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Success of the CCNA Program: Personal Growth, Employment, and Education Outcomes

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PREFACE

This White Paper is one of the last in a series of reports that examines the success of students enrolled in the Cisco Certified Network Associate (CCNA) Program offered through the Cisco Networking Academy. For a list of available reports, see our Web site (www.indiana.edu/~iuteam). We presume that the reader is familiar with the Cisco Networking Academy and the CCNA program.

The purpose of this White Paper is to compare CCNA students with an equivalent sample of Comparison students in terms of personal growth, employment, and education outcomes over time. Only those students who were in the 238 Comparison academies were used in these analyses. The surveys were completed by students from July 2004 to July 2006.

The Cisco Networking Academy serves more than 400,000 students at almost 10,000 “academies” located in high schools, community colleges, universities, and non-traditional settings (e.g., career centers, correctional facilities, shelters, military bases) in more than 150 countries around the world. The CCNA program is the Academy’s most popular program.

The Cisco Networking Academy offers a unique education model that combines a centralized curriculum with local control. The course and laboratory materials, the sequence of instruction, and the assessment system are all centrally developed by technical and educational experts working together with the support of Cisco Systems, Inc. All materials are delivered over the Internet, but courses are taught in the classroom by local instructors at each academy who are free to adapt the materials to their local context. Instructional quality is supported by initial instructor training and annual professional development, as well as by an online community of instructors and 24/7 technical support. The quality of instruction is monitored through student performance on the end-of-course exams and through student course evaluations – both of which are common to all courses.

The CCNA curriculum is an applied educational curriculum designed to meet the needs of practicing network engineers. It is designed to provide both deep conceptual understanding and practical skills. Indeed, the curriculum is aligned with teaching standards for United States high school math, science, and language arts education.

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www.ciscolearning.org



Success of the CCNA Program: Personal Growth, Employment and Education Outcomes

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. 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 along three dimensions: 1) educational success - such as staying in school; completing a diploma, certificate, or degree program; and starting a new educational program; 2) employment success - such as keeping a full-time job or starting a new full-time job; 3) personal growth - such as changes in academic self-esteem, career self-efficacy, problem solving confidence, desire for lifelong learning, teamwork skills, and work responsibility.

PARTICIPANTS

We focused on students at a set of academies that were part of a longitudinal study. Approximately 411 academies volunteered to participate in the longitudinal study, however only 268 provided sufficient data to be included in the analyses.

We worked with each academy to identify Comparison group students who came from the same sub-population of the high school, college or university that attracted CCNA students. In some academies, CCNA courses were part of the honors curriculum while in other academies, CCNA courses were considered vocational. We considered this context when we worked with the academy to identify a class that Comparison students take as an alternative to CCNA. Students in that class were invited to participate in the research study; those students who completed the survey were paid for their participation.

CCNA students and Comparison students were invited to complete two surveys online: one as they entered their program (CCNA1 course and equivalent Comparison course) and one as they completed it (CCNA4 course and the same time period for Comparison students). For both entry and exit, the Comparison students were administered the survey at the same time as their CCNA counterparts in the school. The surveys were identical, except that surveys for the CCNA students referred to the CCNA courses and program, whereas the surveys for the Comparison students referred to the courses and program in which

We studied CCNA students and a matching set of Comparison students from the same schools.

Students completed an entry survey and an exit survey.

they were enrolled. All dates for administering the surveys were matched to the schedules of the majority of CCNA students attending each academy. See Technical Report 05-01, and White Papers 05-01 and 05-02 for further details about the surveys and how they were administered.

Our goal was to obtain a total of 1,000 CCNA students and 1,000 Comparison students, as this number of students would ensure reliable generalizability to the population of students in the United States. Most national surveys attempt to recruit 1,000 participants to ensure generalizability, although from a statistical perspective, such samples are larger than necessary. Response rates ranged between 15% and 32% for the CCNA students, with slightly higher rates for the Comparison students (although establishing the exact response rates for the Comparison students is problematic due to the study design).

A total of 644 CCNA students and 1,088 Comparison students completed both the entry and exit surveys during the period of the study (July 30, 2004 through July 15, 2006); only those students who completed both surveys are included in this report. Table 1 presents the number of participating academies and the distribution of students who completed the entry and exit surveys. Because only a small number of CCNA students at universities and non-traditional institutions completed both surveys, these students were omitted from our analyses. Our analyses therefore focus only on the high school and community college students, resulting in a total of 594 CCNA students and 900 Comparison group students in 238 academies.

