

Cisco Networking Academy Evaluation Project  
White Paper – WP 05-03  
October 2005

# Student Engagement in Learning: Findings from the Cisco Networking Academy CCNA2 Course

Thomas Duffy  
Ali Korkmaz  
Alan Dennis  
Barbara Bichelmeyer  
JoAnne Bunnage  
Hasan Cakir  
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](mailto:jbunnage@indiana.edu)  
🌐 [www.indiana.edu/~iuteam](http://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](http://www.indiana.edu/~iuteam)).

This White Paper presents a summary of key findings concerning student engagement in learning in the second CCNA course (CCNA2) in the four-course CCNA program. We presume that the reader is familiar with the Cisco Networking Academy. A more detailed academic report concerning the research that produced these findings is forthcoming and will be available on our Web site. That report will also provide additional background on the Cisco Networking Academy.

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 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.

This research was sponsored by the Cisco Learning Institute  
[www.ciscolearning.org](http://www.ciscolearning.org)



## Student Engagement in Learning: Findings from the Cisco Networking Academy CCNA2 Course

### BACKGROUND AND GOAL

The goal of the research reported in this white paper is to assess the engagement of Cisco students in CCNA2, the second course in the CCNA program. Engagement is the students' active participation in academic discussions and activities both inside and outside of class.

Why is engagement important? There is a long history of research that indicates a strong relationship between student engagement and both their persistence in academic programs and their learning, as measured by test scores in those programs (see for instance Fredricks, Blumenfeld, & Paris, 2004; National Research Council & Institute of Medicine, 2004; Pascarella & Terenzini, 2005). More specifically, if the instructor successfully engages students to actively participate in the learning process (e.g., through asking questions in class, participating in projects, participating in collaborative groups, and discussing the subject matter with other students, the instructor, and others outside of class), then learning and persistence can be expected to increase.

George Kuh and his associates (2001), building on these findings, suggest that an assessment of student engagement is an important metric of the quality of an educational institution. In fact, they argue that engagement is a more meaningful metric of quality than the typical institutional measures used in assessments such as those of *U.S. News and World Report* and *Business Week*. Based on this reasoning, Kuh developed the National Survey of Student Engagement (NSSE) and began administering it to college and university students at participating colleges and universities on an annual basis (over 970 institutions have participated since 1999).

With NSSE, universities can compare the engagement of their students to that of student participants in the full sample. They can also track over years their own progress in engaging students in learning. The success of NSSE has spawned three new instruments with similar objectives: the Community College Survey of Student Engagement (CCSSE), the High School Survey of Student Engagement (HSSSE), and the Law School Survey of Student Engagement (LSSSE).

The CCNA program provides considerable support for the instructors of its courses, thus freeing them to focus on meeting with students and engaging them in an active learning process. Two characteristics of the program are particularly relevant to this. First, the entire curriculum, including the text materials, guidance on conducting labs, and course

The objective of our research was to assess student engagement in the CCNA2 course.

Previous research indicates a strong relationship between student engagement and student learning.

assessments, are all provided online. Thus, an instructor does not have to spend time developing the curriculum, the daily lesson plans, or the tests. Second, during initial training, each instructor takes the course and discusses the content and how to teach it. As a result, each instructor masters the content before teaching begins. Together, these design features should free instructors to focus on student learning, and thus, we would expect students to be highly engaged in their CCNA2 course.

## THE ONLINE SURVEY

We asked students who were in the last half of their CCNA2 course to complete an online survey that assessed three types of student engagement in learning (see Appendix 1 for the specific questions):

- ☒ Active Participation (4 items, e.g., how often students ask questions in class; how often students work with others)
- ☒ Interaction with Instructor (6 items, e.g., talking to instructor out of class; receiving mentoring from instructor)
- ☒ Effort (5 items, e.g., to what extent students worked harder than they expected; how often students were engaged in understanding course content)

The survey asked students to respond to these questions about their CCNA2 class, and about one “other” class they were taking. In each case, they rated their behaviors related to engagement on a four point scale where 4 indicated the behavior occurred “very often” and 1 indicated “never”. From November 2004 to July 2005, a total of 1,506 high school students from 523 academies and 2,609 community college students from 587 academies in the U.S. and Canada completed the survey.

## HOW ENGAGED ARE THE STUDENTS?

Both high school and community college students were more engaged in the CCNA2 course than they were in the comparison course they were taking that semester (see Table 1). With one exception, the average ratings of both groups fell between “sometimes” (a rating of 2) and “often” (a rating of 3) engaging in the particular active learning behavior.

We used the web technology to define the subject of the comparison course. Students were asked what courses they were taking that semester, and a course subject from that list was inserted in place of saying “other” course. The preference was to reference a science course or a computer course if one of these was a course in which the student was enrolled. This was true for 87% of community college students and 78% of high school students).

