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Student Success in the Cisco Networking Academy:
Performance in the CCNA1 Course

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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).

This White Paper presents a summary of key findings of student achievement in the CCNA1 course, the first course in the four-course CCNA program. We presume that the reader is familiar with the Cisco Networking Academy and the CCNA program. An academic report of the research discussed in this White Paper is available on our Web site. That report (TR-05-01) presents additional details about the methodological and theoretical issues underlying the research, as well as 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.

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Student Success in the Cisco Networking Academy: Performance in the CCNA1 Course

WHO IS MOST LIKELY TO SUCCEED?

Cisco Networking Academy programs are offered in a wide variety of traditional and non-traditional settings, including high schools, community colleges, universities, shelters, community service organizations, and so on. We examined the final exam performance of 10,371 students enrolled in the first course in the Cisco Certified Network Associate (CCNA) program at 1,651 academies in the United States during the 2004-05 academic year.

Not surprisingly, students with higher grade point averages (GPAs) and better computer skills were more likely to be more successful, but beyond this, what can we say about who is most and least likely to succeed?

We found that after controlling for ability and motivation, males do better than females, older students do better than younger students, non-degree students do better than degree-seeking students, and students at non-traditional academies do better than students at traditional schools. These patterns hold, despite the fact that the females in the CCNA program report higher GPAs than males, and non-degree seeking students report higher GPAs than degree-seeking students.

A wide range of students enroll in Academy courses. The relative success of some typical types of students and their likely relative success on the CCNA1 final exam are shown in Table 1.

The student most likely to succeed is
- Male
- Aged 26 or older
- Entering CCNA1 with good academic and computer skills
- *Not* seeking a degree
- Atending an academy in a non-traditional setting

TABLE 1. Selected Success Profiles

	More Successful Student	Typical Student	Less Successful Student	Less Successful Student
	Male	Male	Female	Male
	Aged 28	Aged 21	Aged 18	Aged 18
	Non-degree	Taking a degree	Taking a diploma	Taking a diploma
	At a non-traditional academy	At a community college	At a high school	At a high school
	A- GPA	B+ GPA	B+ GPA	B- GPA
	Good Computer Skills	Good Computer Skills	Good Computer Skills	Modest Computer Skills
Exam Success	83%	70%	63%	60%

WHAT AFFECTS STUDENT SUCCESS?

Academy Factors

The centrally-developed curriculum coupled with local delivery is designed to enable local instructors to adapt the program to fit the needs of students in different environments. If the program is truly adaptable, there should be few differences among academies.

We found that academy factors accounted for less than 1% of the variation in student performance. The geographic location of the academy (urban, suburban, or rural) and the academic level of the program (high school, community college, or university) did not make a difference (after accounting for student age). See Table 2.

Academy factors had little impact on student success, suggesting that the program is adaptable.

The lack of difference between urban, suburban, and rural speaks well for the program since general education data suggest that there are wide differences in performance among geographic locations. This finding suggests that the program is appropriate and flexible to meet the needs of a wide range of students and academies.

This consistency across diverse sites also suggests the critical role of instructors in adapting the centralized curriculum to the needs and abilities of their students. For example, at high schools, each CCNA course is typically one semester long, while at universities, courses are typically compressed and taught two per semester.

This also suggests that local instructors play a critical role in adapting the program to the needs of their students.

Students in economically disadvantaged areas performed worse (6.6% below others), while students in non-traditional academies performed somewhat better (2.5%). This means, for example, that a student in an economically disadvantaged area would likely perform 6.6% below an otherwise identical student not in an economically disadvantaged area. If this same student attended a non-traditional academy, then he or she would likely perform only 4.1% lower.