Our analyses focus on high school students and community college students.

TABLE 1. Number of academies and students participating

| | Number of Academies | Number of Students | | | |
|------------------------------|---------------------|--------------------|--------------|-------------|---------------------|
| | | Students | Entry Survey | Exit Survey | Both Entry and Exit |
| High Schools | 118 | CCNA | 2568 | 342 | 217 |
| | | Comparison | 2645 | 455 | 455 |
| Community Colleges | 120 | CCNA | 3585 | 660 | 377 |
| | | Comparison | 1489 | 445 | 445 |
| Universities | 20 | CCNA | 541 | 84 | 30 |
| | | Comparison | 421 | 165 | 165 |
| Non-Traditional Institutions | 10 | CCNA | 173 | 53 | 20 |
| | | Comparison | 344 | 23 | 23 |
| Total | 268 | CCNA | 6867 | 1139 | 644 |
| | | Comparison | 4899 | 1088 | 1088 |

We performed two analyses to assess the representativeness of the students in our sample. First, we checked the comparability of the Comparison students and the CCNA students. For high school students (see Table 2), we see that the CCNA and Comparison samples have very similar reported grade point averages (GPAs) at entry (3.34 vs. 3.37), and the CCNA students tend to be from more urban areas (57.3% vs. 47.5%). The groups also differ in that the CCNA group is both somewhat more male-dominated (88.4% vs. 77.4%) and more IT career-oriented than the Comparison group (54.8% vs. 39.1%). These latter two differences are sample biases we would expect because technology education programs tend to be male-dominated and often attract students who have a technology focus. In high school, there are seldom other classes available offering a technology-oriented focus. Thus, the Comparison students tended to have a comparable ability level, a similar vocational or academic focus as the CCNA students, and enrolled in a class the CCNA students would likely be taking if they were not enrolled in the academy.

Second, we checked to see if the students who took both the entry and exit survey were comparable to those who took only the entry survey. This was to check for any bias in our respondent sample. For this analysis, we consider the population to be all students who took the entry survey. Our CCNA respondents are those who also completed the exit survey. The CCNA non-respondents are those students who were enrolled in CCNA4 at the time of our study, who could have taken the survey, but did not. Drop-outs from the CCNA program are excluded from our analysis. For the Comparison students, non-respondents were defined as any student who took the entry survey, but did not complete the exit survey.

There were few key differences on entry between CCNA and Comparison high school students.

TABLE 2. High school exit survey takers and non-respondents compared on key demographic variables

| | CCNA Students | | Comparison Students | |
|-------------------------|------------------|--------------------------|---------------------|--------------------------|
| | Took Exit Survey | Did Not Take Exit Survey | Took Exit Survey | Did Not Take Exit Survey |
| Reported GPA at entry | 3.34 | 3.24 | 3.37 | 3.12 |
| Males | 88.4% | 90.7% | 77.4% | 79.0% |
| Urban | 57.3% | 42.2% | 47.5% | 42.3% |
| Suburban | 32.6% | 43.2% | 39.3% | 39.5% |
| Town | 9.2% | 4.2% | 4.4% | 5.6% |
| IT career goal at entry | 54.8% | 57.7% | 39.1% | 37.4% |

Both the CCNA and Comparison high school students who completed the exit survey have a somewhat higher GPA than the non-respondents, though the differences are small (.10 and .25 for CCNA and Comparison respectively, see Table 2). We find a geographical bias with a greater percentage of CCNA survey takers from an urban area than the CCNA students who did not take the exit survey. There was a similar, though not as strong, bias for the Comparison students (47.5% vs. 42.3%). The CCNA survey takers also tended to be less suburban than those who did not take the survey.

There were few key differences between high school students who completed the exit survey and those who did not.

We performed the same analyses for the community college students (see Table 3). The comparability of the Comparison students and the CCNA students is high. The reported GPAs at entry are comparable between the groups (3.46 vs. 3.41) and the distribution across geographic areas is also reasonably comparable. However, the CCNA sample again tends to be somewhat more male-dominated (83.2% vs. 74.9%) and more likely to have an IT career goal (87.6 and the 65.8%). Once again, this is expected for a technology-oriented program.

