Incorporating Cisco Networking into a Technology Class

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ABSTRACT

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The purpose of this study is to examine the effectiveness of the Cisco Network Technology Program in bridging the digital divide as measured by classroom strategies, student motivation, student attitude, and student learning. Both qualitative and quantitative methods were utilized to determine the effectiveness of the Cisco Networking Academy Program. The examination focused on two 11th grade classrooms at Hamtramck High School. Hamtramck is an inner-city community, located in the heart of Detroit. It is a racially and ethnically diverse city, with the majority of students speaking English as a second language and with more than 20 languages represented in the school district. More than 70% of the students participate in free lunch program and are considered to be economically at risk students. Few students have computers at home. They have limited access to the few computers in their high school. These computers are reserved for elective computer courses and there is no open lab time.

A purposeful sampling was conducted for this study, the sample population consisting of twenty students in each class, all of whom were trained in Cisco Networking Technologies. The researcher explored viable learning strategies in teaching a Cisco Networking class with a focus on a web-based approach.

The study revealed that the Cisco Networking Academy Program overall was an excellent vehicle for teaching networking skills and, therefore, helping to computer skills for the students who participate in the program. However, the study also revealed that only a limited number of students are able to participate in the program, due to limited computer labs and qualified teaching personnel. In addition, the cumbersome technical language poses a decided obstacle to students' overall success in networking. Laboratory assignments were preferred 90% over lecture and the use of PowerPoint presentations. A combination of practical application, lab projects, interactive assignments, PowerPoint presentations, lectures, discussions, readings, research, and assessment all help to increase student learning and proficiency. These learning strategies also enrich the classroom experience. Classroom strategies are crucial to student success in the networking program. Equipment must be updated and utilized to ensure students are employing practical application skills to networking concepts. The results of the study also suggested a high level of motivation and retention in student participants. Students in both classes scored 80% proficiency on the Achievement Motivation Profile Assessment. The identified standard proficiency score was 70%, and both classes exceeded the standard.

INTRODUCTION

The imbalance of technology in inner-city schools has produced a community of individuals illiterate in technological competency. This imbalance creates the dilemma of equitable access to technology and a lack of technical skill, thus fostering the digital divide. The digital divide is defined in this research as the gap that exists between those individuals and communities that have, and those that do not have, access to information technology literacy therefore producing individuals that also lack proficiency in technology. Research conducted by Indiana University suggested that bridging the digital divide and improving education go hand in hand (Indiana University, 2005). The literature revealed that the most successful efforts to bridge the divide have occurred through the creation of community technology centers that offer students learning opportunities for using the Internet effectively, increasing reading and job career skills, and even taking certification exams (Indiana University, 2005).

The access divide creates a bleak picture and the skill divide is also ominous. Findings on the skill divide are similar to the access divide. The access divide and the skill divide are closely linked in a vicious circle. Individuals without skills have little need to use the computer, and those without access have little chance to develop the skills through trial error and practice (Mossberger, Tolbert & Stansbury, 2003).

According to a study conducted by the Marist College Institute for Public Opinion, Americans believe that providing computer for public use is one of the three most important things their library can do. Public library computers are being utilized by disadvantaged groups consistently. Certain ethnic groups with lower income and education levels rely on

library computers as their only means of accessing computers and the Internet. Home computer ownership for Native American families is estimated at 14 percent, and home Internet access at 8 percent (Toward Equality of Access, 2003). In today's information age, to empower individuals in the use of technology is to support the fundamental American ideal of equal opportunity (Toward Equality Access, 2003). The digital divide is significant, but all parents, educators, students, and policymakers can help to bridge the digital divide by helping students to reach their educational goals.

According to the Department of Education, in 2001, approximately 44 million adults are functionally illiterate; they lack the ability to apply basic literacy effectively. Unless people can read and understand what they find online, using the Internet is neither productive nor meaningful. Therefore, the number of people accessing the Internet should not be confused with the digital divide being bridged.

A report by Carvin (2004) stated that if Americans were ever going to bridge the divide, it would require strategic, ongoing public-private partnerships at the local, national, and international levels. It must be strategic because our efforts must address literacy and content, as well as access, and it must also be ongoing to address new technologies. Carvin also stated that three out of four poor families remain on the wrong side of the digital divide. The gap between the poorest and richest households that have gone online has actually increased since 1997. At that time, 44% of the wealthiest families were online, compared with only 9% of the poorest. In a report on the content side of the digital divide, the Children's Partnership (2003) demonstrated that despite the increase in Internet content, almost none of the content addresses the specific needs of underserved, at-risk audiences: the poor, rural communities, the disabled, the non-native English speakers, and the ethnic minorities.

According to the U.S. Department of Commerce study Falling Through the Net (National Telecommunications and Information Administration, 1999), the digital divide also represents differences in the capacity to use technology tools efficiently and effectively. Complete equity requires high levels of technology proficiency to ensure broader, more meaningful, and increasingly innovative uses of technology by all segments of the population. In turn, these heightened levels of technology proficiency are very critical in the digital age (enGauge 21st Century Literacy Skills, 2003).

