

Cisco Networking Academy Evaluation Project
White Paper – WP 06-01
January 2006

Instructors' Experiences in the Cisco Networking Academy: Impact of the Curriculum on Teaching

Barbara Bichelmeyer
Hasan Cakir
Alan Dennis
Thomas Duffy
JoAnne Bunnage
Xiaojing Kou
Ali Korkmaz
Semiral Oncu



**Kelley Executive Partners
Indiana University**

✉ Kelley Executive Partners
Indiana University
1275 East Tenth Street, Suite 3070
Bloomington, IN 47405-1703

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

PREFACE

This white paper is one 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).

The purpose of this white paper is to describe findings from the CCNA Instructor Survey and the recommendations that arise from those findings. This paper describes the CCNA instructors in terms of demographics, and it explores the impact of the CCNA program on instructors' teaching practices. This paper also explores instructors' perceptions about whether the CCNA program approach can and should be applied to other educational settings. The conclusion of this paper offers recommendations for the CCNA program based on instructors' insights.

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 curriculum is an applied educational curriculum designed to meet the needs of practicing network administrators. 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.

This research was sponsored by the Cisco Learning Institute
www.ciscolearning.org



Instructors' Experiences in the Cisco Networking Academy: Impact of the CCNA Curriculum on Teaching

WHO ARE THE CCNA INSTRUCTORS?

The Cisco Certified Network Associate (CCNA) program is a series of four courses offered worldwide in a variety of traditional and non-traditional settings, including high schools, community colleges, universities, and community service organizations.

We surveyed 3,928 instructors actively teaching in the CCNA program in the United States and Canada about the impact of the CCNA curriculum on their teaching practices and the applicability of the CCNA approach to teach other courses such as mathematics and science. Of the 792 instructors who completed the survey (20.2% response rate), 45% teach in high schools, 46% teach in post-secondary institutions (both 2- and 4-year colleges and universities), and 9% teach in non-traditional environments such as community and vocational centers. This classification refers to the institution in which the CCNA program is offered rather than to the type of degree or diploma program at these institutions.

Detailed information about instructors' demographics, educational background, and professional experiences were reported in a previous white paper in this series (see WP-05-04 at www.indiana.edu/~iuteam). Therefore in this section we describe instructor characteristics only briefly.

Regardless of the type of institution at which they teach, the majority of CCNA instructors hold a master's degree (55%), and another 29% hold bachelor's degrees. High school instructors have extensive teaching experience, but limited professional networking experience. In contrast, instructors in post-secondary institutions have similar teaching experience to instructors in high schools and more extensive professional networking experience (see Table 1).

Of the 792 instructors who completed the survey, 45% teach in high schools, 46% teach in post-secondary institutions, and 9% teach in non-traditional environments.

The majority of CCNA instructors hold a master's degree (55%), another 29% hold bachelor's degrees.

TABLE 1. Instructor teaching and networking experience

	Teaching Experience		Networking Experience	
	High School	Post-Secondary	High School	Post-Secondary
No experience	-	-	54%	20%
Less than 1 year	2%	1%	6%	7%
1-3 years	6%	7%	10%	18%
More than 4 years	92%	92%	30%	55%

The majority of instructors from all three types of institutions have mainly taught computer technology courses during the past three years. These data suggest that the survey respondents are representative of the general population of instructors in the Cisco Networking Academy.

The majority of instructors have primarily taught computer technology courses.

Does CCNA Curriculum Restrict or Enable Teaching Practices?

The standardized curriculum and the online testing system are key features of the CCNA curriculum. We asked instructors about their perceptions of whether the standardized curriculum enables or restricts them in terms of teaching what they believe should be taught in CCNA courses.

Results show that most instructors from all three institution types believe that the standardized curriculum is enabling in that it allows them to teach what they think should be taught (see Table 2). There are no statistically significant differences among the three instructor groups.

Most instructors believe that the standardized curriculum enables them to teach what should be taught.

TABLE 2. Effects of the standardized curriculum on teaching practices

	High School	Post-Secondary	Non-Traditional
Standardized curriculum <i>enables</i> teaching	50%	60%	52%
Neither enables nor restricts	35%	30%	31%
Standardized curriculum <i>restricts</i> teaching	15%	10%	17%

We also asked instructors to elaborate on their responses by telling us *how* the standardized curriculum enables or restricts their teaching. The following two sections describe instructors' comments about how the curriculum helps them to be better teachers or what features of curriculum restrict them from teaching what they believe should be taught.

Enabling features of standardized curriculum

Responses from the 212 instructors who stated that the standardized curriculum enables them to teach what they believe should be taught fell into four major themes (See Figure 1).

