

Cisco Networking Academy Evaluation Project
White Paper – WP 07-01
April 2007

Success of the CCNA Program: Six-month Follow-up

Alan Dennis
Thomas Duffy
Barbara Bichelmeyer
Hasan Cakir
Semiral Oncu
Kelli Paul
JoAnne C. Bunnage



Kelley Executive Partners
Indiana University

✉ Kelley Executive Partners
Indiana University
1275 East Tenth Street, Suite 3080
Bloomington, IN 47405-1703

☎ 812-856-2454
☎ 812-855-6216 (fax)
✉ jbunnage@indiana.edu
✉ www.indiana.edu/~iuteam

EXECUTIVE SUMMARY

The goal of the IU-Cisco Networking Academy Evaluation Project was to assess the success of the CCNA program. Prior reports have examined students' and instructors' experiences in the CCNA program. This white paper focuses on the impact of CCNA on students' education and employment six months after the end of the program.

The heart of this evaluation involves measuring the success of CCNA students relative to a group of students not enrolled in the CCNA program. This provides a benchmark by which we can compare the CCNA program's impact. We studied a group of about 10,000 CCNA and comparison group students who began their studies at 85 high schools and 122 community colleges in the United States during Fall 2004. About 1,100 students remained in the study over its 2 ½ year span and completed the Follow-up survey.

We found that the CCNA program had an "education effect" on high school students and an "employment effect" on community college students. High school students in the CCNA program were more likely to take the SAT/ACT than were the comparison group students, indicating a greater desire to pursue four-year university degrees. Among high school students seeking an IT career, CCNA students were more likely to enroll in a four-year degree program than were comparison group students (who in contrast were more likely to enroll in certificate or two-year degree programs). Among community college students, CCNA students were more likely to obtain a full-time job at a higher salary than were comparison group students.

CCNA students reported that the program positively affected their lives beyond education and employment. Students at both the high school and college levels repeatedly mentioned the "intensity" of the CCNA experience. In most educational environments, we would expect students to complain about the heavy workload, but that was not the case. Instead, CCNA students noted the value of the effort and how it helped them to better understand themselves, to develop an understanding of what they could accomplish through hard work, and to develop lasting friendships.

We conclude that the CCNA program has a significant effect on student education and employment – increased enrollment in four-year colleges for high school students and increased employment and salaries for college students. Further, there is a powerful effect on student attitudes concerning the value of learning and the effort they are willing to expend in learning.



Success of the CCNA Program: Six-month Follow-up

INTRODUCTION

Previous White Papers have focused on teaching practices, student engagement, and student success in specific CCNA courses. In this White Paper, we focus on the overall impact of the CCNA program on student success six months after completion of the program. We compare the success of CCNA students to a “comparison group” of similar students drawn from the same high schools or community colleges who did not enroll in the CCNA program. We consider success in two areas: 1) educational success – such as taking the SAT or ACT, graduating from high school or community college, and starting postsecondary education; and 2) employment success – such as obtaining a full-time job and annual salary levels.

This paper focuses on the overall impact of the CCNA program six months after completion.

PARTICIPANTS

This White Paper examines the success of students enrolled in a set of 85 high schools and 122 community colleges in the United States that were part of a longitudinal study. The study began by asking all CCNA students at these 207 academies to complete an Entry survey as they began the first course in the CCNA program. A total of 6,153 CCNA students completed the Entry Survey – a response rate of 34.2% (see Table 1). We tracked the students at each high school and college as a separate “cohort.” We contacted all students in each cohort six months after the majority of students in their cohort completed CCNA4 and asked them to complete the Follow-up survey. Of the 1,717 students who provided us with valid contact information and permitted us to contact them, a total of 701 CCNA students completed the Follow-up survey (a response rate of 41%).

There were two success measures:
1. Educational Success
2. Employment Success

TABLE 1. Number of academies and students analyzed in this report

	Number of Academies Represented	Number of Students		
		Students	Entry Survey	Follow-up Survey
High Schools	85	CCNA	2,568	323
		Comparison	2,645	192
Community Colleges	122	CCNA	3,585	373
		Comparison	1,489	217
Total	207	CCNA	6,153	701
		Comparison	4,134	411

With help from the academies, we recruited 4,134 “comparison” students who were enrolled in similar non-CCNA programs at these same schools and colleges. These students also completed an Entry survey as they began their programs. We asked 908 of the comparison students for whom we had contact information to complete the Follow-up survey at the same time the students in the CCNA cohort at their academy were asked to complete the Follow-up survey. A total of 411 comparison students did so (a response rate of 45%).

