THE UNIVERSITY OF MICHIGAN’S WOMEN IN SCIENCE AND ENGINEERING RESIDENCE PROGRAM: A QUALITATIVE ANALYSIS

Juliet Webb Ballard, Russell Hathaway, Sally Sharp, Cinda-Sue Davis

Abstract - This paper is being submitted in part as an abridged (preview) version of a study in the final stages of completion, and based on the results of a qualitative analysis of previous studies on the University of Michigan’s Women In Science and Engineering program (WISE), and its learning community component (WISE-RP). The book will be available later this year. It has been predicated upon previous studies, and the information contained herein has been taken from the unofficial manuscript. Recent studies which have addressed retention programs at the University of Michigan include those conducted by; Green, 1996 – in process; Davis, 1996; Nagda, Gregerman, Jonides, von Hippel, & Lerner, 1998; Davis, Hathaway, & Sharp – under review, 2000; Hathaway, R.S., Davis, C.S., & Sharp, S., 2000b Locks, A.M., Hathaway, R.S., Moldenhauer-Salazar, J.C., Gregerman, S.R., & Joniedes, J., under review, 2000; Hathaway, R.S., Davis, C.S., & Sharp, S., 2000b; Coad, 2000, - in progress; Gregerman, 2000.

OVERVIEW AND DESCRIPTION

Without question, there is a serious problem with the retention of female students in the a Science and Engineering Departments of Colleges and Universities in the United States (Davis, 1996). Academia has noted this issue in past decades and actively attempted to address it by increasing the diversity and enrollment of female students. If however, the numbers of female students entering undergraduate science programs had increased, then it logically follows that the numbers of women graduating from those programs would have likewise increased. Subsequently, the number of women represented in Science, Engineering and Mathematics (SEM) fields in the workforce and on the faculties of universities and colleges should also have improved. Unfortunately these high expectations and predictions have not materialized. For example, significantly fewer females than males rate themselves above average or in the highest 10% on perceptions of mathematics ability (female=59.8%; males=80.9%); intellectual self-confidence (female=67.8%; males=84.6%); and computer skills (females=24.6%; males=57.4%). Lastly, entering male students were 8.25 times more likely to say that they intended to major in computer fields than were females (University of Michigan CIRP Data, 1999; Davis, C. S., et al., under review, 2000).

It appears that female students, although comprising a significant percentage of those studying in science in high school, are not following this line of study into higher education course work. With respect to women in computer science (CS) Davis et al (2000) reports:

In addition, it has been well documented that the pipeline, that is the number of women receiving degrees in CS, shrinks from high school through graduate school and beyond. In 1993-94, women made up 50% of high school computer science classes, but the percentage of bachelor’s degrees in CS awarded to women in the same year was only 28.4%. At the graduate level, for 1993-94, the percentages of degrees in CS awarded to women dropped even further: 25.7% at the M.S. level and 15.4% at the Ph.D. level (Camp, T.1997; Davis, C. S., et al., under review, 2000).

The statistics are equally as disturbing for the university departments, with respect to Female faculty representation. This is evident in that even as Universities graduate increasing numbers of female SEM students, only “15.6% of the assistant professors, 9.4% of the associate professors, and 5.7% of the full professors were women.” (Camp, T. 1997; Davis, C. S., et al., under review, 2000).

Faculty composition (as well as interactions with faculty) have been documented as having the potential to negatively, or positively affect female students’ perceptions and therefore retention rates. Tinto (1993) found that faculty members are an important “socializing force” on conducted by the Cooperative Institutional Research Program (CIRP) since 1993. The most recent data concerning female perceptions are alarming.

1 Women in Science and Engineering Program, Women in Science and Engineering Residence Program, University of Michigan, Ann Arbor, MI
college and university campuses. In this respect, faculty-student interactions directly contribute to student’s perceptions of themselves and the learning environment, which is critical to learning and retention (Tinto, 1993). Faculty often have less confidence in the ability of minority and female students, which becomes a self fulfilling prophecy as the students tend to mimic the expectations of the faculty (increasing perceptions of isolation) further complicating the situation by directly effecting retention rates of traditionally under represented students (Wilson, 2000).

Other factors in female retention rates are the differences that exist between male and female epistemological machinations. The literature, and research appears to dictate that women tend to be averse to the male oriented, “weeding out” approach to learning (often experienced in SEM fields) which focuses on the individual, thereby tending to alienate female students (Seymour, 1995). These perceptions (and the academic environment in which they are fostered) lead female students to doubt their abilities, and therefore to loose interest and self-confidence, directly contributing to high attrition rates, and lower retention in SEM fields (Davis, C.S. et.al, 1996; Manis, J. et. al., 1989). It is widely accepted that if one intends to overcome adversity, and enhance strengths and interests, it is important to establish a viable support structure. Contact and connectedness are not mutually exclusive concepts. This sense of contact and belonging (self-concept, and perception) is critical to the retention of female students in the university setting.