TABLE 2. Impact of Academy Factors

Academy Location	
Urban	No Impact
Suburban	No Impact
Town	No Impact
Rural	No Impact
Academy Type	
High School	No Impact
2-year College	No Impact
4-year University	No Impact
Non-Traditional	2.5% above others
Economically Disadvantaged	6.6% below others

Program Delivery Factors

Local instructors at each academy are responsible for designing and teaching the courses to their students. These individuals must understand the technical content of the course, as well the appropriate pedagogical strategies, to enable their students to learn. If the CCNA instructor support system provides good initial training and ongoing support, we would expect to see relatively high quality program delivery, with little variation across academies. Thus, program delivery factors should have little impact on student success.

We found that program delivery level factors accounted for only about 4% of the variation in student success. There was only modest variation in student-rated instruction quality (coefficient of variation = 18%) and student-rated lab quality (19%). By comparison, the variation in undergraduate ratings of instruction quality at the Kelley School of Business at Indiana University, one of the nation's leaders, is 25%.

There was little variation in instruction quality and lab quality, so program delivery had only a small overall impact on student success.

Cisco directly supports a small number of Cisco Academy Training Centers, which provide training and support to several hundred Regional Training Centers (RTCs), which in turn provide training and support to thousands of local academies. Students at RTCs were no more successful than students at local academies (see Table 3), which is, perhaps, the best indicator of the quality of instructor support.

Instruction quality had a significant impact on student success: for every 1% change in student-rated instruction quality, a student's success on the final exam changed by 0.11%. Student-rated lab quality had a significant but very much smaller impact on student success (0.02%). Class size had no impact on success, except that students in very small classes (5 or fewer students) did worse than students in larger classes. We speculate that such small class sizes may be an indicator that the program is not thriving in certain academies and that effects may be due to other factors beyond the class size per se.

Instruction quality had a high impact on student success.

TABLE 3. Impact of Program Delivery Factors

Regional Training Center	No Impact
Instruction Quality	High Impact
Lab Quality	Modest Impact
Class Size	
5 or Fewer Students	2.5% below others
6-9 Students	No Impact
10-19 Students	No Impact
20-25 Students	No Impact
26 or More Students	No Impact

Student Factors

The individual ability and, to some extent, motivation of each student were the primary factors influencing student success.

The individual ability and motivation of each student is usually a major factor influencing his or her academic success. The CCNA program is no different. Student factors accounted for 22% of the variation in student success.

Not surprisingly, a student's self-reported grade point average in prior courses was the largest single factor accounting for success in the CCNA1 course (see Table 4). Computer skills were also a major factor contributing to success, but problem-solving skills were not.

Demographic factors such as gender and age had significant impacts: males and older students did better than females and younger students. Interestingly, students not seeking a degree were more successful than those seeking a degree (by 4.7%).

The perceived value of the program and the desire for lifelong learning also had significant, but modest, impacts on success.

Students having an IT career goal were no more or less successful than students with career goals in other fields. Students seeking an IT career perceived the program to have greater value to them, but only by a small amount compared to those not seeking an IT career. Interestingly, 43% of students aged 18 and under did *not* want a career in IT, whereas 18% of the older students did *not* want an IT career.

TABLE 4. Impact of Student Factors

Grade Point Average	Very High Impact
Female	4.1% below males
Age	
18 and Under	3.2% below age 19-25
19-25	No Impact
26 and Older	1.7% above age 19-25
Non-Degree Seeking	4.7% above others
Computer Skills	High Impact
Problem-Solving Skills	No Impact
Perceived Program Value	Modest Impact
Desire for Lifelong Learning	Modest Impact
IT Career Goal	No Impact

WHAT MATTERS MOST TO SUCCESS?

The Academy enables students to rise to the level of their own ability and motivation.

The *relative* importance of the 12 factors we found to significantly influence student success is shown in Table 5. Five of the six most important factors in this table are student factors that the Academy has little ability to influence: grade point average, age, computer skills, gender, and degree status.

This is both good news and bad news. The good news is that this means that the Academy and its programs, as designed and implemented by Cisco, and as delivered by instructors at local academies, enable students to rise to the level of their own ability and motivation.