We assessed the comparability of the CCNA and comparison students in our sample at program entry by examining their responses to the Entry survey. We found no significant differences between the two samples, except that the CCNA students were slightly more likely to be male and have an IT-career orientation than their comparison group counterparts. Therefore, we included these two factors as control variables in all of our analyses to ensure that these differences did not bias our results. A small proportion of the CCNA and comparison group high school students reported that they were still in high school at the time of the Follow-up survey (2.1% and 9.7% respectively) and were excluded from our analyses (except for the education outcome of taking SAT/ACT as the Follow-up survey was administered after most high school seniors students take the SAT/ACT).

We assessed the representativeness of the students who completed the Follow-up Survey by comparing the responses on the Entry survey of those who completed the Follow-up survey and those who did not. There were no differences except that high school CCNA students who completed the follow-up survey had a slightly higher GPAs (insert the CCNA and then comparison GPA's) at entry than CCNA students who did not complete the follow-up survey. Based on these analyses, we conclude that the samples are reasonably comparable and representative of the population from which they were drawn. We provide additional information on these analyses in the Appendix.

The CCNA students and comparison students were similar at program entry.

The CCNA students and comparison students who did the Follow-up survey were similar to those who did not

EDUCATION AND EMPLOYMENT SUCCESS

Analysis Strategy

We examined five education and employment outcomes for high school students (see Table 2) and four outcomes for community college students (see Table 3). These outcomes are slightly more precise than those used in prior reports (which did not differentiate between enrollment in new 2-year programs and enrollment in new 4-year programs).

CCNA and comparison students are affected not only by differences in the programs in which they are enrolled but also by individual differences upon entry into the program. Therefore, it is important to

We controlled for student background variables to ensure a valid analysis of the outcomes.

look for moderating effects of key individual variables on the program-outcome relationships. As noted above, we examined gender and career goal as controls. A student's socioeconomic status (SES) is well known to affect graduation rates and the pursuit of additional education, so we also included it (see Table 4). Cisco policy prohibited us from asking SES-related questions on the survey, so we used per capita income from the student's zip code as a proxy for SES. We used univariate analyses of variance (ANOVAs) using the program type and individual differences variables to determine if the CCNA program had a greater (or lesser) impact and if that impact was influenced by gender, SES, or career goal.

TABLE 2. Definition of Outcome Variables for High School Students

Outcome Variable	Definition
Taken SAT/ACT	Student reports he or she has taken or is registered to take the SAT or ACT.
Graduated	Student reports he or she has graduated from high school or is in a 4-year degree program.
Started Certificate or AA program	Student reports that he or she has started or is about to start a Certificate or an Associate degree program.
Started Bachelor's Degree program	Student reports he or she has started or is about to start a 4-year degree program.
Full-time job	Student reports he or she currently has a full-time job or is about to start a full-time job in the next six months.

TABLE 3. Definition of Outcome Variables for Community College Students

Outcome Variable	Definition
Graduated	Student reports he or she completed an Associate degree .
Started a new educational program	Student reports he or she is starting a new certificate, associate or 4-year degree program.
Full-time job	Student reports he or she currently has a full-time job or is about to start a full-time job in the next six months.
Salary	Self-Reported annual income of full-time working students.

TABLE 4. Definition of Control Variables

Control Variable	Definition
Gender	Self-reported gender.
Career goal	Students selected from a list of nine career goals. Students were classified as having an IT/networking career goal or a career goal outside of IT.
Socioeconomic status	Per capita income for the student's 5-digit zip code area as reported by the U.S. Census Bureau (census.gov). Students were divided into three income groups (low 1/3, average, high 1/3).

High School Student Outcomes

We found significant differences between the CCNA and comparison group high school students. CCNA students were more likely than comparison students to have taken the SAT/ACT (see Table 5). There was also an interaction with per capita income, such that CCNA students who were in high-income areas were even more likely than their comparison student counterparts to have taken the SAT/ACT (83.7% vs. 62.2%).