The self-concept of the female students in SEM departments has therefore become a cause for concern among the faculty and administration of universities. In examining the question of a Self-Assessment Evaluation for this study, the question of focus is a central issue. Does the University share responsibility for the lack of retention, and success in the motivation of its female students? What about their (students) perceptions of ability, and proficiency? Is there a more obscure, less obvious culprit? In review of the literature this study attempts to answer that question, with acceptance (lack of integration) being the primary suspect. (Locks, A.M., Hathaway, R.S., Moldenhauer-Salazar, J.C., Gregerman, S.R., & Joniedes, J., under review, 2000, p. 9). Several models were reviewed, including those posited by; Astin, 1993; Pascarella & Terenzini, 1991; and Tinto, 1993.

Integration of Resilience Approaches into the WSE Programs

Cohoon (2001) concluded a study of all 23 Bachelor degree-granting CS departments in the state of Virginia between the years 1992 and 1997. The Cohoon study was conducted to identify specific factors that effect female retention at the undergraduate level in SEM fields. Generally speaking, this study found that the primary factors affecting attrition were: the availability of “same—sex peer support, faculty characteristics and behaviors, and institutional/community support (Cohoon, 2001). In attempting to qualify the differences between the departments that retained female students at a higher rate than others, Cohoon found that there were four glaring consistencies, implying that gender composition, faculty attitudes and institutional context have a significant effect on female retention:

- The faculty included at least one woman; was stable; valued mentored and supervised female students; enjoyed teaching; shared responsibility for success with their students;
- The department had above average support from its institution;
- Graduating seniors had access to a strong local job market; and perhaps high starting salaries; and
- There were sufficient numbers of female students in each class for them to support each other. (Cohoon, 2001)

The primary focus of resilience studies, regarding the evolution of pedagogy is: to identify the positive effects (benefits) that can be brought forth by the experience of adversity, such as those which provide the individual with a self-knowledge that he/she can benefit from in future interactions. (Aldwin, 1994; Affleck & Tennen, 1996; Park, Cohen, & Murch, 1996). Protective factors have been identified by research in the past decade that can be applied in the academic context (Bernard, 1991, 1995; Winfield, 1994; Comprehensive Training to Assure Resiliency in Students 1996; Henderson, 1997).

Females do appear to have a general tendency toward resilience, when compared to their male counterparts in a family setting. However, this propensity does not necessarily translate into resilience in the academic environment. In “at risk” family environments and families in general, girls have been found to be more resilient than boys (Werner, 1985), however, the same difference in epistemological machinations that make girls more resilient in family environments, appear to work against women in SEM programs – where the environment (academically speaking) tends to favor male learning (Seymour, 1995). Seymour further found that women appear to be losing confidence in their ability to “do science” in general.

As earlier stated, the perceptions born of these differences, and the contemporary paradigms they have fostered, appear to have lead female students to doubt their abilities – which directly effects self-confidence – and therefore contributes directly to high attrition rates, and lower retention in SEM fields (Davis et al., 1996; Manis, J. et al., 1989). For instance, in the U.S., of the female entrants that intended to major in computer science at the undergraduate level in 1987, 69% changed their major by 1991, as compared to 46% of male entrants (Seymour & Hewitt, 1997). What factors contribute to this disparity (in
the academic setting), in light of the inherent resiliency of females in the family setting? This study attempts to address this question, and propose potential solutions to the challenges presented. Thus, the consideration of resiliency as a function of gender in this secondary analysis, is on ways in which it can be helpful or hurtful to learning and retention in higher education science, engineering, and mathematics (SEM) programs. More specifically the WISE program at the University of Michigan.

Further Analysis

In the Cohoon study, detailed quantitative and qualitative analysis was used to ascertain that gender composition was the single strongest determining factor in gender-based attrition. In particular, departments with higher female enrollment were more likely to retain female students in numbers that were comparable to those of male student retention (Cohoon, 2001). Similarly, other empirical studies have found that there is a direct correlation between the social compatibility of students’ peers (in terms of major concentration), and students’ persistence in science, mathematics, and engineering course work (Astin & Astin, 1992). Faculty characteristics/practices and attitudes were also found to be a factor in gender attrition. Cohoon’s research also discovered a correlation between high faculty turnover, and a disproportionately high rate of female attrition. Faculty attitudes toward females in the department were shown to be a factor, in that the more indifference that existed toward female students (with faculty members reporting no difference in perception between male and female students, or some perception of female disadvantage) tended to lose female students at disproportionately higher rates.

Furthermore, Cohoon found that the existence of mentoring in SEM fields (defined as activities such as recruiting individual students into professional activities; offering personalized advice to individual students; encouraging individual students; and helping individual students establish careers), and more importantly the correlation between the amount of time (spent by faculty members) mentoring and female retention rates, was direct and positive (Cohoon, 2001). This remained the case with regard to faculty perceptions of enjoyment of teacher-student interactions on behalf of faculty members. The presence of female faculty members proved to be another determining factor in disproportionately high female attrition rates. In departments with female faculty members, there was a significant difference in the retention of male and female students (Cohoon, 2001).

