CompTechS
Computer Technical Support

Internships and Underrepresented Student Persistence in Technical Education—the CompTechS Program

Year 2 – Findings
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By: Catherine Ayers
Susan Malmgren
Dr. Andrew La Manaque

DE ANZA COLLEGE

Dr. William Doherty, Third Star Consulting & Education
Dr. Marti Atkinson, nLight Consulting

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Executive Summary

The CompTechS Program in the Occupational Training Institute at Foothill-De Anza Community College District was funded in June 2007 by the Advanced Technological Education Program of the National Science Foundation to study the impact of the program on student persistence in the IT field, especially for low income and underrepresented groups.

The research cohort for the year two study consisted of 98 students who were in the CompTechS program for varying periods of time between June 2007 and December 2008. The total unduplicated number in any of our target groups (low income, women, and underrepresented minorities) was 74 students. The primary sources of data were the following:

1. Pre-assessments of entering students, refurbishing lab evaluations of students and employer evaluations.
2. Completing student exit surveys and interviews conducted by staff.
3. Student survey regarding valuable features conducted online.
4. Foothill-De Anza CCD institutional data bases and student information systems.
5. Student tracking database of California public institutions.

The second year findings are organized around the following research questions and are consistent with the findings in year one.

1. How do students in the program assess the value of the internships and learn-by-doing methodology?

- Students gave high ratings to their CompTechS experience, especially to the helpfulness of supportive staff, the campus refurbishing lab, and acquiring skills.
- Completing students reported that the hands-on aspect of the program, gaining new skills and knowledge and gaining industry experience were the best things about the program.
- Highly valued key features of the program were the well-defined lab procedures and distributing computers to students who need one.

2. What is the impact of the internship experience on success, persistence in the major and plans for careers or transfer?

- Of the 98 students in the research cohort, 80 were enrolled at community colleges, in universities, or had graduated in Fall 2008. From entry into the CompTechS Program through December 2008, the persistence is 82%. From additional follow-up with the 18 completers not in this group, we learned from their self report that four (4) others are working in the field, two students are finishing degrees at four year institutions, and one other reported being at a community college. If we consider these seven (7) completers, CompTechS students' persistence in the field is 89%.
- There were no statistically significant differences on the rate of persistence for the target group of 74 students (low income students, women and underrepresented minorities) as compared to the non-target group within CompTechS.
- In computer related coursework, the CompTechS student success rate (a grade of C or better) accumulated over the quarters that students were at Foothill-De Anza after applying to CompTechS *was 74% as compared to 67% percent for De Anza students in Computer Information Systems* courses over a comparable timeframe.

- Career plans - Eight of the 44 completing students reported in their exit survey that they changed goals since starting the program to clear IT goals.

3. What are the motivating factors that impact attraction, persistence and success?
Learning and improving skills, relevant hands-on experience, coaching and support were valued by students, thus motivating them to continue. The well-organized, structured refurbishing lab emerged as a key feature as well as the fact that they were distributing computers to needy students.

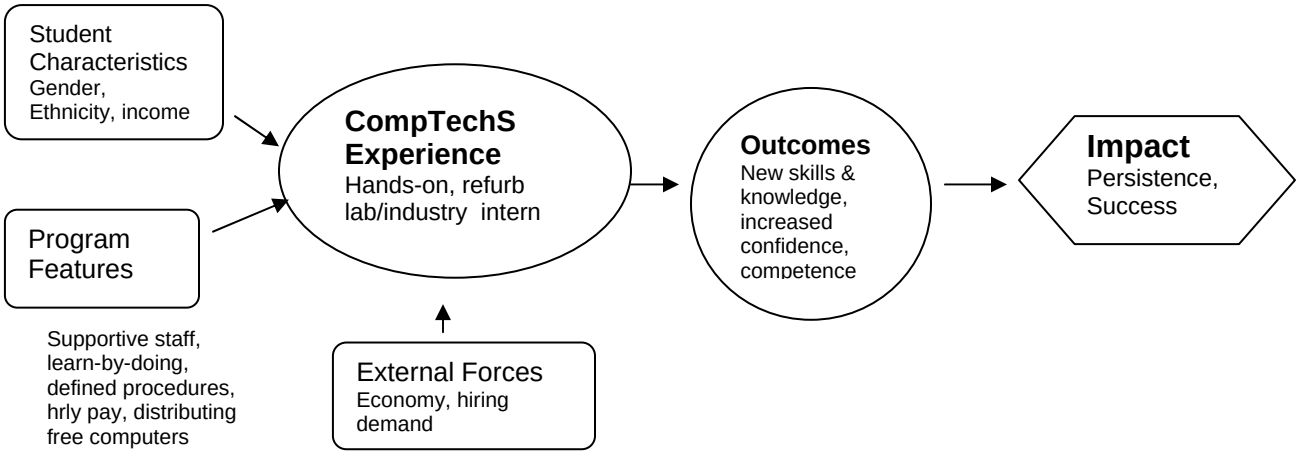
4. Did students' attitudes improve toward computing fields?
The most significant improvement reported by students was their feeling of confidence and competence in technical fields.

5. What are the differences in the impacts of the industry internship as opposed to the campus internship?
We saw no statistically significant differences on any of the variables. Thus, the results indicate that participation in the Campus Lab only versus both the Campus Lab and Industry Internship did not influence enrollment patterns or probability of success in coursework. Further, it did not influence the perception of the students on the value of the program.

6. How does the impact of the CompTechS Program vary for different student populations?
The results suggest participants in the program had very similar experiences regardless of their gender, ethnicity and economic status. Low income students and women had better success rates in other technical courses. More data is needed to determine patterns in specific ethnic groups. Students who rated low on the skills pre-assessments when entering the program did not change their relative order in terms of performance on lab evaluations. However, they were successful in computer related coursework and persisted in the field at the same rate as the rest of the group.

The program has been effective in equipping students with technical skills and increasing self confidence. Underrepresented groups in the computing fields are persisting and performing successfully in coursework. We are making progress in documenting the practices that make this program effective. Our intent is to develop a model that describes the program allowing it to be scaled successfully to other environments.

CompTechS Program Model, version 1



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Introduction

The CompTechS Program in the Occupational Training Institute at Foothill-De Anza Community College District was funded in June 2007 by the Advanced Technological Education Program of the National Science Foundation to study the impact of the program on student persistence in the IT field, especially for low income and underrepresented groups.

The CompTechS (Computer Technical Support) program provides about 50 students a year with paid internships in a computer refurbishing lab on the De Anza College campus and also places qualified interns in local industry. Through the hands on experience in the production environment of the lab, students gain valued hardware skills and clarify career goals.

The computers to be refurbished in the lab are acquired through the solicitation of used computers from local companies and the community, providing a socially responsible means of retiring computer equipment. At the same time, the program bridges the "digital divide" by recycling refurbished computers to disadvantaged students – 227 refurbished computers were given to financial aid recipients, Equal Opportunity Program and Services (EOPS) and CalWORKS (public assistance) students in the last year.