President Bush signed The No Child Left Behind Act of 2001 (NCLB), a landmark in education reform designed to improve student achievement and change the culture of America's schools. This Act reauthorized the Elementary and Secondary Education Act (ESEA), the principal federal law affecting education from kindergarten through high school. In amending ESEA, the new law represents a sweeping overhaul of federal efforts to support elementary and secondary education in the United States. It is built on four common-sense pillars: accountability for results; an emphasis on doing what works based on scientific research; expanded parental options; and expanded local control and flexibility . One component of NCLB initialized in the President Bush 2004 budget, included investments that will help ensure access to postsecondary education for low-income students and families, including $10.9 billion for the Pell Grant program, an increase of $549 million or 5.3%. This boost comes on top of the $1.3 billion supplemental for Pell Grants that the President proposed for fiscal year 2002 in an effort to maintain the maximum Pell Grant award at the $4,000 level specified by congressional appropriators (Page, 2002).

Statement of the Problem

There is a digital divide problem facing students in inter-city schools. There exists an unacceptable imbalance of access to technology in America's inner-city schools, an imbalance that has produced a community of individuals illiterate in technological competency and one that has contributed to the digital divide (Cuban, 2002). The digital divide has been formed by many factors: the market, the state of the economy, and the government. While equal access to technology is crucial universally, it is also absent from many education systems.

In today's Information Age, computer application literacy is vital to enhancing children's economic growth. In years past, if a person who did not have access to the Internet, was not economically stunted. However, today's computer illiterates cannot perform any of the activities that are becoming commonplace, - online research, online billing, online reservations, banking transactions, online grocery ordering, online postage stamp ordering, and a host of others (Digital On-line, 2000). In the very near future, the current way in which society conducts business will have become dramatically altered. Thus, individuals who wish to function in the 21st century must augment their technological skill level.

The literature revealed that a majority of today's citizens are not utilizing technological resources. In a study conducted by Pew Internet and American Life Project (2001), it was found that half of Americans 18 and over do not have Internet access; this is approximately 94 million people. The study revealed that these individuals were more likely to be minorities and less affluent than their peers. More than 78% of those who live in households earning more than $75,000 have Internet access. In contrast, only 31% of those who live in households earning less than $30,000 have access. Non-users are less likely than users to be employed. Forty-two percent of those not online have full-time jobs, and 9% have part-time

jobs, while 66 % of those online are employed in full-time positions, and 14% have part-time jobs. In addition, Whites are notably more likely to have Internet access than those in other racial and ethnic groups. Fifty percent of Whites have access to the Internet, compared to 36% of Blacks and 44% of Hispanics. Those not online have less education than those online. More than 71% of non-Internet users a have a high school education or less, compared to 32% of Internet users who have at least that level of education or less. The "have-nots" develop into "do-nots," while the "haves" are on a path to knowledge, motivation, and long term vision, creating for themselves opportunities for future success, productivity, and competitiveness. The "have-nots" continually require new and different skills to improve the quality of their lives. They need a solid knowledge base and a constant flow of information to make routine decisions. At the same time, these individuals must develop new competencies to compete in an increasingly competitive global marketplace and participate in expanding global communities. All individuals must have ready and equal access to the resources that will enable them to build such competencies. Among all individuals, communities and societies, the need is great to keep pace with ongoing changes in technology, the economy, and our social and political structures. Society must implement educational programs that provide each individual the means to learn, based on his/her needs and abilities. These learning methodologies should be flexible and more innovative than those implemented in past decades (Pew Internet & American Life Project, 2001).

Purpose of the Study

The purpose of this study was to determine the effectiveness of the Cisco Networking Academy Program in helping to enhance computer skills in two Cisco Networking classes at Hamtramck High School in an inner city community. The effectiveness of the Cisco Networking class in enhancing these skills was measured by:

1. Classroom strategies as measured by student surveys;
2. Student motivation as measured by the Achievement Motivational Profile Assessment;
3. Student attitude as measured by the Scientific Orientation Test; and
4. Student retention as measured by Final Assessment Score.

Rationale for the Study

This research illustrates a means of enhancing computer skills in underserved populations in inner-city communities. Students in inner-city schools do not have as much capability of accessing technology as their counterparts in more affluent school districts. Teachers in the public schools continue to be hired to teach subjects for which they are ill-equipped, their students lagging behind others in the same age bracket. The computers in their classrooms, if there are any, are outdated and restricted in Internet accessibility to conduct research and learn the most rudimentary computer commands. Many of these instructors have slender knowledge of the subject, with no formal computer training, especially in areas of troubleshooting, updates, and new products. Teachers are not solely to blame for this imbalance. There are budget considerations that affect each school district, the majority of which depend on the number of students registered. There are administrative issues as well. Another issue is that students are neither motivated nor stimulated to learn because many have other issues to cope with at home that may take their attention away from their studies. Lastly, some students may not be able to grasp certain concepts. There are many variables that contribute to these students' limited computer skills.

REVIEW OF THE RELATED LITERATURE

In the process of reviewing the literature, the researcher downloaded the No Child Left Behind Act from the Internet, and reviewed the National Technology Plan and the 21st Century Skills Forum information. The researcher read various critical studies on the digital divide and technology education in the United States, as well as magazine articles that focused on education and the digital divide. The researcher also read the Census Bureau reports on the topic, which provided statistical information on the association between ethnicity, household income, and community information and computer usage.

