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Value of the CCNA Program: Perspectives on Satisfaction and Applicability from CCNA and Comparison Group Students

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PREFACE

This White Paper is one of 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 discover the value of the CCNA program through an exploration of perspectives of CCNA students as well as students from a Comparison group about program satisfaction, the value of various instructional elements and the applicability of the CCNA approach to other types of courses. Only those students who were in the 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 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. 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



Value of the CCNA Program

INTRODUCTION

Previous white papers have focused on teaching practices, student engagement, student success in specific CCNA courses, and the overall impact of the CCNA program on student success. We contrasted 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. In this white paper, we explore the perspectives of CCNA students and Comparison group students about program satisfaction, the value of various instructional elements and the applicability of the CCNA approach to courses in other areas such as mathematics, science, and technology.

PARTICIPANTS

We focused on students who attended academies that were part of a longitudinal study. Approximately 411 academies participated in the longitudinal study, but only 246 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 as we worked with each academy to identify a class that Comparison students took 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 both invited to complete an end-of-program Exit survey that was administered at the end of the CCNA program. CCNA students took this online survey when they completed their CCNA4 course; the Comparison students took their survey when the majority of the matching CCNA students at their academy were completing their CCNA4 course. 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 they were enrolled. See Technical Report 05-01, and White Papers 05-01 and 05-02 for further details about the surveys and how they were administered.

We focused on students who attended academies that were part of a longitudinal study.

CCNA students took this online survey as they completed the CCNA4 course; the comparison students took their survey when the majority of matching CCNA students at their academy completed the CCNA4 course.

Our analyses focus only on students taking the CCNA program in high schools, community colleges, and universities. A total of 1,040 CCNA students and 1,065 Comparison students completed the Exit Survey during the period of the study (July 30, 2004 through July 15, 2006) and are included in this analysis. Table 1 presents the number of participating academies and the distribution of students who completed the Exit Survey. For more details about the population and the survey, see White Paper 06-04: Success of the CCNA program.

TABLE 1. Number of academies and student participants

	Number of Academies	Number of Students	
		Students	Exit Survey
High Schools	98	CCNA	291
		Comparison	455
Community Colleges	127	CCNA	665
		Comparison	445
Four-year Colleges and Universities	21	CCNA	84
		Comparison	165
Total	246	CCNA	1040
		Comparison	1065

OVERALL SATISFACTION WITH THE PROGRAM

To assess student's satisfaction with their program, we used a set of six questions (with responses on a 5-point Likert scale from strongly disagree to strongly agree). The wording of these questions varied slightly depending on whether students were in the CCNA program or the Comparison group, as well as whether they attended high school or community college (see Appendix 1).

We combined these six questions into one overall satisfaction score. We calculated reliability scores for the set of questions for each subgroup separately¹. Reliability scores ranged from .91 to .94, indicating good reliability of the scales.

Table 2 shows the percentage distribution of students who were highly satisfied with their program, which we defined as a satisfaction score of 4.00 or higher on the 5-point scale.

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We combined these six questions into one overall satisfaction score.

¹ The six sub-groups were: CCNA high school students, comparison group high school students, CCNA community college students, comparison group community college students, CCNA university students, and comparison group university students.

TABLE 2. Percentage of students satisfied with their program

	Male		Female	
	Comparison Student	CCNA Student	Comparison Student	CCNA Student
High School Student	68.9% (224)	66.9% (162)	70.7% (70)	46.7% (21)
Community College Student	66.6% (213)	78.1% (422)	73.1% (76)	77.3% (92)
University Students	54.3% (63)	72.5% (50)	62.8% (27)	80.0% (12)

Note: The number in parenthesis is the number of students in that group

Table 2 indicates that, in general, students seem to be very satisfied with their program – whether they are in the CCNA program or in the Comparison group. In order to understand whether the differences between groups were significant, we examined these scores using three ANOVAs (one for each academic level) comparing CCNA and Comparison group students by gender. Satisfaction was treated as dichotomous, with students defined as satisfied (a satisfaction score of 4.00 or higher) or not satisfied.