Other studies have found that institutional involvement is significant in the retention of students. In attempting to address the question of institutional involvement in fostering resilience, Benard (1991, 1995) found that schools should foster social competence, problem-solving skills, autonomy, a sense of purpose, and a critical consciousness. In the interest of increasing these behavioral traits, encouragement through the creation of caring relationships and high expectations, combined with opportunities for participation were cited (Bernard, 1991, 1995). In particular:

The curriculum should be thematic, experimental, challenging, comprehensive and inclusive of multiple perspectives—especially those of silenced groups. Instruction that supports resiliency focuses on a broad range of learning styles; builds from perceptions of student strengths, interests and experience; and is participatory and facilitative, creating ongoing opportunities for self-reflection, critical inquiry, problem-solving and dialogue. Grouping practices that support resilience promote heterogeneity and inclusion, cooperation, shared responsibility and a sense of belonging. And, lastly, evaluation that supports resiliency focuses on multiple intelligences, utilizes authentic assessments, and fosters self-reflection (Bernard, 1995).

UROP and WISE Program Approaches

The UROP and WISE programs currently incorporate varied approaches mentioned by Rolf & Johnson (1999), and implied by the research results of others such as Cohoon (2001) in attempts to increase resiliency. These include adaptations derived from various approaches, including; linkage to established, community-wide interagency collaborations (Dryfoos, 1990); broadening opportunity structures through intensive, individualized attention (Cohoon, 2001; Werner, 1989); provision of intensive individualized intervention to build skills (Cohoon, 2001; Dryfoos, 1990); engaging peer norms in the intervention process (Cohoon, 2001; Rolf & Johnson, 1999); and linking youth with the world of adult work (Rolf & Johnson, 1999).

Residential Learning Communities and Living Learning Arrangements

As colleges and universities have seen an unprecedented growth spurt since 1965 (a quadrupling of the population – Levine and Associates, 1989), we have seen a dramatic increase in the need for new and innovative residential arrangements to accommodate this increasingly diverse population of students (Schroeder, Mable et al. 1994). Some of the more recent innovations have included “apartment-style” accommodations, suite arrangements, and cluster units (Winston, Anchors, and Associates, 1993).

A watershed in the paradigm realignment toward an earlier focus on the “whole student’s” education was the model known as the “student development perspective” (Chickering and Reisser, 1993; Miller and Prince, 1976). Research had already established the connection between the influence of college programs, housing facilities and personal development/educational experiences (Riker and
DeCoste, 1971; Chickering, 1969; 1974; Astin, 1984; Kuh, Schuh, Whitt, and Associates, 1991). *Tomorrow's Higher Education* (THE) Project, which was created by the American College personnel Association in 1968, was an outstanding example of this emerging paradigm.

Shortly after Brown (1972) called for an expanded role of student affairs workers and staff toward dramatically increasing their roles in the academic aspects of student lives and developmental matters, Chickering (1974) identified positive correlations between the persistence, retention, graduation, and academic success of residential learners as compared to commuters. Moreover, numerous other academic leaders have subsequently acknowledged the positive impact of involvement in campus activities, and residential hall participation across the academic spectrum (Kuh, Schuh, Whitt, and Associates, 1991).

Longitudinal studies have examined the associations between informal contact with faculty and the perception of cognitive development gains perceived by students (Endo and Harpel, 1982, 1983; Ekfber, McLaughlin, Williamsen, and Hardy, 1985; Spady, 1971). These studies echoed the findings of earlier researchers (Wilson, Gaff, Dienst, Wood, and Bavry, 1975; Pascarella and Terenzini, 1978). Pascarella and Terenzini (1978) in particular found positive correlation coefficients reflecting the relationship between non-class contact with faculty and reported gains in intellectual development.

The relationship between perceived growth of cognitive skills and the quality of the interactions between students and “major agents of socialization on campus were further explored in related longitudinal studies (Endo and Harpel, 1993; Pascarella, Duby, Terenzini, & Iverson, 1983; Terenzini & Pascarella, 1980a; Volkwein, King & Terenzini, 1986). The findings of these studies provide convincing evidence for the “whole student” shift in focus of the progressive residential learning movement.

Based on the work of Pascarella, Terenzini and others in recent decades – there has been much research to establish the linkages that exist between psycho-social and intellectual development in the educational process. These linkages have been explored in the context of the relationship between cognitive developmental and emotional processes, intellectual development, and interpersonal – social development while building upon the interplay between social context and interpersonal relationships (Baxter, Magolda, 1992, 1995; Blenenky, Clinchy, Goldberger, and Tharule, 1986; and Gilligan, 1982).

Subsequently, there have been calls to explore alternative teaching pedagogies and a proliferation of practices which call for “transactional learning” approaches, and new (progressive) approaches to augment and enhance classroom instruction (Freire, 1978; Giroux, 1983; Scnniedewind and Davidson, 1987). Some of the new methodologies, and pedagogies that have taken hold are liberation theory (Freire, 1970; McLaren and Leonard, 1993; Shor, 1992), critical cultural perspective approaches (Rhodes and Black, 1995), collaborative learning (Bruffee, 1987; 1993; Gabelnick, MacGregor, Matthews, and Smith, 1990; Goodsell, Maher, Tinto, Smith, and MacGregor, 1992), and constructivist pedagogy (Brooks and Brooks, 1993).