There were no *overall* differences between CCNA students and comparison group students for the other four outcomes, but there was a significant interaction between career goals and starting post-secondary education. Among students who had an IT career goal, the CCNA students were more likely to enter a bachelor's degree program (38.9% vs. 25.0%), while the comparison students were more likely to enter an associates or certificate program (56.3% vs. 34.1%) (see Figure 1). Among the students who did not have an IT career goal, there were no significant differences between CCNA and comparison students in attending either level of post-secondary education.

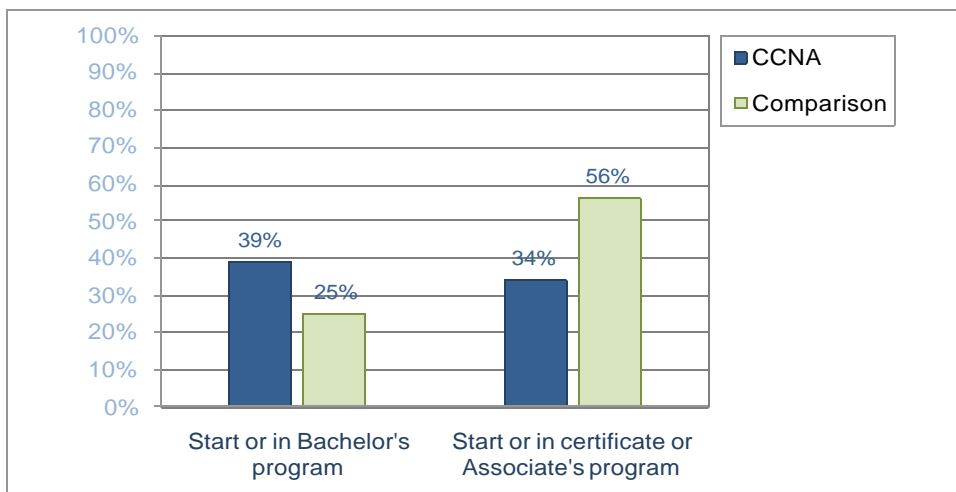
CCNA students take the SAT/ACT at higher rates, which suggests a greater interest in pursuing postsecondary education.

Among students with an IT career goal, CCNA students are more likely to enroll in a four-year program than are comparison group students.

TABLE 5. High School Student Outcomes

Outcome	CCNA	Comparison
Taken SAT/ACT	74.3%	67.2%
Graduated from high school	69.4%	63.9%
Started certificate or Associate's program	25.1%	27.1%
Started Bachelor's program	37.8%	41.7%
Full-time job	16.0%	7.6%

FIGURE 1. Education Choices of High School Students with an IT Career Goal



In summary, the CCNA program had a significant impact on high school students' educational choices, but no impact on their full time employment. After controlling for potential differences between the samples and for SES, high school students taking the CCNA program took the SAT/ACT at higher rates than similar students not enrolled in the CCNA program, which suggests that the CCNA program increases students' interest in pursuing postsecondary education. The CCNA program had a greater impact on students' post-secondary education choices for those students with an IT career goal: IT-oriented CCNA students were more likely to pursue a four-year degree program whereas IT-oriented comparison students were more likely to pursue a certificate or two-year degree. This suggests that the CCNA program better motivates and prepares students seeking IT careers to continue into four-year degree programs rather than two-year programs.

Community College Student Outcomes

We found significant differences between the CCNA and comparison group community college students. In direct contrast to the high school students, the CCNA program had a significant employment impact but no significant impact on continuing education. No significant differences were found between CCNA and comparison group community college students for graduation rates or starting a new education program (see Table 6).

Significant differences were found for full-time job and salary. CCNA students were more likely than comparison students to have a full-time job (62.7% vs. 47.5%). Of the students who reported having a full-time job, CCNA students reported a higher annual salary than their comparison group counterparts (\$40,661 vs. \$33,950) (see Figure 2).

In summary, the CCNA program had a significant impact on community college students' employment success. After controlling for potential differences among the samples and for SES, community college students who participated in the CCNA program were more likely to obtain full-time jobs that yield a higher annual income than community college students who did not participate in the CCNA program.

