VIEWING VIDEO-TAPED ROLE MODELS IMPROVES FEMALE ATTITUDES TOWARD COMPUTER SCIENCE

Gloria Childress Townsend
Computer Science Department
DePauw University
Greencastle, Indiana 46135
gct@depauw.edu

1. INTRODUCTION

One of the challenges of Computer Science education lies in finding ways to address the two-pronged problem of declining female enrollments in introductory Computer Science classes and shrinking numbers of female Computer Science majors in upper-level Computer Science classes. One approach to solving this problem involves changing young girls' attitudes toward Computer Science during their middle school years, so that these girls will enroll in mathematics and Computer Science classes first in high school and then later in college.

This paper highlights three separate studies using video taping to introduce a college-aged female role model to ninth-grade girls. Viewing videos changed these girls' attitudes toward Computer Science.

2. THE PROBLEM AND ONE SOLUTION TO THE PROBLEM

In 1988, 32.5% of Computer Science undergraduate degrees were granted to women [3]. Five years later only 28% of bachelor's degrees in Computer Science were awarded to women [2]. This current national portrait of decreasing numbers of female Computer Science graduates underscores the importance of improving female attitudes toward Computer Science.

Several recent programs demonstrate great success in recruiting women to Computer Science by bringing high school girls to campus for weekend workshops and summer camps [1,4]. Once a year, DePauw University hosts a similar--and similarly successful--weekend for high school girls. Science students and science faculty sponsor workshops for this program, DePauw Institute for Girls in Science (DIGS.)

SIGCSE '96 2/96 Philadelphia, PA USA
©1996 ACM 0-89791-757-X/96/0002....$3.50

Exit questionnaires administered during the DIGS weekends indicate that the experience increases girls' awareness of the scope of science-related activities as well as their enjoyment in pursuing some of these activities.

I briefly mention this one solution to the problem of declining female enrollments in Computer Science, because it is a successful solution, because it targets young high school-aged girls, and because I used the March 1995 and July 1995 DIGS girls as subjects for my three studies.

3. A SECOND SOLUTION TO THE PROBLEM

As a supplement to the kinds of activities (such as the DIGS program described in the paragraphs above) that allow younger students exposure to role models, I prepared a video that captured the words and personalities of two women [5]. In the first half of the video, I interviewed one of our female senior Computer Science majors, who talked briefly about her life before college, her experiences in Computer Science activities at DePauw, and the new job that she would pursue upon graduation. When her baby toddled into camera range, I talked about the student's difficult pregnancy and lengthy hospitalization during her junior year, demonstrating one of the central themes of the video, "women overcoming adversity."

In the second portion of the video, I interviewed a woman who, as an art major, enrolled in only one Computer Science course. She talked about using the concepts (such as iteration) from my class in a computer animation project for an art class. My former student also talked about being the first art major at DePauw to use the computer as a medium in her senior art project. During the voice-overs, both the animation project and a story board for the student's senior project were viewed.

Along with the Computer Science major, she overcame some adversity, but his adversity followed a more universal theme. The art major related her former fears of computers and overcoming those fears. She stressed that she felt it was important to challenge one's self in life and that her life had taken a different turn, because she had accepted the challenge of work in computing.

In the conclusion of the video I addressed the other theme of the presentation: Experience in computing can range from one single Computer Science course to a Computer Science major and beyond, but any exposure in the spectrum is valuable. During this portion of the video, my voice alone is heard, while scenes from the taping with the two women are interspersed with the view of a "Computer Science 2" simulation (rat in a maze), that is described as one students could develop after little more than one Computer Science course.

4. MARCH 1995 STUDY

This year's (1995) annual SIGSCE meeting coincided with DePauw's DIGS weekend. In order to test the new video and to include a Computer Science component in the weekend's activities, I arranged for the new video to be screened in my absence.

The twenty-four, first-year, high school girls from central Indiana were divided by random selection into two groups of twelve girls each. The experimental group viewed the video and then completed an attitude scale; the control group performed these two tasks in reverse order. (It was not necessary for the latter group to view the video, since it was the control group; neither did it prejudice the experiment to allow the students to do so.)

The attitude survey consisted of ten statements dealing with interest in Computer Science, perceptions of computer scientists as anti-social people, and the usefulness of studying Computer Science. Students completed the scale with true or false responses. I "graded" the scale by awarding one point for every true or false response that demonstrated a favorable attitude toward Computer Science.

The data (twelve sets of scores) were analyzed using a one-way ANOVA for Hypothesis One: "There is no statistically significant difference in attitude toward Computer Science among students in the control group (attitude survey administered first) and those in the experimental group (video viewed first)." The results are summarized in Table 1, which is appended to this paper.

The analysis of data indicated the hypothesis should be rejected. The results showed significant statistical differences due to the treatment (video) at the .03 level.

