The Analysis of Computer Networking as an Honors Class at Marshfield High School

by

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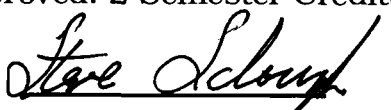

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ABSTRACT

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The criteria colleges use to accept students and high schools use to measure the success of students has a lot to do with the classes taken and the grades received in them. The pressure to earn a perfect GPA, class rank, and high scores on SAT and ACT tests has an impact on what classes high achieving students will choose to take. Honors classes serve these students by offering accelerated, rigorous curriculums. These classes are often attractive to students and their parents because the grading scale is out of a 5-point scale rather than the 4-point scale of the non-honors classes, in most cases. This

has the effect of luring high achieving students away from classes that may be equally challenging but do not have honors status.

Marshfield High School has two existing Information Technology courses that are taught through the Cisco Academy Program and appear on the surface to be candidates for honors credit. This qualitative study analyzes the Computer Networking I and Computer Networking II courses to determine whether they meet the criteria to be considered honors level. Recommendations are made based on the results of this analysis.

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CHAPTER I: INTRODUCTION AND BACKGROUND

"Students and their parents are keenly aware of how important a strong grade point average (GPA) and high test scores are to being admitted to college. Colleges want to know that the students they are considering accepting are ones who challenge themselves with the most rigorous course work offered at their high schools" (*Honors and advanced placement program: Understanding the advantages.*2005). This is evident at Marshfield High School where the enrollment in advanced placement (AP) and honors level courses has dramatically increased. Honors level classes allow students to work off of a 5.0 grading scale as apposed to the 4.0 grading scale of their non-honors counterparts. (see Appendix A) According to Kingston (personal communication, June 30, 2005) the competition for class rank, GPA, and college admission has certainly drawn students to the honors classes and away from other comparable classes that do not have the honors status. The Computer Networking I, and Computer networking II courses are two non-honors courses that seem to be affected by this trend.

The Computer Networking program at Marshfield High School consists of four sequenced semesters of computer networking training. The curriculum for these two classes has been developed by Cisco Networking Academy Program, and is delivered as a part of the Cisco Academy Program. It is presented in a web-page format and standardized throughout the world with lectures, labs, and assignments administered by a qualified instructor. Tests are also standardized and taken on-line. Each semester must be

passed in order to take subsequent semesters. The Cisco Academy System will be discussed further in the literature review.

In order to obtain the honors status a course must go through an approval process. According to Marks, (personal communication, June 5 2005) the process for approving an honors Course involves four main steps.

1. The analyzing and documenting course based on criteria that has been developed by the school district's Steering Committee. The Steering Committee is composed of the department chairpersons and the curriculum director for the district.

2. If the initial findings of the analysis are favorable for honors credit the findings must be presented to the Steering Committee and defended.

3. If the Steering Committee finds the proposal acceptable, a recommendation will be made to the school board to accept the course as honors.

4. The school board then must then vote to accept or deny the Steering Committee's recommendation.

Statement of the Problem

Students taking Computer Networking and Computer Networking II courses at Marshfield High School are not receiving honors credit.

Purpose of the Study

High achieving students and their parents are favoring honors level credit courses due to their implications for GPA, class rank, and therefore college placement. The IT courses at Marshfield High school that have typically served these students with success have seen a decline in the enrolment of the high achieving students due to the non-honors status. The purpose of this study is to analyze the Computer Networking I and Computer Networking II courses document the characteristics of those that could meet the criteria required for honors credit.

Research Questions

This study will attempt to answer the following research questions.

1. How do the Computer Networking courses prepare students for post-secondary education?
2. How are state and national standards integrated into Computer Networking courses?
3. How are the Computer Networking courses targeted towards high achieving students?
4. How does a culminating project demonstrate the use of high level thinking skills?
5. Is the Computer Networking curriculum relevant to students at Marshfield High School?

Significance of the Study

1. The Technology Education Department of Marshfield will use the information gained from this research to decide whether to pursue honors level credit for the Computer Networking I and Computer Networking II courses.

2. Other departments within the Marshfield School District could use the findings of this research to determine whether they have classes that should or should not receive honors status.

3. Other schools with Cisco Networking Academies could use this research as a means to determine whether their networking classes should be offered at the honors level.

4. Anyone wanting to learn more about honors level credit and the criteria used to distinguish between honors and regulars level classes could use this research.

Limitations of the study

This is a qualitative study; therefore the results will be reported as ideas rather than quantitative values based on statistical analysis.

1. This study will focus on Marshfield High School, which has a unique process for approving honors courses. It may be difficult to find specifically related research on this topic.

2. It is not within the scope of this study to make changes based on the findings of this survey.

3. Due to the relatively recent development of the Cisco Academy System the information collected is fairly new.

Definition of Terms

Several terms need to be defined for clarity of understanding. These are:

1. School-to-work – In Wisconsin, School-to-Work is a system of education-related opportunities that center on actively preparing all students to enter the global workforce of the future. These opportunities provide students with strong academic, technical, and life skills deemed by both business and educational leaders to be necessary skills for the future. The partnerships between business and education that have been developed throughout the state are the foundations of the School-to-Work system, and connect the classroom to the community and the world of work. (Crary, 2004)

2. Information Technology – "Information technology provides the "engine" used to drive useful information systems. This includes computers, software, Internet/Intranet and telecommunications technology." (*Terminology: Computer and information systems technology.*2004, p1)

3. Articulation – "When the word articulation is used by educational institutions in Wisconsin it frequently means a process by which a student from one educational institution is granted some kind of credit by another institution. In order for this to happen there is typically an articulation agreement in place between the two institutions. (Crary, 2004, p1)

