/13 & 10/15	Test Taking Skills
	10/16	Engineering Activity
9	10/20 & 10/22	Presentation Skills
	10/23	Stress Management
10	10/27 & 10/29	How to be a Successful Women in Engineering
	10/30	Women's Center & Judicial Affairs
11	11/3 & 11/5	Multimedia Center
	11/6	CIMMS Tour
12	11/10 & 11/12	Hypatia Committees and Feedback Discussion
	11/13	Naval Sea Systems Command (NAVSEA) Panel
13	11/17 & 11/19	Women In Engineering & Technology Presentations
	11/20	Women In Engineering & Technology Presentations
14	12/1 & 12/3	Women In Engineering & Technology Presentations
	12/4	Women In Engineering & Technology Presentations
15	12/8 & 12/10	Course Evaluations and Wrap-Up

The goals of the course are stated as follows:

- To foster achievement in first-year women engineering students.
- To enhance personal study skills and habits.
- To gain a sense of confidence in academic ability.
- To identify and employ strategies and skills for academic and professional success.

The course has been revised each year based on the feedback provided by the students and instructors. It currently is one-third engineering topics, one-third personal and professional development topics and one-third presentations. The engineering topics were originally faculty presentations addressing the various degree programs, however this was not viewed positively by the students. For fall 2003, the students were instead involved in hands-on engineering activities and tours of engineering facilities. For example, they toured The CAVE, a virtual reality facility, and the Center for Intelligent Materials Systems and Structures. They also were given toolkits (referred to as McGyver boxes) filled with various items and required to design and construct something useful. They had to provide a class presentation on their project and its development. These types of engineering activities received a much more positive response from the students.

The introduction of personal and professional development topics is continually an issue with freshman students. They believe they already possess the necessary time management and study skills to be successful and frequently express displeasure with having them introduced in class. However the results of the pre and post surveys yielded some interesting perspectives.

Course Survey Analysis

The survey provided in Table 2 was given to the Hypatia students at both the beginning and the end of the semester. The initial post-survey was given to the students during the last week of classes. After viewing the results, it was determined that more useful information would be obtained if the survey was given to the students after they had received their final grades for the semester. At this time only twenty-three students have submitted the final survey, made available on January 1, 2004. Therefore the data presented is preliminary. A more complete analysis will be performed after all surveys have been received. It should be noted that identification of each survey respondent is available. Therefore the analysis contains the pre- and post survey responses for the specific twenty-three students that submitted the final survey. Table 3 contains the preliminary data results.

Table 2: Pre/Post Survey for HYPATIA Cohort 2003

For statements 1-6, rank each statement from 1-5 (1 = not good, 2 = somewhat good, 3 = good, 4 = very good, and 5 = extremely good).

1. Rank your study skills.
2. Rank your ability to manage your time.
3. Rank your ability to create PowerPoint presentations.
4. Rank your ability to give effective PowerPoint presentations.
5. Rank your test taking skills.
6. Rank your ability to manage stress.
7. Do you have an up-to-date resume?
 - a. Yes
 - b. No
8. What type(s) of learner are you?
 - a. Visual - learn by seeing, watching and demonstrations.
 - b. Auditory - learn through verbal instructions from others or self.
 - c. Kinesthetic - learn by doing; direct involvement.
 - d. Combination - learn by doing two (or all three) of the above learning styles.
9. What is your intended major?
 - a. Aerospace and Ocean Engineering
 - b. Biological Systems Engineering
 - c. Chemical Engineering
 - d. Civil and Environmental Engineering
 - e. Computer Science
 - f. Electrical and Computer Engineering
 - g. Engineering Science and Mechanics
 - h. Industrial and Systems Engineering
 - i. Materials Science and Engineering
 - j. Mechanical Engineering
 - k. Mining and Minerals Engineering
 - l. I don't know
 - m. Other, if other, what major?
10. How many total hours per week do you plan to study outside of class?
11. How many hours per week do you plan to study outside of class for each course?
12. What GPA do you expect to have at the end of your first semester?
13. Please list the classes you are taking this fall. For each course, what grade do you expect to get at the end of the course?
14. Which class do you think will be your hardest class this semester?
15. Which class do you think will be your easiest class this semester?
16. Do you plan to join any student organizations or take part in any extracurricular activities? If so, what activities?
17. How many times do you plan to visit home during the semester?