There were few key differences on entry between CCNA and Comparison community college students.

In assessing the representativeness of the samples, we find that the CCNA survey takers are comparable to those who did not take the survey in terms of reported GPA (3.46 vs. 3.42). However, the Comparison student sample has a somewhat higher reported GPA than the non-respondents (3.41 vs. 3.27). For both CCNA and Comparison students, the sample group and non-respondents also tend to be comparable (within 5 percentage points) in terms of gender and IT goals. However, the CCNA sample tends to be more biased toward towns, with fewer suburban students represented. In contrast, the Comparison sample tends to under-represent students from towns and over-represent urban students.

There were few key differences between community college students who completed the exit survey and those who did not.

TABLE 3. Community college exit survey takers and non-respondents compared on key demographic variables

| | CCNA Students | | Comparison Students | |
|----------------------------------|------------------|--------------------------|---------------------|--------------------------|
| | Took Exit Survey | Did Not Take Exit Survey | Took Exit Survey | Did Not Take Exit Survey |
| Reported GPA at entry | 3.46 | 3.42 | 3.41 | 3.27 |
| Males | 83.2% | 88.1% | 74.9% | 73.8% |
| Urban | 56.2% | 57.9% | 54.9% | 47.0% |
| Suburban | 24.9% | 30.3% | 22.1% | 25.1% |
| Town | 11.3% | 6.7% | 12.0 | 18.8% |
| IT career goal reported at entry | 87.6% | 84.5% | 65.8% | 64.0% |

In summary, for both high schools and community colleges, the CCNA and Comparison samples are comparable in terms of reported GPA. This is particularly important because entry ability level is an important predictor of success and thus, we know that ability as reflected in GPA will not result in a bias in the comparisons. However, for both the CCNA and Comparison samples, there is a slight bias in that the respondents report a slightly higher GPA than the non-respondents. Further, both the CCNA and Comparison student samples are reasonably representative of the population from which they were drawn in terms of career orientation and gender. However, relative to the Comparison students, the CCNA students tend to be somewhat more male-dominated and have a greater IT orientation. These differences are greater for high school students, but are to be expected in examining a technology program. There are small variations in terms of both comparability and representativeness of the samples in terms of geographic location, but our prior research has not found any impact of geographic location on student performance. We conclude that the samples are comparable and reasonably representative of the population.

EDUCATION AND EMPLOYMENT SUCCESS

We examined a set of five education and employment outcomes. These outcomes are defined in Table 4. The variable “Taken SAT/ACT” outcome was examined only for high school students, because the SAT/ACT is typically only taken by high school students.

TABLE 4. Definition of outcome variables

| Outcome Variable | Definition |
|----------------------|--|
| In-program | Student reports he or she is currently in an educational program leading to a diploma, degree or certificate, and will not complete that program within the next six months. |
| Graduated | Student reports he or she completed a diploma, degree or certificate program in the last six months or will complete his or her current program within the next six months. |
| Taken SAT/ACT | Student reports he or she has taken or is registered to take the SAT or ACT (used for high school students only). |
| Starting new program | Student reports he or she will start a new degree or certificate program within the next six months. |
| 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. |

CCNA and Comparison students are affected not only by the differences in the programs they take, but also by differences in their abilities and motivation upon entry into the programs and by the characteristics of the schools they attend. When making comparisons about the effect of the program on student success, it is important to

control for these differences to ensure that any variations in outcomes are not due to selecting better students (or more at risk students) or to differences in the number of students surveyed from different schools.

Table 5 lists the control variables we used to control for individual and school differences. Although we could not ask questions related to the individual student’s socioeconomic status (SES), we were able to use the student’s zip code to determine the per capita income for his or her area. We used this as a proxy for student SES. We also investigated interaction effects to determine if the CCNA program had greater (or lesser) impacts on female students, richer/poorer students, students with higher/lower grade point averages (GPAs), and IT/non-IT career seeking students.

We controlled for differences in students’ ability and motivation, and the income in their region.