It has been found by researchers (Winter, McClelland, and Stewart, 1981), that dormitories (as college living arrangements) may not be the most productive environments for students to grow and learn. It has even been suggested that they may have the opposite effect of restricting growth by insulating, and overly protecting students in their pursuit of growth opportunities. Thus the advocates of greater emphasis on peer culture, active student involvement, and the establishment of new relationships between academic and student affairs as noted by numerous researchers (Astin, 1985; Boyer, 1987; Kuh, Schuh, Whitt, and Associates, 1991; Pascarella and Terenzini, 1991, 1994; Barr and Upcraft, 1990; Mayhew, Ford, and Hubbard, 1990), have found a compelling solution to the monumental challenges educators face in the residential college (living-learning residence) model.

**Statement of Problem**

Alarming to many academics, is the fact that while the numbers of female students (at the University of Michigan in particular) in SEM departments have shown increases in enrollment, the number of female professionals in the field has decreased. The question has become: how can the University of Michigan specifically, and other universities and colleges in the United States increase the number of female students enrolled in SEM programs, and simultaneously retain these students and graduate them? This question is being examined by academics, government officials, and industry leaders alike, as the Science and Engineering sector in the United States in general is experiencing unparalleled labor shortages. One thing is for certain; there exists a dramatic shortage of women, and minorities in the sciences. What do students’ perceive to be the root causes? The problems resulting in the lack of retention and matriculation of these demographics must be addressed, and remedied without delay.

Equally disturbing, is the fact that number of women in the United States as a percentage of the total population is slightly greater than 50%. Furthermore, there should be a direct correlation between the number of women enrolled in (and more importantly who graduate from) undergraduate programs and the number of women in graduate programs, and entering the workforce. Unfortunately this is not the case. As educators rush to find the answers in longitudinal studies and statistical models, there is an emerging paradigm shift away from exclusively focusing on inclusion initiatives, for example; to increase numbers of women students admitted to colleges and universities, and toward improving retention and graduation rates of female students by focusing on strengthening resolve and administrative comittment.
Commitment to diversity does not appear to be the problem. The University of Michigan, for instance, has been a progressive force in the education of women for over a century. Beginning in the early 1870’s, and continuing to the Michigan Mandate and the Michigan Agenda for women in the 1980’s the University has remained committed to an ongoing improvement in the recruitment and retention of female students and has maintained its efforts to insure “equitable access” and achievement for its students (Gregerman, 2000). In 1980 the University established its WISE (Women In Science and Engineering) program and the WISE-RP program was established in 1993. This program has addressed the complex problems encountered by women students in science, engineering, and mathematics – primarily using a combined strategy of intervention programming, research policy, and advocacy (Davis, C. S., et al., under review, 2000).

**Purpose**

The primary purpose of this study is to determine perceptions held by female Science, Engineering and Mathematics (SEM) students in the WISE Program at the University of Michigan. The intention of the study is to determine the ways in which an existing living/learning residence program fosters retention and enhances the rate of successful female student interactions within the program. This study is being conducted, in order to reposition the university’s program to better serve its female students; by enhancing its commitment to the students, and increasing the success rate with regard to matriculation from first to second year students. This is being done in the best interest of understanding students’ perspectives on their experiences, both facilitating and inhibiting them. This is achieved by identifying (among other things) commonality of experiences, and female student’s perceptions of acceptance, integration and interactivity. The goals of this research are to:

- Determine faculty attitudes, as perceived by students, towards female students, their capabilities, potential for success and relevance, in science and engineering majors.
- Determine if female students who do obtain degrees in science and engineering majors have common characteristics and experiences.
- Evaluate whether participation in the Women in Science and Engineering Residence Program increases the likelihood of women pursuing degrees or careers in these majors. This will be accomplished by conducting a secondary analysis with a focus on students’ perceptions.
- Disseminate the findings within the University of Michigan, as well as other Research I universities, to be used as a foundation for intervention programmatic efforts, living and learning approaches to educating female students in the SEM fields and making curricular changes.

**Significance**

Despite years of success (both at the University of Michigan and Colleges and Universities nationally) in increasing the numbers of women pursuing degrees in science, the SEM fields (in general) have remained frustratingly resistant to change, and have had little success in increasing retention of female students. Indeed, the numbers of female students enrolled have often decreased in the past two decades. I hope to focus on student’s perceptions of themselves and their involvement in the program, in an effort to identify ways in which the University can adjust its mission (with regard to the WISE program) toward improving its success in attaining its goal (improved retention and matriculation). The final objective of the study is to analyze the impact of living and learning communities on retention.

The knowledge obtained from this evaluation will guide the University of Michigan in formulating interventions and retention approaches, both in and out of the classroom and improving the influence of WISE-RP. It is important to find ways in which the university can encourage and support female students who enter as SEM majors. These findings will also be highly applicable to other academic institutions, particularly Research I universities.