Our hypothesis is that the program will increase persistence and participation of students, including low income students, underrepresented minorities and women in continued computing related coursework and degree programs. Findings from the research in the first year of the ATE project were very promising regarding student persistence in the field and success in computer related courses. In Year 2, the research has benefited from a larger sample size and builds on the year one findings.

Methodology

The Research Questions

This report presents findings to the research questions posed below. The intention in year two has been to develop a model that frames the findings around student characteristics and program features that contribute to the student experience and outcomes – especially persistence in the field though continued study or employment. The research model hopes to examine and describe the key features of the program that yield positive outcomes.

Table 1: Research questions for year two and source of data

Research Question	Data Sources, Methods
1. How do students in the program assess the value of the internships and learn-by doing methodology?	Completing Students and past students surveys and interviews
2. What is the impact of the internship experience on success, persistence in the major and plans for careers or transfer?	Institutional databases. Application and interview. Exit/completer surveys. Quantitative analysis

Research Question	Data Sources, Methods
3. What are the motivating factors of the program that impact attraction, persistence and success?	Program staff and evaluators; student surveys and interviews
4. Did students' attitudes improve toward computing fields?	Student survey and interviews
5. What are the differences in the impacts of the industry internship as opposed to the campus internship?	Institutional databases Students, Quantitative analysis
6. How does the impact of the CompTechS Program vary for different student populations?	Past student survey, Quantitative analysis

The primary sources of data for the year one research were the following:

- Pre-assessments of entering students, refurbishing lab evaluations and employer evaluations.
- Completing student exit surveys and interviews conducted by staff.
- Student survey of valuable features conducted online.
- Foothill-De Anza CCD institutional data bases and student information systems.
- Student tracking database of California public institutions.

Analysis

Analysis of the data collected for the research was conducted in two stages. The initial stage focused on descriptive analyses resulting in simple descriptive statistics such as percentages, frequencies and means. These analyses were sufficient to answer a number of the research questions. They were also used to validate the data collected and insure its consistency.

The second stage of analyses was inferential in nature. Two types of relational analyses were conducted. The first type investigated group mean differences on selected programmatic or performance measures. Typically Analysis of Variance was used for this purpose. The second type of analysis examined relationships between categorical variables; typically Chi-Square tests were applied in these situations.

Most of the group mean differences were tested using a one-facto Analysis of Variance (ANOVA) approach. This, the difference between males and females, those in the target group vs. those who were not, etc were all tested with this one factor ANOVA approach. A two-factor ANOVA approach was used to test whether the lab only experience compared to the industry internship plus lab differed by student characteristics such as ethnicity, etc.

Demographics

For the purpose of our Year 2 research, we analyzed data collected from students who had been in the CompTechS program for a period of time between June 2007 and December 2008 – a total of 98 students. Within this group, we also focused on target groups of low income, women and

underrepresented minorities, including Hispanic, African American, Pacific Islander, Filipino based on historical difficulties of these groups documented in the literature. In addition, we continued to look at Southeast Asian groups as part of our target, because research on Asian subgroups has suggested that Southeast Asians (i.e., Vietnamese, Cambodian, Laotian) have more obstacles to success and are less prepared academically (Government Accountability Office, 2007) [1]than Chinese, Japanese, Koreans and Asian Indians.

Low income students are defined as those receiving financial aid and public assistance.[2]

Table 2: CompTechS Financial Aid Status and Ethnicity

Ethnicity	Total #	Financial Aid	No Aid	Ethnic Group %
African American	3	3	0	3%
Latino	9	4	5	9%
Pacific Islander	3	1	2	3%
Cambodian	1	0	1	1%
Vietnamese	15	11	4	15%
Chinese	18	13	5	18%
Japanese	1	0	1	1%
Korean	2	0	2	2%
Asian Indian	8	3	5	8%
Other Asian & Midl East	12	10	2	12%
White, Non-Hispanic	25	9	16	26%
Declined to State	1	0	1	1%
Total	98	54	44	100%
Percent		55%	44%	100%

[1] US Government Accountability Office, *Higher Education: Information Sharing Could Help Institutions Address Challenges Some Asian American and Pacific Islander Students Face*, Report to Congressional Requesters, July 2007. www.gao.gov.new.item/07925.pdf

[2] In California, the community colleges are relatively low cost at $13/quarter unit. Those qualifying for financial aid are categorized as low income and this included public assistance recipients: CalWORKS, a Temporary Assistance to Needy Families program that provides financial support to parents/caregivers; and EOPS (Equal Opportunity Program and Services) students that receive college support services for low-income and educationally disadvantaged students, funded by the State of California.

Results – Year Two

The research cohort for the year two study were those 98 students who were in the CompTechS program for any period of time between June 2007 and December 2008. The CompTechS program accepts students into the program throughout the year – and students complete the on-campus portion after 144 hours in the refurbishing lab. If they don't go into an industry internship, they then exit the program to make room for others. The 98 students had internships in the campus refurbishing lab or in industry, or both, during this period.

The total unduplicated number in any of our target groups (low income, women, and underrepresented minorities) was 74 students, or 75.5% of the CompTechS student population. Sixteen students out of the 98 were women, 16%. Fifty-five percent (55%) of our research cohort were receiving financial aid as compared to only 20% in the overall De Anza College student population.

How do students in the program assess the value of the internships and learn-by-doing methodology?

Our year one data indicated that students gave high ratings to their CompTechS experience and outside evaluators corroborated the data through their independent interviews. Comments from a past student survey confirmed the positive impact the program had on their professional goals.

In year two, data was analyzed from:

- Exit surveys and interviews with the 44 students who left/completed the program from June 2007 through December 2008.

  In addition, we decided to explore what CompTechS program features students valued the most. It was thought that this investigation would lead to key features and factors that would contribute to successful replication of the program, when we later focus on dissemination. Data was analyzed from:

- A short pre-survey regarding factors that attracted students to the program, given to new refurbishing lab interns during the application process.
- An online post-survey regarding factors/features that were most valuable to them, given to students who had completed the program.

Some of the results are reported under the question on motivating factors.

Exit Surveys and Interviews

Forty-four students completed the program during project year 1 and 2, and did an exit survey and short interview with the program coordinator. The helpfulness of the campus refurbishing lab and the supportive staff received the highest marks from almost all students.

Table 3: Ratings of the CompTechS program by completers.

Component – Helpfulness to you	Rating on 1-6 scale, w/ 6 as high
The program to your career goals	5.2
The hands-on lab	5.6
Supportive staff	5.8
Acquiring skills	5.6
The paid internship	5.3
Resume building	5.3
Preferential enrollment	5.1
Academic guidance	4.9

Best aspects of the program

Consistent with year 1, completers identified the best aspect of the CompTechS program in their exit survey as gaining new skills and knowledge (61% - 27 responses)) and gaining industry experience (23% - 10 responses).

