An Interactive CD ROM to Sensitize Engineering Students to Diversity Issues

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Abstract - There is an ever-increasing emphasis on teamwork both in the engineering classroom and the workplace. As a result, engineering students need to be aware of how diversity issues play a role in group dynamics. Understanding diversity allows student teams to work more effectively, and provides students with particularly marketable skills for today's corporate environment.

With this in mind, the Foundation Coalition commissioned a project to develop a multimedia training for engineering student-related diversity issues in the form of an interactive CD ROM. Arizona State University's Women in Applied Science and Engineering (WISE) Program spearheaded this collaborative effort, including graduate students from Educational Media and International Business.

The final product will be piloted in ASU's first-year Foundation Coalition classroom during the fall, 1998 semester. Eventually, the program will be made available to engineering programs nation-wide. With the program, engineering students explore multiple situations where diversity is an issue. At a critical point, the student will have to make a choice of what a character should do or say to deal with the situation. The program will include multiple features to keep the student involved in the learning process.

Designing a fully functional training in a form of a computer program is a lengthy process. The steps include doing a review of the relevant research, designing the framework, designing a storyboard, writing a script, soliciting feedback, recruiting a cast, shooting video, creating animation, programming, testing, and debugging. This paper discusses this process and the program content.

INTRODUCTION

The Higher Education Research Institute (HERI) has been conducting longitudinal studies of undergraduate students nation-wide for 27 years [1]. A portion of this research involves monitoring 25,000 students at 217 institutions, surveying entering freshmen and following them through their academic careers. The study has revealed that only 44% of the students majoring in engineering their freshman year were still in engineering their senior year. Women and minority students were more likely to switch out of engineering than men and majority students [2].]. It has

been documented that one of the most salient retention issues for women and minority students is the academic climate within engineering, including sexist or racist attitudes on the part of faculty and peers [3]. In an effort to improve and enrich the learning experience, to increase the efficiency and quality of performance of the engineering student work teams, and to increase student retention (especially among female and minority students), the "Diversity in Engineering Student Work Teams" interactive CD ROM program was developed.

The CD ROM project is a joint effort between the Foundation Coalition and Arizona State University's Women in Applied Science and Engineering (WISE) Program. The National Science Foundation-funded Foundation Coalition, now in Year 6, links seven higher education institutions: ASU, Rose-Hulman Institute of Technology, Texas A & M University, Texas A & M - Kingsville, the University of Massachusetts-Dartmouth, the University of Wisconsin-Madison, and The University of Alabama in an effort to improve engineering education. The Coalition's mission is to construct improved curricula and learning environments, to attract and retain a more demographically diverse student body, and to graduate a new generation of engineers who can more effectively solve societal problems that demand: life-long learning, teamwork, communication skills, appropriate application of math and science, integration of knowledge, and flexibility and competence in using modern technology. The Foundation Coalition commissioned the WISE Program to develop the CD ROM program in order to contribute to these efforts.

The CD ROM program is designed to assist first-year engineering students with overcoming some of the potential difficulties that may arise in their engineering work teams by (i) heightening awareness of issues of diversity, (ii) changing attitudes and stereotype information and (iii) increasing teamwork skills. The topic of diversity is potentially a very sensitive one as it deals with attitudes and value systems. Therefore, the instruction is delivered subtly, emphasizing experiential activities, and presented in a manner considered appropriate and appealing (i.e. "cool") to the audience.

The program strives to accomplish these goals by introducing some scenarios with potential difficulties that arise when working in teams with diverse members. The scenarios, played out in the form of video sequences, provide the learner with an opportunity to select an appropriate

response at a critical juncture in the situation. The learner is then given feedback directly following the response or at the end of the entire sequence. If the responses to the situations are inappropriate, the learner is given the opportunity to go through the sequence again. The program is flexible in terms of remediation so as not to lose the interest of the learner. A User's Manual will accompany the program, with additional activities and tips for the instructor.

