RETENTION OF FRESHMAN WOMEN ENGINEERING STUDENTS THROUGH AN ABILITY-BASED LEARNING SEMINAR

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INTRODUCTION

The language and experiences of the more computer literate often intimidate capable students. What seems mystical magic to the uninitiated is often simply a case of knowing the proper instructions or procedures. Women students seem especially vulnerable to feelings of intimidation and lack of confidence regarding technical equipment and computer jargon. This project aims to demystify the seemingly magical computer and makes comprehensible seemingly incomprehensible computer conversations. Achieving these goals will help freshmen women gain the confidence needed to succeed in the rigorous engineering disciplines.

In the social and personal as well as the technical area, small group activities are a key component for retention of students, particularly women studying engineering. According to Bandura's theory for the study of gender differences in educational and career decisions, self-efficacy expectations, or our beliefs about our competence, are the main reasons we choose to persevere in our career choices. Research conducted by Dr. Richard Light at Harvard University and Dr. Raymond Landis at California State University has confirmed the value of small study groups as a way to increase self-efficacy. These peer communities permit the opportunity to share information and engage in group study, as well as provide the framework for developing an environment which promotes personal development. By establishing a collaborative community group, this project aims to reinforce technical self-efficacy through building personal skills designed to increase self-confidence in academic and work settings.

In light of these facts, a pilot course was developed in the Department of Computer Science and Engineering at Auburn University by Judy C. Aull, Senior Academic Advisor, and Carolyn L. McCreary, Associate Professor of Computer Science and Engineering. Ms. Ashley C. A. Dunham, M.S.P.H. and faculty member at Wake Forest University School of Medicine developed the evaluation and assessment portion of the project as well as provided consultative advice on the course contents. This course was designed for retention of freshmen women engineering students using the concepts of

ability-based learning which have been so successful at Alverno College, Milwaukee, Wisconsin. The ultimate goal of the course is to teach a class to freshmen women that will substantially increase the number of women graduating from Auburn with engineering degrees. A proposal was developed for the pilot course and funding was obtained from the Auburn University Breeden Endowment for Enhancing Instruction. In a campus-wide competition, the project was one of three funded.

COURSE DEVELOPMENT

Developing a curriculum for ability-based learning involves defining the capabilities of the student who has successfully completed the program, identifying things which the student should be able to do upon completion of the program, identifying criteria to look for in student performance to verify that she has achieved the goals, determine ways to assess her achievement, create activities that will elicit the desired abilities, and design models and/or standards on which she can judge her own personal performance. The following is the development team's definition of the successful student's capabilities and things the successful student should be able to do upon completion of the course.

1) Objectives:
   a) She will be vested in continuing her study in engineering
   b) Her experience and knowledge of personal computing hardware and software will increase her technical skills and confidence in working with computers
   c) She will become more comfortable conducting and participating in technical discussions about computer hardware and software
   d) She will become familiar with internet capabilities and limitations
   e) She will be connected with a supportive group of peers
   f) She will be more aware of her own strengths and her own learning style
   g) She will develop good study habits
   h) She will develop an understanding of group dynamics

2) Abilities the student will develop:
   a) Identify the various engineering disciplines and describe the types of problems each solves
   b) Identify the field of engineering most appealing to her and state three reasons why she wants to study in this area
   c) Connect a computing station with monitor, mouse, printer, and speakers
   d) Add to a PC a component such as a sound card or hard drive
   e) Build a PC from a motherboard and components
   f) Install software on a PC hard drive and remove software from a PC
   g) Understand the function of each PC component
   h) Understand the meaning of short hand descriptors of PC components
   i) Receive telephone support help to solve hardware and software problems
   j) Search the world wide web for information on a given topic
   k) Create a home page for the internet using HTML
   l) Explain how to create a multi-media presentation
   m) Understand the importance of peer group support in the classroom and show this by independently forming small groups in which she feels comfortable working

n) Become familiar with professional societies including the Society of Women Engineers and the benefits of membership

o) Understand that involvement in her curriculum may include forming relationships with a group of peers who are different from her but constitute the majority gender in the College of Engineering

p) Become comfortable in an academic setting where she is in the minority

q) Take the Myers-Briggs Personality Inventory to identify her individual personality type and become aware of how this type affects her learning and study habits

r) Take the Learning Styles Inventory to gain an understanding of her individual learning style

s) Participate in counselor facilitated classroom small group discussion of the results of the tests and the impact these results can have on her ability to study and learn

t) Develop good study habits by applying her understanding of the results from the Myers-Briggs and Learning Styles Inventory

u) Participate in workshops and small group activities on test-taking strategies, note-taking strategies and time management

v) Keep a daily calendar logging how time is spent

w) Become aware of free tutorial services available in the College of Engineering and schedule at least one appointment with a tutor

x) Become aware of the availability of faculty and how to access their assistance through seminars conducted by faculty members and through informal interaction with selected faculty and administrators in the College of Engineering

y) Will understand group dynamics

The course activities will help the retention of women in engineering in two ways: (1) through hands-on, practical experiences, they will gain confidence in their ability to succeed in laboratory and technical work. It will help them make up for their lack of hands-on experience had by many of their male peers, and (2) through their work with peers, self-assessments and study of group dynamics, the women students will gain the social skills and support needed to succeed in the engineering curriculum.