Table 4. Student valuation of learning and industry experience – Exit surveys

What was the best aspect of the CompTechS Internship Program
<u>Improved skills/learning. Hands-on aspect – 61%; Year 2 completer responses:</u> What I learned was the best aspect of the CompTechs Internship. Computer trouble shooting skills I get to learn new things and get hand on experience in the lab at De Anza College. Learned a lot about computers and programs and being able to help others. Get hand on experience…. Exposure to technology, hands on opportunity Hands on learning experience. The hands on experience was most beneficial, It helps me to expand knowledge about computer hardware, and improve my trouble shooting skills. The emphasis on training and facilitating a diverse learning environment. …building and getting core skill sets. Hands on working with computers The experience from the lab and internship. Comp Techs internship program is a great chance to get an experience in technical area and improve communication skill as well. Learned Apple gosting skill, personally gained experience
<u>Industry experience, Contacts/references, resume building -23%; Yr 2 responses:</u> Helpful in getting in the door. "Good reference when looking for work." .. and the contacts in the industry which Susan has were just great. Getting real work experience, learn about high tech fields, learn about industry. Getting foot in the door, …experience with real work/company."

What needs improvement?

As with the first year, patterns of responses regarding what needs improvement were less pronounced, and did not constitute any dissatisfaction with the program. The opportunity to work on more current and advanced equipment; opportunity for more hours; more space in the lab; and more advertising to let students know about the program were responses represented multiple times. As last year, a few answered that nothing needs improvement, and others left the answer blank. New constructive responses were to expose students to Unix and Mac (the lab is an authorized Microsoft refurbisher); add skills training in other IT areas; and provide a certificate ("more goal-oriented students achieve something like a piece of paper").

Key Features and Valued Characteristics of the CompTechS Program

In order to quantify the valuable features of the program and establish the *key* features, a new survey was instituted in Fall 2008. Twelve (12) responses from completers rated different factors/features for positive impact and value.

The organization, well defined procedures and supportive atmosphere in the refurbishing lab emerged as key elements that we will need to emphasize when this model is replicated. Distributing refurbished computers to deserving students also is key.

Table 5. Student valuation program characteristics

Factor	Positive Impact on you?		
	Yes!	Some	Neutral*
Well define procedures (in the lab)	92%		8%
Distributing computers to students who need one	91%		9%
Supportive atmosphere in the lab	83%	8%	8%
Hands-on work	83%	8%	8%
Working with a team in the lab, each with a role	82%	18%	
Organized workflow in the lab	82%	9%	9%
Learning new technical skills	75%	17%	8%
Possibility of being placed in industry	67%	25%	8%
Challenging work	58%	17%	25%
Career and professional advice	50%	50%	
Advice on courses to take or certifications to pursue	42%	42%	16%

*No completers responded "Not really" or "No!" – which were the possible negative responses.

Comments from the exit survey were consistent with the supportive lab atmosphere being an important feature: "Very laid-back atmosphere, great learning environment," "I got to work with some really nice people in a small friendly environment." "Your excepted [sic] as you are." "The flexibility and openness of the program directors." All were responses to a question about best aspects of the program.

In retrospect, the most valuable aspects of CompTechS

In addition to hands-on experience and learning technical skills, students valued the support and coaching from the program staff.

Table 6. In retrospect, the valuable program aspects

Aspect of the CompTechS that have been most valuable	Yes!	Some
Hands-on hardware experience	75%	8%
Coaching, advice and support from Joe and Susan	75%	8%
Learning new technical skills	75%	8%
Industry based internship	73%	18%
Learning about the nature of the work	73%	18%
Learning by doing in the lab	73%	9%
Support of other students	58%	25%
Setting my career goals and directions	42%	33%

In the survey of former students that completed before June 2007, a predominant theme was the clarification of goals that students realized because of their experience in the CompTechS program. "Well before working for CompTechs I was not really sure about my major but after working there and getting a hands on experience on refurbing used computers I realized that this is what I wanted to do as a major and I decided on pursuing my bachelor's in computer engineering." The term "setting goals" in this survey item may have had the connotation of an exercise or activity, and was not remembered as an aspect that was valuable.

Value of Industry Internship

Thirty-five (35) of the 44 completing students had an industry internship. Students who had experienced an industry internship valued the contacts and resume building most (77%), followed by real industry experience and opportunity to learn on the job at 70% each. If the response *Yes!* And *Some* were combine, all three of these items were at 100% -- so highly valued. The opportunity to be hired by the company after the internship was rated low at 30%. It is possible that this would have been rated higher before the industry internship and reflects whether they were hired or not.

What is the impact of the internship experience on success, persistence in the major and plans for careers or transfer?

A primary data source for retention was, and will continue to be, the institutional data on student enrollment and success within Foothill-De Anza CCD. In addition, the institutional researcher at De Anza College licensed a student tracking system that allowed for tracking enrollments for students who completed the program and their studies within FHDA and transferred to four-year public institutions within California. The 98 students who had been in the program from June 2007 through December 2008 were the research cohort for this year two report.

As well as their persistence in computer related courses and technical (STEM) courses, we realized the need to examine students' persistence from quarter to quarter in general education. Students on a degree or transfer track may have quarters without any technical courses. This is especially true of part-time students who take fewer units per quarter.

Because of our special interest in the persistence of target groups of low income students, women and underrepresented minorities, we examined data specific to these groups. Aside from our target group's persistence and success, we looked at the overall CompTechS group, plus a comparison group of De Anza students outside of the CompTechS program.

Persistence

Of the 98 students in the research cohort, in Fall quarter/semester 2008, eighty (80) were enrolled in FHDA, in four-year universities, another community college, or had graduated. So from June 2007 to December 2008, the persistence is 80 out of 98 in coursework, 82%.

Table 7: Persistence in coursework by the research cohort.

CompTechS –Yr 1&2	Fall 2008 enrollment	Persistence rate in coursework
98 students, June 2007-Dec 2008	54 enrolled at FHDA, 26 enrolled in university or other cc = 80 total	82%

For the 18 students whose last documented enrollment was prior to Fall 2008, we made an effort to track their status. From self report, we know four (4) others are working in the field, one of whom was recently laid off. We have learned from two other students that they are finishing degrees at four year institutions though we cannot confirm through an outside source; one other reported being at a community college. *If we consider these seven (7) completers, CompTechS students' persistence in the field is 89%.*

There were no statistically significant differences on the rate of persistence for:

- The target group of 74 students (low income students, women and underrepresented minorities) as compared to the non-target group within CompTechS (primarily white and Chinese men).
- Year one cohort vs Year two cohort
- Industry Internships vs Lab Only experience.
- Financial Aid vs No Aid
- Target Ethnicity vs non-target ethnicity
- Women vs. men. The comparison of males and females yielded a probability very close to the threshold (p=.057). Though there was no statistical difference in male and female persistence, we should follow this next year as it approached a significant difference with male persistence in the field being higher.