TABLE 5. Definition of control variables

| Control Variable | Definition |
|---------------------------|---|
| Gender | Self-reported gender. |
| Grade Point Average (GPA) | Self-reported grade point average in their current school on the entry survey. |
| Technical Skill | Self-reported on the entry survey using four questions asking about the frequency of their experience in conducting various computer related tasks. |
| Motivation | Self-reported on the entry survey using seven questions asking about the value of the CCNA or Comparison courses and the expectation of success. |
| Career Goal | Self-reported on the entry survey. Students selected from a list of nine career goals. Students were classified as having an IT/networking career goal or a 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 four income groups based on above or below the mean income and greater than +.75 or less than -.75 standard deviations below the mean. |
| Geographic Location | Academy location classified as rural, town, suburban, or urban using the National Center for Education Statistics (NCES) database (nces.ed.gov). |
| Local Academy | Academy classified as either being a local academy or an RTC/CATC. |

High School Student Success

A multivariate analysis of variance (MANOVA) on the three education outcomes and the employment outcome found that overall, after controlling for incoming student abilities and motivation and differences in school characteristics, CCNA high school students were more likely than Comparison high school students to have graduated, to have taken the SAT/ACT, and to be starting a new program. There were no significant differences in the likelihood of still being in school or having a full-time job. Furthermore, there was an interaction with the per capita income such that CCNA students in the lowest income regions

After controlling for ability, motivation, and regional income, high school students in the CCNA program were more likely to have graduated, taken the SAT or ACT, and be starting a new education program.

were even more likely than Comparison students from those regions to have taken the SAT/ACT and to be starting a new program. There were no other interaction effects; that is, the CCNA program did not affect females differently than males, it did not affect students with higher GPAs differently than those with lower GPAs, and it did not affect those seeking an IT career differently than those not seeking an IT career.

The probability of students achieving each of the outcomes as a function of the educational program and the per capita income are presented in Table 6. These probabilities reflect the effects of the CCNA program after controlling for incoming student ability and motivation, and school differences (as described in Table 5). The totals do not add to 100% because many students achieved more than one outcome. For example, students may be continuing in school but also be near graduation and/or starting a new program at college or university and/or starting a full-time job.

TABLE 6. Outcomes for high school students by per capita income.

| Outcome | Per Capita Income in the Region | | | | | |
|----------------------|---------------------------------|--------|------------|-------------|---------|----------|
| | Students | Low | Low Middle | High Middle | High | Total |
| | N* | 26; 50 | 75; 143 | 39; 148 | 77; 109 | 217; 450 |
| In-Program | CCNA | 38.0% | 31.9% | 40.9% | 37.0% | 37.0% |
| | Comparison | 23.2% | 29.0% | 26.2% | 23.1% | 25.4% |
| Graduated | CCNA | 82.6% | 54.1% | 55.6% | 33.0% | 56.3% |
| | Comparison | 44.7% | 41.1% | 26.5% | 26.2% | 34.6% |
| Taken SAT/ACT | CCNA | 80.5% | 45.3% | 61.5% | 60.5% | 62.0% |
| | Comparison | 39.8% | 49.1% | 38.7% | 49.4% | 44.2% |
| Starting new program | CCNA | 70.1% | 41.4% | 53.9% | 41.4% | 51.7% |
| | Comparison | 33.1% | 52.3% | 41.4% | 28.5% | 38.8% |
| Full-time job | CCNA | 8.5% | 8.0% | 11.7% | 7.7% | 9.0% |
| | Comparison | 14.2% | 12.5% | 12.6% | 9.6% | 12.2% |

* N is the number of CCNA and Comparison students, respectively, in each income region and the total.

Significantly more high school CCNA students completed their program than did the Comparison students; the differences are considerably greater for students in the lowest per capita income regions. The increased success in completing a degree program would appear to

translate into a greater tendency for students to consider postsecondary education. Across all income groups, a significantly greater proportion of CCNA students took the SAT or ACT exams than did the Comparison students with the greatest difference between groups in regions where the income is lowest.

Taking the SAT or ACT seems to also translate into a desire to pursue higher education. Once again, a significantly greater proportion of CCNA students overall were starting a new education program within the next six months. As with taking the SAT/ACT, the differences are particularly striking for regions where the income is lowest.