PREPARATION

In preparation for the creation of this program, the authors have researched the literature on the subject of diversity in the classroom and workplace, including gender differences and the "chilly climate" (especially Myra and David Sadker's work and Bernice Sandler's research), studied similar diversity materials created by and used in academia and industry (e.g., UC Davis video "Equity in Engineering"; Purdue University's "Classroom Climate Workshops: Gender Equity Video and Facilitation Guide"), participated in on-line forums on the subject, attended relevant conferences (e.g. AAC&U's Diversity, Learning & Institutional Change), took part in industry diversity training seminars and workshops, and conducted an anonymous Internet-based survey of freshman engineering students at Arizona State University.

Once a draft of each module was developed, focus groups of engineering students provided feedback for refining the content and presentation. Furthermore, a presentation of the program at two national conferences (American Association of Engineering Educators and the Women in Engineering Program Advocates Network) provided feedback from educators and program directors. In fall, 1998, the CD ROM will be piloted and assessed in the first-year Foundation Coalition classroom at ASU, described further in the next section.

AUDIENCE DESCRIPTION

The CD ROM program will initially be used by freshman engineering students in the Foundation Coalition program in the College of Engineering at ASU. These students, recipients of an integrated engineering curriculum devised by the National Foundation Coalition and emphasizing the team approach to study, are taught all courses together in one large group for which special classrooms have been designated and equipped with computers and Internet access. The professors of these engineering students meet regularly to monitor improvements for the smooth integration of all courses, such as the English Composition course, into the engineering curriculum. These professors have expressed enthusiasm about the program and will incorporate the delivery of the CD ROM into the course syllabus, giving 20-30 minutes weekly which is the time needed to complete each module with discussion.

During the 1997-98 year, the class consisted of nearly 70 students, of which over 83% were males. Over 85% were white, only 4% were African American, 5% were Hispanic, 1.5% were Native Americans and 0% were foreign students. After feedback from the pilot group, the program will be further refined and disseminated to other Foundation Coalition programs, and then to other engineering programs.

PROGRAM CONTENT

The program starts off with an introduction of the mechanics of the CD ROM (i.e. description of buttons, print and help functions) by the program's moderator. The moderator then provides an introduction to the program goals and content, including an explanation of diversity. The moderator, a young white male, is intended to reflect the majority of the audience and therefore facilitate a connection between the program and themselves. The next sequence, an introduction to diversity, is the "sales pitch," the motivator which should help the learner buy into the experience and feel as though the program is credible and worthwhile. Ann Livermore, Vice President of Customer Support for Hewlett Packard; Craig Barrett, CEO of Intel Corporation; and the Dean of the College of Engineering and Applied Sciences at Arizona State University, Peter Crouch; make brief video appearances emphasizing the importance of diversity skills and the CD ROM program.

After completing the introductory phase, the learner will enter an "academic realm", consisting of six modules. Each module has a specific instructional objective, and focuses on one or more diversity issues. Diversity issues include valuing differences relative to gender, ethnicity, culture, age, physical ability, and more. Table 1 indicates the settings, or modules, and each diversity issue addressed:

The academic modules portray situations, through video segments, in which diversity issues come to play in the classroom or laboratory setting as the various members of the engineering student teams interact. At certain "forks in the road" the learner is asked for a response based on his/her judgment. Feedback for incorrect and correct answers is provided either after each response or following the entire video sequence. The learner will then have the option of going through the experiential video sequence again to try a different option. The learner can obtain a printout of the decision path taken at any time.
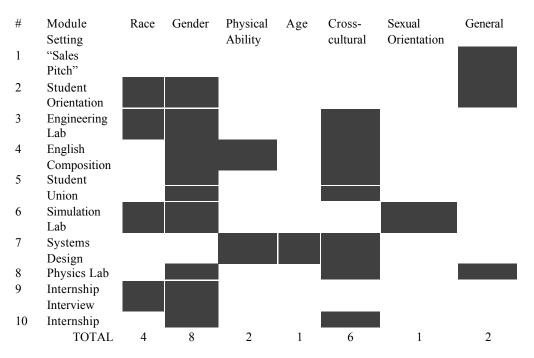
TABLE 1
Diversity Issues Per Module

