

AC 2007-2041: AN INTEGRATED LIVING AND LEARNING COMMUNITY FOR FIRST AND SECOND YEAR UNDERGRADUATE WOMEN IN SCIENCE AND ENGINEERING

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An Integrated Living and Learning Community for First and Second Year Undergraduate Women in Science & Engineering

Abstract

The Women in Science and Engineering (WISE) Village combines a group living experience with resident, upper-class mentors who assist in the transition to university life. Programs for the WISE community are designed to promote academic success, foster the formation of lasting relationships with fellow students, professors and mentors, and provide out-of-classroom experiences. The WISE Village is a supportive environment in which women engage in focused inquiry within their disciplines and develop the skills and talents necessary to become successful students and professionals in STEM fields.

When the WISE Village began in 2003, it was as a partnership with University Housing, the College of Engineering (COE), and the College of Physical and Mathematical Sciences (PAMS). The Village has since expanded to include the College of Agriculture and Life Sciences (CALs), the College of Natural Resources (CNR) and the College of Textiles (COT) and has grown from 56 participants in 2003 to 250 participants this academic year 2006-07. Currently, 60% of the women are freshmen, 35% are sophomores and 5% are juniors (mentors).

This paper will present an update on the WISE Village, a review of the program's goals, in terms of assessment results from the first three years, and a discussion of the evolving plans of the Village, including the implementation of a sophomore track within the program.

Introduction

Women only account for 24% of all science and engineering workers, although they comprise 46% of all workers (Graham & Smith, 2005).¹ Moreover, women and minorities continue to be underrepresented in science, technology, engineering and mathematics (STEM) at both the undergraduate and graduate levels. For example only 20% of engineering baccalaureate degrees are awarded to women (NSF, 2004).²

Interest in science and engineering majors by female freshmen has not changed significantly in the past 25 years (NAP, 2006).³ Women are still found to leave science and engineering majors in greater percentages than men (Graham & Smith, 2005¹; Schroeder, 1998⁴; Seymour and Hewitt, 1997).⁵ One study in engineering found that only 29% of top women stayed in the major whereas 82% of top men stayed (Schroeder, 1998).⁴ In an effort to reverse these trends, North Carolina State University (NCSU) developed the Women in Science and Engineering (WISE) Village, a living learning community of scholars for first and second year women. Encouraging and supporting more women to major in STEM fields in college "remains the single most important way to increase the representation of women in science and engineering occupations" (Graham & Smith, 2005, p.352) therefore the WISE Village was created to address these needs.¹

In 2003 the Women in Science and Engineering Village was established at NCSU by the Colleges of Engineering and Physical and Mathematical Sciences in conjunction with University Housing. The WISE Village is a residential based living and learning community created specifically for women in engineering, math, and science. The program employs upper-class mentors who assist the new students in the transition to university life and majoring in STEM fields. Essential elements of the program include encouraging academic success, cultivating the formation of lasting relationships with fellow students, professors and mentors, and offering out-of-class experiences that target academic and personal needs of the women.

The Village has seen considerable growth since its inception. In the fall of its first year, there were 56 participants. The following year the Village increased to 130 women and expanded to include CALS, CNR, and COT. Finally, in the Fall of 2006, the program saw its largest contingent yet with approximately 250 women living on three floors of a residence hall. First year students are paired with an upper-class mentor, (usually a junior), and all of the students live in a suite-style residence hall. Sophomore students are interspersed with first year students and mentors, although they are not assigned to a specific mentor.

Funding for the WISE program is a combination of university funding and corporate funding. The program was started with monies from the housing budget and corporate and departmental funds from Engineering and Physical and Mathematical Sciences. Soon after its inception, however, WISE received significant funds from the university and eventually recurring support in the university budget. The various member colleges continue to contribute solicited corporate funds to add programs such as research awards for sophomore students, field trip opportunities, and others.

Goals of the Village

The goals of the WISE Village were separated into participant and programmatic categories. The following table contains the original goals and evaluation methods implemented when the Village first began.