**Definition of Terms**

Some operational terms used in the study are listed here:

1. WISE (Women in Science and Engineering) residence program. -- In 1980 the University established this program that has addressed the complex problems encountered by women students in science, engineering, and mathematics – primarily using a combined strategy of intervention programming, research policy, and advocacy (Davis, C. S., et al., under review, 2000).
2. The Coad study (Coad, 2000, - in progress) – This study was conducted with a focus on the Science and Engineering Majors in the Summer Research Support Programs. This study was conducted to establish a methodology for the assessment. The report consisted of three parts: data collection, data analysis, and data reporting. Focus group interviews were conducted within the scope of six primary characteristics.
3. PORT (Participation, Observation, Reflection, and Transformation) Model -- The PORT Model of resilience in education addresses these concerns, and actually modifies them for the challenges of
contemporary learning. The acronym PORT contains four components which empower the educator and student alike with a guideline for fostering resilience, as well as encouraging interactivity.

4. The Four Influence Domains – A): the acute stressor or challenge, B): the environmental context, C): the individual characteristics, and D): the outcome. Points for transactional processes are the confluence between the environment and the individual and the individual choice of outcomes. Therefore, resilience research on predictors discussed in this paper are organized into these four major predictors of retention as listed above (Kumpfer, 1999).


6. Outcomes – The fact of having approximated desirable outcomes, or having distanced oneself from undesirable outcomes, or the characteristics that enable the approximation of desirable outcomes (Kaplan, 1999).

7. Risk Factors – Any factor that may place the student at risk of failure. A symptom treatable with intervention (i.e. the resilience education approach).

8. CS – Computer Science
9. CE – Computer Engineering
10. SEM – Science, Engineering and Mathematics
11. GSI – Graduate Student Instructor
12. ELRC – Engineering Learning Resource Center

**Research Questions**

The research questions are:

1. What is the most important contributing factor regarding female student retention for WISE-RP students?

2. What people, programs, and/or support networks are identified as encouraging female students?

3. What has been: a.) the biggest challenge for University of Michigan female SEM students and b.) how have these students worked to overcome the challenges identified, or how do they plan to overcome them?

4. Given the challenges identified, have these students ever contemplated changing from SEM and if yes, for what reasons?

**FOCUS GROUPS, PILOT STUDY AND CODING**

Eight focus groups were conducted, four groups of 1st year WISE-RP and four groups of NON-WISE-RP students. There were 15 people contacted per focus group. The groups of women were further broken down by ethnicity. The controls were found using M-Pathways and were drawn from the general student body and matched for G.P.A. and College entrance exam scores. A general description of the pool of students available for this study can be found on the WISE website at the University of Michigan portal.

One of an array of Learning Communities at the University of Michigan, the WISE Residence Program brings together over 115 first year and sophomore women to live together on the fifth floor of Mosher Jordan Hall. The 2001-2002 WISE-RP Class is comprised of 93 first year women and 22 upper-class women who serve as Big Sisters to the incoming students. Three juniors and seniors, who are the WISE-RP Resident Advisors, live with, direct programming and offer support for the students in the program. (http://www.umich.edu/~wiserp/)

WISE-RP women are not exclusively limited to the school of Engineering. They are drawn from majors in various areas of the Colleges of LS&A as well as the Engineering School, Natural Resources and Environment, Kinesiology, and Nursing. Over 1/3 of the women in the program are women of color. Although the majority of those enrolled are from the state of Michigan, they hail from all over the country and the world.

The focus group study was designed to enhance the probability of obtaining honest comments and perceptions from the students. Each focus group consisted of students with similar race/ethnicity, gender, and academic interests. African American female science majors comprised, one focus group; Asian American female engineering science students comprised another. Every WISE-RP and NON WISE-RP student who agreed to participate was interviewed. A sub-sample of male and female White and Asian American general population students were also interviewed. Focus groups of matched controls were developed. For example, the female African-American engineers were matched to those in the general population focus groups on incoming high school grade point average, ACT scores, SAT scores, and major fields.

The focus group design was structured in such a way to help us determine whether and to what degree students in the three programs differed in their descriptions of their undergraduate science and engineering experience, and whether they differed from the control students’ descriptions. We developed the focus groups to consist of students with the same race and gender to mitigate group dynamics that might interfere with the content of the discussion if the groups had been composed of mixed races and genders. The focus groups were conducted by facilitators with similar racial and ethnic backgrounds. For example, a female African American facilitated the female African American WISE-RP science students, and a White
female facilitated the White female WISE-RP, and control focus groups.

Chief among the concerns in obtaining reliable focus group data was the experience and the competency of the moderator. Arguably, one of the chief concerns in the qualification of the moderator was the ability to “stimulate and guide the group” (moderating skills p.101). Understanding and interpreting group dynamics was also important in obtaining accurate data. Maintaining the focus of the group and drawing out the more introverted members was the focal point of our moderator screening process. It was important for the moderator to display the ability to manage transitions between topics and to gently channel the conversation toward the project’s empirical goals (moderating article p101). Sensitivity and knowledge of the subject material were also important. The moderator was not required to be an expert in the area of research, but a general command and display of knowledge with regard to the participants experiences was essential to establishing mutual respect and trust.

Once the team was assembled and the alterations to the evaluation criteria were established, we began the focus group process anew. The groups were divided according to race. As well, each group (Asian American, African American, etc.) were divided into sub-groups (WISE RP, NON WISE-RP). Groups were assessed according to the aforementioned criteria. Special emphasis was placed on the students’ perceptions of interaction with faculty, peers, and academic support provided by the University.