The most frequent explanation as to why the standardized curriculum is enabling is because it provides a solid foundation and framework for teaching network administration (63 responses). These instructors indicated that the curriculum is valuable not just for teaching CCNA courses and about Cisco equipment, but also for teaching networking as a profession. Some instructors stated that they use the material and

The standardized curriculum provides a solid foundation and framework for teaching the network administration courses.

content from the CCNA curriculum to teach other computer classes as well. The positive aspects of the curriculum that were particularly noted by these instructors were that the order of chapters flows well, the materials on this highly technical subject are kept up-to-date, and the content is aligned with the certification exam.

The second major theme (39 responses) focused on the value of standardization. These responses explained that providing the same content for a diverse group of students allows these students to develop the same skills in network administration. Several respondents noted that having a standardized curriculum increases instructors' confidence about students' knowledge because instructors know what content was covered in previous courses, so they do not have to repeat previous topics. These instructors noted that the standardized curriculum has helped them to become more organized in their teaching activities, with the result that they are better able to guide their students to achieve the goals of the course.

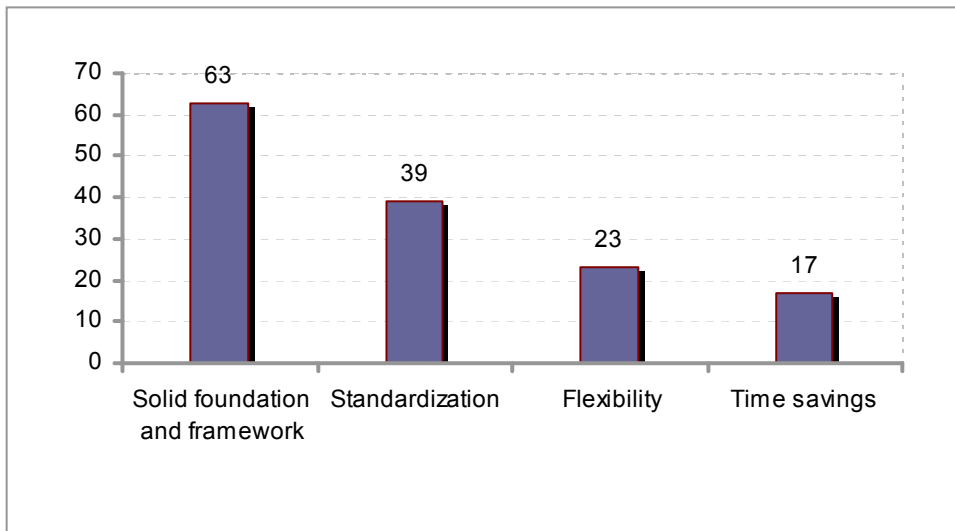
The third major theme in these qualitative responses, noted by 23 instructors, was that the curriculum is flexible enough to allow instructors to add or discard content so that they can change the emphasis on different topics.

The final theme focused on time. Seventeen instructors stated that the curriculum provides multiple resources for instruction such as PowerPoint presentations, online simulations, and standardized tests, which helps them to address the various learning needs of their students. Another group of instructors (17) appreciate the fact that they do not have to spend time finding materials for courses, which means that they can focus more of their time on working directly with students.

The standardized curriculum has helped instructors to become more organized in their teaching activities.

The CCNA curriculum provides multiple resources for teaching.

Figure 1. Enabling features of the standardized curriculum



Restricting features of standardized curriculum

The 103 responses from instructors who believed that the standardized curriculum limits their teaching fell into five major themes. First, 34 instructors stated that the sheer volume of content in CCNA courses creates time restrictions because there is so much content that must be covered in a given course (i.e., the curriculum limits the instructor's ability to add material).

The second largest group of responses (16) related to the ways that the standardized curriculum restricts instructors in the level of detail they must teach. These comments state that the curriculum addresses many unnecessary small details that require memorization rather than development of critical thinking skills, and that there is not enough emphasis on the big picture of networking administration. Instructors feel obliged to cover these details because they will likely be addressed on the certification exam, but would otherwise omit them from their teaching.

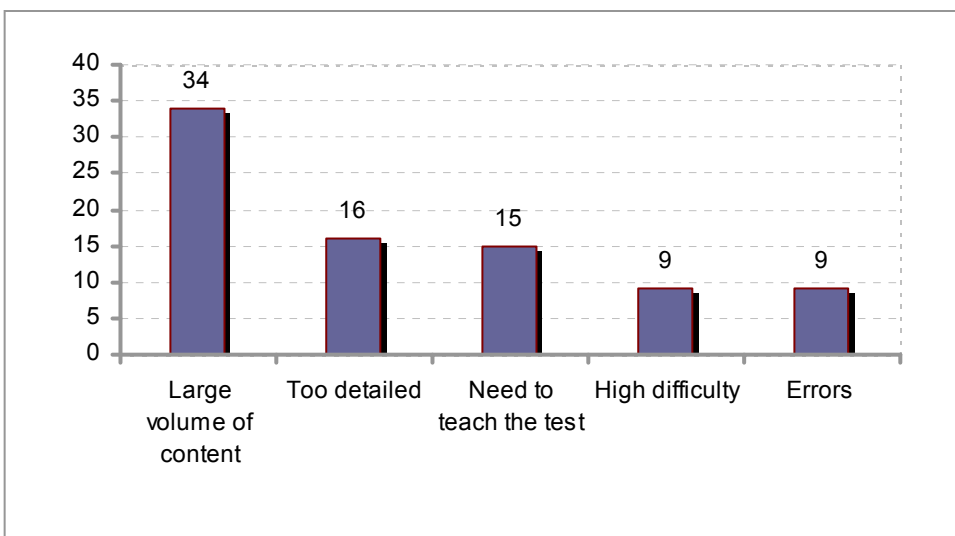
In a closely related theme, 15 instructors commented that the standardized curriculum and the close tie between the curriculum and the certification exam forces them to teach to the test rather than what they believe should be taught.