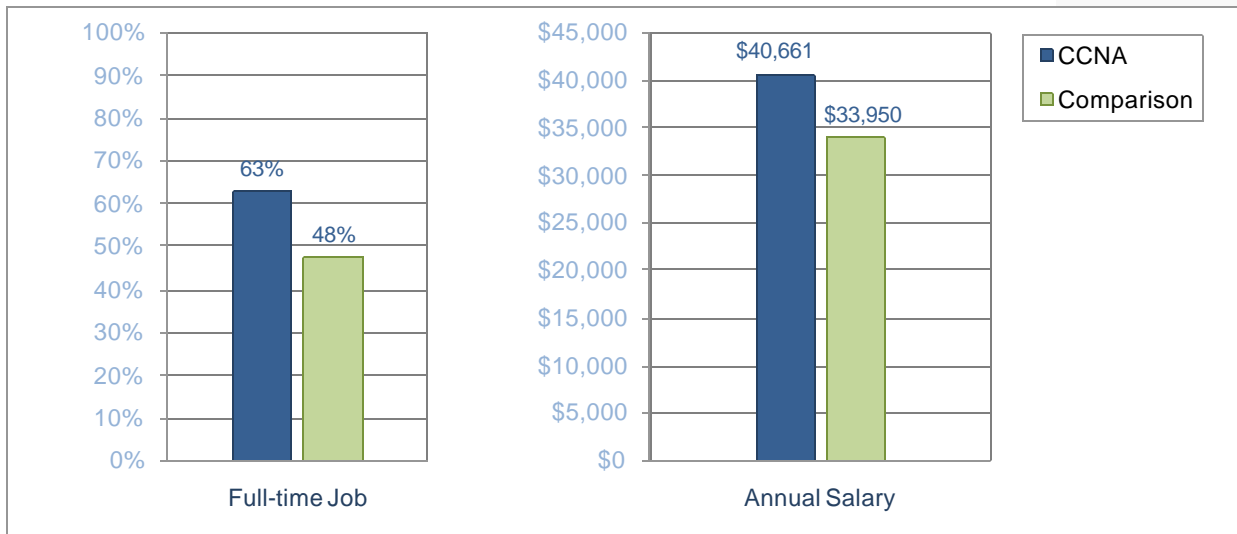
In contrast to high school students, community college students are significantly different on employment with no impact on continuing education.

CCNA students in Community Colleges are more likely to obtain full-time jobs that yield a higher annual income than Comparison students.

TABLE 6. Community College Student Outcomes

Outcome	CCNA	Comparison
Graduated	37.0%	34.6%
Starting a new educational program	28.4%	26.3%
Full-time job	62.7%	47.5%
Annual Salary	\$40,661	\$33,950

FIGURE 2. Community College Students' Full-time Job and Annual Income



WHAT CCNA STUDENTS SAY

We also asked students who had completed the CCNA program to reflect on how the program had affected their lives and to think about what advice they would give to students who are about to enter the CCNA program. A total of 664 students responded to these questions.

Impact on Their Life

We asked CCNA students to describe in their own words how the CCNA program has made a difference in their life. An overwhelming majority of students said the program had made a positive difference in their lives, and they provided specific examples to explain why they responded in this way. Students frequently commented on how the challenging curriculum compared to other courses and how that challenge helped them prepare for future education or careers.

- ✍ "The CCNA program was the most in depth and intense learning program of all my classes in my degree, I took more information from each part of the class than in all my other classes combined, I wish all my classes in the computer field were as intense as the CCNA courses were because I feel I would have taken a lot more experience out of them." (community college student)
- ✍ "It is serving as a great complement to other technical courses I have or am taking, such as the A+ and Oracle DB programs. It has also given me a much greater desire and incentive to learn more technology skills in college and in my future endeavors." (high school student)

The vast majority of CCNA students said the program had made a positive difference in their life.