Success

Success is defined as a grade of C or better and "pass" on the table below is synonymous with success. In computer related coursework accumulated over the quarters that students were at Foothill-DeAnza after applying to CompTechS, *the CompTechS student success rate was 74% as*

compared to 67% percent for De Anza students in Computer Information Systems courses over a comparable timeframe.

The success rate in overall coursework was 80% for the CompTechS student grades. The success rate of CompTechS students was highest in non-technical courses at 85%. Females in the program did slightly better in computer related coursework than their male counterparts. However, the number of courses was smaller for females.

Table 8: Course Success Rates by Selected Target Groups within CompTechS – accumulated over multiple quarters.

Comparison Group	# of course grades	Pass	Did Not Pass	Withdrew
CompTechS- All	1121	80%	12%	9%***
Computer-related Courses*	399	74%	15%	11%
Other Tech**	235	77%	13%	9%
All Other Courses	487	85%	9%	6%
Computer-related, Female	68	76%	10%	13%
Computer-related, Male	331	74%	15%	11%
Financial Aid	732	80%	12%	9%
No Aid	389	79%	12%	9%
Comparison Group	# of course grades	Pass	Did Not Pass	Withdrew
African American	24	42%	38%	21%
Asian Indian	95	71%	22	7%
Cambodian, Vietnamese	166	80%	11%	9%
Chinese	309	86%	6%	8%
Japanese	17	100%	0	0
Hispanic	109	66%	21%	13%
Middle Eastern	109	91%	3%	6%
Other Asian	61	75%	15%	10%
Pacific Islander	33	85%	6%	9%
White, Non-Hispanic	193	79%	13%	7%

*Computer-related courses are from the following departments: Computer Information Systems, Computer Networking & Electronics, Computers on the Internet, Computer Applications, Computer Aided Design & Digital Imaging.
**Other Tech courses: Biology, Chemistry, ENGR, Math and Physics.
** *Percentages were rounded to the nearest full percent, so lines add up to 99-101%.

Success rates of selected target populations

Targeted ethnic populations did better for the most part than the overall De Anza Computer Information System success rate of 67% success. However, Hispanics performed the same as the comparison group and African American had significantly lower success rates in computer related courses. However, the African American group accounted for only 3 students, so one needs to be cautious regarding conclusions based on this data.

The target populations for the most part had better success rates in other technical (STEM) courses than in computer-related coursework, and the best success rates in non technical courses. The exception was the Hispanic group, who took only 12 other technical courses over this period with a success rate of 50%, as opposed to having taken 47 computer-related courses with 66% percent success.

Table 9. Selected target populations and course success rate

Target Group	# of students	Computer-related Courses*	Technical courses**	All Other courses
African American	3	35%	67%	100%
Hispanic	9	66%	50%	70%
Pacific Islander	3	78%	82%	92%
Cambodian/Vietnamese	16	80%	73%	83%
Female	16	76%	93%	87%
Low income	55	68%	81%	87%

*Computer-related course departments: Computer Information Systems, Computer Networking & Electronics, Computers on the Internet, Computer Applications, Computer Aided Design & Digital Imaging.
**Other Tech courses: Biology, Chemistry, ENGR, Math and Physics.

Plans for careers and transfer

Data and quotes from the 44 completing students and the past student survey provided insights into impact of the program on career plans and educational goals.

Plans to continue to take classes were extremely high at 98% for CompTechS completers at the time of their exit questionnaire. In reality, 91% of past students (32 students who had been in the CompTechS program before June 2007) had taken courses since completing the program. Those students who planned to complete a four-year degree, or had already completed, was high at 89% of the 44 completers in the research cohort. We will continue to follow transfer after they finish their coursework within Foothill-De Anza Community College District.

Eight completing students reported in their exit survey that they changed goals from the beginning of their time in the program to more clear IT goals, such as the following comment:

- "I do not have anything in mind" to current plan, "Career in IT."

Some changes represented more clarity, like the one below:

- "Learn about CS; get a job anywhere" to current plan, "Job in network security."

Three other students who had started with IT related goals changed their minds.

- From "To become a network engineer" to current plan, "To become a civil engineer. Actually the program exposed me to the IT market, and I got a good idea how IT is in reality."
- One doubted their Computer Science choice by the time they finished the program, because others in the lab were "better" compared to them.

This last response is contrary to the substantial data about increased confidence as a result of the program, but consistent with clarification of goals. Other of the completers reported that they focused their goals more, or confirmed them, "I realized I really like hardware."

The poor economy has impacted recent completers: "…wanted to get entry level networking job, but [I am] going to my old career as a trainer because of current economy and job shortages."

What are the motivating factors that impact attraction, persistence and success?

Factors that Attracted Students to the Program

During the application process, students reported that the opportunity to work with computers and to learn new technical skills were the most prominent attractions to the CompTechS program. The part-time job, though very important to 68% of the respondents, was not as important as most of the other factors. This finding may be significant to other institutions considering adopting the CompTechS model, since an unpaid student internship may be a possibility if other important features are in place.

Table 10. Factors attracting students to CompTechS

Feature/Factor that attracted you to the program	Yes!
Working with computers	91%
Opportunity to learn new technical skills	89%
Flexible schedule	83%
Possibility of being placed in industry	83%
Resume builder	74%
Part-time job	68%
Convenient location of refurbishing lab	59%

Student Motivation to Continue

The survey items reported in tables 3-6 (valuable program impacts and features) also are likely indicators of what features of the program motivated students to continue. The well-organized, structured refurbishing lab emerged as a key feature that motivated students, and the fact they were distributing computers to needy students. As indicated previously, learning and improving skills, relevant hands-on experience, coaching, advice and support were valued by students, thus motivating students to continue.

Refurbishing Lab Practices

An interview with the lab instructional coordinator supported the survey results on valued program characteristics (Table 5), in which students highly valued the well defined procedures and organized workflow in the refurbishing lab. The lab coordinator yielded some other points that are relevant here.

- Start students on day one on the work that needs to be done… immediately engage them, rather than putting them through an observation period.
- Provide an organized production environment. Have a pre-set series of steps. Having a really well defined structure allows them to know the step they are working on and to concentrate on just that procedure until completion.

- An important first step for an instructor is to set up the procedures, breaking the refurbishing steps into sequential parts. The nature of computer troubleshooting allows for you to break it down into smaller steps.
- Maintain small groups of 4-6 interns in the lab at a time. Assessing personal needs necessitates having a smaller environment. Also, they can feel comfortable speaking up and getting support.
- Don't hesitate to give students a task that they may think is above their skill level. It may be intimidating to them, but also it is a confidence booster. Pair them with a student that may be more competent.

Lab Processes

- In the "production environment" the students do a step in the process, but will rotate over the course of their internship. When they come into the lab, they do the job that needs to be done. Listed on the white board are systems in testing, in progress and those to be picked up, plus special notes about projects.

