COMPUTER HARDWARE DIAGNOSIS AND REPAIR FOR WOMEN AND GIRLS

Judi W. Wakhungu, Nüket Acar, Catherine L. Rung
Women in the Sciences and Engineering (WISE) Institute
The Pennsylvania State University
University Park, Pennsylvania

INTRODUCTION

Computer science and engineering majors continue to be areas in which women are underrepresented at all levels, and there is evidence that the problem is worsening. An annual survey done by the professional organization CRA (Computer Research Association) reveals that B.A. degrees awarded to women in computer science in 1996 were under 18%, half of the rate of B.A.s awarded to women in 1984 as reported by NSF in its publication, 96-311.¹

In 1997, the National Science Foundation awarded Penn State's Women in the Sciences and Engineering (WISE) Institute a grant of $234,160 over two years to train women and girls at five sites to diagnose, upgrade and repair computer hardware. The project, called "WISE-Cache or Changing Attitudes in a Computer Hardware Environment," was the creation of two Penn State faculty members from the Science, Technology and Society Program, Drs. Judi Wakhungu and Richard Devon. The project was devised to help stem the serious declines in the number of women majoring in computer science and engineering as noted above.

GOALS

Objectives for the project included:

- Devise a short-term, hands-on computer intervention that is easy to understand, relatively cheap to run, has a short time-line to implement, and can be widely disseminated;
- Create a hands-on training experience for a primarily female audience in order to teach diagnosis of common microcomputer hardware problems, repair, parts exchange and installation of hardware peripherals and up-grades;
- Create instruction models for this training that will serve a variety of consumers: undergraduates, K-12 students, teachers and pre-service teachers, voluntary community groups and others in a variety of settings;
- Redress inequities in the distribution of educational technology by recycling the repaired computers to rural or inner-city schools;
- Demonstrate increased confidence in all project participants in their ability to fix mechanical problems and to decrease computer mystery or anxiety where it exists
- Involve corporations and government agencies directly in a cost-effective, community based project that can improve skills of the developing workforce;

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• Increase computer literacy across the board by increasing community awareness and participation.

GENERAL OVERVIEW

Principal investigators on the project were Dr. Judi Wakhungu, Director of the WISE Institute and Dr. Richard Devon, Director of NASA's Pennsylvania Space Grant Consortium at Penn State. The program took place at five sites: Penn State's University Park Campus, Penn State's Altoona College, Penn State's Berks-Lehigh Valley College, Temple University, and Wheeling Jesuit University.

Over the total two-year span of the grant, WISE-Cache will train 500 to 800 women and girls in a variety of settings from middle schools to graduate school and K-12 classrooms. Men were also invited to take part in the training.

This project was an outgrowth of the PA Space Grant's five-year-old student-run computer-recycling program, SCRUNGE, which solicited donations of used computers from industry for placement in rural and inner-city schools or in non-profit agencies. To date, SCRUNGE has recycled about 1,000 computers free of charge. Both Temple University and the West Virginia Space Grant Consortium have spin-off SCRUNGE recycling programs.

"The computer repair course," said Dr. Devon, "really came about when we found that women engineering majors participating in SCRUNGE were uneasy about opening computer boxes to repair them. Although the women students were highly software literate, dealing with hardware wasn't part of their experience."

Testing confirmed that women's confidence levels about their competence to deal with hardware rated near zero, even among women whose confidence levels about their competence with software rated about seven on a ten-point scale. To remedy this confidence gap, Dr. Devon ran a pilot course with 10 undergraduates, followed by three sell-out summer sessions for 36 K-12 teachers who were allowed to take the computers they had repaired back to their schools.

The major advantage of this training is that it can be easily adapted to other institutions and to an assortment of different population groups. The program can be run as a course for academic credit, as a volunteer or service program as the basic recycling program demonstrates, as an in-service or pre-service training for K-12 teachers, or as a one- or two-day demonstration model or summer research camp activity for female middle- or high-school students.

Dr. Dawn Pickard, Director of NSF's Model Programs for Women and Girls, said that the strength of the project is in its win-win strategy. "Everyone benefits," she said. "The schools get computers, the donors get a charitable tax deduction, and the participants gain a valuable skill which can be job-related."

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In 1998, the first year of the project, training for teachers took place at 4 sites with either in-service or graduate level credit available for teachers. Sessions were in high demand with Temple University reporting a 60-person waiting list for the instruction. As our pilot program discovered, the free 486 computer to be taken back to the classroom was a major draw.

For K-12 students, both formal and informal training was done in sessions lasting from a few hours to a few days, using otherwise useless 286s donated to us. No computers were given away at this instruction level.

At the undergraduate level, new classes were created which could be taken for academic credit. At the Penn State Altoona College site, students upgraded computers from the campus administration offices using new parts paid for by the institution, giving the students and the project high approval and high visibility.

In response to urgent demands from female graduate students at Penn State University Park, we conducted a daylong ‘short course’ to accommodate their schedules, using our stock of 286/386 instruction-only computers.