There is inconsistency in technology used between low and high-income schools. Seventy-two percent of large districts say they face barriers in providing their schools with access to the Internet. Urban school districts are more likely to report barriers to Internet access than are suburban or rural districts. Barriers include: hardware (33% of districts), software (16% of districts), and lack of time for staff training (16% of districts) (Grunwald, P. & Associates, Rockman, 2002). Schools that educate disadvantaged students have a ratio of 1:16 Internet connections, compared to their counterparts at high income schools. Research has revealed that participants in the technology-enriched classrooms appeared to score significantly higher in mathematics achievement than their peers in the non-technology-enriched classrooms (Grunwald, P. & Associates, Rockman, 2002).

President Bush signed the enhanced No Child Left Behind Act on January 8, 2002. NCLB focuses on four components: 1) Stronger accountability for results (states must describe how they will close the achievement gap and make sure all students, including those who are disadvantaged, achieve academic proficiency); 2) More local freedom (states and school districts have unprecedented flexibility in how they use federal education funds, in

exchange for greater accountability for results); 3) Encouraging proven educational methods, which place emphasis on determining what educational programs and practices have been proven effective through rigorous scientific research; and 4) More choices for parents (this federal law allows parents to choose other public schools or take advantage of free tutoring if their child attends a school that needs improvement).

The "have nots" are a growing number of underclass citizens who lack fluency, motivation, and are illiterate in computer technology. This group will have limited employment prospects as they lack access to technology, and thereby lack skill to compete globally. They will have limited income potential, instability in the family, and a future of disillusionment and discontent (Cuban, 2002). Poverty causes digital impoverishment, which in turn contributes to continued poverty.

The issue of the digital divide has captured and consumed the attention of educators, politicians, and advocacy groups from coast to coast over the last ten years. The access divide coexists with the lack of proficiency and skills in technology literacy. In 1996, the Clinton administration announced a Technology Literacy Challenge facing American students, which led to the creation of the first national education technology plan. The plan focused on private, federal, state, and local attention to education technology. Following that, the Clinton administration envisioned a 21st century in which every child would have access to technology (U.S. Dept of Education, Office of Educational Technology, 2000).

Technology Evolution in Schools

The review of the literature supports the need for equitable access to technology. Research on the digital divide reveals that the United States has made progress toward the four goals of NCLB. At the start of this decade, there was one instructional computer for

every 20 students. In 1998, there was more than one instructional computer for every six students. Between 1993 and 1999, access to the Internet grew from 35% to 95%. During the same period, classrooms with Internet access increased from 3% to 65%. School connectivity rose from 65% in 1998 to 85% in 2000 (Technology, 2000). These statistics indicate an increase in access to the Internet, but a barrier to technology remains when 35% of the population still lags behind in proficiency skills. What happens to the 35% of the population without access to technology? There seems to be a small but constant increase in access, but inequity still exists in skill levels.

In studies conducted by the Center for Research on Information Technology and Organizations at the University of California Irvine, researchers Anderson and Ronnkvist (1999) found that schools with higher concentrations of racial minority enrollments have less technology. Although this statistic implies a need for equitable access of technology in inner-city schools, the digital divide umbrella expands across multicultural boundaries; it crosses class, region, education, race, gender, age, economics, disabilities and language (NCES, 2000).

Classrooms in wealthier schools are also more likely to have Internet connections, compared to poorer schools, 82% vs. 60% of classrooms (U.S. Department of Education, Office of Educational Technology, 2000). Students in high-poverty schools were more likely to use these technologies for drill and practice activities, rather than for activities that promote higher order learning. This validates the findings from NTIA (2000), which stated that the income-level divide in technology access and education threatens to exclude lower income populations from opportunities to raise their standard of living. It is evident that success in this society will require significantly different skills than in the past (CEO Gorum, 2001; International ICT Literacy Panel, 2002).

The enormous digital divide does not seem to be disappearing immediately. In a report titled, “A Nation Online: How Americans Are Expanding their Use of the Internet” by the U. S. Department of Commerce (2002), the authors suggest that Internet use among African-Americans, Asians and Latinos is substantially lower than that of White non-Latinos. A study by Robert Fairlie, 2005 states that African Americans' access to computers at home is 40.5 percent, in contrast with 38.1 percent of Latinos. Asians' rate of home Internet access is 70.3 percent. Similarly, Whites have the largest rate of computer ownership, at 77.7 percent. There is a noticeable racial disparity in Internet access that transfers into disparity in technological skill.

Other factors that contribute to the digital divide are income, education and geographic area (U.S. Department of Commerce, 2000). It is common knowledge that ethnic and racial groups vary in income levels. (U.S. Census Bureau, 1993). Lower income levels among African Americans account for 27.4 percent of the disparity between White, non-Latinos, and African Americans in computer ownership. Lower income-levels are also responsible for 27.7 percent of the disparity in Internet use at home. The differences between African American educational levels and White educational levels account for 9.4 percent of the home computer rate gap and 15.2 percent of the Internet use rate gap (Fairlie, 2005). The study by Robert Fairlie supports the information in the article titled Falling through the Net: Defining the Digital Divide.