- An intern is directed to start on systems that are "in testing" because they are closest to completion and you want to get them off the board. The next priority is "in progress": hardware repair, or the software installation/configuration checklist.

- However, the systems for "pick-up" supersede all. This is when a student comes into the lab to pick up their computer. The team needs to understand that this is the public face of all the work they've done. So the system needs to be ready by the time scheduled on the board, and may require the team to scramble to get it completed, prepared/set up for demo/orientation, paperwork ready, etc. It's good to include the interns in distribution of the free computer to needy students – they like to know that their work helps others.

In the interviews that the evaluators had conducted in year one, students mentioned the learning that took place in the low key atmosphere of the lab as motivating them to continue. In response to the question: What helped motivate you to continue, an answer was, "The atmosphere in that lab, because everyone was eager to learn. It was like a home. It was very organized." Feelings of being comfortable in the environment contributed to their success and perhaps their persistence in the field.

Did students' attitudes improve toward computing fields?

In year one, the most significant improvement reported by students was their feeling of confidence and competence. In interviews conducted by the evaluators, *all* of the interviewees had said their experience in the program increased their level of self confidence. In addition, they felt more confident technically and more ready for the workplace. "Yes – it made me feel more confident, gave me the feel for my field and what it's like."

In year two, the exit survey for completers was adjusted to ask these specific questions in order to have quantitative data. There were 28 respondents and the responses were consistent with year one.

Table 11. Exit Survey – Self confidence, technical competence and readiness for the workplace.

Did the program impact:	Yes
Your self-confidence	93%
Feelings of technical competence	93%
Readiness for the workplace	93%

28 responders

Especially for the underrepresented groups involved, confidence is arguably one of the most important attitudes to impact.

What are the differences in the impacts of the industry internship as opposed to the campus internship?

To investigate whether there were any differences resulting from the type of programmatic experiences that a student had, we compared group mean differences on a number of measures between those students who had participated only in the campus lab and those students that had been in both the campus lab and in an industry internship. We compared the groups on the following measures:

- Rate of persistence in the field
- Probability of Success (grade of C or better) in a Computer Class
- Probability of Success in a Technical Class
- Probability of Success in any Other Class

Additionally for the 44 students who completed the program and responded to the Exit Survey we examined differences on:

- Perceived Helpfulness of Program to Goals
- Perceived Value of Hands-On Lab experience
- Perceived Value of Paid Internship

The results of the comparison of the two groups using a One-way Analysis of Variance technique produced no statistically significant differences ($p<.05$) on any of the variables. Thus, the results indicate that students that participated in the Campus Lab only versus the Campus Lab & Industry Internship did not influence enrollment patterns or probability of success in their courses. Further, it did not influence the perception of the students on the value of the program.

This finding would seem to be evidence that the program is not differently effective no matter which program component(s) a student participates in.

Differences across student populations

We also looked at a sub question concerning the differential effects or performance across different student populations for the lab only experience and the industry internship. For example, does the industry internship have a different impact for males than females?

With the larger sample size it was possible to perform a two-factor comparison (for example, male vs. female and lab internship vs. industry internship) of the mean performance on:

- Probability of Passing a Computer Class
- Probability of Passing an Other Tech Class (STEM)

- Probability of Passing an Other Class (Non-technical)

The two-factor analysis tests main effects for the two factors and, most importantly for this research issue, the interaction of the two factors. It is the interaction effect that would show that the two program components are acting differently across the groups of the second factor (such as gender).

The results of the two factor analyses mirrored those already reported for Year One and for the Year Two one-factor comparisons. The only analysis that produced a statistically significant interaction was for the different internships by Gender for the probability of passing a non-technical class. Specifically females with industry internships had a higher probability of passing a non-technical class than males with internships, while the reverse was true for the lab only interns. Two notes of caution about this finding: first, there were only 4 females with industry internships who took other non-technical classes; second, there may be a selection bias operating and we really can't tell whether the approach is having a different impact or whether females with better performance are assigned to industry and thus they are more successful in other classes.

In sum, the two factor analyses support the findings from our first year that the internship components are not differentially effective across groups of interest.

How does the impact of the CompTechS program vary for different student populations?

In order to investigate whether there were any differences resulting from student characteristics (gender, ethnicity, financial aid status), we compared group mean differences on a number of measures:

- Persistence in the field
- Probability of Success (grade of C or better) in a Computer Class
- Probability of Success in a Technical Class
- Probability of Success in any Other Class
- Working status on entering the program

Additionally for the 44 students who completed the program and responded to the Exit Survey we examined differences on:

- Perceived helpfulness of the program to goals
- Perceived value of hands-on Lab experience
- Perceived value of paid internship

There were statistically significant differences regarding the probability of success in technical classes (other than computer classes): those receiving financial aid and females did better.

There were no statistically significant differences found between the two gender groups on any other measures. The results suggest participants in the program had very similar experiences regardless of their gender or ethnicity. While the participant's experiences may be unique to each individual, they are not shaped by their physical characteristics. As we have more persistence data in the coming year and larger numbers of women and targeted underrepresented minority students, we will again look for any significant variance in their rates of persistence.

Year One and Year Two Cohorts

The year one and year two student cohorts did not differ in gender or ethnicity. However, there were more industry internships for the first year cohort. This is likely related to the down economy rather than the students' readiness to be placed, as the nine employers who are participating in the internship program have cut the number of positions.

Skill Level on Entering the CompTechS Program and Impact

Two skill assessments are given to entrants to the CompTechS program, a Hardware Quiz and a Hardware Identification test. These two assessments provide a reading of the skill level of new program participants prior to any programmatic intervention. Students also are evaluated throughout their time in the program by the Lab Instructional Coordinator and, for those placed in industry, by their industry supervisor.

Students who rated low on the pre-assessments tended to stay lower on the lab evaluations relative to those who started higher – they did not change their relative order in terms of performance. However, there were *no statistically significant relationship between score on the pre-assessments and persistence in the field.* Nor was there a relationship to course success, even in computer related courses. Thus, students who rated low in skills upon entering the program were as successful in coursework and persisted at the same rate as the others in the program.