Given the CNA program’s innovative approach, we expected to find high student engagement for the CCNA2 course.

We assessed student engagement through a survey that focused on three types of engagement: active participation, interaction with the instructor, and effort.

This engagement for high school and community college students was present for all three measures (Active Participation, Engagement with Instructor, and Effort). The practical significance of these differences is shown in the last column of the Table 1. Cohen (1988) has suggested that in terms of practical significance, effect sizes less than .30 should be considered small effects, while effects greater than .80 can be thought of as large effects. Thus, by this metric, the students are more engaged in their CCNA2 course, but the practical significance of that effect is small.

Both high school and community college students were more engaged in their CCNA2 course than in their comparison course.

**TABLE 1. Reported Engagement in the CCNA2 and Comparison Course**

Academy	Engagement Type	CCNA2 Course	Comparison Course	Cohen d Effect size
High School	Active Participation	2.50	2.37	.20 (Small)
	Interaction with Instructor	2.19	1.96	.30 (Medium)
	Effort	2.88	2.68	.27 (Small)
Community College	Active Participation	2.63	2.47	.23 (Small)
	Interaction with Instructor	2.26	2.20	.08 (Small)
	Effort	3.00	2.84	.25 (Small)

Scales: 1 = never, 4 = very often.

We also compared the engagement ratings of the high school and community college students in this study to the ratings of students who completed the High School Survey of Student Engagement (HSSSE) and the Community College Survey of Student Engagement (CCSSE). The results here are not so clear-cut: only interaction with the instructor was significantly greater than the norm value, but this was true for both the high school and community college students (see Table 2). Additionally, the community college students reported expending more effort in their CCNA2 course than CCSSE students reported for their classes in general. Although there are fewer differences that were statistically significant in the comparison to these norms, the practical significance of the effects is larger. Based on Cohen (1988), these three effects would be considered to be of medium practical significance.

The CCNA students interacted more with instructors than the students in the norm group.

**TABLE 2. Reported Engagement of CCNA2 Students and Norm Students**

Academy	Engagement Type	CCNA2 Students	Norm Students	Effect size Cohen's d
High School	Active Participation	2.51	2.45	ns
	Interaction with Instructor	2.17	1.84	.43 (Medium)
	Effort	2.88	2.82	ns
Community College	Active Participation	2.59	2.48	ns
	Interaction with instructor	2.21	1.99	.30 (Medium)
	Effort	2.98	2.66	.52 (Medium)

Scales: 1 = never, 4 = very often.

The comparison of CCNA2 engagement to the norms for student engagement does not fully replicate the findings based on the comparison to student engagement in the CCNA2 course. However, the overall conclusions remain the same: students are more engaged in CCNA2, but the differences are modest.

## WHICH STUDENTS ARE MORE ENGAGED?

### High School Students

In general, research has found that males are more engaged in science and technology than females. That is consistent with what we found for the high schools students. The males reported significantly more active participation and greater effort than did females, though the practical significance of the differences is small based on Cohen's (1988) recommendations. While males also reported more interaction with the instructor, that difference did not reach significance.

**TABLE 3. Engagement by Gender for High School Students**

Engagement Type	Males	Females	Cohen d Effect Size
Active Participation	2.53	2.37	.22 (Small)
Effort	2.91	2.71	.26 (Small)
Interaction with Instructor	2.21	2.13	ns

Scales: 1 = never, 4 = very often.

Community college students reported expending more effort for their CCNA2 class than the students in the norm group reported for their classes in general.

Male high school students reported more active participation and greater effort than females.

Students who were working either full or part-time in a job related to their education rated their engagement higher than those who were going to school but not working, or who were also working but in an area not relevant to their education. Specifically, students involved in educationally relevant work interacted with the instructor significantly more than either of the other groups (see Table 4). These students also reported significantly more effort than those working in areas not relevant to their education and significantly more active participation than those not working.

High school students who also had a full- or part-time job in a relevant area were more engaged in their CCNA2 course.

**TABLE 4. Engagement by Work Status for High School Students**

Engagement Type	Work Relevant to Education	Work not Relevant to Education	Not Working	Cohen d Effect Size
Active Participation	2.66	2.49	2.49	.24 (Small)
Effort	3.02	2.82	2.91	.28 (Small)
Interaction with Instructor	2.50	2.18	2.15	.45 (Medium)

Scales: 1 = never, 4 = very often.

In contrast, the ratings of engagement did not differ as a function of either class size or geographic location for the high school students.

