# Can a Women in Technology Freshman Seminar Change Student Attitudes? A Pilot Study

**Mara H. Wasburn, Susan G. Miller**
**Purdue University**

Abstract

Increasingly, companies and corporations are seeking to diversify those areas of their workforce that are predominantly male. Many of those positions are highly technical. However, despite abundant career opportunities, women are not preparing themselves for technology-related careers that would fill these positions. In 2002, a partnership was developed between the School of Technology at Purdue University and John Deere to create a retention vehicle for beginning women students in the School. In this paper, we will present an overview of the freshman seminar *Women in Technology: Exploring the Possibilities,* developed as the result of this partnership. We will discuss the results of a survey of students' attitudes and beliefs about women in technology-related disciplines, administered before and after each semester of the seminar; compare the preliminary results from those surveys to the same survey administered to a control group; and offer recommendations for strategies aimed at retaining women students in technology and engineering.

## Introduction

A variety of programs have succeeded in attracting more women into the fields of science, engineering, and technology over the past two decades. Many of these women are now in highly visible positions. However, although women constitute 46 percent of the labor force, less than a quarter of the scientists and engineers in this country are women.[1] A July 2001 report released by The National Council for Research on Women finds that much of the progress that women have made in these areas has stalled or eroded. The report underscores the increasing need for a scientifically and technologically literate workforce as we enter the new millennium. One year earlier, the Morella Commission, charged with developing strategies to attract more women and minorities into science, engineering, and technology, reported to the Committee on Science of the House of Representatives that significant barriers to attaining that goal are present from elementary school through college and beyond.[2] Women and girls will comprise half of the available science, engineering and technology talent pool. Therefore, it becomes imperative not only to attract but also to retain women and girls in these disciplines.

As early as elementary and middle school, male/female attitudes toward science and technology begin to differ. This continues on into high school during the critical period when girls begin to develop an understanding of their socially defined gender roles.[3,4,5,6] They have some reservations about the seemingly male "computer culture" as they watch boys utilizing computers for violent computer games and what they see as technology for its own sake.[3] There is little software that appeals to them. Therefore, the tendency of boys to monopolize the computers is not being vigorously challenged.[7] As a result, girls do not take advantage of after school computer clubs or enroll in higher-level computer classes.[8]

Contributing to girls' unequal participation in science, mathematics, and computer education are tracking, negative judgments about their ability, and access to qualified teachers and resources.[9] By the time they are at the point where they must choose careers, girls have less experience with computers and perceive that they are behind, decreasing their likelihood of entering the fields of science, engineering, and/or technology.[7]

There is a dearth of young women enrolled nationwide in secondary school computer science advanced placement classes. Their absence does not appear to stem from disinterest in computers but rather from applications that seem more attuned to the interests of boys.[3] Hence, as young women enter colleges and universities in the areas of science, engineering, and, they are disadvantaged by their lack of computer experience.[8] They also appear to have career goals that are not as well defined as those of their male counterparts, and often lack confidence in their abilities.[10, 11] They encounter college and university classes that are unfriendly to them, impeding their learning. The absence of women faculty and mentors both within the classroom and outside of it, few women students in their classes, and the lack of supportive networks can create a "chilly climate" for women in non-traditional fields. It is during this critical period that many of them transfer into other fields.[12, 5 , 13]

Research suggests that female students are most concerned about isolation, the perceived irrelevance of theoretical preparatory courses, negative experiences in laboratory courses, classroom climate, and lack of role models.[14] Other studies have suggested that the different learning styles of women may influence their desire to enter engineering or technology fields. Additional data indicate that the problem is the image that engineering and technology are not disciplines whose primary goal is to help society, a frequently cited desire of female students.[15]

This paper presents an overview of the freshman seminar *Tech 101 Women in Technology: Exploring the Possibilities*. We will discuss the results of a survey of students' attitudes and beliefs about women in technology-related disciplines, administered before and after each semester of the seminar; compare the preliminary results from those surveys to the same survey administered to a control group; and offer recommendations for strategies aimed at retaining women students in technology and engineering.