Female high school students in the CCNA program were significantly less satisfied than any other group of high school students. The other three groups of high school students did not differ from one another. At the community college level, CCNA students were more satisfied with their program than Comparison students were with theirs. There were no differences between males and females. Students from universities present a similar pattern to community college students: male and female CCNA students were both more satisfied with the CCNA program than Comparison students were with their degree program.

In summary, we find that most students were satisfied with their program. CCNA students in community colleges and universities were more satisfied than their Comparison group. However, in high school, CCNA female students were less satisfied than any of the other groups.

CCNA and Comparison group students were very satisfied with their program.

Female high school students in the CCNA program were significantly less satisfied than any other group of high school students.

CCNA students in community colleges and universities are more satisfied than the comparison students.

VALUE OF INSTRUCTIONAL RESOURCES

Students were asked to rate the value of instructional resources in terms of their helpfulness to the learning process. Students rated each resource on a 5-point Likert scale where 1 was least valuable and 5 was most valuable.

We examined the value of instructional resources in two steps. First, we examined the differences *between* CCNA students and Comparison group students. We identified the percentage of students from the CCNA and Comparison groups who placed high value on various instructional resources by rating a resource as 4 or 5 (Very Valuable or Extremely Valuable). We used Chi-square non-parametric tests to determine if there were differences between the CCNA and Comparison group students. These comparisons were conducted separately for high school students, community college students, and students at four-year colleges and universities.

Second, we examined the differences in the relative value of the instructional resources *within* each program, whether CCNA or Comparison group. We performed an ANOVA for each of the six groups of students representing the cross between degree and program type (see footnote 1). The independent variable in each case was the type of learning resource. Each analysis was followed by a sequence of post-hoc comparisons used to determine the relative ranking of each resource (i.e., resources that were rated significantly higher or lower than other resources). Thus, in the sections below, we present the resources in three groups – those rated significantly higher than other resources, those in the middle, and those rated significantly lower than other resources.

High School Students

As shown in Table 3, the CCNA students rated most instructional resources as more valuable than did the Comparison students. The three exceptions are instructor's content knowledge (where there is no significant difference in rating) and paper textbooks and course projects (both of which are rated significantly lower by the CCNA students).

CCNA students rated most instructional resources more highly than the Comparison students.

TABLE 3. Percentage of *High School* students who viewed instructional resources as “Very Valuable” or “Extremely Valuable”

	Comparison Student	CCNA Student
Online readings and examples	42.9% (182)	60.0%* (174)
Paper Textbooks	45.8% (194)	31.8%* (92)
Tests and quizzes	52.8% (224)	64.8%* (188)
Classroom lectures	61.1% (259)	72.1%* (209)
Classroom discussions	65.0% (275)	73.4%* (213)
Lab activities	68.2% (289)	78.9%* (228)
Online simulations and e-labs	N/A	62.4% (181)
Course projects	61.6% (261)	53.1%* (154)
Instructors' content knowledge	79.2% (336)	84.1% (244)
Instructors' teaching ability	75.7% (321)	82.4%* (239)