Other smaller themes worth mentioning include concerns that the difficulty level of the curriculum is inappropriate for students (9 comments) and that errors in the curriculum are restrictive because students learn certain concepts incorrectly (9 comments).

The volume of content in CCNA courses creates time restrictions.

Standardized curriculum forces teachers to teach tests and memorization.

Figure 2. Restricting features of the standardized curriculum



Some instructors also provided suggestions for how to improve the CCNA curriculum. Seventeen instructors suggested that an online search function would help make the materials easier to use. These instructors would also like to have the ability to highlight online readings and add their own notes within the online text. Additionally, a small number of instructors expressed the desire to receive e-mail alerts about modifications to the online materials. A mechanism that identifies the relative importance of each topic would also be helpful to instructors so they could allocate appropriate time to various topics. Finally, instructors would like to see more challenging lab activities in order to better foster students' skills at troubleshooting and critical thinking.

- Instructors want:
- online search
 - e-mail alerts about modifications
 - A ranking system to identify relative importance of each topic
 - challenging lab activities that foster critical thinking

Do Online Testing and Feedback Impact Teaching?

The online testing feature of the CCNA program provides students with immediate and individualized feedback. We asked instructors how the testing and feedback features have affected their teaching practices.

Instructors from all three groups (high school, post-secondary and non-traditional) reported online testing and feedback has impacted the way they teach CCNA courses (see Table 3). There were no significant differences in responses among instructors from high school, post-secondary and non-traditional institutions.

Instructors from all three groups reported online testing and feedback has impacted the way they teach CCNA courses.

TABLE 3. Effects of online testing and feedback on teaching practices

	High School	Post-Secondary	Non-Traditional
<i>Affected quite or very much</i>	62%	61%	65%
<i>Affected some</i>	21%	27%	22%
<i>Affected a little or not at all</i>	17%	12%	13%

A total of 540 additional comments from instructors helped to provide clarification about the ways in which online testing and feedback impact their teaching. The comments were divided into two major categories, depending on whether the comment was about 1) the testing system or 2) individualized feedback. In each of these two major categories, instructor comments were further broken down into two categories, depending on whether the comment was 1) a description of how the testing system or feedback is used by instructors and students, or 2) an evaluative comment by the instructor about the strengths or weaknesses of the testing or feedback mechanisms.

Impact of Online Testing System

The aspect of the online testing system that was most often commented upon by instructors was its impact on how these instructors

focus the goals of instruction. Fully sixty-nine (69) instructors stated that they “teach to the test” or use the online testing system to prepare students for the certification exam, while only six instructors explicitly stated that they do not teach to the test.

Thirty-eight instructors indicated that they use the online testing system more as a teaching and learning tool rather than as an evaluative tool, meaning they use the tests in a formative manner rather than as a measurement device. Nine of the instructors in this group explained that they allow and encourage students to take tests multiple times, while six instructors indicated that they do not put too much weight on the module tests in their figuring of final grades. Several other instructors mentioned that they use the online tests as pre-tests to gauge students’ knowledge of content prior to teaching, or that they allow students to take online tests at home or as open-book tests. Related to the idea of using the online tests in a formative manner, one instructor wrote that he wishes the CCNA curriculum would provide more practice tests that could be used before students are assigned to take “real” tests.

In addition to comments about using online testing as a learning tool, there were 102 evaluative comments provided by instructors about the online testing system. Of these, 32 were positive comments that indicated instructors value the online tests and find them helpful for fostering students’ successful mastery of content about networking administration and preparing them for the certification exams. However, the majority of evaluative comments about online testing (provided by 59 instructors) expressed negative opinions about various aspects of the system. The largest group of negative comments (48) had to do with instructors’ opinions about the quality of test items. Comments from these instructors indicated that they believe the test items focus on trivial information, are too narrow in scope, are written to be purposefully difficult or “tricky” for students, and include errors and misinformation. Additionally, 10 instructors expressed the opinion that items in the online tests are not well-matched with the goals of the curriculum or with the certification exam.