#	Module Setting	Race	Gender	Physical Ability	Age	Cross-cultural	Sexual Orientation	General
1	"Sales Pitch"							■
2	Student Orientation	■	■					
3	Engineering Lab	■	■			■		
4	English Composition		■	■		■		
5	Student Union		■			■		
6	Simulation Lab	■	■				■	
7	Systems Design			■	■	■		
8	Physics Lab		■			■		■
9	Internship Interview	■	■					
10	Internship		■			■		
	TOTAL	4	8	2	1	6	1	2

After completing the seven academic-situation modules, the student continues on into a "corporate realm" as an engineering intern. As in the academic realm, the corporate world will engage the learner in a number of experiential learning situations. Following the corporate experience modules, the learner will be return to academia for one additional module, hopefully with added insight of the real world which will assist her or him in succeeding in the interpersonal aspects of engineering work team activities in the classroom.

Following each video sequence are questions and statements prompting introspection and serving as primers for discussion in a small group or classroom setting. There are also video clips of student testimonials throughout the program, helping the learner realize that the scenarios presented are realistic. Finally, wisdom buttons throughout the program direct the learner to more information on a given topic. At times, this wisdom button connects the learner to the program's web site. The web site will be updated regularly, providing relevant connections to other sites and updated information related to the topic at hand.

The program can be self-paced or part of a regular lecture schedule. The latter is ideal, as it allows more classroom interaction since students will be working in the same module at the same time.

MEDIUM SELECTED

The CD ROM format for this project was inspired by the work of John Horan, Ph.D. Horan, a Counseling Psychology professor at Arizona State University, has completed similar interactive projects using multimedia computer-based instruction in the area of self-esteem for adolescents. Both programs utilize a cognitive restructuring strategy to change or reinforce attitudes in their target audience. Research on Horan's projects has shown that such computer-based interventions are effective [4].

The present CD ROM program was developed using MacroMedia Director 6 and is self-contained as it is launched with a stand-alone executable file (i.e. learner does not need to have MacroMedia Director installed on the computer to run the program). The program will be delivered on CD-ROM for IBM PC, IBM-compatible and Power Macintosh computers with CD-ROM drives, and through the Internet via CD-ROM-directed links. MacroMedia Director was selected for its flexibility and capabilities to incorporate multi-channels of various media simultaneously. This is most suitable for the many video sequences contained in the program and the feedback to be provided to the learner.

ASSESSMENT

As described in the Preparation section, throughout the development of the CD ROM formative assessment has been conducted. Summative assessment will take place during the piloting of the project in the Foundation Coalition

classroom. Pre and post surveys on the students' perceptions of diversity issues will be conducted to measure the impact on the CD ROM and accompanied activities and discussions throughout the fall semester. Foundation Coalition first-year faculty will also provide feedback as to the effectiveness of the program by observing the program's impact on classroom and team interactions. Although the CD ROM will be in a fixed form, hot links from the CD ROM to a dynamic web site will allow for continual modifications and updates to the program.

DISSEMINATION

Upon completion of the pilot project, the CD ROM will be made available to the other Foundation Coalition institutions. It is projected that the CD ROM program will be available to all U.S. engineering schools by spring, 1999. A small fee will be charged for the program to cover the cost of production and shipping.

CONCLUSION

The CD ROM program is designed to heighten sensitivity to diversity issues, allowing students to identify, and effectively deal with, such issues when they arise in team work and other situations. Such skills are highly sought after in today's global economy. Further, it is believed that this CD ROM program will improve retention of women and minority students by improving the academic climate in the engineering classrooms in which it is utilized.

REFERENCES

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