### Community College Students

The findings for community college students were considerably different. We found no difference in engagement between males and females, or as a function of their work status. However, we did find that students in smaller classes reported expending more effort and interacting more with the instructor than students in large classes (see Table 5). This was the only significant difference found for our three engagement variables (active participation, effort, and interaction with instructor) across a range of individual difference variables. In addition to no effect for gender or job type, there was also no effect for geographic location and no effect as a function of whether or not students were taking other courses along with CCNA2.

For CCNA2 students in community college, there was no difference in engagement between males and females.

**TABLE 5. Engagement by Class Size for Community College Students**

Engagement Type	Small (<10)	Medium	Large (>20)	Cohen d Effect Size
Active Participation	2.57	2.61	2.55	ns
Effort	3.01	2.97	2.93	.14 (Small)
Interaction with Instructor	2.28	2.19	2.10	.25 (Small)

Scales: 1 = never, 4 = very often.

## DISCUSSION AND CONCLUSIONS

We found that student engagement was greater in their CCNA2 course than in their comparison course. This was true for all three measures of engagement (Active Participation, Effort, and Interaction with the Instructor), but, the effects were modest in terms of their practical significance, not nearly the size of effect we anticipated. Further, our findings indicated that engagement was greater for high school students who were already working in an area relevant to their education.

We hypothesized that two characteristics of the CCNA curriculum model would free the instructor to spend more time to work with students, engaging them in the learning process. These two characteristics are: the centralized and online curriculum and assessment which largely frees the instructor from test and curriculum development; and the content training instructors go through before teaching.

While we found modestly high levels of engagement, these levels were not as great as we would expect based on what we perceived as the significant benefits to the instructor of the CCNA curriculum model. It may be that we were simply wrong in our assumptions of the instructional benefits of the delivery model. Perhaps the material and the instructional requirements are sufficiently demanding or complex that the instructor must still spend a large portion of his or her time in planning their course or otherwise engaging in administrative activities rather than spending more time interacting with students.

An alternative interpretation focuses on the delivery model rather than the curriculum model. That is, while the instructors may have more free time to actively engage the students, they may not have the needed pedagogical model or skills. Indeed, traditional teacher-centered (i.e., non-interactive) approaches to teaching still tend to dominate in education, in spite of the consistent findings that active learning is related to better learning. The findings therefore suggest that the delivery model, focused on pedagogical practices and training should

Community college students in the CCNA2 course who were in smaller classes interacted more with the instructor and expended more effort on the course.

The modestly high levels of engagement are not as great as expected based on the affordances of the curriculum model.

be reviewed. There may be a need to modify instructor training to include a greater emphasis on pedagogical practices. There may also be a need to encourage local academies to apply pedagogical criteria in selecting instructors for the CCNA program.

An alternative to training and selection would be to eliminate the use of local instructors. This could be accomplished through a self-study program or through the use of “master” instructors teaching online and at a distance. However, we do not see this as an effective strategy since it would eliminate the benefits of the localization and hands-on mentoring. Students at both the high school and community college levels report that the hands-on lab is the most important component of their learning (Duffy, et al. White Paper 05-05, in preparation. Both groups also see the lecture as very important to their learning, while the high school but not the community college students see the classroom discussion as important. We believe that the local instructor is an important factor in adapting the course to local needs and to particular student needs. This is especially important in the high school context.

In summary, the recommendation arising from these findings is that the pedagogical skills and training of instructors should be examined to determine if there is a need to increase their learner-centered pedagogical skills through selection or training. This recommendation is based on the belief that identifying or developing effective teachers with pedagogical strengths is equally important to developing their technological strengths. Indeed, the pedagogical training could also be used to address broader program and national goals, for example, engaging females and minorities in science and technology.

Developing the pedagogical strengths of teachers is equal in importance to developing their technological strengths.

Instructors play a key role in the delivery of quality instruction for the local context.

Instructor training and instructional practices in the Networking Academy program should be examined to determine whether the pedagogical preparation is adequate.

## RELATED READINGS

- Astin, A. W. (1993). *What matters in college? Four critical years revisited*. San Francisco: Jossey-Bass.
- Chickering, A. W. & Gamson, Z. F. (1987, March). Seven Principles for Good Practice in Undergraduate Education. *AAHE Bulletin*, 39, 3-7.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, New Jersey: Lawrence Erlbaum Publishers.
- Finn, J. D., & Rock, D. A. (1997). Academic success among students at risk for school failure. *Journal of Applied Psychology*, 82, 221-234.
- Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School Engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, 74(1), 59-109.
- Kuh, G. D. (2001). Assessing what really matters to student learning: Inside the National Survey of Student Engagement. *Change*, 33(3), 10-17.
- National Research Council & Institute of Medicine. (2004). *Engaging schools: Fostering high school students' motivation to learn*. Washington, DC: National Academy Press.
- Pascarella, E. T. & Terenzini, P. T. (2005). *How college affects students: A third decade of research* (2<sup>nd</sup> ed.). San Francisco: Jossey-Bass Publishers.

