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In this issue:

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Saralyn Grenga Mathis
The Richard Stockton College of New Jersey
Pomona, NJ 08240 USA

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Introductory Course Improves Retention, Especially For Women

Saralyn Grenga Mathis
Lyn.Mathis@stockton.edu
Computer Science and Information Systems
The Richard Stockton College of New Jersey
PO Box 195, Pomona, NJ 08240 USA
609-626-5519

Abstract

An introductory course helps freshmen, especially women, who plan to major in Computer Science and Information Systems be successful in the major. Among the women (n = 31) who intended to major in Computer Science and Information Systems, 100% (n = 7) of those who enrolled in this introductory course were still enrolled and remained Computer Science and Information System majors a full year later versus 83.3% (n = 24) of the non-introductory course students. Persistence rates at least to the end of the second year and beyond are more striking (100% for course females vs. 33.3% for non-course females); males also benefited (66.7% (n = 6) vs. 49.7% (n = 149)). Course content and pedagogy are based upon factors that research has found to positively influence women majors.

Keywords: IS education, CS education, pedagogy, cooperative learning, gender issues, women, introductory computer course

1. INTRODUCTION

Women could help supply the expected demand for competent Information Technology workers. Nevertheless, the percentage of women earning bachelor's degrees in computer science (CS) continues to decline despite the need for computer specialists and the high salaries associated with these occupations (Dohm and Shniper, 2007). In 1984, women earned 37% of the bachelor's degrees in computer science (CS) (National Science Foundation [NSF], 2000); in 2005-2006, women earned only 14.2% of these degrees (Zweben, 2007).

The challenge for programs is to retain freshmen women who plan a computing major and to recruit other qualified women (Margolis, Fisher, and Miller, 2000). Some authors have suggested that computing programs need an introductory course to recruit women and to help women build their confidence and computer skills before they take their first programming course (Davis and Rosser, 1996; Scragg and Smith, 1998; Tillberg and Cohoon, 2005).

In the fall of 2000, The Richard Stockton College of New Jersey (Stockton) first offered such an introductory course, GNM 1031 - Women in Computing, (GNM). The instructor hoped GNM, a freshmen seminar, would help freshmen, especially women, who planned to major in Computer Science and Information Systems (CSIS) remain in the major (Mathis, 2001, 2002). The focus of this article is on GNM and how well it met this goal.

2. KEY FACTORS AFFECTING WOMEN MAJORS

Research has confirmed that interest in computing is the strongest motivator for both women and men to have a computing major (Dryburgh, 2000). Yet women's loss of confidence in computer classes can extinguish their interest. Highlighting this problem, a study at Carnegie Mellon found a connection between women's confidence and their interest (Margolis et al., 2000). First-year women majoring in CS arrived with very positive attitudes towards computing

but, in their first semester of CS classes, their confidence began to deteriorate. Often the women majors switched to other majors because they felt that everyone knew so much more than they did.

This self-perception of skill proficiency has been shown to be a predictor of enrollment in computer courses for first and second-year students (Campbell, 1992). As compared to men, however, women have less pre-college computing experience. In an analysis of the 1990s research on women in computing, Dryburgh (2000) found that all studies indicate that women have less computer preparation.

Positive peer interaction, however, can protect students against the feeling that they do not belong (Margolis et al., 2000). When comparing undergraduate retention rates in Virginia's coeducational CS departments, Cohoon (2001) found that having enough women in each class to support each other was an important factor for having comparable retention rates for men and women.

Considering their need for positive peer interaction, it is not surprising that women learn better in a cooperative environment than they do in competitive or individualistic environments (Clarke and Teague, 1994; Sandler, Silverberg, and Hall, 1996; McDowell et al., 2006). After observing the positive effect that peer study groups, informally initiated by students, had on retention, Seymour and Hewitt (1997) concluded that group learning should be initiated formally at a very early stage. They posited that formal incorporation of peer group learning "into the curriculum and pedagogy of basic classes clearly offers one of the most immediately-available, cost-effective ways to increase persistence" (p. 177). Although men benefit from cooperative pedagogy too, they appear to thrive better in a competitive environment than do women (Rosser, 1990).

In addition to positive peer interaction, relationships with faculty are important to women students (Dryburgh, 2000; Seymour and Hewitt, 1997). At Carnegie Mellon, many women described the importance of the advice, support, and encouragement of college teachers and advisors during their first year (Margolis et al., 2000). Cohoon (2001) found that Virginia CS departments that retained women at comparable rates to men included at least one woman faculty member and had faculty that mentored and supervised female students. These faculty members also enjoyed teaching and shared the responsibility for student success with their students.