- ✍ "CCNA was a useful curriculum to pursue in high school because of the career skills it gave. Despite the fact not many high schoolers will receive their CCNA certification; I am strongly supportive of CCNA being offered in high school." (high school student)
- ✍ "The program gave me what many other programs might not have, THE HANDS ON EXPERIENCE! The hands on lessons were very intense. Making use of very true-to-life situations and scenarios. Such hands on lessons enabled me to become better prepared for what awaits me in a world outside the classroom. From this hands on experience I have a new found sense of confidence to face just about any task or situation that is asked of me." (community college student)

Many of the students also identified a direct impact on their current career or plans for the future. For example, after having participated in the CCNA program, students stated the following:

- ✍ "I am currently a free-lance networker. Having completed these courses I now am creditable when it comes to computers and networking." (high school student)
- ✍ "I've been promoted within my company to a job in the network support group, which has given me a pay raise, more responsibility and much more job satisfaction. It's opened the door to a whole new world." (community college student)
- ✍ "The CCNA Program taught me a lot about networking. It also made me decide that networking might be a career option I would choose in the future. Taking the CCNA Program also helped me decide what I wanted to go to college for. It was very helpful." (high school student)
- ✍ "If I didn't have the knowledge from the class I would probably be one of the next persons to be let go." (community college student)

A number of students talked about the impact of the CCNA program on their overall personal development and how this relates their future career opportunities.

- ✍ "The CCNA program made me a better student in many ways. Before my CCNA classes I did not have much of a goal for a career after high school. After my CCNA classes, I have a greater interest in computers, and I know now that the computer industry is the field for me." (high school student)
- ✍ "It has made me appreciate the intricacy and hard work involved in designing, building, and maintaining a working and safe network. It has taught me that even in fields dealing with cutting edge technology, there is always going to be teamwork and critical thinking involved in solving problems related to networking." (high school student)

- ✍ "I learned a lot about Cisco routers, and networking. I learned a lot more, however, about life from our class. At our technology center, I made lasting friendships, and will never forget the experiences we shared." (high school student)
- ✍ "The CCNA program allowed me to reach further and apply myself more. I was able to learn things that I never thought that I could. It gave me the confidence to strive harder for the things that I wanted in life. Starting a new career late in life is risky, but by me succeeding in the CCNA program, I know that I will be able to accomplish anything that I set my mind to achieve." (community college student)

Finally, several students used words such as “life-changing” and “life-altering” to describe how the CCNA program has made a difference in their lives.

- ✍ "CCNA absolutely changed my life. Maybe it was just because it was my first step towards a career in internetworking, but the knowledge and experience I gained have been invaluable." (high school student)
- ✍ "I was able to change careers almost immediately after finishing CCNA4. I went from a struggling single mother working in the food and beverage industry surviving off of \$10,000 a year gross income to securing a great position with a large corporation starting at \$30,000 annually with a full benefits package. My whole life is changing thanks to education." (community college student)

Advice to New CCNA Students

We also asked CCNA students to describe in their own words what advice they would give to students just starting the CCNA program. The overwhelming majority of the CCNA students commented on the value and difficulty of the curriculum and advised future student to pay attention, work hard, and to be persistent.

- ✍ "Don't be intimidated if this is all new to you. Stick with it! Take advantage of any and everything offered to you - instructor led lectures, labs, online curriculum, labs, practice quizzes, etc. Oh, be sure you understand the OSI model completely." (community college student)
- ✍ "Ask lots of questions--if you don't understand something it's very important to find someone who does and have them explain it to you well. An instructor that knows what he or she is doing is one of the most helpful things you can have, and that instructor doesn't necessarily need to be your teacher. In some cases the best instructor is a classmate who simply understands the material much better than you do but can still "translate" the

The majority of CCNA students cautioned prospective CCNA students about the difficulty of the curriculum.

sometimes-confusing cisco-speak and network management language into something easier to understand." (high school student)

- ✍ "The material covered in the CCNA program is second to none. You will gain vital information necessary in the field of networking. I encourage anyone interested in pursuing a career in information technology to take the CCNA program, as a matter of fact I highly recommend it." (community college student)

Many students commented about the importance of completing lab assignments and working with other students on hands-on exercises.