Students were paid $15 each for participation. Approximately 40% of those contacted participated in the study. The collection process included first contacting students by Email, then following up with a phone call. The focus group interviews were conducted by trained facilitators, and the tapes were transcribed upon completion.

In the pilot study it was discovered that many of the students made the decision to major in the sciences in high school often with the assistance of “bridge” programs (Coad, 2000, - in progress). In most cases, the student’s “professional goals” appeared to have been established in advance of college entry. “ The decision to major in a particular field, or the choice of a particular Engineering program usually came within the first year, based on the perceived congruence of the program with professional goals (biology, CMB, bio-engineering for pre-meds).” (Coad, 2000, - in progress)

The Coad pilot study (Coad, 2000, – in progress) provided us with a number of potential areas of improvement in the focus group process. These included a number of “Next Step” options. In preparation for this secondary analysis, the researchers concentrated on asking the questions suggested by Coad, including:

1. What are the target population and sample for the larger study?
2. What are the number and types of subgroups needed?
3. What number of focus groups is needed, given 1., and 2.)?
4. What are the time frames for data collection, analysis, reporting?
5. What are the anticipated uses of the data?

The data was collected in the raw form of transcripts, then the transcripts of the 1st year WISE-RP students were analyzed to uncover ways in which WISE-RP made a difference. Open coding was the method of analysis used. NUD*IST was the software program used to manage the data. It was decided that NUD*IST 4 was the best equipped program for its improved ease of use over the previous versions (2 and 3). Among the increases in efficiency afforded by the new program were the Node Explorer and Document Explorer components of the new program. These gave the researchers immediate node information, document information, and allowed for easy editing.

As this study was a qualitative analysis, we chose to use the format established in a 1996 draft report of focus group findings submitted by Denise Green (Green, 1996 – in process). It was decided that this report (Green, 1996 – in process) provided a sufficient foundation for the secondary analysis using the current group of focus group participants. In it the author identified five major themes that result from a complete analysis: a) supportive environment of WISE-RP; b) academic benefits of WISE-RP; c) lack of student and faculty interaction; and d) need for improved academic counseling.

Open coding was the analytical approach used to analyze the focus group data. After retrieving the transcript file on disk, the transcripts were formatted in order to prepare them for coding. At the completion of extensive and exhaustive research, the first phase of open coding was conducted. This phase included detailed and broad levels. At the conclusion of the first phase, a list of categories (or trends) was submitted to the evaluation committee and a summary was provided.

There were a total of 9 categories. Table 1 provides a list of these major categories and their corresponding NUD*IST Node Number, and definitions.
**PRELIMINARY RESULTS**

The preliminary results of the WISE transcripts provides us with a wealth of knowledge that is supported by the literature and which appears to be consistent with our expectations. The findings have been viewed through the prism of the social and developmental psychological prospective, the cognitive, as well as the epistemological prospective. Although these findings are preliminary, I have included some general commentary, with correlations to the program, quotes by the research subjects, and some theory descriptions as well. All of the females reported that the environment provided by the learning environment of the program (collaborative opportunities, mentoring, tutorials, research, faculty interactions) was a plus – enhancing their experience, and contributing to their ability to succeed.

The WISE-RP and NON WISE-RP focus group participants interpreted/discussed aspects of their college experiences very differently. When asked about the academic support they received from the University, WISE-RP students expressed a heightened sense of support from the academic and social programs provided. NON WISE-RP students reported a lower level of perceived academic support from the University and felt reluctant to access peer assistance as a result of the competitive nature of their disciplines.

When asked specifically to report on interactions with male peers, WISE-RP participants characterized these interactions as neutral, while NON WISE-RP students characterized these interactions as competitive. With respect to faculty interactions, first year students expressed the most notice of inadequate interactivity. The preliminary analysis also revealed that students who participated in WISE-RP seem more sensitive to issues and challenges that women face. As focus group participants articulated different aspects of their experiences, WISE-RP students appeared to articulate (perceived) barriers to women in engineering more clearly than NON WISE-RP students.

**Asian-American Females**

Beginning with the Asian-American females I found that the Social Developmental perspective generally presented in the larger community had been offset by the determination of family members to provide an environment that was less prejudicial with regard to expectations – potential, and positive with regard to promoting female achievement in the SEM fields (Beyer, 1990; Button & Rommey, 1991; Potts & Martinez, 1994). They were much more likely to state that they had family members who worked in the field, and growing up, that the expectation was that they would follow in those footsteps. In a sense, this would echo the findings of Eckes & Trautner (2000), in that the behavioral patterns of these women were influenced by the “trajectory” of their social knowledge with regard to gender identity. Therefore, having been raised in family environments where these higher expectations were a given, other studies including those with regard to social learning theory (Bandura, 1977, 1976; Perry & Bussy, 1979; Bellinger & Gleason, 1982; Gleason, 1975; Lindsey, Mize & Pettit, 1997) appear to