Others have suggested that women need help to develop a more realistic personal perception of computing as an area of study and work (Clegg and Trayhurn, 1999; Margolis and Fisher, 2002). Classes should make women aware of the issues that affect women and provide information about careers and about women who successfully integrate their computing with their lives (Margolis and Fisher, 2002; Rosser, 1990).

3. GNM COURSE CONTENT AND STRUCTURE

The design of GNM incorporated the above research findings and recommendations for positively influencing women's success in CSIS. To attract interested students to CSIS during their first semester at the College, the author designed an introductory course to be a four-credit hour Freshmen Seminar; every freshman must complete one. As described earlier (Mathis, 2001, 2002), the course included units to encourage students to develop their computer skills, to learn about computing careers and the computing environment, and to become aware of the issues that affect women in computing.

The instructor of the course used a laboratory-based, group-work teaching style that may be more appropriate for women computing students than the more traditional lecture method. In this cooperative environment, students had structured assignments and were encouraged to ask the teacher or other students for guidance to complete assignments. Successful group learning was emphasized rather than competitive individual achievement.

During the course, students designed and built their own Websites and also solved several real world problems with a modern programming language. The problems that they solved involve typical business-related problems such as calculating the cost of a rental car, a monthly cell phone bill, or the cost of an order at fast-food store with a limited menu. The programming language used lends itself to rapid application development so that students did not get bogged

down with details; instead, they could focus on the big picture, the usefulness and fun of programming.

To learn the skills to accomplish the above tasks, the class worked together in the computer laboratory. First, the instructor showed them how the finished product would look and function. Then, the class clarified the problem and defined the tasks for its solution. After the tasks were defined, students decided which task had to be done first and explained how they knew it must be done first. Next, the instructor showed them how to accomplish that task and they replicated the solution on their own computers. As the class completed each new task, they took notes together with a word processor and used screen shots when appropriate. To help them solidify their understanding, the teacher often included repetitive tasks within the problem so that they could perform, immediately, the repetitive task on their own for practice. When the solution was complete, they solved a similar problem for homework which the instructor graded in the laboratory and provided instant feedback. Students were required to create individual solutions but they were encouraged to help each other.

During the iterative solution process described above, the instructor encouraged students to help each other and to ask her for help if they made a mistake that they or their neighbors could not correct. Other students used the time when the instructor was helping individuals or grading homework to help each other or to work on their own individual task practice or homework.

In this Freshmen Seminar that precedes the first CSIS course, the emphasis was on everyone succeeding together. The process is slow and not as much CSIS material was covered as would be in a more traditional manner. However, because the course is not a CSIS course, there was more flexibility to focus on modeling the solution process and on building a learning community.

Although some Freshmen Seminar course requirements are not related directly to developing computer skills, the instructor co-opted these requirements as opportunities for the class to learn about the issues that affect women in computing and to provide information about computing careers. For example, Freshmen Seminars must have a library use and information literacy unit. In GNM, students used these skills to find scholarly articles to complete a research project about some issue that affects women in computing. The articles were required to be on the same topic, about an experiment, and had to be written by the authors of the experiment. They wrote a one-page summary of each article. Eventually, each of these summaries became a page of their Website. In oral presentations, students conveyed their findings to the rest of the class. Another required component, Career Services, allowed students to explore computing careers and to build a resume that also became a page of their Website.

4. IMPLEMENTATION OF THE GNM COURSE

Probably because of its name, Women in Computing, most GNM students have been women. Although CSIS majors were encouraged to enroll in the course, they were not required to do so. The majority of the students who enrolled had majors other than CSIS. They had good basic writing and algebra skills. In general, they had positive attitudes towards computing. Although they had good basic word processing, presentation, and Internet skills, they had little, if any, experience with Web authoring or with programming and problem solving. While maintaining high levels of computer confidence, the first group to take the GNM course reported an increase in their perceptions of their computer skills in five of eight areas (Mathis 2001, 2002).

Between fall 2000 and fall 2005, the author taught the GNM course five fall semesters. In fall 2000, the course did not include a programming unit. Since fall 2000, the course has evolved to include an increasingly stronger programming and problem solving component.

The present article concentrates only on the students who enrolled in the GNM course between fall 2000 and fall 2005 *and* who planned to major in CSIS. The author collected transcript data for *all* full-time, first-time freshmen who entered Stockton with an intended CSIS major in the fall semesters between fall 2000 and fall 2005. The last semester included in the transcript data is spring 2007.