- ✍ "The lab work, more importantly, the problems that arise from doing the lab work are the most valuable skills you receive and retain from the program. Our program required the labs be broken down, configurations defaulted, after each session and then rebuilt again. This helped reinforced attention to detail and tested basic connectivity/configuration troubleshooting skills. Many students did not see the value in the process, yet the repetition is what makes it stick." (community college student)
- ✍ "The hands-on exercises in the Lab Manual are probably the most important aspect of the CCNA program. You can listen to lectures all day and read the Companion Guide all night, but if you can't/won't/don't do the Labs, you are seriously hurting your chances of passing the certification test." (community college student)
- ✍ "If there is one thing that sticks in my mind above others it's not how much technical knowledge you possess, but rather how well you are able to communicate with other members of a project team and resourcefulness in finding the information you need to solve the problem at hand. Work on building your communication skills along with your technical skills because if you are unable to communicate your thoughts to others you will be less successful." (community college student)

In summary, virtually all of the students who answered these questions had positive comments about the program and how it has had a positive impact on their lives. They also provided constructive advice to the students that will follow them into the CCNA program.

DISCUSSION

Employment and Education Outcomes

The heart of this follow-up evaluation involves measuring the success of the CCNA students relative to a comparison group of students. The comparison group is important for the evaluation since it provides a benchmark by which we can compare effectiveness of the CCNA program. The comparison group was carefully chosen at each school or college to be representative of the same population from which the CCNA students came. Interestingly, this varied from school to school, with some schools considering CCNA as part of the honors program, others including it as vocational, and most seeing it as simply electives any student can take. While our sample size shrunk considerably over the two and half years we tracked these students, our analysis of these final samples indicate that the CCNA and comparison groups are comparable and representative of the larger population based on an examination of demographic characteristics when they entered the program.

The findings show different effects for high school and community college students. The CCNA program has an “education effect” on high school students, encouraging them to seek four-year post-secondary education in greater numbers than those not in the program. Among high school students, the CCNA students are more likely to take the SAT and for those interested in IT careers, are more likely go on to four year institutions than the comparison students. The comparison students, in turn, show a greater tendency to attend community college. There were no differences in employment. Given the student comments on the program as discussed below, one might infer that the CCNA program gives the students increased confidence in their abilities and that is what leads to the greater attendance at four year colleges. Without that rigorous experience, the comparison students seek community college as their next educational step.

The findings for the high school students are reasonably consistent with what we found in the evaluation at the time of graduation (WP 06-04). At that time, as in the present data, there was no effect of CCNA participation on employment or the prospects of employment. However, high school CCNA students, as in the previous findings, were more likely to take the SAT than comparison students. In that earlier study, we also found that this education effect was much greater for students in low income areas – a finding not replicated in the present data.

In contrast, the CCNA program has an “employment effect” on community college students, enabling them to obtain full time jobs in greater proportions and with higher salaries than students not in the program. Among community college students, CCNA students had greater employment success, with 15% more CCNA students employed

The CCNA program has an employment effect on college students, such that they are more likely to obtain full time employment at higher salaries than comparison students.

full time and with an average salary almost \$6,000 higher than the comparison students working full time. There is no educational effect for community college students: comparison and CCNA students graduate from community colleges and go on to new programs at the same rate.

The educational findings are reasonably consistent with the findings from the end of program evaluation (WP 06-04) in that we failed to find any education effects for community college students. However, the end of course evaluation also failed to find a significant effect on employment. Thus, the employment effect found in the present study emerged sometime after graduation. This might suggest even greater employment effects in a comparison made after an even longer post graduation interval.

Student Evaluation of the Curriculum

The CCNA program is viewed very positively by the students. Students at both the college and high school levels repeatedly mentioned the “intensity” of the CCNA experience. They described the very high work load and they advise incoming students to be prepared to work hard. In most educational environments, we would expect students to complain about the heavy workload. However, we found students expressing the value of the effort they had to put into the CCNA classes. They talked about the level of learning they achieved and the value of that learning. Perhaps most importantly from an educational perspective, many of the students described how the effort they put in helped them to better understand themselves, to develop an understanding of what they could accomplish through hard work, and to develop what they felt were lasting friendships through their collaborative efforts.

We asked similar questions of CCNA students as they were finishing the final CCNA course (WP 06-04) and we received similar answers. In that end of program survey, just under 60% of the students reported that the CCNA approach *should* be used in their other math, science, and technology classes. The proportion of high school and college students making this recommendation at the six-month follow-up was about the same. However, as we read through both sets of general comments, it would seem that the value that CCNA students place on the program experience has grown over time. That is, their recognition of the level of effort and the overall value seems to be greater six months after the program. Thus, the vast majority of students strongly value the curriculum and that value seems to increase with time.

