DOES TRADITIONAL PEDAGOGY HINDER FEMALE STUDENTS IN COLLABORATIVE LEARNING AND LAB EXPERIENCES?

Carol M. Lamb, Assistant Professor,
David G. Kurtanich, P.E., Associate Professor
School of Technology
Youngstown State University

1. Introduction

This paper serves to outline the work in progress in the School of Technology at Youngstown State University (YSU), which is to engage female engineering technology students more fully in collaborative learning, and actual lab procedures. The conceptual framework for this research project is based on a paper published in the January 1995 Journal of Engineering Education, titled "Improving the Academic Environment for Women Engineering Students through Faculty Workshops." [Henes, Bland, Darby, McDonald, 1995]. By using this study as a basis, we will narrow the focus to negative experiences female students have in the lab.

This study is comprised of three phases. Phase one consists of synthesizing previous research and data to support the necessity and validity of the study. During the second phase of the study we will establish baseline data, using a developed assessment tool and observations to evaluate first year students that are based on current pedagogy in engineering technology at YSU. In the third phase we will augment the pedagogy of lab procedures, to be more in line with the female students' cognitive learning style, while ensuring a conducive educational experience for all students. We will assess the students before and after the change to compare the results. If there has been a positive impact on the female students' collaborative learning and lab experiences, the revised pedagogy will be implemented.

In 2004 only 11.7% of bachelor degrees in engineering technology were awarded to women [Gibbons, 2005]. One of the major reasons cited for why women leave engineering is negative lab experiences. A survey done at UC Davis, involving students in 11 undergraduate engineering classes, reflected that 12% of females, compared with 2% of male students felt

inadequate and intimidated in laboratory situations [Henes, Bland, Darby, McDonald 1995]. Studies suggest that males and females are different in their cognitive learning and verbal communication methods. These differences might suggest that the traditional pedagogy in lab procedures may cause females to doubt they fit in, also resulting in a negative lab experience. With respect to communication, men generally reach the point they wish to make quickly, while women tend to take longer because they use more detail [Robertson, 1997]. Research has also shown that female students are more likely to feel comfortable in laboratory experiments if they understand the relationship of a given experiment to previous experiments, and if they understand lecture material covered in the class. They are eager to discover how information is related to and influenced by other factors [Rosser 1993]. Females also prefer a holistic approach to engineering and science, one that brings relevance and connectivity between the coursework and the outside world [Powers, DeWaters 2004].

2. Pedagogical Challenges

One of our main goals, as educators, is to teach in a manner that enables students to learn. Since research indicates that inherent learning ability differs for men and women, it seems reasonable that the style of teaching we use should be dependent on whether the student is male or female. According to Clewell and Campbell [2002], males tend to consider facts in isolation, while females integrate them into a broader context. Sue V. Rosser states "Females are often more eager to discover how one bit of information is related to and influenced by other factors" [Rosser, 1993]. Lab instructors have noted that male students tend not to listen to instruction, unable to wait to play with the equipment, while female students', on the other hand, typically want more information about what they are doing and how it relates to previously studied topics [Rosser, 1993]. It has been suggested that females lose confidence in their abilities, in part, from a mismatch between their ways of knowing and learning and the academic environments of engineering programs [Hathaway, Sharp, Davis 2001]. In applying this information to the performance of female students in lab situations, we tend to see male team members working with the equipment while female team members record data or perform supportive type roles [Rosser 1995].

According to research by Huang and Brainard, females tend to relate the quality of a classroom experience to whether they felt they 'belonged' [Huang, Brainard 2001]. This suggests that the traditional pedagogy in lab procedures may cause females to doubt that they fit in. It might also explain why we see an under-representation of females in engineering programs, and few females taking the lead in collaborative learning and lab experiments. The behavior of female students, who defer to male team members in the labs, may foster uncertainty about their future success in engineering and may cause them to reconsider their direction of study. According to a study by Heyman, Martyna, Bhatia [2002], females, particularly of high ability, are more likely than males to view difficulties as aversive. This situation is more apparent in engineering technology programs that have more lab experiences in the curriculum, therefore, decreasing the potential for collaborative learning and impacting female student retention within engineering technology programs.

The goal of this research project is to engage female engineering technology students in a collaborative learning and problem-solving process, and that they are fully engaged in the actual lab procedure. With this goal in mind, the following question is raised; Does the traditional manner in which lab procedures are presented favor male students over female students, therefore hindering female students from fully engaging in collaborative learning? We will collect baseline data, during the second phase of the project, on first year engineering technology students at YSU, using the current pedagogy. Baseline data will be comprised of data gathered by observing actual lab procedures, to determine levels of engagement by female students. We will adapt and customize an assessment tool to evaluate the level of engagement of female students to include their assessment of the pedagogy used to present lab procedures.

3. Anticipated Findings & Discussion

We expect our research findings to reveal that traditional pedagogy used in lab procedures are more favorable to male students. We also expect our research finding to reveal that changing the pedagogy we will give female students self-confidence in the collaborative learning experience to be fully engaged in lab experiments. The ultimate goal of this research project is to identify necessary changes that will improve morale and aid in the retention of females in engineering and engineering technology programs.

The impact of this study, with respect to the under-representation of females in Science, Math, Engineering, and Technology (SMET), will be to change the pedagogy by making the lab settings more conducive to the inherent learning abilities of female students', thereby increasing their self-confidence in lab environments and collaborative learning. According to a study conducted by the American Society of Mechanical Engineers (ASME), besides technical skills, employers look for people with good communication and strong team skills [Adams, 2003]. Through active and collaborative learning, we anticipate that female students will gain valuable experience in developing interdependence and teamwork skills. These skills are also identified as essential knowledge for engineering, and engineering technology students by the National Accreditation Board of Engineering and Technology (ABET, Inc.).