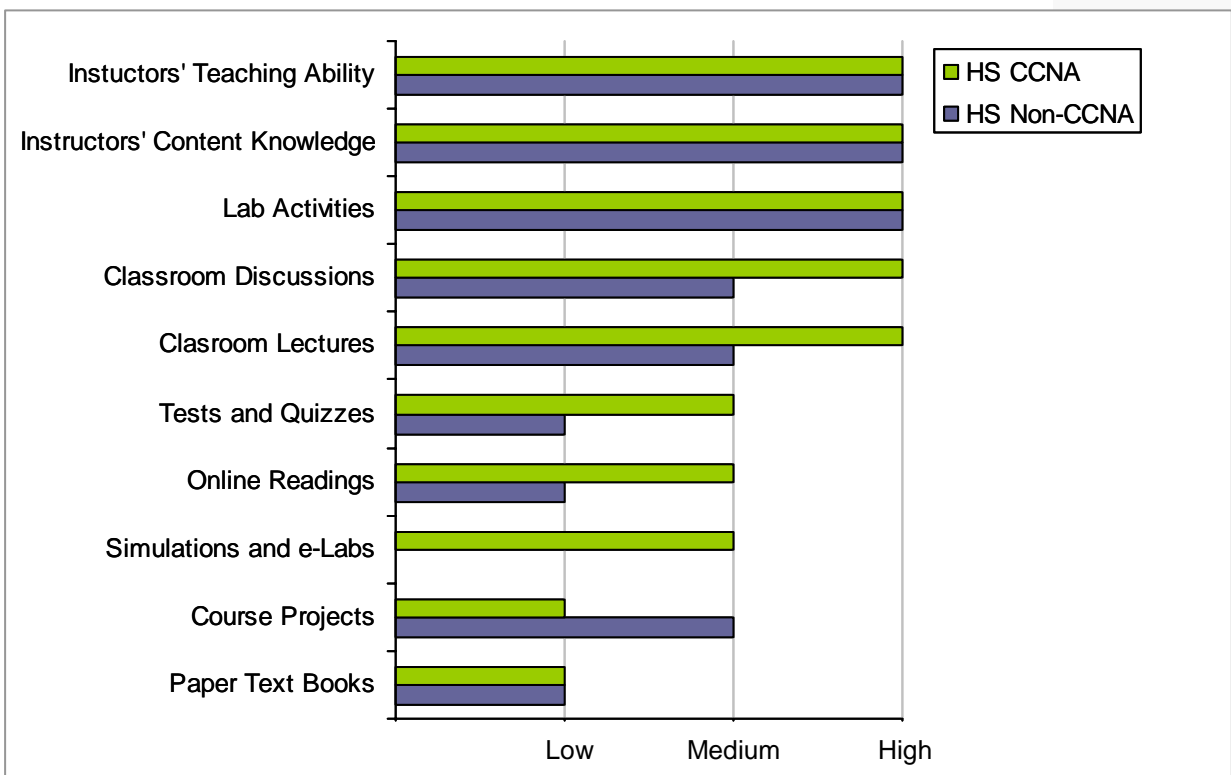
* Significantly different ($p < 0.05$)

Note: The number in parenthesis is the number of students in that group

While the CCNA students tended to place higher value on many of the instructional resources, there is reasonable agreement between CCNA and Comparison high school students as to what are the most and least valuable resources. Figure 1 shows that high school students in both the CCNA and Comparison groups place the highest value on their teachers' abilities to teach, teachers' content knowledge and lab activities. CCNA students also place high value on classroom

discussions and lectures. CCNA and Comparison students both rate paper textbooks as the least valuable instructional resource. The CCNA students also gave low value ratings to course projects while the Comparison students rated tests and quizzes and online readings as least valuable. No comparisons can be made between CCNA and Comparison students for simulations and e-labs, since these are not necessarily a part of the Comparison students' course or degree experience.

FIGURE 1. Relative value of instructional resources for *High School* students



Community College Students

Table 4 shows that community college CCNA students find greater value in online readings and examples and lab activities for their learning process than do Comparison students. However, community college CCNA students find significantly less value than the Comparison students in paper textbooks and in course projects.

Community college CCNA students find greater value in online readings and examples and lab activities than do Comparison students.

TABLE 4. Percentage of *Community College* students who viewed instructional resources as “Very Valuable” or “Extremely Valuable”

	Comparison Student	CCNA Student
Online readings and examples	57.3% (243)	77.0%* (511)
Paper Textbooks	72.4% (307)	55.5%* (368)
Tests and quizzes	69.6% (295)	72.9% (483)
Classroom lectures	76.6% (324)	78.1% (517)
Classroom discussions	78.3% (332)	78.6% (522)
Lab activities	81.4% (345)	87.2%* (577)
Online simulations and e-labs	N/A	73.1% (484)
Course projects	77.2% (325)	70.0%* (461)
Instructors' content knowledge	84.2% (356)	87.3% (578)
Instructors' teaching ability	81.3% (344)	84.1% (557)