Impact of Individualized Feedback

Of the 102 instructors who commented specifically about how they used the individualized feedback feature of the online testing system, the majority (59) explained that they use the feedback to help identify the content areas with which students are having problems, and re-focus their teaching to emphasize important and missing points, as well as to review important areas with students before final exams. Sixteen instructors explicitly stated that they discuss the feedback with students in order to help students overcome particular problems identified by the test. Other instructors require or simply encourage students to use the

Instructors “teach to the test” or use the online testing system to prepare students for the certification exam.

Some instructors use the online testing system more as a teaching and learning tool rather than as an evaluative tool.

Some of the test items focus on trivial information, are too narrow in scope, and include errors and misinformation

Instructors use feedback to identify each student’s problematic content areas.

feedback on their own, without providing any direct advice to students about how to apply the feedback. Only three instructors mentioned that they use the feedback to support individualized instruction for each student.

Of the 125 evaluative comments provided by instructors about the individualized feedback feature of the testing system, 68 were positive comments which indicate instructors value the individualized feedback because it is helpful in facilitating students' learning. Many of these instructors mentioned that the testing and feedback system allows them to spend more time in class interacting with students, preparing content and working on lab activities. The biggest problem identified by instructors (42) with the individualized feedback was that it is difficult to use because the feedback is not specific enough to provide clear directions about how to improve student performance.

The individualized feedback facilitates students learning.

Do Instructors Modify Curriculum to Improve Student Learning?

Instructors play a crucial role in facilitating student learning. Most instructors customize teaching and learning materials based on their own experience and the ability level of their students in order to ensure a good fit between the materials and their students' needs. We attempted to understand how instructors modify the course materials to identify possible areas for improvement in future course materials. We asked instructors if they had made any major improvements to CCNA courses that helped students to learn, and if instructors answered yes, we asked them to describe the improvement and explain how it helped student learning. Instructors responded to this question with a wide variety of answers, which were grouped in five categories, presented in order from the most frequent to least frequent number of responses (See Figure 3).

In the largest category, 120 instructors stated that they are happy with the curriculum, material and the content of CCNA courses and they have not made any modifications to improve student learning. Comments of instructors in this category indicated that they are either very satisfied with the curriculum and materials or that they do not have time for both teaching the material and adding new material to the curriculum. The answers in this category show a balanced distribution among instructors in high schools (51), post-secondary institutions (56), and non-traditional academies (13).

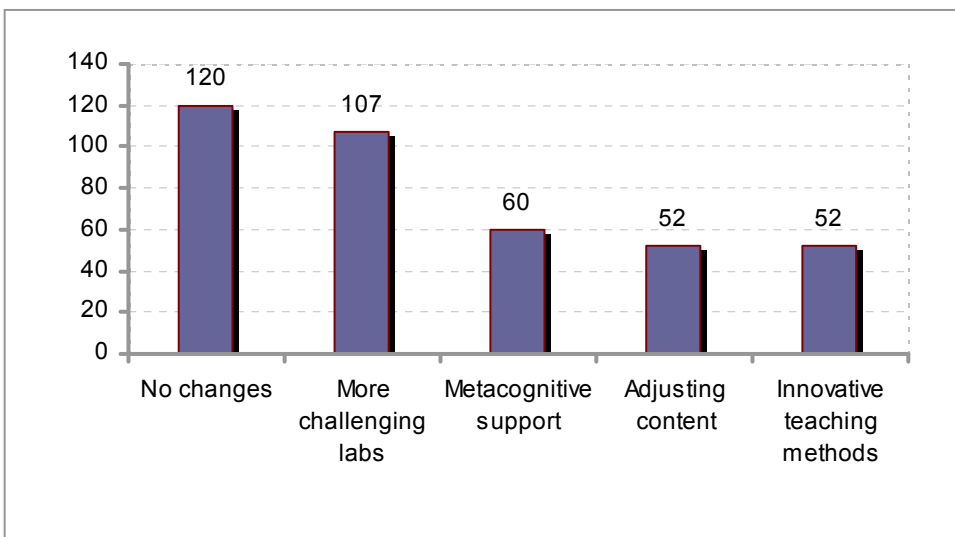
One third of the CCNA instructors made no modifications.

The second largest category (107 instructors) focuses on improvements and adjustments related to hands-on labs. Instructors identified a number of strategies that enhance hands-on labs and e-labs to better facilitate student learning. Thirty-seven instructors report that they increase the amount of time students spend in labs during class or by opening the labs for long hours after class so students can work with the equipment to complete networking tasks. Some instructors stated that they have used router simulator software or had

Instructors improve hands-on activities by creating more challenging tasks.

students create their own router simulator to work at remote locations from the school lab site, such as in their homes. Also, 22 instructors reported that they created new and more challenging lab tasks to develop students' critical thinking about the situations they will face as professionals, or revised lab materials to make them error-free. Another 12 instructors stated that they created lab tasks that require students to build and manage a wide area network from scratch. Finally, 10 instructors stated that, because they believe lab equipment is the key to successful student learning, they work to update and enrich the lab equipment.