## Background

Purdue's School of Technology consists of eight departments: Aviation Technology, Building Construction Management, Computer Technology, Electrical and Computer Engineering Technology, Computer Graphics Technology, Industrial Technology, Mechanical Engineering Technology, and Organizational Leadership. Table 1 documents the fact that the School of Technology enrolls 12% women students, the lowest enrollment of women students of all the Schools at Purdue.

Career opportunities for women in all areas of technology abound. Despite heavy efforts to recruit women into technology-related fields, the School of Technology continues to lag behind science and engineering in percentage of women enrolled. As shown in Table 2, the proportion of women students enrolled in the School of Technology has declined during the most recent five-year period.

Table 1. Undergraduate Female Enrollments by School at Purdue University, Fall 2004

| School | Percentage of Women | School | Percentage of Women |
|---|---|---|---|
| Veterinary Medicine | 95 | Agriculture | 46 |
| Education | 81 | Science | 37 |
| Pharmacy, Nursing, & Health Sciences | 71 | Management | 33 |
| | | Engineering | 21 |
| Liberal Arts | 60 | Technology | 12 |
| Consumer & Family Sciences | 59 | | |

Source: Office of the Registrar, Purdue University

Table 2. Students by Gender at Purdue University, School of Technology

| | 1999 | | 2004 | |
|---|---|---|---|---|
| | Percentage | n | Percentage | n |
| Male | 82.9 | 3,579 | 87.5 | 3,662 |
| Female | 17.1 | 740 | 12.5 | 523 |
| Total | 100.0 | 4,319 | 100.0 | 4,185 |

Source: Office of the Registrar, Purdue University

A 2002 survey of women technology students revealed that they often face difficulties as they find themselves isolated in many of their classes, seeing few women role models with whom they can identify. Nearly one-third of the women students surveyed are uncertain about or lack confidence in their technology skills. Nearly one third of them believe that the professors in their technology classes do not treat women and men equally, and approximately one quarter of them do not feel comfortable going to their professors for assistance outside the classroom. Although many of the women surveyed say that they feel confident in their abilities in their technology courses, nearly one-third are uncertain or disagree. Additionally, almost one-quarter indicate that they do not feel like equal participants when working on group projects with male teammates.[16]

Development of *Tech 101 Women in Technology: Exploring the Possibilities*

With seed money from John Deere, *Tech 101 Women in Technology: Exploring the Possibilities* was established as a first year seminar, tailored toward helping entering women students gain a better appreciation of the career opportunities available with a technology degree, the ways in which technology benefits society, and how women with technology-related careers balance work and family. Funds were made available to bring women professionals to campus to serve as speakers for the course.

The course was designed to create a network of women students by affording them the opportunity to meet and interact with students from other departments within the School of Technology, many of whom they would be unlikely to see in their classes. The course consists of three major components:

- Class discussion. Conversations surrounding recent articles, research, case studies, and videos serve as the basis for the class. They raise issues such as women in non-traditional careers, balancing work and personal life, women and power, and women's

leadership. The class provides an informal, supportive setting for discussing those issues and/or whatever else is important to the students.

- Presentations by guest speakers. Women Technology professionals, many from major corporations, serve as guest speakers for the class, sharing their knowledge and experience about education, career options, obstacles they have overcome, balancing professional and personal lives, and internship opportunities with their companies.
- Group presentations. Working in groups, students write and present a research paper on one of *Working Mother* magazine's Top 100 companies for working mothers, choosing one in which they have a particular interest.

Retention Goals

Many of the retention enhancing strategies around which the course was designed were based on the theoretical framework developed by Tinto. He postulates that a student's decision to persist or withdraw is a longitudinal process dependent on his/her academic and social experiences in college and external influences on the student (such as the student's finances). These experiences affect the student's ongoing level of commitment to his or her college attendance goals, and the student's level of integration within the university community.[17]

The research literature on women in STEM disciplines indicates that they are much less likely to enroll in those areas than are their male counterparts. Those who do enroll are far less likely to remain.[12] Historically, some reasons that have been cited are lack of confidence in their math and science abilities, and lower levels of self confidence and self-efficacy, resulting at least in part from their lack of technological experience in college compared to men.[18]

Students often fail to consider career-relevant decisions until shortly before they graduate. The women students in this course are encouraged to create a personal road map to career development and planning by which they can better navigate their subsequent semesters of work and study at Purdue.