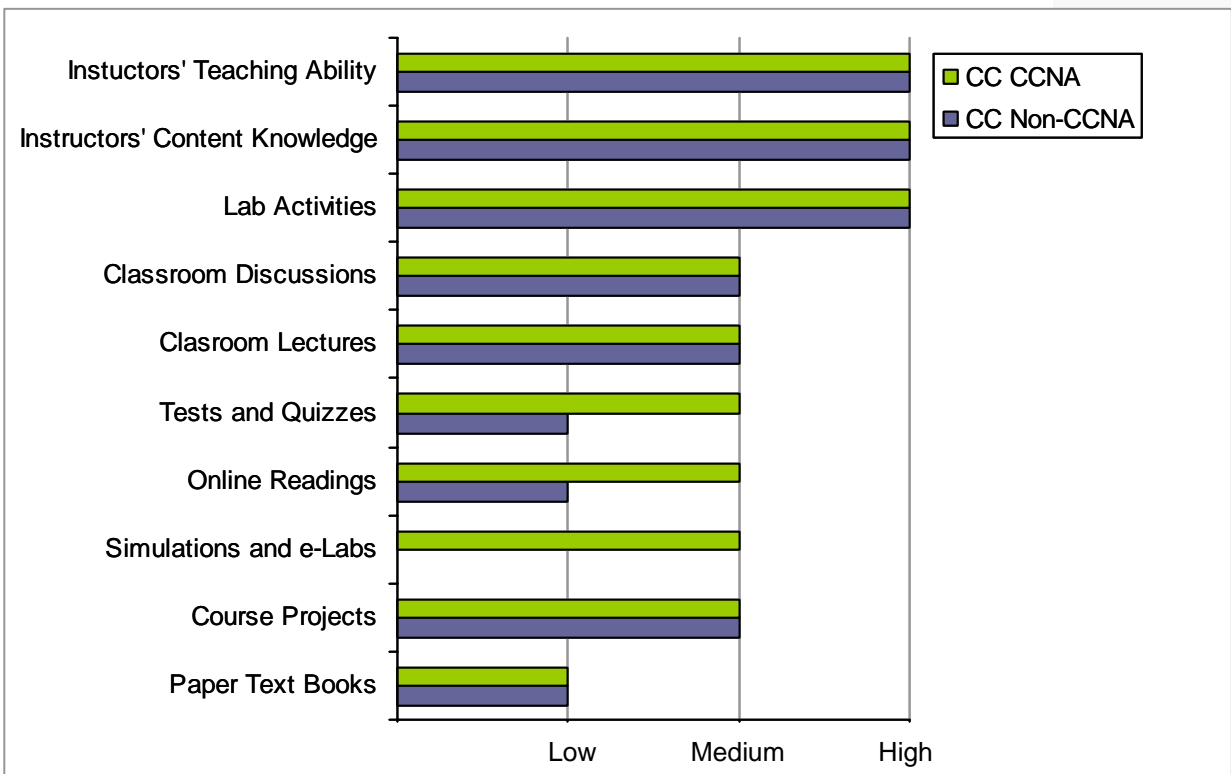
* Significantly different ($p < 0.05$)

Note: The number in parenthesis is the number of students in that group

Figure 2 shows the relative value of the resources to both groups of community college students. CCNA and Comparison students both place the highest value on their teachers' abilities to teach, teachers' content knowledge, and lab activities. CCNA students and Comparison students also agree that classroom discussions, classroom lectures and course projects are of medium value. Community college CCNA students and Comparison students differ somewhat on their value ratings for online readings and tests and quizzes. Both student groups rate paper textbooks as the least valuable instructional element.

CCNA and Comparison group students both place the highest value on their teachers' abilities to teach, teachers' content knowledge, and lab activities.

FIGURE 2. Relative value of instructional resources for *Community College* students



Four-Year College/University Students

CCNA and Comparison students in four-year institutions rated the value of each instructional element very similarly, except paper textbooks and course projects (see Table 5). A lower percentage of CCNA students than Comparison students rated paper textbooks and course projects in their programs as very valuable or extremely valuable.

TABLE 5. Percentage of *four-year College and University* students who viewed instructional resources as “Very Valuable” or “Extremely Valuable”

	Comparison Student	CCNA Student
Online readings and examples	61.6% (98)	61.9% (52)
Paper Textbooks	69.0% (109)	41.7%* (35)
Tests and quizzes	67.9% (108)	66.7% (56)
Classroom lectures	73.6% (117)	66.7% (56)
Classroom discussions	76.7% (122)	69.0% (58)
Lab activities	77.8% (123)	86.9% (73)
Online simulations and e-labs	N/A	71.4% (60)
Course projects	77.4% (123)	64.3%* (54)
Instructors' content knowledge	86.2% (137)	85.7% (72)
Instructors' teaching ability	81.8% (130)	83.3% (70)