Figure 3. How instructors modify the curriculum



Sixty instructors stated that they have made improvements and adjustments to the curriculum by providing metacognitive supports such as review and guidance materials for readings, tests and study methods. Forty instructors explained that they prepare these guidance materials because they feel the curriculum materials are too difficult for some students, especially high school students, and because the curriculum does not provide adequate cues that distinguish between important concepts and “nice-to-know concepts”. Instructors also mentioned that they have provided students with strategies for note-taking and completing homework assignments, developed clear and organized syllabi that provide an overview of the course for students, used analogies as much as possible to teach difficult topics, and they have created competitive environments to motivate student learning.

The fourth category includes comments from 52 instructors about adjustments and improvements related to the content of CCNA courses. Thirty-one instructors stated that the content of some topics (especially subnetting and access control lists) is not sufficiently detailed so they provide extra material on these topics. Additionally,

Some instructors prepare support documents for students about how to study CCNA material.

Some instructors put more emphasis on certain topics such as subnetting and access control lists.

some instructors stated that the order of particular chapters does not make sense or limits the time that instructors spend, therefore, they change the order of chapters to better teach the content and give students a firm foundation for subsequent courses in the curriculum. Several instructors stated that errors in the curriculum hinder student learning and motivation so they have revised chapters and lab materials to fix errors. Some instructors stated that they enhance their courses by incorporating their own personal industry experience into their teaching. These instructors give examples, problems and solutions from their work experience to students as they see appropriate. Other instructors mentioned that they have created ongoing case studies that can be used throughout an entire course.

When able, instructors incorporate their own personal industry experience into their teaching.

The fifth category (also 52 instructors) focuses on the ways in which they emphasize routine instructional methods. Comments include instructors' statements about bringing a new teaching method to their course or emphasizing instructional activities such as individual student work, case studies, class discussions, team work, demonstration, lecture, student presentations, field trips, study groups.

Does Teaching CCNA Impact on Teaching Other Courses?

The curriculum and the teaching methods that are built into CCNA courses are different than those traditionally used by high school and college instructors who prepare and implement their own course materials. The CCNA program provides rich teaching and learning resources, authentic assessment methods, and online access to course content, lab activities and a testing system. Considering the differences between CCNA and traditional courses, we asked instructors, first, if teaching in the CCNA program is different from the way they teach other courses, and second, whether teaching in the CCNA program has changed the way they teach in other courses.

TABLE 4. Difference of teaching CCNA from other courses

	High School	Post-Secondary	Non-Traditional
Teaching CCNA courses is <i>different</i> from other courses	48.5%	28.2%	43.9%
Teaching CCNA courses is <i>somewhat different</i> from other courses	26.3%	34.5%	34.1%
Teaching CCNA courses is <i>not much different</i> from other courses	25.2%	37.3%	22%

Table 4 shows the percentages of instructors who perceived differences between teaching in the CCNA program and teaching traditional courses. While most post-secondary instructors state that teaching in the CCNA program is not much different from teaching other courses, instructors from high schools think that teaching in the

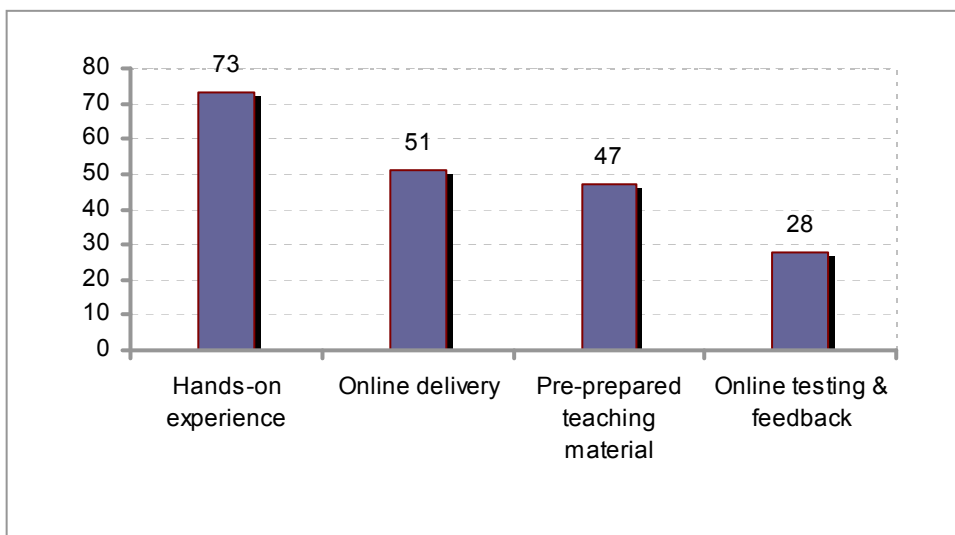
High school instructors stated that teaching CCNA courses is different than teaching other courses.