There are significant consequences to the digital divide for disadvantaged minorities, as technological skills become imperative in the industry and for education. The U.S. Department of Labor’s 2002-3 Occupation Outlook Handbook states that the fastest growing occupations from 2000 to 2010 are Network and Computer Systems Administrators and Network Systems and Data Communications Analysts, Software Engineers-Applications, Computer Support Specialists, and Computer Software Engineers-Systems Software. The

literature suggests that employment in technology and the percentage of employees using computers and the Internet at work have increased significantly over the past decade. A considerable number of new employees are required to use computers, and workers who use computers on the job typically earn more than their counterparts who do not use computers (Freeman, 2002). Another indication that computer use is becoming increasingly important is that job seekers are utilizing online job searches to find positions in industry. Sixty percent of all workers use a computer at work, and 46 percent use the Internet at work (Fairlie, 2005). The educational impact of the digital divide also seems to be significant. In research conducted by Fairlie (2005) and Beltran, Das, and Fairlie (2005), they suggested that home computers increased school enrollment, high school graduation, and grades. Fairlie also found evidence that home computers decreased school suspension and criminal activities.

In the past, the skills workers learned were good for decades. Today, workers need to constantly learn new skill sets. Today formal education from kindergarten through college is crucial in preparing future generations of workers, but education will not end there (Losing the Competitive Advantage? A Challenge for Science and Technology In the United States, 2005).

The education of the workforce starts with K-12. Without a strong background in math and sciences, students will have trouble earning technology degrees and ultimately technology jobs. (Losing the Competitive Advantage? A Challenge for Science and Technology in the United States, 2005).

METHODOLDGY

Design of the Study

This methodology chapter includes the design of the study, population, sample size, procedures and techniques, instrumentation, and data analysis utilized in the research, This study will determine the effectiveness of the Cisco Networking Academy Program in enhancing the technology skills of selected 11th graders in a diverse inner-city high school.

Participants were asked to commit to the program for one full school year - September to May (approximately seven months, or 180 days, allowing for holidays, winter and spring breaks). In the event that students could not complete the program due to an unexpected event within the first two weeks of the study, that student would be replaced by a student on a wait list. However, new students would not be able to participate after that time.

The researcher utilized both qualitative and quantitative methods of data collection. The qualitative methods included non-numerical data such as survey data, observed data, and other information obtained in the study. Quantitative methods were used to collect and analyze numerical data obtained..

Population

A convenience sampling was conducted by which students were specifically chosen to participate in this study, and participation was of a voluntary nature. The participants were forty students from Hamtramck High School assigned to participate in the study. Hamtramck High School has a student body of 915.

The criteria used to select these individuals were as follows:

- Students lived in the Hamtramck School District.

- Students had a desire to gain skills in computer networking, specifically the Cisco Networking Academy Program.
- Students had no knowledge of computer networking technologies.

In this study, the term "diverse" refers to the ethnicity of the student population. The ethnicity of the student population was comprised of 14% African American, less than 1% American Indian, 28% Asian, less than 1% Hispanic, and 56% White .This information was taken from the Michigan Department of Education 2004-2005 statistics.

Sample

The sample for the study was two groups of students consisting of twenty students in each group selected from an ethnically and culturally (Hispanic, African American, and Polish nationality) diverse urban school in the Hamtramck School District. Participants ranged in age from 16 to 17 years, and the gender distribution was 62% male, 38% female. The participants were 11th graders in two diverse Cisco Networking Technology classes at Hamtramck High School. The classes met for 45-minute intervals, for a period of four months. All students in the study used English as their first language.

Participants were given the same instruction, lab materials, assessment tools, and interactive materials. Students were expected to attend training five days a week, 1 1/2 hours per day, for a total of 16 weeks.

Student Observations

Over a 15-week period, the researcher conducted observations of two high school Cisco Networking classes. These observations totaled 30 visits, each approximately 45 minutes in length. Data were collected on each student by circling the class and observing students' interactions during group lab assignments, research assignments, individual lab assignments,

and teacher presentations. The observations were recorded on an Observation Protocol Form (Appendix E). Students' motivation towards learning a new skill was observed. Also, the climate of the classroom to determine whether or not student-centered learning could be accomplished in this setting was observed.

DATA ANALYSIS

The purpose of this study was to determine the effectiveness of the Cisco Networking Technology Program in enhancing the computer skills of students in two Cisco Networking classes at Hamtramck High School in an inner city community. The effectiveness of the Cisco Networking class was measured by:

1. Classroom strategies as measured by student surveys;
2. Student motivation as measured by the Achievement Motivational Profile;
3. Assessment of learning;
4. Student attitude as measured by the Scientific Orientation Test; and
5. Student retention as measured by Final Assessment Score.

Observations

The observations were conducted to observe students' interactions individually and students' interaction in groups of two or three. Observations were read for a second time and information was coded by circling various terms common in all the observations. Observations were then studied again, and words and sentences previously circled were categorized. Categories began to emerge and will be addressed later in this chapter. These categories include

- Attitude towards computer networking
- Retention
- Classroom strategies

- Motivation

The researcher will discuss each individually in the subsequent pages.