In summary, we find a very strong effect of the CCNA program on high school student educational success. CCNA students show higher rates of completing school, taking the SAT or ACT, and planning to pursue further education. Importantly, while these effects hold for all income levels, the effect is greatest for those living in regions where per capita income is lowest.

CCNA students from the lowest income region were more likely to be starting a new education program.

Community College Students

A multivariate analysis of variance (MANOVA) on the education and employment outcomes indicated that overall there were no significant differences in outcomes for CCNA and Comparison students attending a community college. However, there was a significant interaction between taking the CCNA program and per capita income for two of the four outcomes (in a program and starting a new program). The probability of students achieving each of the outcomes as a function of the educational program and the per capita income are presented in Table 7. These probabilities reflect the effects of the CCNA program after controlling for incoming student ability and motivation, and school differences (as described in Table 5).

As shown in Table 7, for the lowest income region, the CCNA students were significantly more likely to still be in a degree or certificate program than the Comparison students. However, for the high middle income region, there is a reversal, with the Comparison students more likely to be in school.

The CCNA students in regions where per capita income was highest were more likely than the Comparison students to be starting a new education program (see Table 7). However, the Comparison students in the other income regions show a greater tendency to start a new program.

There were no significant differences in the recent completion of a degree or certificate program, or in having or starting a full-time job.

In summary, the impact of the CCNA program is not as strong for community college students as it is for high school students and the effects are more complex. Only two outcome measures are related to

having taken CCNA. The positive outcomes are reflected in the fact that community college students are more likely to stay in programs if they are from lower income areas and more likely to be starting new educational programs if they are from high income areas. However, both of these effects reverse themselves. But, in each case, these effects are reversed for the students at the other end of the income scale.

TABLE 7. Outcomes for community college students by per capita income

| Outcome | Per Capital Income in the Region | | | | | |
|----------------------|----------------------------------|----------|------------|-------------|--------|----------|
| | Students | Low | Low Middle | High Middle | High | Total |
| | N* | 113; 129 | 152; 177 | 80; 72 | 32; 63 | 373; 414 |
| In-Program | CCNA | 87.9% | 74.0% | 53.1% | 63.0% | 70.3% |
| | Comparison | 73.6% | 71.8% | 69.8% | 66.2% | 69.5% |
| Graduated | CCNA | 53.2% | 42.3% | 32.4% | 48.3% | 44.1% |
| | Comparison | 57.8% | 52.9% | 49.9% | 36.7% | 49.3% |
| Starting new program | CCNA | 19.2% | 16.1% | 20.0% | 27.9% | 20.8% |
| | Comparison | 27.5% | 24.3% | 29.1% | 8.7% | 22.4% |
| Full-time job | CCNA | 44.7% | 50.5% | 70.2% | 68.0% | 57.9% |
| | Comparison | 54.0% | 56.7% | 60.6% | 60.4% | 58.4% |

* N is the number of CCNA and Comparison students, respectively, in each income group and total.

PERSONAL GROWTH

One of the objectives of the CCNA program is to provide a rigorous and relevant curriculum that will promote positive values and personal growth. We examined six such “personal growth” constructs as shown in Table 8. The six personal growth constructs are assessed through a series of questions asking about the students’ attitudes or beliefs.

The questions reflecting these six attitudes were asked on both the entry and exit surveys. Thus, we can compare CCNA and Comparison students in terms of the change in these personal growth constructs over time. As before, we examined the impact of the CCNA program on these attitudes over time after controlling for the same individual and academy differences as described in the previous section (see Table 5)

We used four or five survey items to assess each of the personal growth constructs and each item was rated on a five-point scale from

“strongly agree” to “strongly disagree.” We expected the number of items along with the five-point scale to yield a reasonable range of scores for each construct. Initial validation of the instruments with a sample of over 100 CCNA students indicated an acceptable distribution of scores. However, an examination of the ratings on the entry survey indicates that both the CCNA and Comparison students had particularly strong beliefs and were confident in their academic and work related skills. That is, there were a substantial number of students who answered *all* the questions for a construct with the maximum value of five. On average, 13.2% of the Comparison students and 15.3% of the CCNA students gave a perfect rating of five to a construct.

We measured six personal growth constructs at entry to and exit from the program.