The number of first-time, full-time freshmen who planned to major in CSIS dropped dramatically over the study period from a high of 53 students in the fall of 2000 to a low of 13 students in the last class, fall 2005. The number of women also declined from 11 in fall 2000 to one in fall 2005. Of the total 186 first-time, full-time freshmen CSIS majors who entered Stockton during the fall semesters of this study, 31 (16.7%) of them are women. Seven of these 31 women enrolled in the GNM course; six of the 155 men enrolled.

To compare the students who took the GNM course to those who did not, the author calculated the one-year retention rates as CSIS majors, for the GNM and Non-GNM groups. Then, she calculated rates at which they persisted as CSIS majors to graduation or to spring 2007 if they had not graduated by then.

5. ONE-YEAR RETENTION RATES FOR GNM VS. NON-GNM STUDENTS

Table 1 shows the comparison of the one-year retention rates for CSIS majors who enrolled in the GNM Freshmen Seminar versus those who did not. Only those students who remained CSIS majors and who were enrolled the following fall were counted as retained CSIS majors. The results of the GNM students are shown at the top of Table 1; the results of the students without GNM are at the bottom.

Although there are only 13 CSIS majors in the GNM group, the results are interesting. The results for the students who enrolled in the GNM course are displayed on the right side of Table 1. As one can see, the seven females who took the GNM course were retained at a higher rate (100%) than the Non-GNM females (83.3%). Twenty of the 24 Non-GNM females were enrolled as CSIS majors one year later; all seven of the GNM females were retained. The six GNM males, however, have a lower retention rate (66.7%) than the 149 Non-GNM males (79.9%). The other interesting item to note is that in both groups the females were retained for at least one year as CSIS majors at a higher rate than males.

Table 1 Freshmen CSIS Majors Retained for One Year with and without GNM

Combined Fall 2000 to Fall 2005 data *(N = 186)*

Subgroup	*n* First Fall	*n* Second Fall	Percent Retained
With GNM			
Females	7	7	100.0
Males	6	4	66.7
All	13	11	84.6
Without GNM			
Females	24	20	83.3
Males	149	119	79.9
All	173	139	80.3

6. RETENTION RATES TO GRADUATION OR TO SPRING 2007 (IF NOT GRADUATED) FOR GNM VS. NON-GNM STUDENTS

Table 2 displays a comparison of the rates at which GNM versus Non-GNM students persisted as CSIS majors until at least the spring semester of their second year. Students who had either graduated with a CSIS bachelor's degree or persisted as CSIS majors until spring semester 2007 were counted for this comparison. Thus, intended CSIS majors in the first fall of the study, 2000, were tracked six and a half years (53 students) while those in the last fall of 2005, were followed one and a half years (13 students). These results are striking.

When one examines Table 2, the GNM course appears to be valuable. GNM students persisted as CSIS majors at a much higher rate than Non-GNM students (84.6% vs. 47.4%). All of the female GNM students had either graduated or were retained as CSIS majors until spring 2007 whereas only 33.3% of the Non-GNM females did. Males also benefited from the GNM course (66.7% for GNM males vs. 49.7% for Non-GNM males).

Table 2 Freshmen CSIS Majors Graduated or Retained until Spring 2007 with and without GNM

Combined Fall 2000 to Fall 2005 data *(N = 186)*

Subgroup	*n* First Fall	*n* Spring 2007	Percent
	With GNM		
Females	7	7	100.0
Males	6	4	66.7
All	13	11	84.6
	Without GNM		
Females	24	8	33.3
Males	149	74	49.7
All	173	82	47.4

7. CONCLUSIONS

Although size of the group with GNM is small (seven males and six females) and, thus, no inferences can be made about the larger population, the results are striking. The GNM course appears to have met its goal – to help freshmen CSIS majors, especially women, be successful CSIS majors. The students who took the GNM course improved their computer skills. They learned more about computing as a field of study and work. Several of the GNM women have continued a mentoring relationship with the instructor. When she was a senior, one former GNM student commented that they built learning relationships with other CSIS majors in their first semester at Stockton. When they took CSIS courses, they already knew other students; they felt that they had some resources. They learned about some of the issues that women in the field have faced. Another senior reported that the GNM course challenged her to overcome some of these issues, when they arose for her, and to remain a CSIS major. The GNM course appears to have helped these students be successful CSIS majors.

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