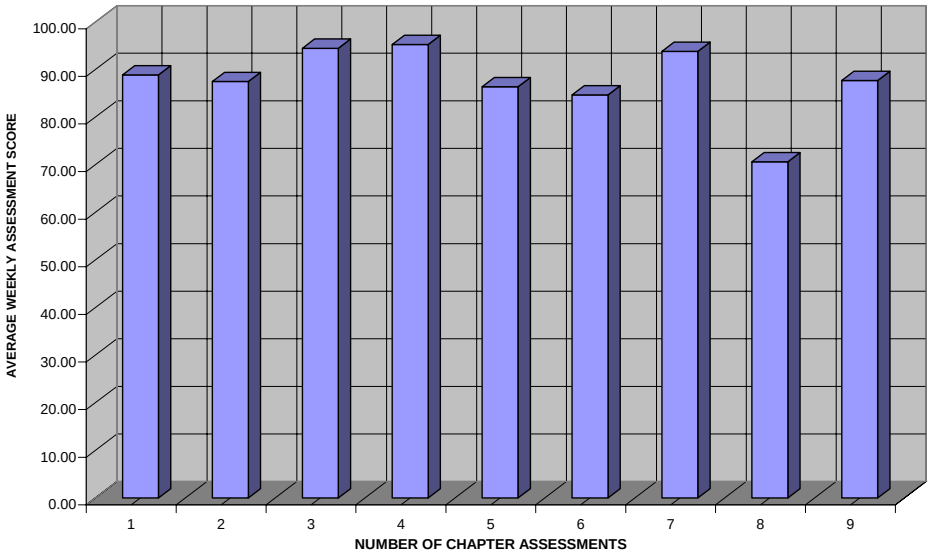
Student Attitude

The research reveals that students in both classes were frustrated in taking numerous notes in class, and students in both classes were also frustrated with the abundance of technical reading that is required in the class. The researcher observed on various occasions' students' reluctance to read the material. Students would talk a little and read a little, but they did not concentrate in class. The observations indicate the underlying surface of the students' attitude.

The Scientific Orientation Test (S.OR.T) measured the students' science orientation. The assessment includes three subsets, including overall science interest and related attitude. Student attitude was moderate.

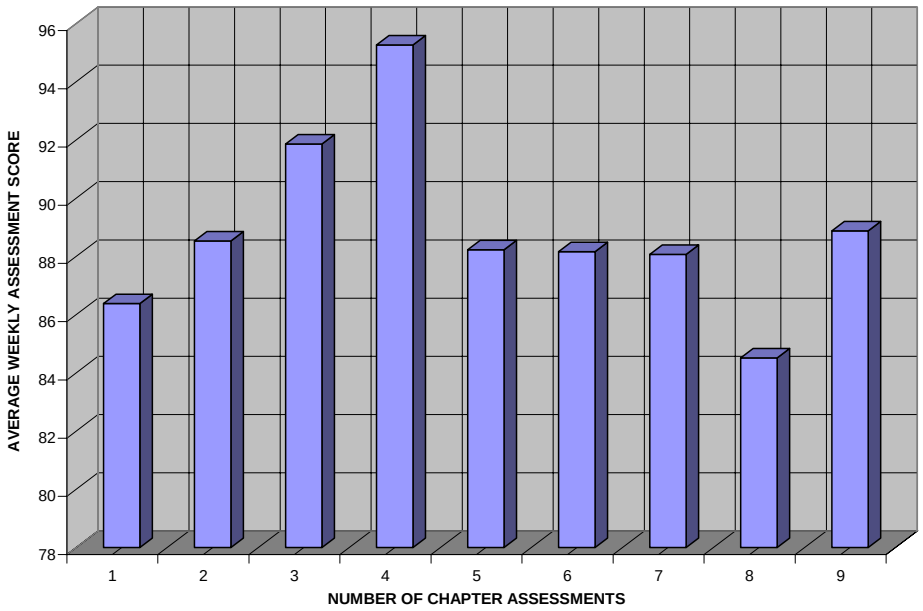
Student Learning

Figure 1. Weekly Assessment (5th Hour)



The weekly assessments measure student learning on a regular basis. In this researcher's observations, it was clear that the students were able to answer correctly any question that the instructor presented. This implied an understanding of concepts. Students in the 5th hour class scored 87% overall on the weekly online chapter assessments, and students in the 6th hour class scored 89% overall on the weekly online chapter assessments.

Figure 2. Weekly Assessment (6th Hour Class)



The weekly assessment scores demonstrate student proficiency on concepts in each chapter. The 6th hour class scored slightly higher than the 5th hour class. Three students in the 6th hour class scored 92%, compared to four students in that same class who scored 96%. Other students scored as high as 88% and not lower than 84%, which indicates that students comprehended the data. The high scores indicate a high level of proficiency in curriculum content and retention. Proficiency occurred even with the apparent frustration with the technical reading and the abundance of note taking the students were required to complete. It also shows in retrospect that some students were motivated and not overwhelmed by the intense reading and note taking, while others felt overwhelmed. This is an interesting outcome.