CCNA program is somewhat different from teaching other courses in their institutions.

We asked instructors why they think teaching in the CCNA program is different from or the same as teaching non-CCNA courses. We received 299 responses, and analysis of these data yielded a wide variety of answers. Among these answers, four themes emerged. Instructors who believe that teaching in the CCNA program is different from other courses state that this is due to the many hands-on labs and simulations provided by the CCNA program (73 responses), the online nature of the CCNA curriculum (51 responses), the fact that the curriculum and testing materials are “pre-prepared” for them to provide structured content for CCNA courses (47 responses), and the logistical aspects of online testing provide accessibility and immediate feedback (28 responses). Finally, several instructors stated the reason they teach differently in CCNA courses than other courses is because the CCNA courses have much more content and are much more complex than other courses.

The CCNA program is different from other courses due to the many hands-on labs and simulations, the online nature of the CCNA curriculum, pre-prepared material, and accessibility.

Figure 4. Why teaching CCNA courses is different



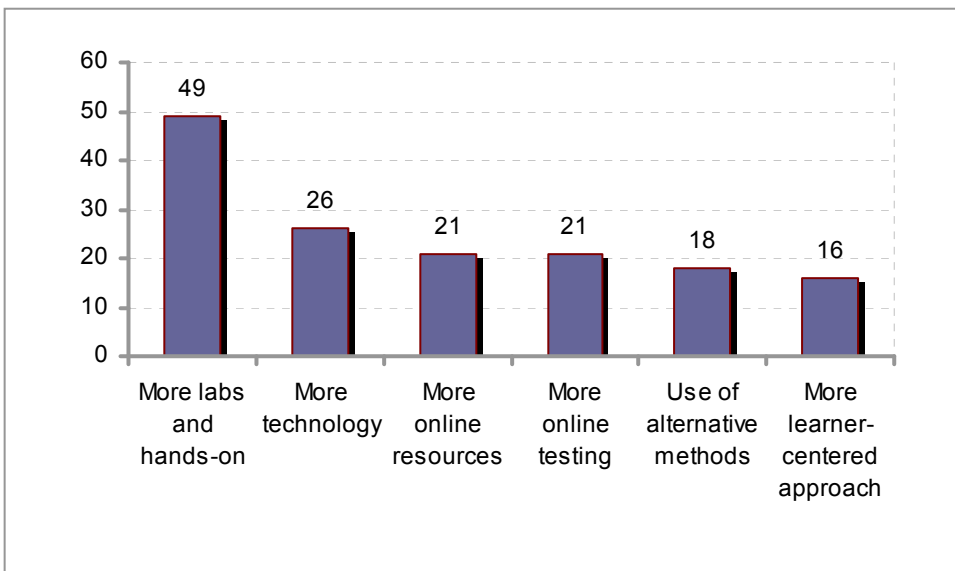
Though we expected that teaching with an online standardized curriculum might have an impact on the way instructors teach other courses, instructors reported that teaching in the CCNA program did not lead to changes in the teaching methods they use for other traditional courses (see Table 5). Instructors from all three types of institutions agreed that teaching in the CCNA program does not have much effect upon the way they teach non-CCNA courses.

TABLE 5. Impact of teaching CCNA courses on teaching other courses

	High School	Post-Secondary	Non-Traditional
Teaching CCNA courses <i>changed</i> teaching other courses	19.2%	18.8%	19.5%
Teaching CCNA courses <i>somewhat changed</i> teaching other courses	21.9%	25.2%	29.3%
Teaching CCNA courses did <i>not change</i> teaching other courses	58.8%	56%	51.2%

We also asked instructors to explain how and why teaching in the CCNA program has changed the way they teach in non-CCNA courses. Most instructors did not answer this question because they did not believe the CCNA courses have affected the way they teach other courses. The 222 instructors who provided responses stated that teaching in the CCNA program has prompted them to use more labs and hands-on learning activities in other courses (49), to utilize more technology for teaching and learning activities in the courses (26), to use more online resources (21), to conduct more practical assessments and online testing (21), to use alternative methods such as games for learning activities (18), and to engage in more learner-centered instruction in their other courses (16).

Figure 5. The impact of CCNA on other courses



Most instructors stated that the CCNA courses have not affected the way they teach other courses.

The CCNA program has prompted instructors to use more labs and hands-on learning activities, to utilize more technology, more online resources, online testing, games, and learner-centered instruction in their other courses.