Table 3. Preliminary Pre- and Post-survey data

	not good	somewhat good	good	very good	excellent
My study skills are	0%	4%	29%	52%	4%
	0%	17%	35%	39%	9%
My time management skills are	0%	9%	52%	35%	4%
	0%	17%	35%	39%	9%
My ability to manage stress is	8%	29%	35%	23%	6%
	0%	9%	48%	26%	17%

What is your intended major?	Number of Students (Pre-survey)	Number of students (Post-survey)
Aerospace	4	3
Biological systems	2	5
Chemical	2	1
Civil	4	2
Computer	2	1
Electrical	0	3
Engineering science and mechanics	2	2
Industrial and systems	1	2
Materials science	0	1
Mechanical	2	2
Mining	1	1
No idea	0	2

How many total hours per week do you plan to study outside of class?

Pre-survey 24.4 Post-survey 25.74

How many hours per class?

Pre-survey 3.53 Post-survey 4.83

What GPA do you expect to earn?

Pre-survey 3.25 Post-survey 3.17 (actual GPA earned)

When evaluating their study skills, 4% of the students believed that their skills were somewhat good. This increased to 17% in the final survey. Additionally, 4% of the students initially believed they had excellent study skills; the number increasing to 9% after the students had viewed their fall semester grades. It follows that those students who downgraded their study and time management skills earned lower than expected grades, while those that upgraded their skill level evaluation earned about what they expected to earn. Only 9% of the students initially believed they would earn less than a 3.0, while 35% actually did earn less than a 3.0 on a 4.0 scale.

The number of hours studied per week earned several responses similar to ‘as much as necessary’ both in the pre and post surveys. But on the whole the students believed that they put in more hours per class than they initially planned to. It is interesting to note that in general, students discovered that their ability to handle stress was better than initially expected. They traveled home much less than they expected to, with 39% initially planning to visit. The final analysis revealed that 65% traveled home only once during the semester.

Profile of Hypatians

Virginia Tech enrolled approximately 185 non-transfer women freshmen in general engineering for fall 2003. Of these only sixty-six (66) or 35.6% applied to the Hypatia program, with fifty-two accepted. The success of Hypatia participants is well documented. For example, the Hypatia participants exhibit better academic performance on average than non-participants (for 2003, an average GPA of 3.09 versus 2.71). The overall retention is higher for Hypatia participants, with 94% of Hypatia participants still enrolled in engineering compared to 75% of non-participants.

This information is particularly emphasized in all printed advertising. Program and application information is mailed to all women offered admission to the College of Engineering. Additionally a letter is mailed directly to their parents describing the program and its potential for helping their daughter become a successful student. The resulting number of applications is less than what is expected by CEED. The question then becomes what are the characteristics of those students who do choose to apply and participate in Hypatia. The thought is that if these characteristics can be identified, then a more targeted and successful recruiting effort can be made, the result being a larger percentage of students applying to participate.

In an attempt to generate a profile of students for recruiting purposes, a survey was distributed to all student participants of Hypatia in August 2003. The survey was based on the Factors Influencing Pursuit of Higher Education (FIPHE) Questionnaire developed by Harris and Halpin.⁶ There are 114 questions ranging from how long they have lived in their current home to the size and diversity of their high school, to opinions expressed by friends and family regarding their pursuit of an undergraduate engineering degree. Due to its length, the actual survey is not included in this paper.

Analysis of the survey responses is continuing, however some preliminary results appear to be very useful when identifying potential Hypatia participants. The following is a general description of a typical Hypatia student referred to as Leah.

Leah is equally likely to be from out of state as a Virginia resident, but attended a predominantly white, public high school with a graduating class size of about 350. She has lived in her current home for more than 14 years. She is a student athlete and, and holds a leadership position in several student organizations. She also participates in some form of the arts (music, drama, art). She has traveled quite a bit both within and outside of the United States.