Classroom Strategies

Figure 3. Retention Reinforcements

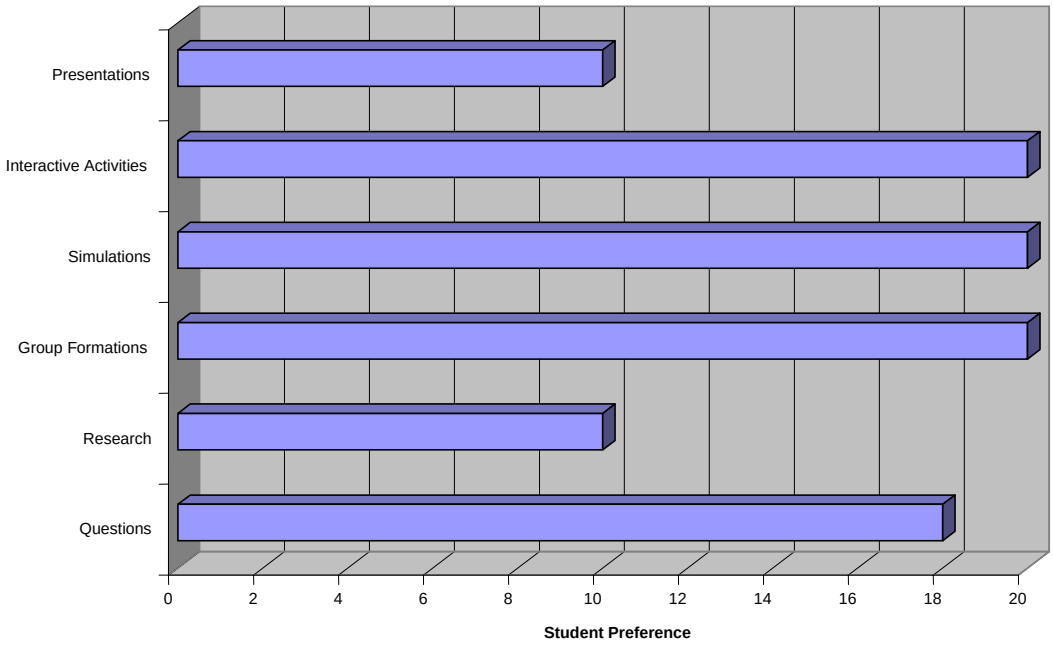


Figure 3 demonstrates the learning strategies utilized in the classroom and the responsiveness of students to each method.

Observations revealed the students retain the technology learned by various reinforcements. Data analyses revealed these categories: questions and answers, research, group formations, simulations, interactive activities, and presentations. The three activities that were observed by the researcher to be used by 50% of the students were interactive activities, simulations, and group formations. Twenty students of those observed liked to learn in a group, preferred learning utilizing interactive assignments, and enjoyed learning using simulations. The instructor created a question/answer session. In one scenario, the

instructor paused in the middle of a presentation and asked students to “name layer 3 in the OSI model.” Many hands went up to respond to the question. The instructor created a similar scenario in each presentation.

Group formations consisted of two to three members of a group assigned to complete a lab assignment, such as creating a static IP and configuring in a TCP/IP session. It also included group discussion of a particular concept.

Simulations were presented to enhance a concept. One such simulation was Packet Tracer. This particular software application enforced concepts by simulating a real world situation and then defining the solution through telling a story utilizing animation. The concept in this particular scenario was learning what a packet was and how it assisted in the delivery of an email message over the Internet. As stated previously, PowerPoint presentations were conducted weekly, as well as chapter assessments. Both of these methods reinforced concepts and helped achieve retention as verified by the scores obtained in the chapter assessments summarized in Figure 1 and Figure 2 .

Lectures were conducted periodically before demonstration of a concept. Lab assignments, which may have consisted of creating a small network with two computers, assigning a communication protocol so that the computers could communicate with each other, were another way in which concepts were reinforced. Students also made patch cables as a lab assignment. Students were put on teams of ten in order to play computer Jeopardy. Playing computer Jeopardy is another strategy used to reinforce networking concepts. In my observation, this game created competition, assisted with learning efforts, and motivated the students to learn the concepts to win.

The research reveals that questions and answers, research, group formations, simulations, interactive activities, and presentations were learning strategies that contributed to student learning in the Cisco Networking class. The results show that group formations, simulations, and interactive activities were preferred by 50% of the students observed. The

research suggests that these strategies were preferred by most students when presented with a choice of various learning strategies. The findings also reveal that the hexadecimal/binary conversions, cable making, and router configuration created a challenge for most students. I observed various students saying the following:

> Why do we need to learn this, this is not a math class (11/01/05)
>
> These conversions are difficult; I don't understand (11/01/05)

In observing the instructor, this researcher documented several themes that emerged. The instructor seemed confident in most of the concepts he introduced to the students. When the instructor was not completely confident in a concept, the concept would be presented very quickly and stressed to the students to read the on-line curriculum and give a homework assignment. This finding supports the finding by (Bichelmeyer, B., Bunnage, J., Cakir, H., Dennis A., Korkmaz, A., & Thomas, D., 2006)), which stated that instructors would spend too much time on easy material and then speed through the material that is hard to understand. Of course, this may simply reflect the skill level of the instructor. If the instructor does not go into a concept deeply enough, the students are left uncertain and lack confidence in completing the task. The student finds difficulty because those concepts are also difficult for the instructor (Bichelmeyer, B., Bunnage, J., Cakir, H., Dennis A., Korkmaz, A., & Thomas, D., 2006). The instructor always asked before, during, and after a presentation whether there were any questions. If there were no questions, the instructor asked questions of the students, using analogies to reinforce concepts. As various analogies were used, the concepts became crystal clear to the students.

Presentations were shared with the students by file share. The students had a copy of the presentation in a file folder on their desktop with the presentation for that chapter. The instructor demonstrated the laboratory assignment before the students completed the

assignment. Monitoring of the students' tasks on the Internet was conducted by the instructor each time the students were assigned an Internet task. The instructor utilized a software program titled "Screen Watch," which allows an individual to monitor web sites visited.