COURSE CONTENT

During the quarter the students participated in technical laboratories and personal development activities. The technical labs were designed to enhance knowledge of both computer hardware and software. The personal development activities were intended to increase understanding of self and thereby in succeeding in Engineering at Auburn. Some of the specific laboratories included adding to a PC a component such as a sound card or floppy drive; building a PC from a motherboard and components; downloading and installing software from the internet; understanding the function of each PC component; creating a home page for the internet using HTML; taking the Myers-Briggs; taking the Learning Styles Inventory; participating in workshops and small group activities on test-taking strategies, note-taking strategies and time management. Also an important part of the course content was a visit to all departments in the College of

Engineering where students participated in activities to assist them to become familiar with the various disciplines so career direction could be decided and concrete educational goals could be established. In addition participation in the laboratories, there were homework assignments as well. Students were required to write letters on specific topics such as their greatest fear as a new college student. They also were required to purchase a daily calendar and keep it with them at all class sessions. An interview with their academic advisor was required as well as joining a professional group such as the Society for Women Engineers, Association for Computing Machinery, etc. There was a career planning assignment which required the students to schedule an interview with someone in the field which they believed most interested them and this person could not be a fellow student but had to be someone knowledgeable about engineering such as a department chair, dean of engineering, practicing engineer, etc. These, along with other homework assignments, were designed to assist the students in becoming comfortable in a technical environment and in establishing a sense of community in engineering.

ASSESSMENT

The assessment plan has three segments: evaluation of the plan, the implementation, and the outcome. To assess planning, we consulted with three groups: an outside evaluation consultant, pre-engineering and current women students in engineering, and stakeholders in the retention of women in engineering. We conducted focus groups and individual interviews with pre-engineering women students about their perception of retention needs for women in engineering as well as their perception of the importance of this program. Changes were made in the plan based upon focus group and interview input. We met with stakeholders in the retention of women in engineering to gain their support for the program and their suggestions for improvements in the program as well as to solicit their help in identifying administrative barriers to the program and the development of strategies to overcome those barriers. One of the team members attended a workshop to learn about ability-based learning before attempting to adapt this teaching style to a large university setting. Before the first class meeting handouts and classroom materials were tested for clarity. Baseline statistics were gathered on students enrolled in the class and on a random control group of students enrolled in engineering but not in the project class.

In the pilot offering of the course, we conducted individual weekly random interviews of students in the program and used the information gained in interviews to conduct classroom discussion to ascertain majority consensus on the quality of each program component. This permitted us to quickly make changes to incorporate student suggestions. The teaching team met weekly to assess sessions from the previous week and to make changes based upon team perceptions. Stakeholders such as the Computer Science and Engineering department head and Assistant Provost for Undergraduate Studies met with the team at mid-quarter to discuss the success of the implementation of the program and identify changes that needed to be made. Written evaluations were also done three times during the quarter as well as at the end of the course. Additionally, at the end of the course we conducted individual exit interviews of all participating students to identify strengths and weaknesses in the program. All information gained was used to develop the final course format and construct the syllabus for the course. Since that pilot course was offered, the Department of Computer Science and Engineering has supported

teaching the course for three years. That department has provided space, equipment access and support of a graduate teaching assistant.

To establish the baseline parameters for statistical analysis of data on students completing the course the first quarter, information was compiled on all enrolled students as well as a randomly selected control group of entering engineering freshmen not enrolled in the course. At the conclusion of the quarter statistics were gathered on students in the class and control groups for the following three quarters before any comparison was made. The statistical consultant on the project had warned even in the proposal development phase that the small size of the sample would preclude identifying any characteristics with statistical significance. With this knowledge, a comparison of the intervention and control group was made in relation to grade point average and persistence in engineering majors. While the findings indicated that the students completing the class persisted in engineering at a higher rate, the prediction of the statistician was correct. There was no statistical significance. There seemed to be little difference in grade point averages between the two groups. The most positive evaluation feature of the course was the student written evaluations that in all categories were excellent to good. An additional benefit of the course was the relationship development between the participating students and the teaching team. Those relationships have continued outside the classroom and in many instances have led to continuing mentoring of the participating students.

In the Fall of 2000 Auburn University will be changing from the quarter to semester system. Because of this change all curricula are being examined and updated. As a part of that process, the College of Engineering plans to add a retention course to its freshman requirements and Judy Aull has been asked to design the course. While the worth of the retention course designed and offered by this team may not have been proven to have statistical significance, developing the course did have great significance for freshmen students at Auburn. In addition to developing a retention course for all undergraduate engineering students, the teaching team has organized a group of women at Auburn University who are, adding components of a Women in Engineering program to the University for the first time.