Table 1: Program and participant goals for the WISE program

WISE Participant Goals	Evaluation Methods
Begin to develop an identity as an engineer, mathematician or scientist	Administer Pittsburgh Attitude Survey (Pre-and Post-); Additional customized surveys, concept mapping
Meet women with common interests and build lasting friendships	Conduct focus groups semi-annually
Increase self-awareness through acknowledging personal strengths and weaknesses	Administer gender identity instrument (BEM Sex Role Inventory) Administer Felder's Learning Style Tool
Explore career and personal goals	Ongoing through workshops, journaling, concept mapping

Develop leadership skills	Administer Skills Leadership Inventory (pre- and post-)
Maintain balance between academic and personal life	Utilize calendar tools to plan time; compare actual schedule with plan to adjust as necessary
Increase the percentage of freshman women entering the sciences and engineering at NC State	Monitor/evaluate matriculation statistics in engineering, statistics of incoming freshman women in the sciences
Increase the retention rates of women in science and engineering	Use as benchmarks cohort data (including a non program control group as well as a program control group)
Increase the graduation rate of women in science and engineering	Monitor/evaluate freshman data (compare with benchmarks)
Increase the percentage of women in science and engineering who pursue graduate degrees in same or related fields	Monitor/evaluate graduate school application/acceptance data
Increase knowledge of career options in science and engineering	Utilize focus groups, career interest surveys and career opportunity workshops

Two of the participant goals were measured using the assessment method of concept mapping. These measured goals include developing an identity as an engineer, mathematician or scientist, and increasing self-awareness including defining career and personal goals. The WISE participants were compared to a group of male College of Engineering students. By examining the content of their concept mapping, some differences and similarities in their identity as a student and their beginning identity as an engineer or scientist were found. More of the women mentioned their use of group study sessions and the need to attend class than men. In addition, when describing themselves as a professional, females tended to list “involvement with others” while the males tended to list “work hard” and “do a good job.” The WISE participants took an end of year survey in 2004 which illustrated they had identified some of their strengths such as time management, working in groups and people skills. One woman remarked, “I have learned that I am a person that others go to for help.”

Concept mapping is extremely time-consuming to administer and evaluate, and the participants did not feel as though they gained valuable information. Therefore, it was determined that it was not feasible to continue to use concept mapping as an assessment tool given the number of students participating in the program. Focus groups were utilized to evaluate participant goals in the first year of the program. Exit surveys have been conducted at the end of each academic year to solicit feedback about the WISE Village and the students’ experiences. The number of students taking these surveys has increased each year with 39 completing them in Spring 2004, 53 in Spring 2005 and 76 in Spring 2006 for a total of 168 women. The following comments from the exit surveys were made about their participation in WISE:

- It’s the best thing I’ve done in coming to college.
- (WISE) gives us confidence.

- I was able to make friends within my suite and make connections with people in engineering majors. I was able to get information on internships & interviews with the speaker series, and I adjusted better to college life by having a mentor there for me.
- Hearing different speakers has also helped me start thinking about what I want to do when I graduate. I am interested in both research and teaching.
- I learned that I could effectively work with other women, that I could make independent decisions that could help me in the end, and that I was able to push myself to the limit and succeed with the help of others.
- I really can do all this math.

WISE programmatic goals such as percentages of freshman women entering the sciences and engineering and retention of women in sciences and engineering are measured quantitatively each year. Table 2 provides enrollment data for the past four years.

Table 2: Percentages of freshmen women entering the engineering and sciences

2003-2004	Percentage of females in freshman class	Number of students in freshman class
<i>Engineering</i>	16.1%	1147
<i>Physical and mathematical sciences</i>	37.6%	178
<i>Agriculture and Life Sciences</i>	66.3%	591
2004-2005		
<i>Engineering</i>	18.1%	1235
<i>Physical and mathematical sciences</i>	49.7%	177
<i>Agriculture and Life Sciences</i>	62.0%	613
2005-2006		
<i>Engineering</i>	13.3%	1176
<i>Physical and mathematical sciences</i>	41.7%	187
<i>Agriculture and Life Sciences</i>	67.7%	685
2006-2007		
<i>Engineering</i>	16.8%	1397
<i>Physical and mathematical sciences</i>	44.9%	178
<i>Agriculture and Life Sciences</i>	63.5%	745