The research revealed that integrating various learning strategies into the classroom provides a rich learning environment for students to succeed. The instructor utilized various cognitive skills to reinforce various concepts. The learning strategies outlined above help to develop retention, motivation, and classroom strategies. They also helped to reinforce learning, and encourage participation and interaction in the classroom environment.

Figure 5. Respondents' Themes

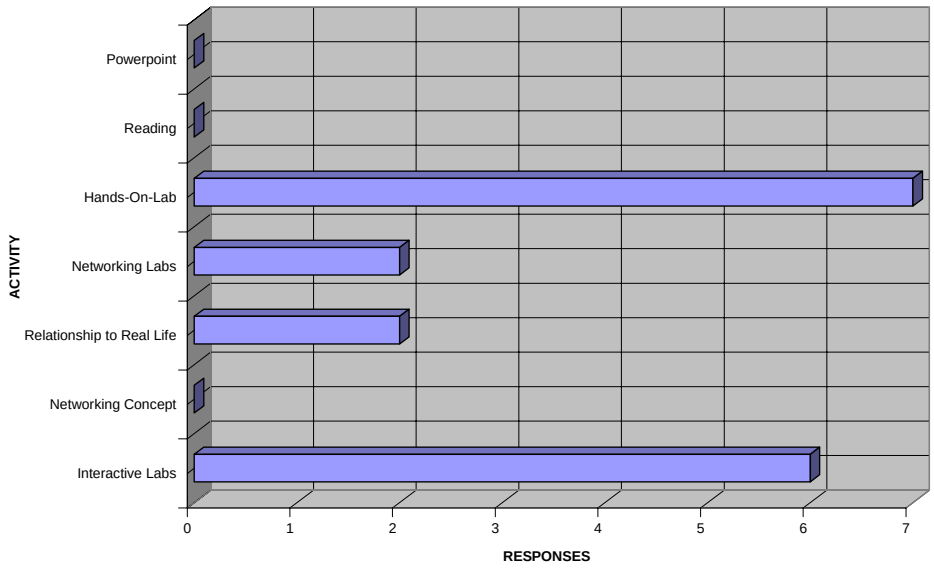


Figure 5 represents the students' responses to the interview questions. Six students responded that interactive labs excited them enough to read more, do more exercise, or research more in the classroom. The interactive exercises used in the Cisco classroom were Packet Tracer and Jeopardy.

Seven students responded that the hands-on labs excited them enough to work harder in the networking class. This supports two other perceptions mentioned earlier – that interactive and hands-on exercises in the technology class should be utilized.

Two students responded to networking labs, and two students responded that the reference to real life situations in an analogy or discussion gets them excited to learn more. Networking concepts, PowerPoint, and reading did not receive a response. The data indicated a low benefit in utilizing these methods of instruction, but even if a few of the students benefited from these methods of instruction, these methods could be utilized in combination with the more popular strategies.

Participants were asked, "Do you talk to your friends, family, and classmates about the course?" Fifteen said they did, four said that they did not, and one did not respond.

The results indicate that the learning is shared with family, friends, and classmates. The student and the community benefit, thereby helping, at least in a small way, to bridge the digital divide.

Students were asked, "What are you going to do with the new learning?" Six students responded by saying they wished to get involved with computer repair. Six students wanted to work on home and family computers. One respondent said he wanted to be a Network Administrator. Others were not sure.

Students were then asked to describe the challenges they were having with the material. Seven respondents confirmed that binary and subnetting creates a challenge for them, which verifies previous statements from students in the section on motivation, in which participants responded that subnetting and hexadecimal were challenging concepts. It also verifies my observation of the difficulty students were having with the binary assignments. Six respondents said that the computer language is hard to understand, while three respondents felt the reading is boring. Two of the respondents felt that the lab created a challenge, while

two other students felt there was just too much to learn with routers. It is clear that students felt overwhelmed by the various technical tasks to complete, as well as the abundance of reading assignments, but they continued to do it with vigor and on most days with a pleasant attitude.

Pre-Assessments

During the first week of the study, participants were given a pre-test to evaluate the level of networking skills. The students' average score was 44% in the 5th hour class and 56% in the 6th hour class. The low scores indicate a modest amount of networking skill and minimal understanding of networking terms in the assessment).

Post Assessment

A paired sample t-test was conducted to evaluate the impact of the Cisco training given to students in the 6th hour class. The results indicate a significant increase in scores from Pre-test (M= 35.57, SD=15.89) to Post test (M=77.63, SD=8.03),t=-14.07, p<.0005. These scores indicate that the students began the training with very little knowledge of networking. At the completion of the training students expanded their knowledge of networking concepts and learned a new skill.

Table 1 represents respondents Paired T-Test for the 6th hour class.

Table 1 Paired T-test (6th Hour)

	N	Mean	StDev	SE Mean
Pre-Test	19	35.57	15.89	3.64
Post Test	19	77.63	8.03	1.84
Difference	19	-42.05	13.03	2.98

A paired sample t-test was conducted to evaluate the impact of the Cisco training given to students in the 5th hour class. The results indicate a significant increase in scores from Pre-test (M= 38.39, SD=20.51) to Post test (M=77.84, SD=14.45),t=-11.75, p<.0005. The Confidence Interval is 95%. These scores indicate that the students began the training with very little knowledge of networking. At the completion of the training students expanded their knowledge of networking concepts and learned a new skill.