<table>
<thead>
<tr>
<th>Node Number</th>
<th>Major Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>WISE Program Participation</td>
<td>Discussion related the WISE residential program that focuses on differences between participants and non-participants.</td>
</tr>
<tr>
<td>Two</td>
<td>Interactions</td>
<td>Discussion related to interactions with peers, faculty, and administrators in the University environment, specifically within the classroom.</td>
</tr>
<tr>
<td>Three</td>
<td>Academic Major</td>
<td>Discussion related to academic major, science or otherwise, including several subcategories that emphasize problems encountered when a student is 1) selecting a major or 2) maintaining a science major.</td>
</tr>
<tr>
<td>Four</td>
<td>Future Plans</td>
<td>Discussion on career and/or educational goals to pursue after college.</td>
</tr>
<tr>
<td>Five</td>
<td>Best Academic Experience</td>
<td>Discussion on student’s best academic experiences, in or outside of the classroom.</td>
</tr>
<tr>
<td>Six</td>
<td>Research Involvement Outside The Classroom</td>
<td>Discussion on research outside the classroom.</td>
</tr>
<tr>
<td>Seven</td>
<td>Worst Experiences</td>
<td>Discussion on student’s worst experiences at the University of Michigan</td>
</tr>
<tr>
<td>Eight</td>
<td>Encouragement</td>
<td>Discussion on programs that the students felt encouraged them while pursuing a bachelor’s degree in engineering.</td>
</tr>
<tr>
<td>Nine</td>
<td>General College Experiences</td>
<td>Discussion on the different aspects of their undergraduate experience.</td>
</tr>
</tbody>
</table>
have predicted the success of the Asian-American females with regard to self-concept, and therefore self-confidence.

Interestingly, the Asian-American females pointed out that they acknowledge cognitive differences between men and women in classroom behavior. For instance, one research subject stated – “Females tend to kind of like, if they, if they’re having trouble with something they’re like its my fault. I’m doing something wrong or maybe I’m not good enough. But you know when…. talk about his problems its always, oh, that’s too hard or like the teacher was bad or you know that, so the way that you deal with the problems is different…”

These types of findings, that females tend to internalize failure as a product of lack of ability or as a “belief” about their ability or as an “attitude” is consistent with the findings of numerous researchers included in the literature review (Shoenfeld, 1983; Lampert, 1990; Pokay & Blumenfeld, 1990; Seegers & Boekaerts, 1993; Frank, 1988; Garofolo, 1989; McLeod, 1992). They were also quick to note the competitive nature of the atmosphere in the engineering program – both acknowledging the need for collaboration, and the culture of the field in general. “On one hand I think like engineers are a different breed because they have that where they have to be independent and competitive because most everything is like you’re graded on a curve and you are in competition with each other…. And then on the other hand you have to all work together as a team to solve things and there’s more and more companies that that’s like an attribute they look for in people that they’re looking to hire. More than some other kinds of qualifications.”

Interestingly, Asian-American females didn’t appear to see their race as being positive or negative. They tended to downplay the importance of race in their success or as an educational issue. This was a marked departure from the experiences and the opinions of the African-American females. They reported having strong math and science backgrounds going into the WISE program, which has also been documented to be a plus in terms of students’ beliefs about their ability, and potential for success. They were also very much interested in continuing on to a graduate program after working in the field for a few years. This was further evidence that they were exceptional based on the standard level of expectations for women in the field. As with the other groups of females, one of the chief complaints was of lack of time compared with their contemporaries in other colleges. In a way, there was a slight tone of condescension, that they were working so hard, and their fellow students in other programs had multitudes of free time – marking a clear difference in social priorities. All three groups of women felt that in this sense, being in the program was a plus for them in regards to their environment being shared by people with similar challenges and priorities – positively effecting their ability and level of concentration.

African-American Females

The African-American students appeared to be much more conscious of their status as “the only one” in their classes. Statements like: “Well, I’ve heard the comment about me being a girl and them not wanting to talk to me or anything… but all my friends, I’m a minority… so its like… I’m the only Black person in the whole class…” were common. African-American females also tended to notice gender differences in the academic experience. For instance, in answer to the question: Are the experiences different for men and women? They tended to answer along the lines of one research subject who stated: “Yes. There’s a lot of… women in engineering. Everywhere I go first of all I mean that seems like that’s bigger at least to me right now then race is…. I have had more problems interacting with men then women and that’s odd because normally it’s the other way around. And there’s a lot of sexism here because we’ve all seen the guy comic where you ought to keep a girl and this and that so… when I came here that was one of the things that I noticed, the sexism…”

With regard to sex roles, and other psycho-social machinations the African American women tended to support the findings of many researchers (Cobb & Yackel, 1998; Chenan & Siweya, 1996; Kahle et al., 1993; Madon, Jussim, & Eccles, 1997; Brownlow, Jacobi & Rogers, 2001).

Once again the academic support was mentioned as being a major plus as a adjunct to their classroom experience, the ELRC was mentioned as being extremely helpful, as were the research opportunities provided. The African-American women tended to highly value these support structures and found them essential to their success in the academic program. The also spoke of an interest in continuing on to the graduate level. As well, they demonstrated a profound understanding of the link between graduate school and teaching. Having had mediocre experiences with male GSI’s they felt the need for a female perspective with regard to the “climate” variables mentioned by Mullis & Jenkins (1988). These being the “student centered,” and “teacher centered” approaches.