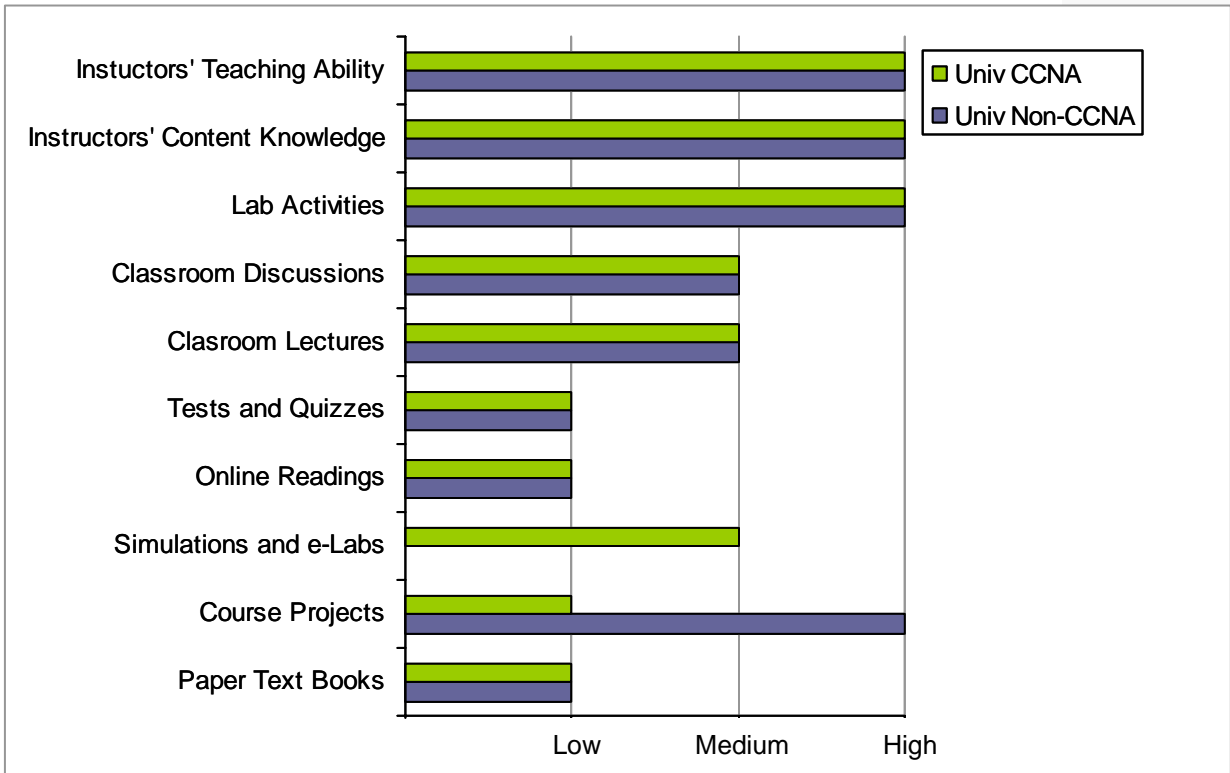
* Significantly different ($p < 0.05$)

Note: The number in parenthesis is the number of students in that group

Figure 3 shows that four-year college and university students in the CCNA program and in the Comparison group both place the highest value on their teachers' content knowledge and lab activities. CCNA students and Comparison students also agree that classroom discussions and classroom lectures are of medium value. These students differ somewhat on their value ratings for course projects. Both student groups rate paper textbooks, tests and quizzes, and online readings as the least valuable instructional elements.

Four-year college and university students in the CCNA program and in the comparison group both place the highest value in their teachers' content knowledge, and lab activities.

FIGURE 3. Relative value of instructional resources for *Four-year College and University* students



It is clear that the majority of students at all degree levels, in the CCNA program and in Comparison groups, place the highest value in their teachers' abilities to teach and in their teachers' content knowledge. Additionally, all students place high value on lab activities. Taken together, this implies that teachers with strong pedagogical skills and solid content knowledge may be better able to inspire students to engage in hands-on experience through lab activities.