This ceiling effect impacts the type of analysis that can be done as well as the interpretation of the analysis. For example, with a strong ceiling effect, a regression toward the mean can be expected (i.e., students with very high ratings on the entry survey often tend to provide lower ratings on the exit survey). Thus, we can expect negative gain scores. Further, because of the large number of perfect scores, we cannot look at relative gain as we had planned. Relative gain examines the difference from the entry survey to the exit survey relative to how much the score could have increased (the difference between the entry rating and a perfect rating). Because a perfect rating would result in a denominator of zero, this approach could not be used.

In the following sections we look at the simple percentage change in gain score, the difference between exit and entry surveys, divided by the maximum value for the scale (5.00). However, for the reasons just discussed, caution must be exercised in interpreting these gains.

TABLE 8. Personal characteristics assessed

| Variable | Description | Number of Survey Items | Internal Consistency (Cronbach alpha) |
|-----------------------------|---|------------------------|---------------------------------------|
| Academic Self-Esteem | How prepared they are for class and whether they seek help when they have trouble understanding | 4 | .81 |
| Career Self-Efficacy | How confident they feel that they will be successful in their career. | 5 | .86 |
| Work Responsibility | Taking initiative at work and meeting requirements. | 4 | .82 |
| Collaboration and Team Work | Helping others, working together, preferring teams. | 5 | .68 |
| Life-Long Learning | Enjoy learning and expect to continue learning throughout life | 5 | .85 |
| Problem Solving Confidence | Confidence in ability to solve problems and generate creative solutions. | 4 | .83 |

High School Students

A multivariate analysis of variance (MANOVA) found no significant differences in growth between the CCNA students and the Comparison students for all six personal growth constructs. We did, however, find differences in problem solving confidence due to an interaction between CCNA program participation and the career goals of the students. The findings for the impact of career goals are shown in Table 9. While there is no overall difference in the change for CCNA students or Comparison students, CCNA students with a networking or IT career goal exhibited a gain of about 4.9% in problem solving confidence due to the program. In contrast, CCNA students with a career goal outside of IT and both groups of Comparison students showed virtually no change in problem solving confidence.

The program did not have different effects on males versus females, low versus high income students, or high GPA students versus low GPA students.

In summary, we find few overall differences in growth between CCNA students and Comparison students. The CCNA students with a career goal in IT or networking showed a very small increase in problem solving confidence. One tentative conclusion from these results is that high school students who are more interested in the CCNA subject matter are more likely to show improvements in their ratings of their problem solving skills.

After controlling for ability, motivation, and regional income, we found no overall differences between CCNA and Comparison high school students.

CCNA students with an IT or networking career goal showed greater growth in problem solving confidence.

TABLE 9. Percent change in personal growth constructs for high school students by career goals

| | IT or Networking Career Goal | | Other Career Goals | | Total (All Students) | |
|-----------------------------|------------------------------|------------|--------------------|------------|----------------------|------------|
| | CCNA | Comparison | CCNA | Comparison | CCNA | Comparison |
| Academic Self-Esteem | 4.1% | 0.2% | 2.3% | 1.4% | 3.2% | 0.8% |
| Career Self-Efficacy | 3.4% | 3.2% | 3.1% | 2.3% | 3.2% | 2.7% |
| Work Responsibility | 0.3% | 0.9% | -1.2% | 1.6% | 1.2% | -0.4% |
| Collaboration and Team Work | -1.2% | -0.2% | -2.0% | 0.6% | -1.6% | 0.2% |
| Life-long Learning | 1.6% | 0.8% | -2.6% | 0.2% | -0.5% | 0.5% |
| Problem Solving Confidence | 4.9% | 0.7% | 0.7% | 2.2% | 2.8% | 1.4% |

Community College Students

For community college students we found an overall impact (MANOVA) of the CCNA program on the students' growth. Further analysis indicated there were significant differences between CCNA students and Comparison students for four constructs. Table 10 shows that CCNA students decreased in academic self-esteem, work responsibility, life-long learning, and problem solving confidence. However, these effects are not straightforward. There was also an interaction indicating that the CCNA program had different effects on students who had IT or networking career goals versus those who had other career goals for all constructs except career self-efficacy.

Table 10 shows that the CCNA program had a negative impact for students with career goals *not* in networking or IT. For students with a career goal in networking or IT, there were no significant differences between CCNA students and Comparison students for any personal growth constructs.