## ORIGINAL SURVEYS

Community College Survey of Student Engagement

Available at <http://www.ccsse.org/>

High School Survey of Student Engagement

Available at <http://ceep.indiana.edu/hssse/index.html?reffermsse=index.htm>

National Survey of Student Engagement

Available at <http://www.iub.edu/~nsse/>

## APPENDICES

### Engagement Constructs: Reliability and ratings on individual items

#### Appendix 1: Community College Students

	<b>Cisco</b>	<b>Comparison</b>
	Mean (SD)	Mean (SD)
<b>Active Participation (Alpha* = .621)</b>	2.63 (0.62)	2.47 (0.69)
Asked questions in class or contributed to class discussions	3.01 (0.87)	2.94 (0.88)
Worked with other students in groups during class	3.05 (0.87)	2.64 (0.98)
Worked with other students in groups outside of class	1.98 (0.99)	1.92 (0.98)
Discussed ideas from your readings or classes with others outside of class (students, family members, co-workers, etc.)	2.48 (0.90)	2.38 (0.91)
<b>Interaction with Instructor (Alpha* = .823)</b>	2.27 (0.74)	2.20 (0.76)
Talked about future education plans with a teacher or an assistant	2.28 (0.98)	2.19 (0.99)
Talked about career plans with a teacher or an assistant	2.25 (0.97)	2.16 (0.98)
Discussed ideas from your readings or classes with teachers outside of class	2.05 (0.93)	2.04 (0.92)
Received prompt written or oral feedback from your teacher or an assistant on assignments or class work	2.76 (0.96)	2.67 (0.93)
Interacted with your teacher or an assistant outside the classroom	2.15 (0.98)	2.09 (0.97)
Received mentoring or personal support from your teacher or an assistant	2.12 (1.00)	2.04 (0.97)
<b>Effort (Alpha* = .752)</b>	3.00 (0.64)	2.84 (0.66)
Worked harder than you thought you could to meet teachers' standards or expectations	2.66 (0.93)	2.49 (0.93)
Memorizing facts, ideas, or methods	3.23 (0.79)	2.96 (0.86)
Understanding information and its meaning	3.29 (0.79)	3.15 (0.79)
Applying what you are learning to practical problems or new situations	3.12 (0.90)	2.94 (0.92)
Creating new, more complex interpretations and relationships by combining ideas and information in new ways	2.73 (0.98)	2.67 (0.95)

\* Cronbach's Alpha (1988). Scales: 1 = never, 4 = very often.

## Appendix 2: High School Students

	<b>Cisco</b>	<b>Comparison</b>
	Mean (SD)	Mean (SD)
<b>Active Participation (Alpha* = .678)</b>	2.51 (0.66)	2.37 (0.69)
Asked questions in class or contributed to class discussions	2.86 (0.89)	2.73 (0.93)
Worked with other students in groups during class	3.09 (0.91)	2.82 (0.95)
Worked with other students in groups outside of class	1.72 (0.94)	1.79 (0.95)
Discussed ideas from your readings or classes with others outside of class (students, family members, co-workers, etc.)	1.94 (0.98)	1.81 (0.94)
<b>Interaction with Instructor (Alpha* = .866)</b>	2.19 (0.77)	1.96 (0.77)
Talked about future education plans with a teacher or an assistant	2.32 (1.03)	1.95 (1.01)
Talked about career plans with a teacher or an assistant	2.36 (0.96)	2.13 (0.94)
Discussed ideas from your readings or classes with teachers outside of class	2.34 (1.02)	1.90 (0.99)
Received prompt written or oral feedback from your teacher or an assistant on assignments or class work	2.54 (0.97)	2.41 (0.95)
Interacted with your teacher or an assistant outside the classroom	2.01 (1.01)	1.82 (0.96)
Received mentoring or personal support from your teacher or an assistant	2.03 (1.01)	1.85 (0.96)
<b>Effort (Alpha* = .811)</b>	2.89 (0.72)	2.68 (0.74)
Worked harder than you thought you could to meet teachers' standards or expectations	2.43 (0.98)	2.28 (0.98)
Memorizing facts, ideas, or methods	3.10 (0.90)	2.89 (0.95)
Understanding information and its meaning	3.17 (0.90)	2.89 (0.95)
Applying what you are learning to practical problems or new situations	3.04 (0.97)	2.66 (1.03)
Creating new, more complex interpretations and relationships by combining ideas and information in new ways	2.68 (1.05)	2.54 (1.04)

\* Cronbach's Alpha (1989). Scales: 1 = never, 4 = very often.