Table 2 represents respondents Paired T-Test for the 5th hour class.

	N	Mean	StDev	SE Mean
Pre-Test	19	38.39	20.51	4.70
Post Test	19	77.84	8.16	1.87
Difference	19	-38.94	14.45	3.31

Students were also given a skills exam, which tests the application of the concepts learned. The skills exam assignment was to set up a Peer to Peer network. All students took the skills exam as they configured the switches and/or routers to route packets across the network, utilizing the network simulators. They were excited to show what they could do. Some individuals were nervous, as a time limit of 30 minutes was set to complete this task. Most students completed the skills exam in 20 minutes. They were so excited about being able to ping the host on the network. I heard students say the following:

> Yes, I did it.(Student, Observation 2005)
> Wow. I completed it in time.(Student, Observation 2005)
> It was not hard.(Student, Observation 2005)
> It was tough.(Student, Observation 2005)
> I should have studied more.(Student, Observation 2005)
> I should have paid attention.(Student, Observation 2005)

The average class score was 80.1 % for the 5th hour class and 80.3% for the 6th hour class. Students scored 80% or above on the skills assessment. The scores definitely represent proficiency in application in networking. The students' confidence levels have increased tremendously, as indicated in the statements above.

Summary

In this quantitative and qualitative study, two inner-city Cisco Networking classes were utilized to determine the effectiveness of the Cisco Networking Academy Program, as measured by classroom strategies, student motivation, student attitude, and student retention of the material. In observing the student interaction in the classroom, the researcher observed students stating that the Cisco Networking Academy Program was challenging and very intense. Participants also stated that reading was technical and the assessments were difficult. Participants' statements were verified in analyzing motivation, utilizing the Achievement Motivation Profile (AMP), and motivation to do science, utilizing the Science Orientation Test (S.OR.T). The findings reveal that students in both classes scored 80% proficiency on the AMP assessments. The threshold for proficiency was identified as 70%, so students exceeded the threshold. Students in this study were motivated to complete the assignments in the classroom. Participants reported that laboratory assignments were preferred 90% of the time. The results also reveal that the males averaged 10% higher than the females on the S.OR.T assessment.

The results pointed to the fact that a combination of practical applications, lab, interactive assignments, PowerPoint presentations, lectures, discussions, readings, research, and assessments enrich the classroom experience and adds value to the learning. The above techniques offered a dynamic balance for helping students to comprehend these challenging concepts. The data suggest that classroom learning strategies that were implemented were adequate from the students' perspective. In the researcher's observation, the students spent 90% of the practical skill training time on interactive assignments. The activities reinforced student learning and gave students the practical experience that is required for success in the

networking program. Research conducted by Indiana University (2005) concludes that students should have a combination of interactive lab skills and practical experience in wiring and configuring the routers. Hence, students need a variety of learning resources to successfully master a skill.

Motivation and retaining the material worked together to produce a student who was enthusiastic about learning and, therefore, more likely to learn concepts. Students must be able to apply the new learning by repetition. Therefore, all labs in the curriculum should be assigned by the instructor and completed by the student. Configuration of routers should be performed daily. Repetition is the key to successful retention. Consequently, as a means of enhancing and retaining skills, instructors may allow students to compete against one another in router configuration drills.

The findings revealed that understanding networking concepts and applying the theory are vital to proficiency. The instructor should incorporate additional hands-on labs into the classroom curriculum, thereby giving students real world learning experience. In this school, the lab equipment was adequate, but it was not utilized often. Instructors should implement best practices, stating that all equipment will be utilized in the lab to enhance practical skill. The instructor in the study utilized monitoring tools to enhance classroom strategies and student learning by monitoring students' research progression on the Internet. These learning strategies provided a framework that encourages student success in the networking program. The students scored low on the final online assessment, which suggested that they did not grasp a high level of technical content. In contrast, participants scored high on the skills practical assessment, which indicates retention in the practical application by average assessment scores of 80%. The Cisco Networking Academy Program is effective, as measured by classroom strategies, student motivation, and student attitude and student

retention. The program helps to bridge the digital divide by addressing the access divide, cultural divide and the educational divide.

The researcher suggests that the Cisco Networking Academy Program is an effective teaching strategy for enhancing students' technological skills. Based on the findings of the study, the following conclusions are drawn:

1. The interviews revealed that 80% of students felt confident in downloading information from the Internet, researching information, and creating a peer-to-peer network.
2. The AMP assessment revealed that 52% of the participants were highly motivated, and 48% were motivated enough to complete the assignments and retain the information learned.
3. The interviews demonstrated that classroom strategies used in the classroom encouraged motivation and retention, thereby enriching the classroom experience.
4. The interviews also determined that additional hands-on experience was essential to student proficiency in networking. Therefore, a balance of practical hands-on labs should be implemented into any networking classroom. These components are vital to the overall effectiveness of the Cisco Networking Academy Program.
5. The research suggests that the instructor's expertise in the subject and continuous technology growth fosters a manageable classroom, which in turn fosters student learning and adds value to the classroom experience.
6. The availability of up-to-date equipment to complete lab assignments complements any technology classroom; therefore, students should be allowed to utilize the equipment.

7. The researcher concludes that if instructors follow these guidelines in teaching networking courses, it will help in bridging the digital divide that exists in many challenging socioeconomic communities across the nation.

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