In summary, for those students seeking IT or networking careers, there were no differences in personal growth between community college students in the CCNA program and in the Comparison programs, CCNA students not seeking a networking or IT careers showed declines in personal growth. Once again, we urge caution in interpreting these results because of the potential impact of the ceiling effect.

For students with IT or networking career goals, there were no differences between those in the CCNA program and those in Comparison programs. CCNA students not seeking an IT or networking careers experienced very small declines.

TABLE 10. Percent change in personal growth constructs for community college students by career goals

| | IT or Networking Career Goal | | Other Career Goals | | Total (All Students) | |
|-----------------------------|------------------------------|------------|--------------------|------------|----------------------|------------|
| | CCNA | Comparison | CCNA | Comparison | CCNA | Comparison |
| Academic Self-Esteem | -0.2% | 2.0% | -3.6% | 3.9% | -1.9% | 3.0% |
| Career Self-Efficacy | 0.8% | 0.8% | -1.1% | 1.2% | -0.2% | 1.0% |
| Work Responsibility | -1.1% | -0.6% | -7.0% | -0.8% | -4.0% | -0.7% |
| Collaboration and Team Work | -0.4% | -1.3% | -4.7% | -1.0% | -2.5% | -1.1% |
| Life-long Learning | -0.2% | -0.7% | -7.2% | 0.0% | -3.7% | -0.3% |
| Problem Solving Confidence | 1.2% | 1.6% | -3.4% | 2.1% | -1.1% | 1.9% |

WHAT STUDENTS SAY

We also asked CCNA students to describe in their own words what impact, if any, the CCNA program experience had made on their life. A total of 522 students responded to this open-ended question, of which 217 provided more than a few words in response (109 High school, 90 Community college and 18 Other). The sample of 217 was analyzed. An overwhelming majority of students, 200 out of 217, expressed positive attitudes about the effect of the program on their lives. Only 9 students made negative comments and 4 students made neutral comments.

Many of the students talked about how much they learned and how much more competent they felt. The following three quotes exemplify this.

- ☒ “I am a non-traditional student who has never really started a career. I was a bit intimidated in semester one, but now have a feeling of accomplishment I've never felt before. I am very excited to begin a career in IT with the knowledge I've gained from the CCNA program.” (community college student)
- ☒ “It allowed me to place honorable mention in the 10th annual AITP National Collegiate Conference, a first in my college's history. It has made me more confident on passing the CCNA.” (community college student)
- ☒ “CCNA helped clear up the mysteries of networking and also opened a world of new technologies that I had been unaware of. Before attending, I had a basic understanding of computer networking, now I can visualize every aspect of the networks I encounter.” (high school student)

Many of the students also identified a direct impact on their career. The following five quotes exemplify this career impact.

- ☒ “Yes, I have had 1 Consulting job within a week of obtaining my CCNA. With another job consulting next week.” (community college student)
- ☒ “CCNA has allowed me to advance my career which in this market has also helped me retain my position in a time of outsourcing.” (community college student)
- ☒ “I support TCPIP on IBM mainframe computers and have to interface with the Cisco network staff. Communications was difficult since they didn't understand the mainframe and I didn't understand them. The CCNA course has given me a base to both understand the Cisco side of the network and to continue towards additional Cisco certifications.” (community college student)
- ☒ “I have been able to get more job opportunities and offers because I get to say that I had this training.” (high school student)

Students were overwhelmingly positive about the impact that the CCNA program had on their lives.

Students reported learning a lot, and seeing a direct impact on their career.

- ☒ “It has given me a career goal and allowed me to network with Cisco employees and other *highly* influential people.” (high school student)

Finally, a few students talked about the impact on their personal lives.

- ☒ “It helped with determination. ‘We do these things not because they are easy, but because they are hard.’ JFK” (community college student)
- ☒ “The CCNA program has helped me adjust to college life and enabled me to reacquire [a] desire for learning. Before enrolling in college I had no direction in my life. Even though my major is now Civil Engineering and Business I can appreciate the assistance my time in college has given me in finding a direction in life.” (community college student)
- ☒ “I have met some valuable friends and made a few connections in the computer field which I can call upon if I ever run into a situation that I have a hard time working through.” (community college student)
- ☒ “It made me have to commit myself to something.” (high school student)
- ☒ “It has taught me to work hard, and trust in others as a group.” (high school student)

In summary, virtually all of the students praise the program for its impact on their learning, their career, or their personal growth.