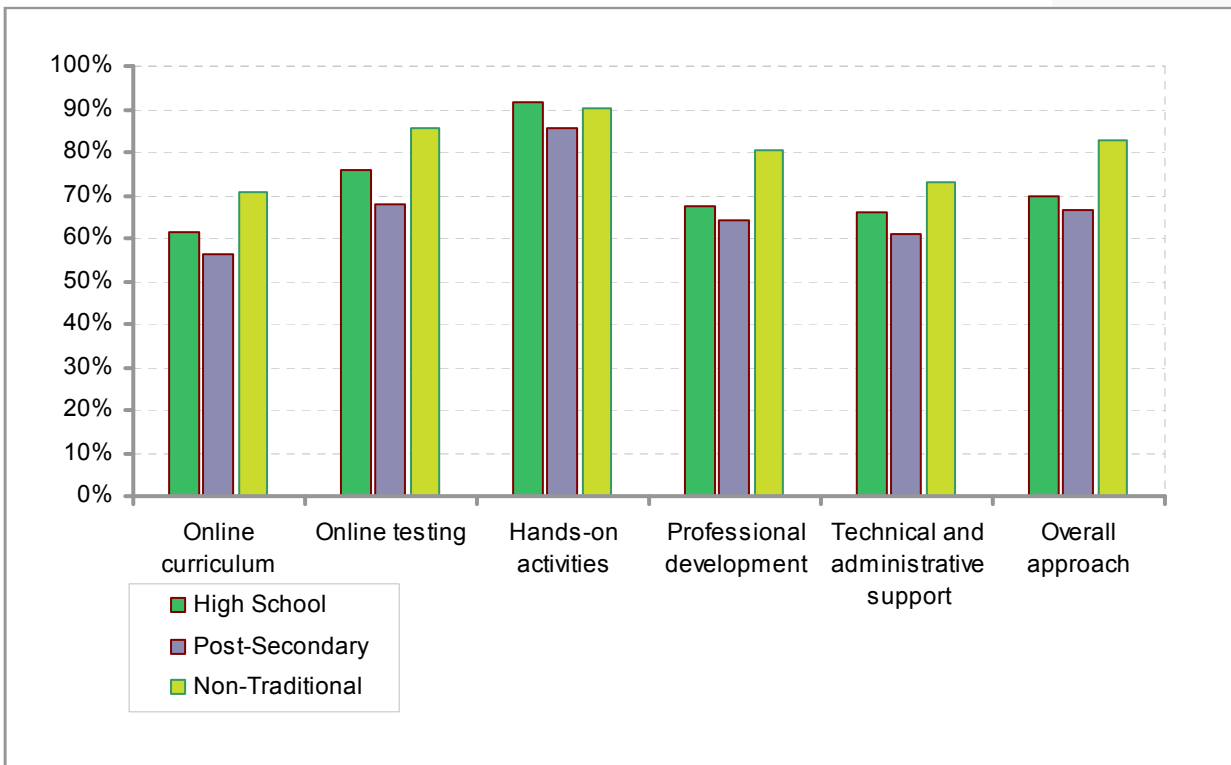
Applying the CCNA Approach to Other Courses

Five components of the CCNA program make it markedly different from traditional teacher-designed courses in high schools and post-secondary institutions. The online curriculum, online testing system, hands-on activities, professional development system and the technical-administrative support systems combine together to create a distinct “CCNA approach” to instruction. We measured to what extent instructors think that these five components and the overall CCNA approach should be promoted in other courses such as mathematics and science to help support student achievement.

Figure 6 shows most instructors agree that the CCNA approach should be used for other courses. Specifically, they strongly support the idea of using the CCNA approach to hands-on activities and online testing for other courses. Instructors at all three types of institutions expressed similar views, with the exception of the approach to online testing. Although most post-secondary instructors support the idea of using the CCNA approach to online testing for other courses, they are not as strongly supportive of this idea as instructors from high schools and non-traditional academies.

Instructors strongly support the idea of using the CCNA approach to hands-on activities and online testing for other courses.

Figure 6. Percentage of instructors agreeing that the CCNA approach is applicable to other courses



Instructors provided additional comments about the unique components of the CCNA approach, including hands-on activities, online curriculum, online testing, as well as the overall CCNA approach.

Many instructors commented that hands-on activities are the main strength of the CCNA curriculum and that such activities can contribute to student learning in other courses as well, although hands-on activities may not be appropriate for courses in some content areas.

The greatest variety of comments from instructors had to do with the online curriculum. On the positive side, many instructors commented that the online curriculum allows students to progress at their own pace toward mastery learning. The online curriculum incorporates multiple teaching strategies and interactive learning tools that engage students in class. Moreover, it is a standardized curriculum that helps instructors to prepare easily for exams and provides equivalent and consistent instruction for all students. Finally, the online curriculum provides current and updated information to students. Instructors who expressed skepticism about applying the online curriculum approach to other courses commented that online curriculum is not feasible for other courses because it is biased towards students who have strong computer skills, while students with less computer skills may not be able to navigate easily in an online environment. Also, the reading medium for online curriculum is a computer screen, which is not appropriate for the large amount of readings required by some courses. Additionally, some instructors stated that the structured nature of the curriculum is restrictive to instructors and does not allow room for flexibility in teaching.