Procedures

The following section describes the initial efforts of a study that we conducted to gauge the effectiveness of our freshman seminar in changing students' attitudes toward technology as a discipline and as a career. The survey questions were modified from the Pittsburg Engineering Survey, designed to assess engineering students' perceptions of the educational climate at their universities.[19]

Closed form questions were utilized for the survey. Due to the small sample size, the questions were rated on a 3-point Likert scale with responses of agree, undecided, and disagree.

Patton[20] recommends utilizing multiple methodologies when studying a phenomenon in order to strengthen the design. That process is termed "triangulation". To triangulate the data, we examined the literature on women in technology-rich disciplines, as well as the literature on freshman seminars. We also incorporated the comments that students wrote on their year-end course evaluations.

Participants

Pre- and post-test surveys were administered to freshman students enrolled in *Tech 101 Women in Technology* from Fall 2003 through Fall 2004. The same surveys were also administered to freshmen women students in the School of Technology who were not enrolled in the seminar. Sixty-six *Tech 101* and 72 Control Group freshmen women students responded to the pre-test. Sixty-nine *Tech 101* and 67 Control Group freshmen women students responded to the post-test.

Limitations

Both the small sample size, and the fact that we are studying the students enrolled in *Tech 101 Women in Technology* limit the inferences we can draw from our data. Students in a course self-select, which means they may be more or less committed to their careers. They may also have very different experiences from the rest of their cohort. Although we have comparable data from women students in a control group, we do not have comparable data from male technology students from which to draw additional comparisons. However, we believe the findings are consistent with the literature cited above, and that the data will permit some limited inferences to be drawn. Because *Tech 101 Women in Technology* students come from such diverse departments, we do not believe that findings are specific to any particular discipline, but can be applied to other non-traditional programs that enroll relatively few women.

Findings

Table 3 below shows the aggregate pre-test survey responses of the *Tech 101* students and those of the control group, while Table 4 shows the aggregate post-test survey responses for both groups:

**Table 3. Women in Technology Pre-test Survey Responses (3-Semester Average)**

| Question | Tech 101 | | | Control | | |
|---|---|---|---|---|---|---|
| | **A** | **U** | **D** | **A** | **U** | **D** |
| 1. A technology career is an appropriate choice for a woman. | 56% | 21% | 22% | 65% | 13% | 21% |
| 2. A technology career will be rewarding. | 78% | 9% | 11% | 65% | 13% | 22% |
| 3. I can balance a technology career and a family. | 51% | 24% | 25% | 47% | 17% | 35% |
| 4. The advantages of studying technology outweigh the disadvantages. | 65% | 21% | 13% | 60% | 17% | 22% |
| 5. Technology **is not** a good career. | 10% | 12% | 77% | 9% | 17% | 74% |
| 6. A technology career **will not** give me enough time to have a family. | 28% | 27% | 45% | 39% | 17% | 43% |
| 7. No other major (e.g., Engineering, English, Science, Art, History) interests me enough to change. | 51% | 28% | 19% | 39% | 39% | 22% |
| 8. The rewards of getting a technology degree **are not** worth the effort. | 11% | 10% | 78% | 4% | 22% | 74% |
| 9. Technology is boring. | 11% | 4% | 84% | 8% | 4% | 86% |
| 10. Women have a harder time succeeding in technology careers than men do. | 66% | 9% | 24% | 57% | 26% | 17% |
| 11. As a technology professional, I will have time for my outside interests (e.g., dance, art, music, sports, etc.) | 63% | 12% | 25% | 39% | 22% | 39% |
| 12. Technology professionals are well paid. | 61% | 23% | 15% | 78% | 17% | 4% |
| 13. Technology professionals contribute more to making the world a better place than other professions. | 23% | 43% | 33% | 22% | 39% | 39**%** |
| 14. Technology professionals are innovative. | 73% | 11% | 15% | 87% | 9% | 4% |
| 15. Women professionals have to be more concerned about how they dress and act than men do. | 82% | 13% | 5% | 65% | 9% | 26% |
| 16. Technology occupations are respected by other people. | 79% | 7% | 14% | 83% | 9% | 9% |
| 17. A technology degree will guarantee me a job when I graduate. | 24% | 55% | 20% | 39% | 52% | 9% |
| 18. I feel that male students in my classes know more about computer software than I do. | 67% | 17% | 15% | 65% | 22% | 13% |
| 19. Technology plays an important role in solving society's problems. | 53% | 29% | 18% | 56% | 17% | 26% |
| 20. I feel confident that, as a technology professional, I can rise to the top of my company. | 45% | 29% | 25% | 56% | 13% | 31% |
| | n = 66 | | | n=72 | | |