There were some statistically significant relationships between persistence in the computer field and the Lab evaluation score and Employer Evaluations. For the Lab scores, attendance was positively related to persistence. Likewise employer rating of attendance, safety, cooperation and task completion has positive relationships with persistence. Thus students who rated higher in these areas had higher rates of persistence

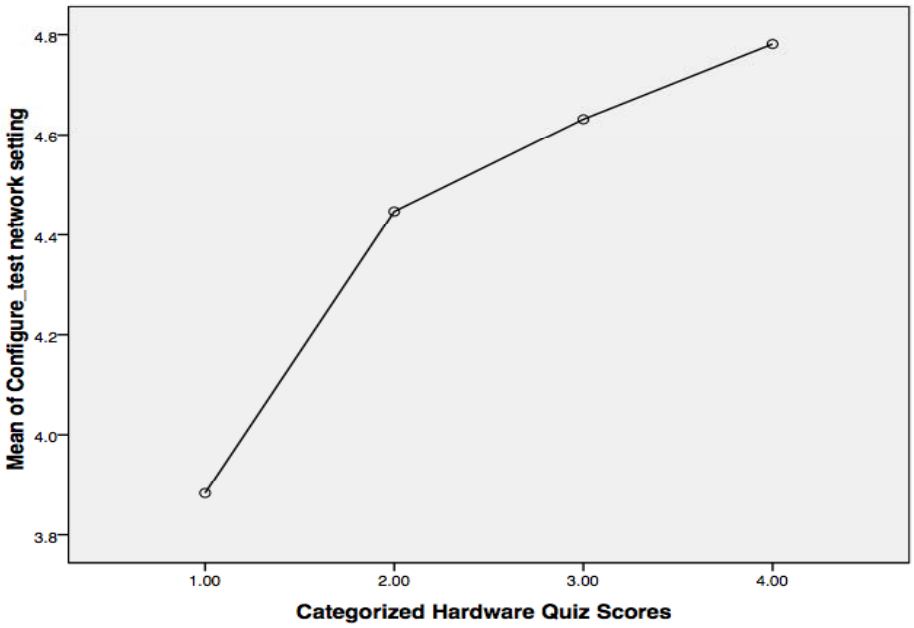
Details – the Statistical Tests:

To investigate whether the two "pre-program" measures predicted later performance a series of analysis of variance (ANOVA) tests were conducted. These ANOVAs tested whether initial group differences on the two Hardware assessments were maintained on later measures of performance, specifically the Lab performance Measures, Academic Course performance, and Employer Evaluations for those individuals who had an industry Internship.

Comparison groups were created on each of the two Hardware assessments. For the Hardware Quiz, four groups were created, each representing approximately 25% of the participants. The individuals were categorized based on their total score as follows:

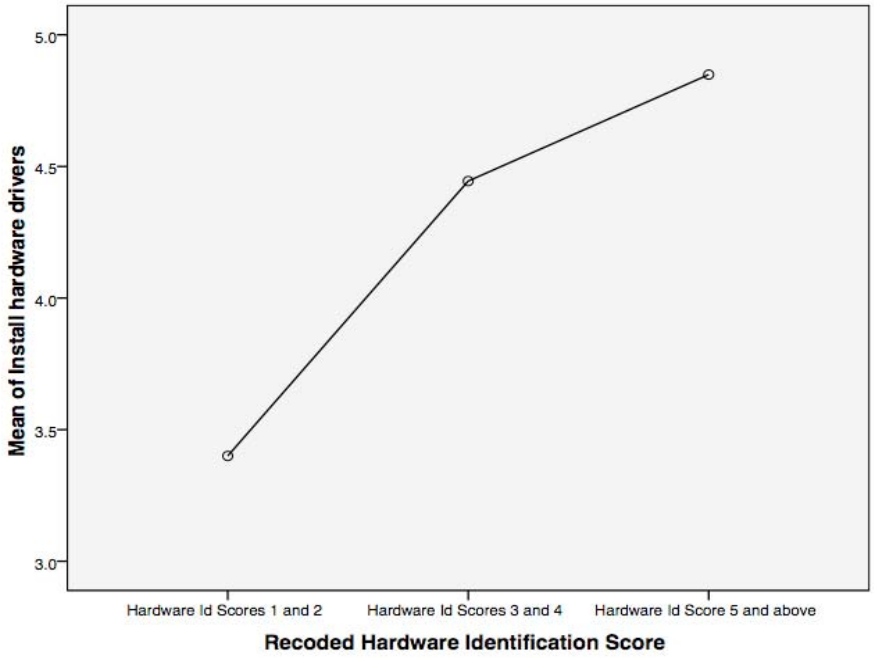
Low	Scores 1 through 4
2	Scores 5 and 6
3	Scores 7 and 8
High	Scores 9 and 10

In a later analysis of the Employer Evaluation, combining the groups with scores of 6 or less created three groups. This was done because the Low group had only a single individual on the Employer Evaluations. The graph of these scores follows next.



For the Hardware Identification assessment, three groups were created, each representing approximately 33% of the participants. The individuals were categorized based on their total score as follows:

Low	Scores 1 through 2
Medium	Scores 3 and 4
High	Scores 5 and above



In a later analysis of the Employer Evaluation, combining the groups with scores of 4 or less created two groups. This was done because the Low group had only a single individual on the Employer Evaluations.

Results of the ANOVA procedures were consistent across the two assessments. First, there were no statistical differences in course performance (probability of passing) for computer courses, other technical courses or other courses. Thus performance differences on the Hardware assessments did not show any relationship to the probability of passing academic courses.

The comparisons on the lab measures did show statistically significant differences based on both the Hardware Quiz and the Hardware Identification test. The results were consistent across the two measures. Statistically Significant differences were found on the following lab evaluation measures:

- Identify PC components
- Install internal PC components
- Download and install BIOS upgrade
- Install Windows operating system
- Install Hardware drivers
- Install & Configure applications
- Configure and Test networking setting
- Give demo to student awarded a computer
- Assess system status regarding specifications (Hardware ID assessment only)

People who had higher initial scores on the Hardware Quiz or the Hardware Identification test generally performed better on all the measures above. It is interesting to note however that the differences were not linear and that usually there was a large performance ‘jump’ between the lowest initial group and the rest of the groups. This suggests that there may be a threshold operating and that students below the threshold stay low on later measures while students above the threshold start to perform very similarly on subsequent measures. The two charts below reflect this pattern.

The comparisons on the Employer Evaluations were complicated by the fact that only a subset of program participants had industry internships. The impact of this selection was that the lowest group on both the Hardware Quiz and the Hardware Identification task had only a single individual in it. As a results two sets of ANOVAs were conducted one, with four groups for the Hardware Quiz and three groups for the Hardware Identification test, and a second set with three groups for the Quiz and two groups for the Hardware Identification test. All groups were defined as described above.

The results for both the Hardware Quiz and Hardware Identification test were consistent. In the cases were there were more groups (with the lowest group containing a single individual) statistically significant differences were found on a large number of the Employer Evaluation measures. These differences were clearly due to the poor performance of a single individual and

were not reflective of the entire group of people with internships. Therefore the second set of analyses was conducted with the single individual combined with the people on the next highest performance group on Hardware Quiz and Hardware identification. When these analyses were conducted, no statistically significant differences were found for people who initially differed on the Hardware Quiz and only two differences were found for people who differed on the Hardware Identification test:

Following documented procedures p=.049
Documenting work p=.038

These results again suggest that a threshold may be operating (although it could also be due to one individual). They also suggest that initial differences can be overcome and are not reflected in subsequent job performance in an industry setting.