5. JULY 1995 STUDY

Following three successful DIGS events, the DePauw organizers applied for and received a GTE Foundation grant in order to host a week-long summer science institute for African-American, Native-American, Hispanic, and Indian ninth-grade girls. The ethnic composition of this group afforded an opportunity to conduct a second experiment which could determine if showcasing college-age minority female Computer Science majors through the medium of video could change these high school girls' attitudes toward Computer Science.

In May of 1995, I conducted an on-camera interview with one of our graduating Computer Science majors who is an African-American. Continuing the theme ("women overcoming adversity") of interviews contained in the first video, I stressed how much I admired the woman, because she was so independent and because she had paid for her entire education herself. This prompted her to say that she took pride in being able to say that she had not once called home to ask for money in four years of college.

The student also discussed how she had been able to accomplish such a feat: She had entered the federal government's Undergraduate Scholarship Program, working during summers and vacations for the Central Intelligence Agency. She also described the one year she had postponed her studies to work on a network project for the CIA.

I substituted the new interview with the African-American student for the first interview in the March 1995 video, but I retained the second interview from the older video, because the interviewed student happened to be Hispanic. These two interviews composed a new video used in replicating the March 1995 experiment with two new subgroups of minority girls.

The twenty-four, first-year, high school girls from central Indiana, participating in the July 1995 DIGS group, were divided by random selection into two groups of twelve girls each. Once again, the experimental group viewed the video and then completed the attitude scale; the control group performed these two tasks in reverse.

The attitude scale used during the March study was administered to the two subgroups. Hypothesis Two was tested using a one-way ANOVA: "There is no statistically significant difference in attitude toward Computer Science among students in the control group (attitude survey first) and those in the experimental group (video first)." The results are summarized in Table 2, which is appended to this paper.

The analysis of data indicated the hypothesis should be rejected. The results showed significant statistical differences due to the treatment (video) at the .04 level.

This p-value of .04 differed little from that in the earlier study, where a p-value of .03 was calculated. The statistical results indicated that young high school girls will change their attitudes toward Computer Science, after viewing video tapes of slightly older women, with approximately the same appearance as they, and after hearing these older women speak about their successful computing experiences.

6. REPETITION OF MARCH ATTITUDE SCALE

Although the analysis of data from the March 1995 study provided encouragement that video work could change young girls' attitudes toward computing, these results could be short-lived. It could be argued that the girls in the treatment group in this study somehow sensed that their more positive responses to the attitude statements would be valued by some or all of the organizers of the DIGS weekend.

On the other hand, the control group girls' responses to the items in the attitude scale differed enough from those of the treatment group as to discount this idea. Additionally, I felt that the natural tendency of experimental subjects to want to please the investigator was softened by my appearing only on camera. I did not personally meet any of the subjects of the March 1995 study.

In any event, I wished to determine, if, after a period of time--four months--and, if removed from the excitement of a weekend away from home at a university populated by older, more sophisticated students, these girls would respond to the same attitude scale in the same ways. I felt that in their own homes, during the middle of summer, these girls would have no cause to remember their earlier responses, no reason to respond in any other manner but honestly to the request of a person they had never met.

I mailed a very short letter to the girls in both the treatment and the control groups, asking them to provide true-and-false responses to an enclosed survey and to return this survey in an enclosed envelope. All twelve of the treatment group surveys were returned; nine of the twelve control group surveys were returned.

6.1 CHANGES IN THE MARCH 1995 CONTROL GROUP

First of all, I compared the control group's original attitude responses to the new attitude responses, because this group had viewed the video, after responding to the attitude scale last March. This comparison allowed the testing of Hypothesis Three, using a one-way ANOVA: "There is no statistically significant difference in attitude toward Computer Science among students in the original (March 1995) control group (attitude survey before video) and that of the same group four months after viewing the video." The results are summarized in Table 3, which is appended to this paper.

The analysis of data indicated the hypothesis should be rejected. The results showed significant statistical differences due to the treatment (video) at the .02 level.

The size of the subgroups was controlled by the number of respondents. Eight of the twelve girls returned complete questionnaires. These eight girls composed the subgroups. If I increased the size of the subgroups to nine by adding the one girl who omitted one item on the repeated questionnaire, then the p-value remained at the .02 level, regardless of whether her response to the missing item was either "true" or "false."

Three of the girls in this control group did not return the attitude survey, and, with a small group of size twelve, this fact is disturbing. Reviewing these three girls' March 1995 scores (5, 6, and 8) and their distribution about the mean (5.8), it is pleasing to see that one score lies above the mean; one, below; and one, very close to the mean. This helps to allay fears that these girls share some common attitude toward Computer Science and that their exclusion could skew the results of the experiment.