Although the percentage of freshman women in the College of Engineering for Fall 2006 is 16.8%, this is one of the largest female cohorts since 1997, due in part to the large total freshman cohort. It is a significant change from 2005-06 when there were only 157 women (13.3%) in the

freshman cohort, down from the two previous academic years. The drop in percentage of women in the freshmen class in 2005-06 for the College of Engineering appears to be due to a lower enrollment rate (23%) of women for that year and not due to a lower admittance rate of women. Typically 76% of the women who apply are admitted into the College of Engineering and 34-39% of these women actually enroll. However, in 2005-06 only 23% of the women who were admitted enrolled, leaving some administrators to surmise this drop was due in part to a slow admission process for that year.

The College of Physical and Mathematical Sciences (PAMS) has maintained a total freshman class each year of approximately 178, except in 2005-2006 when the total number increased by nine, but the percentage of women decreased from the year before but increased from 2003-04. The percentage of women in PAMS continued to increase in 2006-07, although it has not rebounded back to fifty percent. The goal of increasing the percentages of freshmen women entering the sciences and engineering is one that has been achieved in the past two years, and one that remains a priority for both colleges.

The College of Agriculture and Life Sciences (CALs) has experienced growth in the numbers of entering freshmen over the past four years, mostly due to the increasing numbers of students entering the Life Sciences degree program areas. The percentage of women varied from 62% in 2004-2005 to 67.7% in 2005-2006. While women dominate enrollment in the College, even in Animal Sciences where 80% of the student population is female, the College is concerned that women are less likely to continue in their chosen career field than are men. The chosen career fields include veterinary medicine and health related professional careers. The goal for CALs is to increase awareness of successful professional women mentors who have obtained their degrees and persist in their chosen professions while managing other interests.

The goal of increasing the retention rates of women in science and engineering has been monitored very closely each year. Table 3 provides retention data of female students in original major, in any science major, and in any college. Overall, the WISE participants persist in STEM majors at a higher rate than non-WISE women for these three cohort years. Yet when this data is examined by cohort and viewed in terms of specific colleges, the WISE participants are not always retained in STEM majors within their college at a higher rate than non-WISE women.

For all three cohort years, 2003, 2004 and 2005, WISE participants in the College of Engineering were retained in the college at a higher rate than non-WISE participants. For 2003 and 2004 cohorts the percentage of WISE women retained in the College of Engineering (ENG) is larger for each of the evaluation periods (end of spring year one, end of spring year two, and end of spring year three). Yet for the 2005 WISE cohort, the percentage of women retained in the college versus non-WISE participants is not as large as the 2003 and 2004 cohorts.

For the College of Physical and Mathematical Sciences (PAMS), the percentage of WISE women retained in the college is greater than women not in WISE at each of the evaluation periods (end of spring year one, end of spring year two, end of spring year three). This is not the case for the 2005 cohort when non-WISE students were retained at a higher rate than WISE participants. Students who self-select for WISE may not be statistically the same as the general

female population in terms of likelihood of success/retention/graduation. In fact, on average the total SAT scores for non-WISE women in PAMS and ENG is greater than for the WISE women. In the College of Agriculture and Life Sciences (CALs), only three women participated in the first cohort so the numbers are not very meaningful. However in 2004 and 2005, a greater percentage of women in the WISE program were retained at the end of the first and fourth semester than for non-WISE women in the CALs. This retention rate for WISE is slightly greater than the overall retention rates for not only non-WISE women students but for all students the College. Those retention and persistence rates were 81.7% for the 2004 cohort and 84.8% for the 2005 cohort.

It is also important to note that there are few students who have participated in WISE from the Colleges of Natural Resources and Textiles. Therefore, when one WISE participant in the college left, the percentage dropped from a 100% retention rate to a 66.7%, indicating at the end of spring of year one, non-WISE women were retained in the college at a higher rate than WISE participants.