At the other end of the spectrum, the majority of students, regardless of school level or program type, place the least value on paper textbooks.

Several differences between CCNA and Comparison group students are found in these data. First, CCNA students value all types of online instructional elements more than the Comparison students do. This is understandable since online materials are centrally developed for the CCNA program, as opposed to online materials used by other student groups. Second, and somewhat surprisingly, high school CCNA students value lectures and class discussions more than Comparison students. This may indicate that the centrally-developed curriculum provides instructors with resources that lead to higher quality classroom presentations than those received by other students. At the high school level, this may also indicate that the CCNA curriculum is more difficult than the content of other high school courses and students therefore

Students place the highest value in their teachers' abilities to teach and in their teachers' content knowledge.

Students place the least value on paper textbooks.

High school CCNA students value lectures and class discussions more than comparison students.

rely more heavily upon teacher-led direct instruction. In any case, it is clear that all CCNA students find that the presence of a teacher adds great value to the instructional experience by leading class presentations, discussions, and hands-on activities. Further, relatively speaking, CCNA students find greater value in the local presence of teachers than they do in the online materials associated with the program.

CCNA students find that the presence of a teacher adds great value to the instructional experience.

APPLICABILITY OF CCNA APPROACH TO OTHER COURSES

The CCNA program offers a unique blend of standardized curriculum with online student materials, online tests and hands-on labs that enables teachers to customize the course for implementation in their classrooms.

In order to gauge students' sense of the relative value of the CCNA approach to instruction as compared to instructional approaches used in their other courses, CCNA students were asked, "To what extent do you think other courses, such as math, science, and computer technology, should be taught the same way Cisco classes are taught (online materials, online tests, and hands on labs)." Students responded to this question using a 5-point Likert scale which ranged from Strongly Disagree to Strongly Agree.

Table 6 shows that a majority of CCNA students believe that the CCNA approach (that includes online materials, online tests, and hands on labs) should be used in other technology, math and science courses. There is also a low level of disagreement from students who responded to this question.

A majority of CCNA students believe that the CCNA approach should be used in other technology, math and science courses.

TABLE 6. Student perspectives on applicability of CCNA approach to other courses

	Strongly Agree and Agree	Neutral	Strongly Disagree and Disagree
High School Students	59.3% (172)	23.4% (68)	17.2% (50)
Community College Students	60.9% (404)	30.5% (202)	8.6% (57)
University Students	54.8% (46)	34.5% (29)	10.7% (9)

We also asked students to explain why they agree or disagree with the question regarding applicability of the CCNA approach to other courses.

Students provided three main reasons why the CCNA approach should be used in other courses: 1) ease of access to course materials, 2) the learning system supports various instructional approaches and styles of

learning, and 3) the hands-on learning activities greatly enhance learning and are essential for better instruction.

Those students who felt that the CCNA approach provides easy access to course materials appreciated several features of the program materials. First, they appreciated that everything they needed for the course was available online. Second, they valued the fact that all materials including tests, activities and teacher presentations are highly integrated. They also appreciated that they were not restricted by time (they can get materials after class) or location (they can access materials anywhere an Internet-connected computer is available). A number of students noted that the curriculum is convenient not only for people who are comfortable using computers, but also for students who have work and family obligations and students who have physical mobility challenges.

Students who valued the integrated learning system provided by the CCNA program generally appreciated the use of alternative learning strategies that gave them flexibility in the pace of learning while at the same time enforcing a general path of progress. These views were represented by one student who stated, “There are a number of different ways to learn, so the combination of materials, labs, and lectures increases learning opportunities...” Another student noted, “This approach presents the subject from several different angles. It is more work, and takes more time, than just reading a book, but in the long run, it helps you understand and remember the material.”

A few students did not agree with the idea that the CCNA approach should be used in other courses. The most frequently cited reasons for disagreement were concerns about the inadequacy of online curriculum as the primary instructional method for the CCNA course or any course. These students noted a lack of interaction, immediate help and informal discussion with instructors and peers. These students value demonstration by instructors, appreciate the explanations provided by instructors that assure learning, and simply want teacher-student interaction during their courses. One student summarized this view by commenting, “Math and science are classes that need individual personal attention, and would not be as beneficial to the student if only offered online. Completing science labs online would be similar to completing e-labs without actually touching the hardware. You get the basic concept, but miss out on the handling, true real-world troubleshooting, and confidence involved with the interaction to the real thing.”