Both of Leah's parents went to college and both parents work outside of the home. She is more likely to have a brother than a sister, but the odds of one or the other are about 50-50. She has one or more engineers within her extended family. There is a computer with internet access in her home, and she uses it fairly frequently mostly for internet and email access. Her high school GPA is 3.77, and she scored 620 math and 580 verbal on the SAT tests. There is a 50% probability that she attended a summer enrichment camp while a student in high school.

Both of her parents strongly encouraged her to attend college and discussed the demands that college would place on her. Her mother strongly encouraged her to pursue an engineering degree, her father had less influence on the decision. She has a supportive family that she can talk to about college and career goals, although her grandparents do not really understand the demands of being a college student. She makes friends easily.

Leah generally believes that an engineering degree will help her get a better job, and that she will gain a lot of knowledge about this world while earning her degree. She believes that an engineering degree will help her meet professional people and be more successful. She believes that college graduates generally get the best jobs and that the degree is important to future job opportunities. Improvements in her self-esteem and self-pride will result from earning her engineering degree.

Leah does not believe that her race, gender or society in general impose limits on her choice of major. Nor will professors or university administration limit her choice of degree program. In order of importance, Leah chose engineering because she finds it interesting and simply likes the field. Of less importance is her belief that engineering is challenging or provides satisfying work, or the fact that she is good at it. But she could have chosen any major she wanted to pursue.

Leah strongly believes that she has the power to achieve her educational goals. If she becomes unhappy with something in her life, she has the power to make changes. She believes that good things happen in her life as a result of her working to make them happen and that each individual has the power to make their life better or worse. She controls her own future and if she works hard, she will be successful.

Leah received more encouragement from her high school teachers than from her guidance counselors. And while her teachers did talk about the demands that college would place on her, they did not talk about the importance of having an engineering degree. While her high school held briefings on the college application process, she did not attend. She did not take any remedial courses nor participate in any study groups while in high school.

Conclusions

Focus groups have been conducted with students who have chosen to live in the Hypatia community. While the qualitative results have not been fully analyzed nor reported in publications, one finding has become quite obvious. Nearly 40% of all Hypatia participants over the past three years have indicated that the choice to join the community was not theirs. Instead their parents required them to apply and participate. When questioned as to why they did not

desire to become a part of this extremely successful endeavor, the responses indicated that they did not see themselves as being similar to the women who would choose to participate. In their vernacular, they viewed Hypatia as being for ‘geeky girls seeking engineering degrees.’ It is easy to see the similarity with the common (and erroneous) cultural perception of engineering as a profession for ‘geeks’ with horn rimmed glasses and a pocket protector.

However, when asked if this was the environment they found in Hypatia, the response was overwhelmingly opposite. They were extremely satisfied living within the community, having found women like themselves, ‘normal’ girls with far ranging interests from rugby to dance but have one specific goal in common; that of becoming engineer. Additionally, when asked if they would choose to live within Hypatia, or recommend participation to their daughters, again the response was overwhelmingly positive. Further evidence of their satisfaction with Hypatia is the fact that nearly 50% of the current residents are seeking to remain within the community in a leadership role during their second year of undergraduate studies.

Using this information the intent is to develop new recruiting materials that will educate prospective women about the type of person who chooses to live in Hypatia. The key is to inform them that Hypatia is for women just like them. The following is an example of text to be incorporated in the recruiting documents.

If you are a student athlete, currently participate in music, drama
or any other art form;
If you have traveled both within and outside of the United
States;
If you believe that scholarships will be important to financing
your education;
If you have held leadership positions within a student or
community organization;
If you want to **be an engineer**

Then Hypatia is *for you!!*

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Biography

DR. BEVLEE A. WATFORD, P.E. is Associate Dean for Academic Affairs in the College of Engineering at Virginia Tech. She is also the founding Director of the Center for the Enhancement of Engineering Diversity, established in 1992. Watford was the recipient of the ASEE 2003 Minorities in Engineering award due to her efforts to increase the recruitment, retention and graduation rates of under-represented students in engineering.

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