6.2 CHANGES IN THE MARCH 1995 EXPERIMENTAL GROUP

Secondly, I compared the treatment group's March attitude scores to those of the same group in July. In March, I had been pleased to observe the effect of the video on this group, but I was unsure that the effect would survive once time had erased memories of details of the weekend.

All twelve of the girls in the treatment group returned their attitude surveys, although one girl left one item unanswered. Hypothesis Four stated: "There is no statistically significant difference in attitude toward Computer Science among students in the original (March 1995) treatment group (attitude survey after video) and that of the same group four months after viewing the video." The results are summarized in Table 4, which is appended to this paper.

The ANOVA results--for the eleven complete sets of responses--indicated that there were no significant differences between the two groups. The p-value for this calculation was 0.58. As a final means of demonstrating that the positive effects of viewing the video did not diminish over time, I performed ten ANOVAs on the individual sets of items from the attitude scale. None of the resulting p-values indicated significantly different groups--with the level of significance at 5%. The actual p-values ranged from 0.21 to 1.0; four of the ten attitude statements yielded 1.0 p-values.

A summary of these ten p-values, Table 5, is appended to the end of this paper. Statement number 5 is associated with N=11, as one girl did not complete this item on her mailed survey. All nine of the remaining p-values are associated with N=12.

7. SUMMARY AND FUTURE WORK

Three separate studies in 1995 demonstrated these results:

- Viewing a video containing interviews with both a white and a Hispanic woman improved the attitudes

(toward Computer Science) of twelve girls (eleven white and one African-American.)

- Four months later, these same girls held attitudes (toward Computer Science) that were not significantly different from their earlier favorable attitudes. On the other hand, the nine girls from the control group, who had been polled before seeing the video, four months later held attitudes (toward Computer Science) that were significantly different from (better than) their earlier attitudes.

- Viewing a video containing interviews with African-American and Hispanic women improved the attitudes (toward Computer Science) of twelve girls (nine African-American or Hispanic and three Native-American or Indian.)

In the near future, I would like to extend these studies in two areas. First of all, I would like to replicate the studies with three different kinds of audiences: Older high school girls, college women who have had no computer science courses, and college women who have had one introductory computer science class.

Secondly, during the next DIGS weekend I would like to organize a different study involving a control group that would see and hear a live interview with one or more female Computer Science majors and a treatment group that would view a similar scenario in video form. Ironically, this study, which I wished to perform in July of 1995, has been postponed to last, because it has been easier to arrange a video taping at our majors' convenience than to have them take time away from jobs and children in order to make a scheduled personal appearance. This fact forms the first point in my list of video advantages.

Summary of advantages of video taping:

- lessens the possibility of asking the few women in Computer Science to sacrifice too much of their time to recruitment and retention efforts

- provides the ability to replay parts of the interview or to show the entire interview later for group members who are ill, late arrivals, etc.

- increases opportunities to add information about the interviewee that would be difficult to discuss in her presence

- allows the creation of a large array of video modules from which selections can be easily combined to form new videos, tailored to new audiences

- introduces a different perspective each time the video is viewed, because more time has passed and a new audience has arrived, allowing the speaker to update the audience with respect to developments in the lives of the video participants and/or devise remarks that form connections between the experiences of the video participants and those of the members of the audience viewing the video

- creates a student history of the department by compiling a library of video time capsules, suitable for many future uses, including viewing, when the student returns to campus for a "career day" or other promotional event

Combining this list of advantages and the preceding list of study results indicates that capturing the personalities and the unique life stories of young women, as both relate to Computer Science, can improve young girls' attitudes toward Computer Science. It further indicates that this can be accomplished with very little effort and with the additional advantage of reusability--a theme of Computer Science.

8. REFERENCES

1. Benditt, John (Editor), Gender and the culture of science -- women in science '93, *Science*, Vol. 260, (April 1993), 383-432.

2. *The Chronicle of Higher Education*, Source: US Department of Education, (June 9, 1995), A37.

3. Frenkel, Karen A., Women and computing, *Communications of the ACM*, Vol. 33, No. 11, (November 1990), 34-46.

4. Teague, G. Joy and Clarke, Val A., Attracting women to tertiary computing courses: two programs directed at secondary level, *SIGSCE Bulletin*, (March 1993), ACM Press, New York, NY, 208-212.

5. Townsend, Gloria C., "R & R" for women in computer science ==> "recruit and retain", *Proceedings of the Second Annual Midwest Small College Computing Conference*, Vol. 11, No. 2, (September 1995), 58-63.