Interestingly, in this survey no one aspect of the curriculum seemed to be singled out by the students. While the value of laboratory experience and hands-on work were highlighted by students in previous surveys and mentioned by several students in the current study, most students simply talked about the excellence of the curriculum as a whole. This does suggest the value of mixing central development of the materials

CCNA students recognized the value of the effort required to complete the program and knowledge and skills it provided.

with classroom teaching where a local teacher can adapt to local circumstances.

In previous surveys (WP 05-04 and WP 06-01), instructors expressed a similarly positive view of the curriculum, with over three quarters of instructors reporting that they are satisfied or very satisfied with the curriculum. Like the students, this satisfaction was consistent across all components of the curriculum (except for the hard copy version of the online materials which tended to be error prone). Furthermore, about three quarters also said they felt the overall CCNA approach *should* be applied to teaching other science, math, and technology courses in school. The “CCNA approach” valued by these instructors is the unique combination of five key components of the instructional system, including online curriculum, online testing system, hands-on activities, professional development system and the technical/administrative support systems. However, most instructors pointed to the hands on experience as being the elements that most distinguished the CCNA program from the other courses they teach.

Other reports provide insights into the teaching practices of the instructors (TR 06-02), as well as how engaged students were in CCNA courses, and how that engagement relates to success (TR06-03). We encourage the reader interested in these issues to explore those findings further. All of the reports may be accessed at www.indiana.edu/~iuteam.

CONCLUSION

Cisco, in designing the Network Academy program, had three goals: increasing educational participation, increasing employment opportunities and increasing the students’ overall personal development. Thus, the program was not designed to be a technical training program but rather an educational program focusing on conceptual understanding of networking systems and the development of collaborative and problem solving skills in addition to workplace technical skills. We see these goals successfully playing out in enabling students at different levels to obtain different outcomes (education versus employment) depending upon their objectives at different stages in their lives.

We conclude that the CCNA program is a success. As discussed here and in other reports, there is a powerful effect on student and instructor attitudes about the program and the benefits it provides. There are also very meaningful education and employment outcomes that are consistent with what an education policy perspective would find valuable: increased four year college going for high school students and increased employment and salaries for college students.

The CCNA program is a success, enabling students to achieve greater education and employment success.

APPENDIX: COMPARABILITY AND REPRESENTATIVE ANALYSES

This appendix describes in more detail the comparability analysis (to ensure that the students in CCNA and comparison group were similar at the start of their programs) and the representativeness analysis (to ensure that those students who completed the Follow-up survey were similar at program entry to those who did not).

High School Student Samples

The purpose of the comparability analysis is to assess whether the CCNA student sample and the comparison group sample were similar at program entry. For high school students (see Table 7), CCNA students and comparison students who took the follow-up survey are similar at program entry in reported grade point average (GPA) at entry, age, and geographic location when entering the program. However, the groups differ in that the CCNA group tends to be more male-dominated (86.2% vs. 74.7%) and more IT-career-oriented than the comparison group students (57.1% vs. 37.5%). However, these two differences are sample biases that are expected due to the technology focus of the CCNA program.

TABLE 7. High School Follow-up Survey Takers and Non-respondents Compared on Key Demographic Variables at Entry

	CCNA Students		Comparison Students	
	Took Follow-up Survey	Did Not Take Follow-up Survey	Took Follow-up Survey	Did Not Take Follow-up Survey
Reported GPA (4 point scale)	3.34	3.17	3.44	3.28
Average Age (years)	16.78	16.71	16.55	16.69
Per Capita Income	\$24,225	---	\$25,525	---
Gender				
Males	86.2%	89.1%	74.7%	80.2%
Females	13.8%	10.9%	25.3%	19.8%
IT Career Goal				
IT Career Goal	57.1%	58.2%	37.5%	43.8%
No IT Career Goal	42.9%	41.8%	62.5%	56.2%
Locale				
Urban	46.2%	47.2%	47.9%	40.1%
Suburban	39.7%	37.6%	37.7%	41.9%
Town	7.7%	6.5%	4.1%	6.6%

Note. Income data were not available for students who did not complete the Follow -up Survey. Therefore, comparisons could only be made between CCNA and comparison students who completed the survey.