**Table 4. Women in Technology Post-test Survey Responses (3-Semester Average)**

| Question | Tech 101 | | | Control | | |
|---|---|---|---|---|---|---|
| | A | U | D | A | U | D |
| 1. A technology career is an appropriate choice for a woman. | 95% | 0% | 5% | 50% | 22% | 28% |
| 2. A technology career will be rewarding. | 93% | 3% | 5% | 56% | 17% | 28% |
| 3. I can balance a technology career and a family. | 82% | 14% | 5% | 39% | 17% | 45% |
| 4. The advantages of studying technology outweigh the disadvantages. | 91% | 5% | 5% | 44% | 28% | 28% |
| 5. Technology **is not** a good career. | 5% | 0% | 95% | 17% | 22% | 61% |
| 6. A technology career **will not** give me enough time to have a family. | 19% | 24% | 57% | 45% | 17% | 39% |
| 7. No other major (e.g., Engineering, English, Science, Art, History) interests me enough to change. | 66% | 14% | 21% | 28% | 33% | 39% |
| 8. The rewards of getting a technology degree **are not** worth the effort. | 5% | 0% | 95% | 17% | 28% | 56% |
| 9. Technology is boring. | 4% | 0% | 96% | 17% | 11% | 72% |
| 10. Women have a harder time succeeding in Technology careers than men do. | 59% | 18% | 23% | 44% | 17% | 39% |
| 11. As a technology professional, I will have time for my outside interests (e.g., dance, art, music, sports, etc.) | 73% | 23% | 5% | 34% | 28% | 39% |
| 12. Technology professionals are well paid. | 88% | 7% | 5% | 67% | 17% | 17% |
| 13. Technology professionals contribute more to making the world a better place than other professions. | 43% | 38% | 19% | 39% | 22% | 39% |
| 14. Technology professionals are innovative. | 92% | 5% | 4% | 78% | 11% | 12% |
| 15. Women professionals have to be more concerned about how they dress and act than men do. | 78% | 7% | 15% | 72% | 6% | 23% |
| 16. Technology occupations are respected by other people. | 91% | 5% | 4% | 84% | 6% | 11% |
| 17. A technology degree will guarantee me a job when I graduate. | 45% | 40% | 16% | 17% | 61% | 22% |
| 18. I feel that male students in my classes know more about computer software than I do. | 44% | 24% | 33% | 61% | 11% | 28% |
| 19. Technology plays an important role in solving society's problems. | 82% | 14% | 5% | 39% | 22% | 39% |
| 20. I feel confident that, as a technology professional, I can rise to the top of my company. | 75% | 21% | 5% | 33% | 22% | 39% |
| | n = 69 | | | n=67 | | |

The questions can be grouped in 5 general categories:

- **Technology Education**
  4. The advantages of studying technology outweigh the disadvantages.
  7. No other major (e.g., Engineering, English, Science, Art, History) interests me enough to change.
  8. The rewards of getting a technology degree **are not** worth the effort.
  9. Technology is boring.
  17. A technology degree will guarantee me a job when I graduate.
- **Technology Careers**
  2. A technology career will be rewarding.
  5. Technology **is not** a good career.
  12. Technology professionals are well paid.
  16. Technology occupations are respected by other people.
- **Technology and Society**
  19. Technology plays an important role in solving society's problems.
  13. Technology professionals contribute more to making the world a better place than other professions.
  14. Technology professionals are innovative.
- **Work and Family**
  3. I can balance a technology career and a family.
  6. A technology career **will not** give me enough time to have a family.
  11. As a technology professional, I will have time for my outside interests (e.g., dance, art, music, sports, etc.)
- **Technology and Gender**
  1. A technology career is an appropriate choice for a woman.
  10. Women have a harder time succeeding in technology careers than men do.
  15. Women professionals have to be more concerned about how they dress and act than men do.
  18. I feel that male students in my classes know more about computer software than I do.
  20. I feel confident that, as a technology professional, I can rise to the top of my company.

Looking at the pre-test Technology Education questions, the differences between the Tech 101 students and those in the control group as shown in Table 3 are relative small. The maximum difference is found in question 17, in which 15% more students in the Control Group believed they would be likely to obtain a job after graduation than did the *Tech 101* students. However, when looking at the post-test responses to the same questions in Table 4, all 5 questions in this category indicate that the *Tech 101* students have much more positive orientations to their major than do the Control Group students, with the maximum difference of 47 percentage points found in question 4 dealing with the advantages of studying technology.

The questions relating to Technology Careers appear to show a similar pattern. The differences between the pre-test responses of the *Tech 101* and the Control Group women freshmen are nearly identical, with between 3 and 13 percentage points separating the two groups. In the post-test responses, between 7 and 37% more *Tech 101* students held positive attitudes toward

technology careers than did those in the Control Group. Of particular interest is the fact that in Question 2, the percentage of Control Group students who believed that a technology career would be rewarding was less in the post-test survey than it had been in the pre-test. In the *Tech 101* group, only 78% agreed with that statement in the pre-test, increasing to 93% in the post-test.

As has been the case with the two previous categories, the pre-test responses to the Technology and Society questions show similar response patterns between the *Tech 101* students and the Control Group, with the exception of question 14. Fourteen percent more Control Group students found technology professionals innovative and contributors to solving society's problems than did those in the *Tech 101* group. In the post-test, the Control Group students showed less positive views of technology professionals as innovative and as people who contribute to making the world a better place than they did in the pre-test. However, the *Tech 101* students' responses to all three questions rose nearly 20 percentage points from the pre-test to the post-test.

In the Work and Family category, the pre-test results show relatively little difference between the responses of the *Tech 101* and Control Group students as to the ability to balance career and family and time to have a family. However, only 39% of the Control Group students believed they would have time for outside interests as a technology professional, as compared to 63% of the *Tech 101* students. Looking at the post-test results, the Control Group students' responses were similar to those in the pre-test. The *Tech 101* students' belief that they could balance work and family, as indicated in question 3, rose from 51% agreement to 82 % agreement.

The responses to the last group of questions, Technology and Gender, are the most powerful of all. Most of the *Tech 101* and Control Group pre-test responses are quite similar. The exception is question 15, where more *Tech 101* students believed that they needed to be concerned about how they dress and behave in comparison to men than did the Control Group students. The *Tech 101* students' responses to most of the post-test were substantially more positive on these items than were those of the Control Group, rising considerably from their responses to the pre-test as well. For example, in question 1, which asked whether technology is an appropriate career for a woman, the Control Group went down from 65% agreement in the pre-test to 50% in the post-test, while the Tech 101 responses to that item went from 56% agreement in the pre-test to 95% in the post-test. Possibly the most interesting response is how confident the women in the *Tech 101* class felt about their ability to rise to the top of their company as a technology professional. In the pre-test, only 45% of the *Tech 101* women believed they could rise to the top of their company while in the post test, 75% of the students agreed with that statement. The Control Group, on the other hand, expressed less confidence in the post-test than they had in the pre-test, falling from 56% agreement to only 33% agreement.