Demand at all levels has continued to grow. At the Temple University site, the waiting lists for training are still extensive. At the other sites, sessions are generally over-subscribed.

**PRELIMINARY FINDINGS FROM EVALUATIONS**

Feed-back and evaluation from participants shows high levels of satisfaction with the instruction and, as we hoped, increasing ability to understand, use and be comfortable with computers.

At Temple University, some of the back-log of 60 people was accommodated in summer 1999. Penn State University Park ‘sold out’ an undergraduate course in 48 hours in spite of its scheduling during football Saturdays.

Some teacher participants report enhanced status within their school districts with both colleagues and principals. In West Virginia, as a result of the class, an elementary school teacher changed her job from teaching music to computer teacher and support person for two middle schools. She is one of 21 teachers in the state to teach graduate level classes as part of a federal grant.

Many report giving inservice training to colleagues at their own schools. One has become a computer guru in her school, trading hated bus duty for fixing people's computers and printers. Another wrote a “how-to” manual to help her elderly mother learn e-mail.

Our students of all ages describe that their anxiety around computers as markedly diminished or non-existent. This we learned initially when at the Penn State Altoona site

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students received old 286s that could only be accessed by intentionally breaking into the cases. After prying, bashing, and chipping away the boxes, all inhibition on the disappeared.

To examine these and other subjective attitudes toward computers and technology which we hypothesize interferes with young women's participation in these fields, Dr. Devon at Penn State University Park created a three session discussion-only portion of the curriculum in addition to the hands-on hardware instruction. 'Zen and the Art of Computer Maintenance' provided striking responses from students, summarized here:

In response to the question, 'why are you taking this course?' we heard:

a) I like to be self-sustaining, I don't (presently) feel in control. (Independence)
b) I'm a computer engineering major and I know nothing about the inside. (Knowledge)
c) I like to fix things, take things apart. (Avocation)
d) The 'helpline' doesn't help...I don't feel in control. (Frustration)
e) I will break it....My computer hates me. (Fear)
f) They do all these amazing things. I want to know how it works. (Fascination)
g) My father and brother are really into, like, how to fix things (Competition)
h) I like to play computer tricks on my roommate. Good career move. (Power)

By the end of the third discussion session, participants split almost evenly over the question, 'Can you have a relationship with a computer?'

a) Channel to my friends and family, important to my emotional life. (relationship)
b) My teddy bear, my little buddy... my friend... I don't get mad at it. (relationship)
c) You can't curl up with a laptop. (only technology)
d) They lead people away from metaphysics, it's one-dimensional (only technology)
e) Similar to TV, but more pro-active, not so lazy, more like a car (only technology)
f) Something I can't live without. My life stops when I don't have my computer or my car (relationship)
g) Give me control... help find jobs...escape (relationship)
h) Visual images absorb more than books. (relationship)
i) Vicarious living, like books but books do it better because the reader supplies more imagination. (only technology)
j) Just like other technology (only technology)
REFERENCES


APPENDIX

WISE-CACHE Topical Outline  
(Adapted from Mark Minasi)

1. **PC Models: How They’re Different, How They’re Similar**  
   Chips and Buses  
   Listing Other PC Features  
   Etc.

2. **Disassembling the PC**  
   PC Repair Tools  
   General PC Disassembly Advice  
   Peculiarities of Particular Models  
   Etc.

3. **Inside the PC: Pieces of the Picture**  
   The System Board / Motherboard  
   Central Processing Unit (CPU)  
   Types of Memory  
   Modems and Communication Ports  
   Figuring Out Your PC: Some Identification Hints  
   Etc.

4. **Avoiding Service: Preventive Maintenance**  
   Heat and Thermal Shock  
   Magnetism  
   A Sample Preventive Maintenance Program  
   Etc.

5. **Troubleshooting PC Problems**  
   General Troubleshooting Rules  
   Check for Operator Error  
   Run Diagnostic Programs  
   Etc.
6 **Installing New Circuit Boards (Without Creating New Problems to Troubleshoot)**
   Configuring New Circuit Boards
   Installing Switch-Based Motherboards
   Configuring ATs and Beyond: Software Setup
   Etc.

7 **Repairs with Circuit Boards and Chips**
   Fix or Replace Boards?
   How Do You Find the Bad Board?
   Finding and Replacing Bad Chips
   Etc.

8 **Semiconductor Memory**
   Introducing Memory Sizes, Speeds, and Shapes
   Reading Memory Chip Markings
   Tips on Installing Memory Chips
   Etc.

9 **Power Supplies and Power Protection**
   Components of the Power Supply
   Upgrading the Power Supply
   Protecting the PC from the AC
   Etc.

10 **Hard Disk Drive Overview and Terminology**
    Hard Disk Drives and Interfaces
    Disk Geometry: Heads, Tracks, Cylinders, and Sectors
    Disk Performance Characteristics
    Etc.

11 **Installing a Hard Disk**
    Steps in Hard Drive Installation
    Configure the System’s CMOS
    DOS Formatting
    Etc.