The purpose of the representativeness analysis is to assess whether students who completed the Follow-up survey were representative (at program entry) to those who did not complete it. These analyses were conducted separately for CCNA and comparison students. The population consisted of high school students who were invited to take the follow up survey (726 CCNA and 462 comparison). Of those invited, 323 CCNA students and 192 comparison students completed the survey. No differences were found between comparison students who did and did not take the follow-up survey, which suggests that there was no response bias for the comparison group students. However, for the CCNA group, students who took the follow-up survey tended to have slightly higher reported GPAs at entry than CCNA students who did not take the follow-up survey (3.34 vs. 3.17), though the difference is quite small. No differences were found for any of the other key demographic variables, suggesting that, in general, CCNA students who took the follow-up survey were comparable to their counterparts who did not take the follow-up survey.

Community College Student Samples

The same analyses were conducted for community college students in order to assess the comparability and representativeness of the sample. For community college students (see Table 8), CCNA students and comparison students who took the follow-up survey are similar in reported grade point average (GPA) at entry and geographic location when entering the program. However, the groups differ in that the CCNA group tends to be more male-dominated (79.8% vs. 72.4%), tend to be more IT-career-oriented (88.7% vs. 65.3%), and tend to be older (33 years old vs. 30 years old) than the comparison group students. Differences between the CCNA and comparison students in gender and IT-career orientation are, again, biases that are expected due to the technology focus of the CCNA program, since these programs tend to be more male-dominated and attract students with a technology focus. The difference between groups in age, while significant, is relatively small.

Next, comparisons were made between community college students who took the follow-up survey and those who did not take the follow-up survey. These analyses were conducted separately for CCNA and comparison students. The population consisted of community college students who were invited to take the follow-up survey (993 CCNA and 446 comparison). Of those invited, 373 CCNA students and 217 comparison students completed the survey. For both CCNA and comparison group students, no differences were found between students who took the follow-up survey and those who did not take the follow-up survey. This suggests that there was no response bias, such that students who took the follow-up survey were comparable to their counterparts who did not take the follow-up survey.

TABLE 8. Community College Follow-up Survey Takers and Non-respondents Compared on Key Demographic Variables at Entry

	CCNA Students		Comparison Students	
	Took Follow-up Survey	Did Not Take Follow-up Survey	Took Follow-up Survey	Did Not Take Follow-up Survey
Reported GPA (4 point scale)	3.43	3.41	3.39	3.38
Average Age (years)	33.24	33.63	30.04	29.25
Income	\$21,554	---	\$21,077	---
Gender				
Males	79.8%	83.6%	72.4%	78.1%
Females	20.2%	16.4%	27.6%	21.9%
IT Career Goal				
IT Career Goal	88.7%	86.4%	65.3%	65.2%
No IT Career Goal	11.3%	13.6%	34.7%	34.8%
Locale				
Urban	53.9%	53.9%	48.8%	53.7%
Suburban	30.0%	28.2%	29.0%	24.9%
Town	12.3%	11.8%	11.1%	11.8%

Note. Income data were not available for students who did not complete the Follow-up Survey. Therefore, comparisons could only be made between CCNA and comparison students who completed the survey.

In summary, for both high school and community college students, the CCNA and comparison group samples are comparable in terms of reported GPA at entry and geographic location. However, CCNA students are more likely to be male and have an IT-career orientation than their comparison group counterparts, and this was found for both high school and community college students. However, this difference was expected based on the technology focus of the CCNA program. One additional difference was found for community college students. Namely, CCNA students were found to be slightly older than comparison students. Because this age difference was small and the differences in gender and IT-orientation were expected, we concluded that the CCNA and comparison groups were comparable.

Further, both the CCNA and comparison student samples were found to be reasonably representative of the population from which they were drawn. Only one difference was found between students who took the follow-up survey and those who did not. Specifically, high school CCNA students who took the follow-up survey tended to have higher reported GPAs at entry than students who did not take the follow-up survey. Based on these analyses, we conclude that the samples are reasonably comparable and representative of the population from which they were drawn.