Tables 1-5:

Table 1

	SS	df	MS	F	p-value
between	13.5	1	13.5	5.675159	0.026278
within	52.33333	22	2.378788		

Table 2

	SS	df	MS	F	p-value
between	9.375	1	9.375	4.732314	0.040625
within	43.58333	22	1.981061		

Table 3

	SS	df	MS	F	p-value
between	10.5625	1	10.5625	7.083832	0.018605
within	20.875	14	1.491071		

Table 4

	SS	df	MS	F	p-value
between	1.36364	1	1.136364	0.038642	0.584676
within	73.63636	20	3.681818		

Table 5

item	1	2	3	4	5	6	7	8	9	10
p-value	.33	.56	.69	1.0	.21	1.0	.24	1.0	.67	1.0

SURVEY OF ATTITUDES TOWARD LEARNING ABOUT AND WORKING WITH COMPUTERS

Brenda H. Loyd and Clarice P. Gressard
University of Virginia

The purpose of this survey is to gather information concerning people's attitudes toward learning about and working with computers. It should take about five minutes to complete this survey. All responses are kept confidential. Please return the survey to your instructor when you are finished.

Please check the blank which applies to you.

1. Age: ( ) 11 or less ( ) 13 ( ) 15
   ( ) 12 ( ) 14 ( ) 16 or more

2. Grade: ( ) 8 ( ) 9

3. Name: _____

4. Sex: ( ) Male ( ) Female

5. Experience with learning about or working with computers:
   ( ) 1 week or less ( ) 6 months to 1 year
   ( ) 1 week to 1 month ( ) 1 year or more
   ( ) 1 month to 6 months

   Briefly state the type of computer experience: _____

COMPUTER ATTITUDE SCALE

Below are a series of statements. There are no correct answers to these statements. They are designed to permit you to indicate the extent to which you agree or disagree with the ideas expressed. Place a check mark in the parentheses under the label which is closest to your agreement or disagreement with the statements.

	Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
1. Computers do not scare me at all.	( )	( )	( )	( )
2. I'm no good with computers.	( )	( )	( )	( )
3. I would like working with computers.	( )	( )	( )	( )
4. I will use computers many ways in my life.	( )	( )	( )	( )
5. Working with a computer would make me very nervous.	( )	( )	( )	( )
6. Generally I would feel OK about trying a new problem on the computer.	( )	( )	( )	( )
7. The challenge of solving problems with computers does not appeal to me.	( )	( )	( )	( )
8. Learning about computers is a waste of time.	( )	( )	( )	( )
9. I do not feel threatened when others talk about computers.	( )	( )	( )	( )

		Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
10.	I don't think I would do advanced computer work.	( )	( )	( )	( )
11.	I think working with computers would be enjoyable and stimulating.	( )	( )	( )	( )
12.	Learning about computers is worthwhile.	( )	( )	( )	( )
13.	I feel aggressive and hostile toward computers.	( )	( )	( )	( )
14.	I am sure I could do work with computers.	( )	( )	( )	( )
15.	Figuring out computer problems does not appeal to me.	( )	( )	( )	( )
16.	I'll need a firm mastery of computers for my future work.	( )	( )	( )	( )
17.	I wouldn't bother me at all to take computer courses.	( )	( )	( )	( )
18.	I'm not the type to do well with computers.	( )	( )	( )	( )
19.	When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer.	( )	( )	( )	( )
20.	I expect to have little use for computers in my daily life.	( )	( )	( )	( )
21.	Computers make me feel uncomfortable.	( )	( )	( )	( )
22.	I am sure I could learn a computer language.	( )	( )	( )	( )
23.	I don't understand how some people can spend so much time working with computers and seem to enjoy it.	( )	( )	( )	( )
24.	I can't think of any way that I will use computers in my career.	( )	( )	( )	( )
25.	I would feel at ease in a computer class.	( )	( )	( )	( )
26.	I think using a computer would be very hard for me.	( )	( )	( )	( )
27.	Once I start to work with the computer, I would find it hard to stop.	( )	( )	( )	( )
28.	Knowing how to work with computers will increase my job possibilities.	( )	( )	( )	( )
29.	I get a sinking feeling when I think of trying to use a computer.	( )	( )	( )	( )
30.	I could get good grades in computer courses.	( )	( )	( )	( )
31.	I will do as little work with computers as possible.	( )	( )	( )	( )
32.	Anything that a computer can be used for, I can do just as well some other way.	( )	( )	( )	( )

		Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
33.	I would feel comfortable working with a computer.	( )	( )	( )	( )
34.	I do not think I could handle a computer course.	( )	( )	( )	( )
35.	If a problem is left unsolved in a computer class, I would continue to think about it afterward.	( )	( )	( )	( )
36.	It is important to me to do well in computer classes.	( )	( )	( )	( )
37.	Computers make me feel uneasy and confused.	( )	( )	( )	( )
38.	I have a lot of self-confidence when it comes to working with computers.	( )	( )	( )	( )
39.	I do not enjoy talking with others about computers.	( )	( )	( )	( )
40.	Working with computers will not be important to me in my life's work.	( )	( )	( )	( )