CONCLUSIONS AND DISCUSSION

Before summarizing and drawing conclusions, we note two overall cautions with this data. First, the sample, while a reasonable size for most research, is somewhat small for an evaluation of this complexity (as reflected in the diversity of program implementations and the number of relevant variables). While we had a high response rate compared to other survey efforts with CCNA students, the response rate across the two survey periods, often two years apart, shrunk considerably. The small number of CCNA students in high schools was also due to the fact that many of the high school academies only offer the first two CCNA courses and thus, for many students, the program ends there unless there are articulation agreements with a neighboring community college. We did find statistically significant differences in the personal constructs when the actual differences were very small, suggesting that the sample was large enough to detect small differences.

The second caution is that the data are based on student reports. We do not have hard data on employment, degree programs, problem solving skills, etc. However, the use of Comparison groups serves to

A few students described the impact that the CCNA program had on their personal lives.

equate groups in terms of any self-reporting bias. Other research has found that student reports of their own behaviors are reasonably reliable.

CCNA Impact on Personal Growth

With the above cautions in mind, the findings do suggest that career orientation is a factor in the impact of CCNA on changes in personal growth constructs. CCNA high school students with an IT or networking career goal experienced a small increase in problem solving confidence relative to Comparison students. CCNA community college students with a career goal of IT or networking experienced the same personal growth as Comparison students, while CCNA community college students with a career goal *outside* of IT or networking experienced small declines on most of the personal growth constructs. Both the high school and community college findings suggest that the CCNA program may be discouraging for those students who do not have IT or networking as the focus of their career plans.

Because of the restricted range in scores and the ceiling effect, significant differences must be interpreted with caution. However, the qualitative data does support the personal impact of the CCNA program. Virtually all students who responded indicated a positive impact of the CCNA experience – something that we suspect is fairly unusual for school curriculum, especially in high schools. Students reported that it helped them set goals, develop self-determination, and network with others who share their interest. They also report a high degree of learning and an impact on their job or job prospects.

We must note, however, that the CCNA students who were not focused on an IT or networking career rated their personal growth lower than Comparison students and IT and networking focused CCNA students. These results suggest that CCNA students not committed to the IT field could benefit from additional support as they struggle with the curriculum concepts and problems.

CCNA Impact on Employment

There were no strong effects of the CCNA program on employment. Very few of the high school students had a full-time job or were going to begin a full-time job. Even in community colleges, the employment effect is not strong except for those students in the higher per capita income areas. However, the qualitative data does suggest that many students feel more secure in their job or their job prospects. Overall these findings would suggest that efforts should be made to improve the links with employers, especially in the efforts to place students from lower income regions into jobs.

After controlling for ability, motivation, and regional income, there were few differences between CCNA and Comparison students' personal growth, except for CCNA students *not* seeking IT or networking careers, who experienced small declines.

After controlling for ability, motivation, and regional income, we found few impacts on employment for high school and community college students.

CCNA Impact on Education Outcomes

Although most people think of technology courses as vocational and focused on training students in the technology, the results of this evaluation suggest that the CCNA curriculum approach has significant education effects, especially at the high school level and for students from regions with low per capita incomes. CCNA high school students were more likely to complete an education program, take the SAT or ACT (twice as likely for CCNA students in the lowest income regions) and begin a new education program (twice as likely for the lowest income students), even after controlling for initial differences in student ability and motivation.

The effects were not as strong for community college students and tend to be conditional. We would expect less of an educational effect for community college students because they are older and many have more established goals reflected in their initiative to begin post-secondary education. The CCNA students from regions with the lowest per capita income were more likely to still be in school. The CCNA students from the highest regions are more likely to be starting a new education program. However, these benefits are not found at the other income levels. Indeed, at the middle and lower income regions, we find CCNA students are less likely than Comparison students to be starting a new education program.

After controlling for ability, motivation, and regional income, we found significant impacts on education outcomes for high school students, particularly for students from lower income regions.

After controlling for ability, motivation, and regional income, we found few impacts on education outcomes for community college students.