In summary, the results suggest that further investigation of the existence of a threshold needs to be conducted. If evidence of a threshold is found then programmatic intervention may need to be varied depending upon whether a person is above or below certain values on the two initial measures. The results also show that participation in the program can overcome initial differences in the areas of academic course performance, performance in industry setting and on certain lab performance measures.

Conclusions

Student perceptions of the benefits of their experience in the CompTechS program were very positive, whether they were only in the campus based internships in the refurbishing lab, or also in an industry internship. Feelings of being comfortable in the environment, that they were learning technical skills and that the experience was relevant to the workplace made students more engaged – contributing to their success and likely their persistence in the field.

Student persistence in coursework and the field is high at 89%, though it may be too early to draw conclusions with only six quarters of data. CompTechS students' rate of success in computer related coursework is as good, or better, than the rest of the De Anza College population in Computer Information Systems at 74% to 67% respectively. Feelings of confidence and increased competence for students coming out of the program may be contributing factors to persistence.

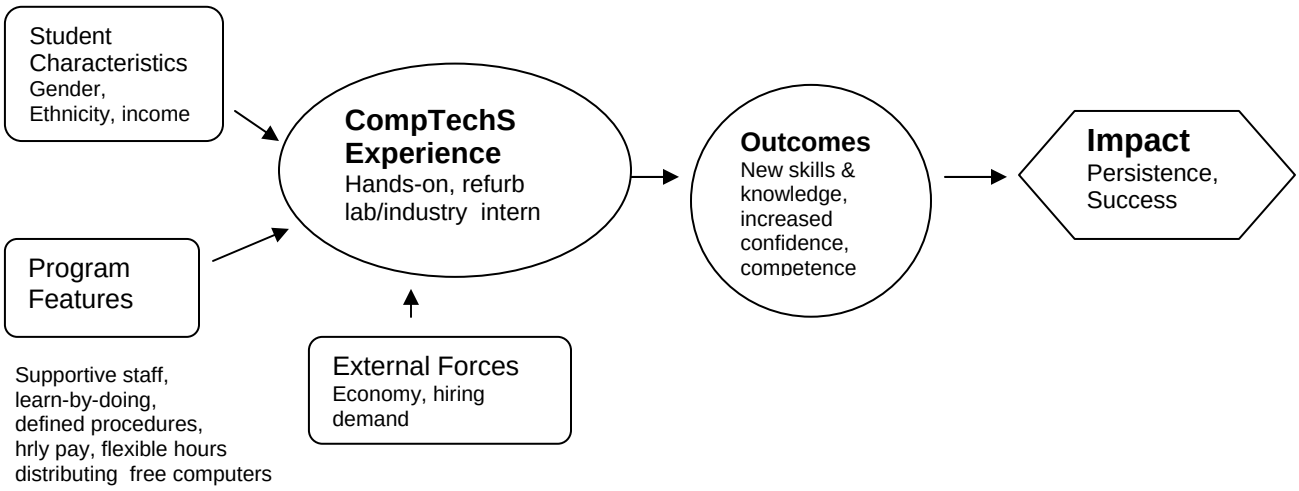
Since we found no significant differences in the impacts of the industry internship as opposed to the campus internship, there are implications for replication of the program. The on-campus computer refurbishing lab and computer scholarship program are replicable at any campus regardless of the surrounding employer base. That is, even rural campuses can provide the benefits of tech support internships to their students.

Generally the results are the same for the students regardless of their characteristics of gender, ethnicity and for those receiving financial aid. Larger numbers in specific ethnic groups will determine patterns in success and persistence that data suggests at this time. For the few African American students, their involvement in the program has not positively impacted their success rate in coursework. The composite of all target groups had better success in non-technical

coursework. CompTechS students had a better success rate in computer related courses than a comparison group of De Anza College students in CIS.

The program has been effective in equipping students with technical skills and also increasing self confidence. Underrepresented groups in the computing fields are persisting, though more data is needed for specific ethnicities. We have begun to understand and document the practices that make this program effective. There is merit in developing a model that identifies those factors that allow the program to be scaled to other environments.

Describing the Program and Key Features



Appendices

POST CompTechS Program - Important Factors

1. Rate the different factors for their positive impact on you.						
	Yes!	**Some**	**Neutral**	**Not really**	**No!**	**Response Count**
Career and professional advice.	50.0% (6)	50.0% (6)	0.0% (0)	0.0% (0)	0.0% (0)	12
Advice on courses to take or certifications to pursue.	41.7% (5)	41.7% (5)	16.7% (2)	0.0% (0)	0.0% (0)	12
Supportive atmosphere in the lab.	83.3% (10)	8.3% (1)	8.3% (1)	0.0% (0)	0.0% (0)	12
Organized workflow in the lab.	81.8% (9)	9.1% (1)	9.1% (1)	0.0% (0)	0.0% (0)	11
Well-defined procedures.	91.7% (11)	0.0% (0)	8.3% (1)	0.0% (0)	0.0% (0)	12
Distributing computers to students who need one.	90.9% (10)	0.0% (0)	9.1% (1)	0.0% (0)	0.0% (0)	11
Hands-on work.	83.3% (10)	8.3% (1)	8.3% (1)	0.0% (0)	0.0% (0)	12
Challenging work.	58.3% (7)	16.7% (2)	25.0% (3)	0.0% (0)	0.0% (0)	12
Learning new technical skills.	75.0% (9)	16.7% (2)	8.3% (1)	0.0% (0)	0.0% (0)	12
Working with a team in the lab, each with a role.	81.8% (9)	18.2% (2)	0.0% (0)	0.0% (0)	0.0% (0)	11
Possibility of being placed in industry.	66.7% (8)	25.0% (3)	8.3% (1)	0.0% (0)	0.0% (0)	12
					view Other (please specify)	1

2. IF you had an industry internship (otherwise skip this item), please rate the value of the following:						
	Yes!	**Some**	**Neutral**	**Not really**	**No!**	**Response Count**
Contacts and resume building.	77.8% (7)	22.2% (2)	0.0% (0)	0.0% (0)	0.0% (0)	9
Real industry experience.	70.0% (7)	30.0% (3)	0.0% (0)	0.0% (0)	0.0% (0)	10
Opportunity to learn on the job.	70.0% (7)	30.0% (3)	0.0% (0)	0.0% (0)	0.0% (0)	10
Opportunity to be hired by the company after the internship.	30.0% (3)	30.0% (3)	30.0% (3)	0.0% (0)	10.0% (1)	10
					view Other (please specify)	1