The bad news is that Cisco can influence only one of the top six most important factors, and this only indirectly: instruction quality. Average instruction quality was moderately high (4.4 on a 5 point scale), which suggests that dramatic improvements are unlikely.

One unexpected conclusion from the data in Table 5 is the relatively low importance of lab quality. The hands-on lab has been a centerpiece in the Academy, enabling students to apply key concepts in a practical setting. Students rated lab quality slightly lower than instruction quality (4.0 on a 5 point scale), indicating some opportunities for improvement. One important limitation to the current study is that we examined student success in only the first CCNA course, which has fewer labs that play noticeably smaller roles than the labs in later courses. Therefore, the importance of the labs in other courses needs to be examined before we can generalize this conclusion to other courses.

TABLE 5. Relative Impact of the Factors

Level of Importance	Factor	Impact	Relative Weight
Critically Important	Grade Point Average	+	.27
Highly Important	Age	+	.13
	Computer Skills	+	.12
	Instruction Quality	+	.11
Moderately Important	Gender	Male +	.08
	Degree-Seeking Status	-	.08
Somewhat Important	Economically Disadvantaged Academy	-	.05
	Non-Traditional Academy	+	.04
	Very Small Class Size	-	.03
	Perceived Program Value	+	.03
	Lab Quality	+	.02
	Desire for Lifelong Learning	+	.02

CONCLUSION

Individual student ability and motivation affect student success in the CCNA1 course more than factors associated with program delivery, or differences among the schools. Instruction quality is important, not only in the conventional sense of teaching, but also through the need to customize and adapt the centralized curriculum to the needs of the students in different settings. One of the more interesting findings is what we did *not* find: none of the traditional differences among schools (e.g., urban, suburban, rural) were found in the Academy.

The overall conclusion is that this unique blend of centralized curriculum and testing, combined with local instruction and a strong instructor support system, enables the best of both worlds: a clear standards-based national curriculum and assessment, and local control and customization of instruction to best meet the needs of a diverse population of students in a wide variety of traditional and non-traditional settings.

This combination of centralized curriculum and local delivery meets the needs of students in a wide variety of settings.

Some students are likely to be more successful than other students. There are at least two ways to approach this finding. One would be to build this information into recruiting materials, so that the program would be more likely to attract those students who stand the best chance of success. This would mean a focus on older, male, non-degree seeking students with good academic and computer skills.

The program can focus on attracting students likely to succeed, or can concentrate on better advising those less likely to succeed.

The other approach would be to use this information in an attempt to make more students successful. One could better advise and counsel those students who are less likely to be successful. For example, this might mean encouraging younger students, especially younger female students, to increase their computer skills prior to starting the program, perhaps by taking the IT Essentials course. It might also mean developing materials and training aimed at helping local instructors better reach students who may struggle in their courses.

Almost half of the teenagers enrolled in the program have no desire for a career in the IT field (likewise almost 20% of the older students have no desire for an IT career). Yet these students do no better and no worse than students seeking an IT career. Non-traditional students in non-traditional settings tend to do better than traditional students in traditional school settings. The conclusion drawn from these findings is that students who are most likely to succeed in the Academy may not be those that past research tells us are most likely to succeed in traditional educational settings.

Successful students in the Academy may not be those who would be the most likely to succeed traditional education settings.

One important question raised by this study is why some factors have the influence they do. Why, for example, are females less successful than males, after accounting for differences in abilities and motivation, and controlling for student perceptions of instruction and lab quality? Why do non-degree-seeking students in non-traditional academies do better than degree-seeking students in traditional school settings, after

accounting for maturity, ability, and motivation and controlling for instruction and lab quality? These are key questions for our future work.

Another important question concerns how the local delivery of the program affects students. What are the best practices for instruction in different settings, and how do instructors best adapt and customize the program for different settings? A prime objective of future work is to understand the instructional and curriculum management strategies used in the different academy contexts.

Future research will investigate why these factors influence student success and the best practices that lead to success in different setings.