Online testing was another category that drew a number of comments from instructors. The most frequently reported comment about testing is that it saves the instructor's time from preparing, administering and grading tests, which leaves more time for instructors to focus on teaching. Secondly, instructors appreciate that online testing provides objective assessment for all students in the program and increases the reliability of test scores. Finally, the system has the ability to provide targeted questions to students based on where they need more mastery, which helps students to learn content more effectively. Some concerns were also evident. The first concern has to do with the validity of the tests and the cognitive skills they measure. Some instructors stated that CCNA tests usually emphasize memorization and tend to focus on minute details rather than the big picture, which may not be appropriate for other courses. The second concern is that online testing requires faculty to teach to the test and restricts them to certain teaching methods, which may not work well in other courses.

Instructor comments were generally positive about applying the overall CCNA approach to other courses. Thirteen instructors explicitly stated that the CCNA approach is the best available for teaching and learning. Positive comments generally had to do with instructors' appreciation

Hands-on activities can be used in other courses as well.

The online curriculum incorporates many teaching strategies and interactive learning tools.

Testing saves the instructor's time and allows more time to focus on teaching.

One concern is that CCNA tests measure minuscule details rather than big picture.

that the CCNA approach allows them to spend more time teaching and mentoring students through their learning process rather than on testing and administration. However, some instructors also identified negative aspects of applying the CCNA approach to other courses. The main reason instructors gave for their skepticism was because they perceive that the CCNA program is primarily designed by technical experts rather than educators, and therefore they feel the program lacks a strong pedagogical basis that could serve as an example for other courses.

CONCLUSION

The instructors who teach in the CCNA program are mature professionals with extensive teaching experience. Post-secondary instructors also have a fair amount of professional networking experience.

The majority of instructors believe that the standardized curriculum is constructed in such a way that it enables them to teach the important networking concepts they believe should be taught to students in the CCNA program. A substantial minority of instructors, however, report that they feel the standardized curriculum restricts them from teaching what they believe should be taught. These instructors feel trapped into “teaching to the test.”

The idea of “teaching to the test” is a highly debated issue in educational contexts today because it is, at core, an expression of concern about classroom control, and a question of whether teachers or the developers of curriculum and standardized tests are the best judges of what students need to learn. Overall, in the case of the CCNA curriculum, it is clear that instructors defer to curriculum and test developers regarding the decision of what is best for students to learn. This deference by instructors may be due at least in part to the fact that the CCNA curriculum is developed by content experts and matched to State and National education standards, as well as to the fact that a major goal of the curriculum is successful student performance on an independent certification examination. Another reason instructors may be comfortable with teaching to the test is because many appreciate the fact that the online testing and feedback systems free them to spend more time on teaching activities and interacting with students.

Instructor satisfaction with the curriculum and teaching material is moderately high, with almost one third of the CCNA instructors stating that they do not feel the need to change materials to improve their teaching. However, nearly half of the instructors stated that they have made important modifications to the curriculum by providing more challenging hands-on labs and materials that provide metacognitive support for students. These instructors feel that the CCNA materials do not guide students very well in distinguishing important concepts from nice-to-know concepts. The next versions of the program should

The CCNA approach allows instructors to spend more time teaching and mentoring students.

The next versions of the program should include improvements to the hands-on labs and text material in order to provide more authentic lab activities.

include improvements to the hands-on labs and text material in order to provide more authentic lab activities and more instructional materials that not only teach course content, but also teach students about learning strategies for how to master the content.

In addition to calls for more challenging lab activities and metacognitive supports, the improvements most often requested by instructors were for test items that focus on important issues rather than minute details of the curriculum; review and adjustment of the difficulty level of content for high school students; ranking of content to identify relative importance of various topics in the curriculum; correction of errors of fact, grammar and style throughout the CCNA materials; and development of capabilities for searching and highlighting online materials.

Most instructors report that the experiences they have had teaching in the CCNA program have not impacted the way they teach in other courses, though this is more likely a function of how the CCNA approach fits in traditional school programs rather than a reflection of instructors' satisfaction with CCNA. A minority of instructors reported that their experiences teaching CCNA did change the way they teach other courses, usually leading to greater use of technology and more learner-centered instruction.

One of the most powerful indicators that instructors have positive views about the CCNA approach is the fact that a majority of instructors expressed the opinion that the "CCNA approach" should be used to teach more traditional subjects such as math and science courses. 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. When integrated together as they are in the CCNA program, these five components are a comprehensive system that allows instructors to effectively and efficiently bring students to mastery of complex curriculum, and facilitates students' successful performance on the CCNA certification examination.

Unique combination of key elements in the CCNA program makes the "CCNA approach" appropriate for teaching core subjects.