“There are a number of different ways to learn, so the combination of materials, labs, and lectures increases learning opportunities...”

CONCLUSION

Overall Satisfaction

In general and across all levels, CCNA students are clearly satisfied with the program. CCNA students in community colleges and four-year colleges and universities are more satisfied with their program than other students are with comparative degree programs.

However, there appears to be an opportunity for improvement of the CCNA program at the high school level. High school CCNA students are *not* more satisfied with the CCNA program than are students in comparable courses. More importantly, female high school students in the CCNA program were significantly less satisfied than any of the other groups of students, *including female students in comparative courses*. In other words, female high school CCNA students would have been more satisfied with their learning experience if they had taken other electives rather than the CCNA program. This indicates that the CCNA program may be de-motivating to female high school students who exhibit interest or skills in computer science, information technology, and networking. Given the already low numbers of females who pursue degrees and careers in these fields, it is important that the CCNA program explore and develop alternative approaches that ensure the CCNA program is engaging to females, and at the very least, does not discourage female high school students from pursuing further coursework or careers in networking and other related fields.

It is important that the CCNA program explore and develop alternative approaches that ensure the CCNA program is engaging to high school females.

Relative Value of Instructional Resources

The majority of students at all degree levels, in the CCNA program and in Comparison groups, place the highest value on their teachers' abilities to teach, on their teachers' content knowledge, and on lab activities. More than Comparison students, CCNA students also value all types of online instructional elements, most likely because of the high quality of these materials as they are centrally developed by a team of content specialists and instructional designers. Relatively speaking, however, it should be noted that all CCNA students find greater value in the local presence of teachers than they do in the online materials associated with the program. It is clear that CCNA students find that the teacher adds great value to the instructional experience by leading class presentations, discussions, and hands-on activities.

These findings indicate that the CCNA program should continue the use of a model that takes advantage of the content and pedagogical expertise of classroom-based teachers. This is particularly true at the high school level, where there is evidence that CCNA students value lectures and class discussions more than Comparison students. This may indicate that the CCNA curriculum is more difficult than the content

CCNA students find that the teacher adds great value to the instructional experience.

The CCNA program should continue the use of a model that takes advantage of classroom-based teachers.

of other high school courses and students therefore rely more heavily upon teacher-led direct instruction.

Applicability of the CCNA Approach to Other Courses

A majority of CCNA students believe that the CCNA approach (that includes online materials, online tests, and hands-on labs) should be used for other technology, math and science courses. Students provided three main reasons: 1) ease of access to course materials, 2) the learning system supports various instructional approaches and styles of learning, and 3) the hands-on learning activities that are part of the CCNA approach greatly enhance learning and are essential for better instruction.

Collectively, data from this study indicate that high school students have a somewhat different experience of the CCNA program than their peers at community colleges and four-year colleges and universities. The CCNA program appears to be more challenging to high school students, particularly females. They rely even more heavily than other CCNA students on the presence of teachers in the classroom, and they value interaction and discussion with instructors and peers. Based on these findings, it may be prudent to develop a CCNA program that is specifically aligned to the abilities and needs of high school students.

It may be prudent to develop a CCNA program that is specifically aligned to the abilities and needs of high school students.

Appendix 1

Satisfaction Items

TABLE 7. Satisfaction Items for Exit Surveys

CCNA Students	Comparison Students
1. The overall CCNA program has been valuable to me	1. The electives I have chosen in question 1 have been valuable to me (for HS students) 1. Overall my program/major has been valuable to me (for college students)
2. I would enroll in the CCNA program again	2. I would {take these electives / enroll in my program/major} again
3. I would recommend the CCNA program to others	3. I would recommend {these electives / my program/major} to others
4. My goals and expectations for the CCNA program have been met	4. My goals and expectations for {these electives / my program/major} have been met
5. The value I received from the CCNA program was worth the effort I put in	5. The value I received from {these electives / my program/major} was worth the effort I put in
6. I have learned a great deal from the CCNA program	6. I have learned a great deal from {these electives I have taken / my program/major}

1= Strongly Disagree, 5 = Strongly Agree