Caucasian Females

Interestingly, the Caucasian Females interviewed generally had a positive attitude toward the SEM field which they remarked as having been present since childhood. This was very good as researchers mentioned in the literature review found that these positive beliefs were indispensable to their success in college and going forward (Carter& Yackel, 1989; Frank, 1988; Carter & Norwood, 1997; Kloosterman, Raymond, & Emenaker, 1996; Pajares & Miller, 1994; Seegers & Boekaerts, 1993).

They also reported a significant degree of family support which was a similar finding with the Asian-American group. Positive experiences with the WISE
program were generally noted. They also spoke of the universities aggressive attempts to integrate them into the general university community (as women). These efforts were spoken of highly, and appreciated. They did however note, an acute awareness of the male domination of the field and the department.

They spoke highly of the collaborative environment offered by the WISE program and how helpful it was for them generally speaking to have instant access to their peers. For instance, comments like: “I love just being in WISE, its so wonderful to be able to walk two doors down and there’s somebody that’s in my Chemistry class and you can ask them a question. I mean, if I lived anywhere else in any other program, or without a program like that it would be very difficult.....” were quite common.

Similarly, this group was quite aware of the perceptions of faculty members, and as importantly their perceptions of their experience – as being essential to their success. These sentiments are in line with the findings of many researchers in the literature review (ie. Hofer & Pintrich, 1997; Kloosterman, 1996; Pintrich, Smith, Garcia, & McKeachie, 1993; DeCorte, Eynde & Verchaffel, 2002). Common statements were: “I think my relationships with faculty members, its all about you know, how I think it is….. “ This group also found a direct correlation between the intensity of the faculty members dedication to them as a female student, and the quality of the experience – or perception of success in the class.

Similar to the other groups, this group found that they were very appreciative of the numerous support mechanisms available to them by the program. They found them essential to their success, and generally wanted to remain in the program. They also overwhelmingly intended to continue their SEM education to the graduate level of study.

**SUMMARY**

Although our findings are preliminary, with the final results to be published later this year, we have found that the WISE program at the University of Michigan has a profound and positive impact on its participants. In this secondary analysis study (Conducted in 2001-2002) the current state of the WISE-RP program at the University of Michigan was examined. Focus groups were established to investigate the experience and opinions of female science students. The effects of student perception of inclusion and group participation in their college experience, is well-documented (Astin, 1993; Pascarella & Terenzini, 1991; and Tinto, 1993). Tinto’s (1975, 1986, 1993) model of student persistence provides us with a further understanding of the importance of social and academic integration – as a measure of retention. Given the predictors for the success and retention of female students at the university level, it is important that we maintain programs such as WISE-RP to ensure the successful matriculation of greater numbers of female students (Locks, et al. – under review 2000).

Barriers to change in the face of diversity initiatives are primarily born of social dilemmas and social identity crises according to Sherry K. Schneider, and Gregory B. Northcraft (1999). Similarly, according to social identity theory, group members tend to obtain self-esteem, validate and demonstrate their social and political importance by “showing favoritism for their social group or category (“in” group). This often happens at a cost to the “out” group (Billig & Tajfel, 1973; Tajfel, Billig, Bundy, & Flament, 1971). Historically, “in” groups have fought institutional change with violent opposition, and have been less than cooperative, as was the case with school desegregation in the United States in the 1950’s. In an effort to overcome these types of barriers, and those that could result from the findings of this study, it is important that one group does not perceive another to benefit from its loss of status creating an organizational dilemma.

Furthermore, it should be stressed that diversity is vital to innovation, renewal, and creativity (Amabile 1983). It is most important to recognize that members of all groups can benefit from the larger group identity: University of Michigan Student, Participant in WISE, etc. Decreasing student perceptions of isolation and rejection contribute to higher retention minority and female students.

Recent higher education approaches appear to be a promising paradigm shift for the future (i.e. Living Learning Communities). The goal of living and learning education is to foster and enhance the student’s strengths and interests to increase chances for lifelong learning and thriving. In the context of this study, this approach takes into consideration the differences in skill sets, consciousness, epistemological processes and experiences that female students bring to the learning environment. It is by taking this approach, that context and connectedness are emphasized. This is particularly relevant with regard to affective skills, and decision-making processes. It is the hope of its proponents (and the researchers) that it will encourage a healthier, more democratic learning community. More importantly, that by fostering connectedness in the educational approach, retention (and graduation) rates for female students in higher education will increase, and correspondingly the percentage of this demographic in the professional arena.

It is the hope of the researchers that we can inspire others to devise and design a permanent assessment tool as a direct result of this study, with a monthly, quarterly, or annual review. As previous studies have shown, certain groups tend to benefit from the program more than others. Although there is speculation, regarding the reasons for this disparity, we have yet to improve the model to correct for these aberrations. The WISE program has proven successful in retaining and improving upon the quality of minority undergraduate experiences, our aim is to generate detailed and telling data to speak for the apparent successes attained by the WISE and WISE-RP programs.