## Discussion

The surveys suggest that students enrolled in *Tech 101 Women in Technology: Exploring the Possibilities* during each of the 3 semesters that data were collected have substantially more positive views of technology at the end of the course than they held when they entered. When compared to a Control Group, they are much more likely to agree that women technology

professionals can have successful careers and families, that technology contributes to improving society, and that they can rise to the top of their profession.

Although we cannot claim a causal relationship between the course and the positive change in the students' attitudes toward technology-related careers, student's written comments gathered throughout the semester support the contention that a freshman seminar can make a difference in student attitudes.

Having a class composed entirely of women created a safe space for students accustomed to mostly male classrooms:

> *It's nice to be in a class that's all women, because my other classes are male dominated. We don't have to censor our thoughts.*
>
> *It was fun, informal. I felt free to speak my mind.*
>
> *It was good to hear speakers and the other girls' opinions and attitudes about women in technology. I was able to really appreciate being a woman in technology.*

The women technology professionals from a variety of companies who served as speakers for the class added an important dimension to the students' experience:

> *I liked this class and the speakers. Instead of hearing stories from videos, the presence of the speakers helped me take in what they were saying.*
>
> *All the videos and case studies made me think about women in technology. The speakers were good motivation.*

Several of the speakers and the videos addressed the challenge of balancing work, family, and personal life:

> *I didn't think I could have a successful career and a family. I think the best thing for me was hearing how women had careers and a life. They had families and their own interests.*
>
> *I think all the discussion about being a mom in a tech career and juggling a family at the same time opened my eyes. I realize what a struggle it can be and I have to be prepared to work around it.*
>
> *Hearing a single woman's view on singleness and a career was refreshing. For once, she's someone I saw able to live a happy life on her own without people bugging her to date or marry.*

Some speakers addressed the issue of women and power. Can women aspire to the corner office and still have a life?

> *I used to believe that men went to work and the women stayed at home with the children. Not anymore. Women are becoming more powerful in their companies.*
>
> *Women can rise to the top. I always thought that because we wanted families, we had to stop progressing in our careers.*

Perhaps most important of all was the fact that taken together, the speakers, the videos, and the discussion helped persuade *Tech 101* students that they could be successful professionals:

> *I did realize that women really had it harder in the workforce. I know now that I will be able to make it.*

## Conclusion and Recommendations

Developing a freshman seminar that encourages and supports first-year women students by building networks to sustain them through to graduation is a beginning. It is hoped that through such efforts, the number of women students enrolled in the School will rise and hence be more conducive to their retention.

Future research employing a larger sample, randomly drawn from both female and male technology students, is needed to yield statistically significant results. Such research could help determine whether freshman seminars do have a positive effect on student attitudes, and which components of freshman seminars are most likely to have a positive impact on women technology students.

The School of Technology will need to recruit more women students to meet the increasing demand by companies for technologically sophisticated employees, especially since many companies are increasing efforts to diversify their workforce. It is our contention that *Tech 101 Women in Technology: Exploring the Possibilities* contributes to laying a foundation for increased recruitment and retention of women to the School of Technology programs to meet those workforce demands.

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## Biographical Information

MARA H. WASBURN is an Assistant Professor of Organizational Leadership and Supervision (OLS) at Purdue University. She holds a Ph.D. from Purdue University. She teaches courses in women and technology, coaching and mentoring, gender and diversity in management, and service learning. She serves as faculty advisor to Women in Technology. Her research interests focus on mentoring with an emphasis on women in technology-related disciplines

SUSAN G. MILLER is an Associate Professor in the Department of Computer Graphics Technology at Purdue University. She received her Master of Science from Purdue University in 1997 and her Bachelor of Science from The Ohio State University in 1988. Prior to working in academia, Susan worked as a professional graphic designer for Purdue, and spent time working for an advertising agency and an architectural firm.