Due to the age of the program, assessment data for the goals of increasing the graduation rate of women in science and engineering, and increasing the percentage of women in science and engineering who pursue graduate degrees in same or related fields is not available. Four year graduation rates will not be available until the end of Spring 2007. Beginning in Fall of 2007, we plan on assessing the goal of increasing the percentage of women in science and engineering pursuing graduate degrees in STEM fields. Although data will be available this spring and fall, it will be for WISE participants who graduated in four years, a less common occurrence for those majoring in engineering. More data is anticipated at the end of Spring 2008.

Table 3: Retention of female students in original major, in any science major, and in any college
(Only students enrolled in that semester or who graduated are included in the analysis)

	College				End second semester (end spring year 1)				End fourth semester (end spring year 2)				End sixth semester (end spring year 3)						
	CALS	ENG	PAMS	Any college	CALS	ENG	PAMS	Any Science	Any college	CALS	ENG	PAMS	Any Science	Any college	CALS	ENG	PAMS	Any Science	Any college
2003 cohort																			
	N	N	N	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Not WISE	344	135	49	90.4	88.1	85.7	91.5	93.2	78.2	64.4	67.3	80.5	86.9	68.6	56.3	61.2	72.3	82.2	
WISE	3	36	16	66.7	88.9	87.5	90.9	92.7	66.7	75.0	75.0	83.6	89.1	66.7	58.3	68.8	74.5	81.8	

	College				End second semester (end spring year 1)				End fourth semester (end spring year 2)					
	CALS	ENG	PAMS	Any college	CALS	ENG	PAMS	Any Science	Any college	CALS	ENG	PAMS	Any Science	Any college
2004 cohort														
	N	N	N	%	%	%	%	%	%	%	%	%	%	%
Not WISE	359	147	66	90.8	85.0	81.8	91.3	94.2	73.5	57.8	62.1	74.8	86.7	
WISE	34	77	24	91.2	93.5	91.7	94.1	95.6	85.3	64.9	83.3	84.4	88.1	

	College				End second semester (end spring year 1)				End second semester (end spring year 1)					
	CALS	ENG	CNR	TX	CALS	ENG	CNR	TX	CALS	ENG	CNR	TX	Any Science	Any college
2005 cohort														
	N	N	N	N	%	%	%	%	%	%	%	%	%	%
Not WISE	386	101	25	58	120	84.5	80.0	87.8	91.7	90.5	93.0			
WISE	77	54	2	18	3	85.2	100.0	66.7	83.3	90.3	90.9			

CALS	College of Agriculture and Life Sciences
ENG	College of Engineering
PAMS	College of Physical and Mathematical Sciences
CNR	College of Natural Resources
TX	College of Textiles

Evolving plans of the Village

The 2007-2008 academic year will mark the fifth anniversary of the WISE Village. The Village continues to grow each year and the program will define the second year component more explicitly. Sophomores will be offered programs specifically designed for their needs. Using Molly Schaller's (2005) research about the forgotten second year student, programs will be offered related to focused exploration, making tentative choices (about majors and careers), and committing to majors and careers.⁶ The second-year students will be required to attend specific programs offered for them. Each sophomore will be asked to participate in undergraduate research, participate in leadership development, or participate in community outreach projects related to women and girls in science and engineering. Resources and guidance will be provided by the WISE Operating Council and Director. Corporate funding will also be sought to underwrite this program.

Conclusion

Although early data assessment reports are mixed, WISE participants are retained in the sciences at a higher rate than non-WISE students. In the College of Engineering, WISE women have been retained in engineering at a higher rate than non-WISE women for each of the cohort years presented. In the College of Physical and Mathematical Sciences, it was noted that WISE women were retained at a higher rate than non-WISE women for two of the three cohort years presented. The College of Agriculture and Life Science has a high percentage of women enrolled in the College. The outcomes for these women will be positive if they connect with other successful professional mentors and persist in their careers beyond the college years. The assessment plan will be revised and additional assessment will be conducted using both quantitative and qualitative methods to try and ascertain if WISE is meeting its participant and programmatic goals. Regardless of assessment, the WISE Village provides a well-balanced and supportive living learning environment specifically for women who are underrepresented in science and engineering.

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