3. In retrospect, what aspects of the CompTechS program have been most valuable to you?						
	Yes!	**Some**	**Neutral**	**Not really**	**No!**	**Response Count**
Hands on hardware experience.	75.0% (9)	8.3% (1)	8.3% (1)	8.3% (1)	0.0% (0)	12
Coaching, advice and support from Joe and Susan.	75.0% (9)	8.3% (1)	8.3% (1)	8.3% (1)	0.0% (0)	12
Industry based internship.	72.7% (8)	18.2% (2)	0.0% (0)	9.1% (1)	0.0% (0)	11
Learning by doing in the lab.	72.7% (8)	9.1% (1)	9.1% (1)	9.1% (1)	0.0% (0)	11
Support of other students.	58.3% (7)	25.0% (3)	16.7% (2)	0.0% (0)	0.0% (0)	12
Learning about the nature of the work.	72.7% (8)	18.2% (2)	9.1% (1)	0.0% (0)	0.0% (0)	11
Learning new technical skills.	75.0% (9)	8.3% (1)	8.3% (1)	8.3% (1)	0.0% (0)	12
Learning to work with different people.	63.6% (7)	18.2% (2)	18.2% (2)	0.0% (0)	0.0% (0)	11
Setting my career goals and directions.	41.7% (5)	33.3% (4)	16.7% (2)	8.3% (1)	0.0% (0)	12
					Other (please specify)	0

4. Optional - Your first and last name:

answered question 6

skipped question 6

5. Optional - Your current employer:

answered question 5

skipped question 7

6. Optional - Your job title:

answered question 5

skipped question 7

CompTechS Program Exit Student Survey

Please take a minute to answer the following questions:

Name: _____ **Date:** _____

1. How helpful was the CompTechS Internship Program to you and your career goals?

   Highest 6 5 4 3 2 1 **Lowest**

2. In your opinion, what was the best aspect of the CompTechS Internship Program?

3. What part of the CompTechS Internship Program needs the most improvement?

4. How helpful were the services listed below:

Program Component								
Hands-on Lab	**Highest**	6	5	4	3	2	1	NA
	Lowest							
Paid Internship	**Highest**	6	5	4	3	2	1	NA
	Lowest							
Academic guidance	**Highest**	6	5	4	3	2	1	NA
	Lowest							
Preferential enrollment	**Highest**	6	5	4	3	2	1	NA
	Lowest							
Supportive staff	**Highest**	6	5	4	3	2	1	NA
	Lowest							
Resume building	**Highest**	6	5	4	3	2	1	NA
	Lowest							

Acquiring skills	**Highest**	6	5	4	3	2	1	NA
	Lowest							

Other (please comment)

5. When you entered CompTechS what was your career goal?

6. Now that you have completed the program, what are your career plans?

7. Which classes did you take while in the program that you feel will help you with your career plans?

College	Course #	Title
DA / FH	_____	_____
DA / FH	_____	_____
DA / FH	_____	_____

8. To what degree did the program have an impact on:

	Yes	Some	Neutral	Not Really	No
A. Your self-confidence?	5	4	3	2	1
B. Your feelings of technical competence?	5	4	3	2	1
C. Your feelings of being ready to be in the workplace?	5	4	3	2	1

D. What workplace you are interested in?

_____

Thank you for taking the time to provide this information. Use a second sheet if you need more space.

Hardware Skills Quiz

1. A system has 3 hard drives, a CD ROM, and a tape drive, all connected to a single internal ribbon cable. The ribbon cable is attached to a 50-pin connector on the motherboard. On what type of bus are these storage devices operating?

    a) IDE
    b) SCSI
    c) FireWire

2. A system passes POST and boots successfully, but both the BIOS and the operating system report an incorrect processor speed. Of the following possible causes, which should you assume and investigate first?

    a) Faulty or damaged motherboard
    b) Incorrect frequency and/or multiplier setting in BIOS
    c) Faulty or damaged CPU

3. When you turn on a system, the power LED lights up and you hear the drives spin up, but no video at all is displayed. The monitor and cable are known to be functioning reliably. Which is a good approach to begin troubleshooting this problem?

    a) Check the video settings in the BIOS
    b) Check the motherboard manufacturer's website to make sure that the monitor is on the hardware compatibility list
    c) Make sure the video adapter card is properly seated in its slot

4. An older system is functioning correctly, but is low on disk space. You add a new 10,000-RPM hard drive for additional space. The drive has been tested, the jumpers are set correctly, and it is detected by Windows without a problem, however, the system is now suffering from sporadic freeze-ups, memory errors, and other unpredictable behavior. What is a likely cause of this problem?

    a) The largest, fastest, drive must always be the "C" drive
    b) The power supply cannot provide enough additional power for the new drive
    c) In adding the new drive, you have exceeded the total amount of disk space that Windows can address

5. You are installing a new CPU in a system. The CPU comes with a heat-sink, and a small tube of white paste. What is the paste used for?

a) It provides for good thermal transfer between the CPU and heat-sink
b) It is a lubricant to keep the heat-sink from becoming stuck to the CPU
c) It simply provides a means to adhere the heat-sink to the CPU before the heat-sink is locked in place, and is rarely used by experienced technicians

6. You are adding an additional hard drive to a Windows system to increase available disk storage. The drive is identical to the current drive in the system. How could you also increase system performance without any other upgrades?

    a) Move the Windows system directory to the new drive
    b) Move the "Program Files" directory to the new drive
    c) Move the page file to the new drive

7. You try to boot a system, but the boot process fails after a series of beeps. Where is the best place to investigate the meaning of the error beeps?

    a) The Microsoft Windows Knowledge Base website
    b) The BIOS manufacturer's website
    c) The sound card manufacturer's website

8. Which motherboard component determines the built-in feature set of a computer system?

    a) CPU
    b) The math co-processor
    c) The chipset

9. You want to test the performance effects of a memory upgrade. You remove a 128MB DIMM memory module from a working system to double the RAM in an identical working system. After removing the module and walking across the room to the other system, you install the memory, but encounter a POST failure. You re-install the module in the original system, but now have a POST failure on that system as well. What is the most likely cause of this problem?

    a) Memory "registers" itself to the first system it is installed in, and should never be moved to another system
    b) One or more of the chips on the module have been destroyed by static electricity
    c) DIMMs must always be installed in pairs

10. You notice that when running multiple applications, a system exhibits an unusually high amount of disk activity, as well as slow performance. The hard drive is likely being kept busy by a process called _____, and performance could likely be improved by _____.

    a) Dynamic Data Exchange, upgrading to a faster hard drive
    b) Paging, adding more RAM
    c) Symmetric Multi Processing, upgrading to a faster processor

Hardware Identification

Choose one answer for each component:

Component #1: a) Modem b) Memory (RAM) c) Video card d) Processor (CPU) e) Network card f) SCSI card g) Motherboard	**Component #2:** a) Modem b) Memory (RAM) c) Video card d) Processor (CPU) e) Network card f) SCSI card g) Motherboard
Component #3: a) Modem b) Memory (RAM) c) Video card d) Processor (CPU) e) Network card f) SCSI card g) Motherboard	**Component #4:** a) Modem b) Memory (RAM) c) Video card d) Processor (CPU) e) Network card f) SCSI card g) Motherboard
Component #5: a) Modem b) Memory (RAM) c) Video card d) Processor (CPU) e) Network card f) SCSI card g) Motherboard	