Will changing the manner in which we present these procedures to students effect how female students engage in research/experimental laboratories? In the third and last phase we will change the pedagogy of lab procedures to include a more holistic approach, in an attempt to align lab procedures with female students' cognitive learning style. Surveys to assess students will be developed and completed at the end of engineering technology courses that include labs. Behavioral observations will be recorded during actual lab procedures, and used to verify if the pedagogical change in presenting lab procedure instructions improves female students' engagement in collaborative learning and labs. Conducting pre-test and post-test evaluations using an assessment tool and lab observations relative to the pedagogical change, will allow us to compare results to observe whether a change in pedagogy has had an impact on a female students' collaborative learning experience and participation in labs. If a positive impact is demonstrated, a revised pedagogy will be implemented. We plan to assess collaborative learning longitudinally as female students' progress through the four-year engineering technology program.

4. Future Phases

If our research confirms that current pedagogy does favor male students, and that we can engage the female students by augmenting the pedagogy, we would like to disseminate this information to include local high schools and community colleges.

Project Timetable:

Phase Two – Summer 2006 thru Spring 2007

- Research and adopt assessment tool(s)
- Implement use of assessment tool(s) during the Fall 2006 and Spring 2007 semesters to assess female students
- Collect data, based on our current pedagogy, to establish a baseline.

Phase Third – Summer 2007 thru Spring 2008

- Evaluate and assess data collected during phase 1.
- Develop a new instructional pedagogy for lab procedures, to include more information.
- Align lab procedures with female student's cognitive learning style.
- Implement changes to the instructional pedagogy for lab procedures in respective courses in Fall 2007 semester.
- Utilize assessment tool(s) during the Fall 2007 and Spring 2008 semesters to assess female students performance

Report Phase – Summer 2008 thru Fall 2008

- Evaluate the data collected to compare results to determine if changes in pedagogy have a positive impact on the collaborative learning experience and lab participation of female students'.
- Disseminate research findings through presenting papers at professional conferences.
- Published findings in professional journals and education magazines.

To disseminate this research information we plan to present papers at professional conferences, as well as have the information published in professional journals and education magazines. Phase three of this research (which is not included in this paper), will be to develop and present seminars, both offsite and onsite, for K-12 teachers and for faculty at two-year and four-year post secondary institutions.

5. Biography

CAROL M. LAMB, *is an Assistant Professor in the School of Engineering Technology at Youngstown State University, Youngstown, OH. She has over 10 years of experience in the consulting engineering sector. She graduated from Youngstown State University with a B.S.A.S. in Civil Engineering Technology in 2001 and earned an M.S. in Engineering Management degree in 2005 from Youngstown State University, Youngstown, OH.*

DAVID G. KURTANICH, P.E., *is an Associate Professor and Coordinator of the Civil and Construction Engineering Technology Program in the School of Engineering Technology at Youngstown State University, Youngstown, OH. He is a registered Professional Engineer in Ohio and Pennsylvania and has over 22 years of experience in the consulting engineering sector. He graduated from Youngstown State University with a B.E. in Civil Engineering in 1978 and earned an M.S. in Civil Engineering degree in 1980 from Carnegie-Mellon University, Pittsburgh, PA.*

REFERENCES

1) Adams, S.G., (2003). Building Successful Student Teams in the Engineering Classroom. *Journal of STEM Education*. July-December. Auburn, AL., 27-32

2) Brainard, S., Metz, S., Gillmore, G. (1997). WEPAN Pilot Climate Survey: Exploring the Environment for Undergraduate Engineering Students. *Engineering Information Foundation*. New York City.

3) Clewell, B., Campbell, P. (2002). Taking Stock: Where We've Been, Where We Are, Where We're Going. *The Journal of Women and Minorities in Sciences and Engineering*, **8**, (3,4), 255-284

4) Gibbons, M. (2005). Women in Engineering, Percentage of Bachelor's Degrees Awarded to Women by discipline in 2004. *PRISM, American Society for Engineering Education*. Washington, D.C., **15**, (2), 20-21

5) Hathaway, R.S., Sharp, S., Davis, C. (2001). Programmatic Efforts Affect Retention of Women in Science and Engineering. *The Journal of Women and Minorities in Sciences and Engineering*, **7**, (2), 107-124

6) Henes, R., Bland, M., Darby, J., McDonald, K. (1995). Improving the Academic Environment for Women Engineering Students through Faculty Workshops. *The Journal of Engineering Education*. January. Washington, D.C.

7) Heyman, G., Martyna, B., Bhatia, S., (2002). Gender and Achievements – Related Beliefs Among Engineering Students. *The Journal of Women and Minorities in Sciences and Engineering*, **8**, (1), 41-52

8) Huang, P., Brainard, S. (2001). Identifying Determinants of Academic Self-Confidence Among Science, Math, Engineering, and Technology Students. *The Journal of Women and Minorities in Sciences and Engineering*, **7**, (4), 315-338

9) Powers, S.E., DeWaters, J., Creating Project Based Learning Experiences for University-K-12 Partnerships, *34th ASEE/IEEE Frontiers in Education Conference*, 2004, Savannah, GA.

10) Robertson, M. (1997). Overcoming Roadblocks in Gender Communication. *The Army Chaplaincy*, www.usachcs.army.mil/TACarchive/ACCOMO/robertso.htm

11) Rosser, S.V. (1993). Female-Friendly Science-Including Women in Curricular Content and Pedagogy Science. *The Journal of General Education*, **42**, (3),

12) Rosser, S.V., (1995), Introduction: Reaching the Majority: Retaining Women in the Pipeline, *Teaching the Majority*, Teachers College Press. New York.