4. Youth Apprenticeship- A two year elective program combines academic and technical instruction with mentored on-the-job learning that makes a real world connection for the students. (Governor's Work-Based Learning Board, 2005)

5. AP (Advanced Placement) High school courses that help students prepare to take an AP exam. Students are eligible to receive advanced placement and/or credit at participating colleges if their scores on the exam meet the postsecondary institution's criteria. (Crary, 2004)

6. IB Courses (International Baccalaureate Courses) Classes developed by the International Baccalaureate Organization. The system consists of a rigorous pre-university course of studies that leads to examinations, for highly motivated secondary school students. Test scores, can be used by students to fulfill university requirements. (*IB educational programmes.*2005)

The next chapter will cover a review of the relevant literature.

CHAPTER II: LITERATURE REVIEW

Introduction

This chapter will discuss the general content related to the Cisco Academy program, including the need for schools to teach Information Technology, the Cisco Academy program structure, certification at the high school level, and advanced placement opportunities for students in the program. The honors credit system, course criteria, and the student application process will also be discussed. In addition, information regarding the relationship between the course curriculum and national standards will be reviewed. Finally a background of qualitative research will be discussed.

The Need for Schools to Teach Information Technology

The use of computers and the networks that connect them has been growing at an exponential rate. Information and communication technology are evolving at an astronomical rate (Wintermute, 1996). Advancements in technology over the past decade have been so rapid that what seemed like state-of-the-art technology as recently as five years ago is now considered archaic. The impact of these technologies on society is drastic. With anytime, anywhere access to both information sources and communication, many of the traditional practices of accessing information and communicating with other people are being replaced by new practices that make these tasks faster, easier, and more accessible.

The need for computer and network literacy has been well documented and many have categorized the requirements that the educational system should fulfill. One example is as follows. The National Educational Technology Standards For Students (NETS) is a project of the International Society for Technology in Education supported by the National Aeronautics and Space Administration, the U.S. Department of Education, and Apple Computer. The objective is to define what computer literacy skills every student should obtain. The goals developed are as follows:

1. Basic computer technology operations and concepts.
2. Social, ethical, and human issues related to computer technology.
3. Computer technology communications tools.
4. Computer technology productivity goals.
5. Computer technology research tools.
6. Computer technology problem solving and decision-making tools.

It is exciting to be a part of transition into a new era of human history – the dawn of the Information Age is upon us and we are pioneers in shaping how this era will unfold and in discovering all that it holds. But in order to thrive and succeed in this new environment, it is critical to make some changes. New skills are not only required to use the technology, but also to integrate it into all aspects of our lives: at work, at home, at leisure, and at school. The methodologies that were developed to satisfy the demands and schedules of life during the Industrial Age are neither appropriate nor efficient for these changing technological times. Along with the new era come completely new professions (Wintermute, 1996)

> "By 2006, almost half of the U.S. workforce will be employed by industries that are either major producers or intensive users of information technology products and services. Innovation has increased demand for high paid, "core IT workers" (*e.g.*, computer scientists, engineers), created new IT occupations, changed skill requirements for some non-IT occupations, and raised minimum skill requirements for many other jobs. Wage gaps between workers in IT industries and all other workers continue to widen" (Buckley et al., 1999, p. 196).

The Cisco Academy Program

There appears to be many ways schools are trying to meet the students' perceived needs for computer literacy. One popular program implemented in many schools is the Cisco Academy System. This program was developed in 1997 to produce students that will have skills in the information technology field and therefore fill a need in the marketplace for these skilled persons. The Cisco Academy System, as the name indicates, was developed by Cisco, a large producer of computer networking equipment and software. The academy system is set up in a tiered scheme of high schools, vocational schools, and colleges, all using standard curriculum developed to satisfy entry level job requirements for an Information Technology (IT) employee.

According to the article *About the Networking Academy* (*About the networking academy* 2005) "the Cisco Networking Academy Program is a comprehensive e-learning program that provides students with the Internet technology skills essential in a global economy. The Networking Academy delivers web-based content, online assessment, student performance tracking, hands-on labs, instructor training and support, and preparation for industry standard certifications." *About the Networking Academy* (*About*

the networking academy 2005) also describes the relationship between high schools and other academies. "Since its inception, over 1.6 Million students have enrolled at more than 10,000 Academies located in high schools, technical schools, colleges, universities, and community-based organizations."

Through the tiered support system, every Academy has a "parent" Academy. Cisco Systems trains the Cisco Academy Training Centers (CATCs). The CATCs train Regional Academies and the Regional Academies train the Local Academy Instructors, who then educate students.

The focus of the curriculum is aimed at a certification program since certifications have become the baseline measure of skills in the IT field as well as an important credential for anyone entering a particular occupation within the field. There are several certifications an academy may choose to teach, all of them in the Information Technology field, detailed further in Chapter 2. The certification program this study will focus on is the Cisco Certified Network Associate (CCNA) at the high school and the impact this program has on students as they make career decisions.

Other factors unique to this program due to the on-line nature of the academy program are defined according to *Cisco Benefits of Being an Academy* (*Benefits of being an academy.*2005). Through the Academy Connection participants have access to a community of users to share best practices, solve problems, access discounts, and request assistance. Cisco ecosystem partners contribute expertise, discounted resources, and Workplace Learning opportunities.

Another component to the academy structure is the relationship with corporations. Aside from Cisco, other companies such as Hewitt Packard, Fluke, and Panduit are

working in cooperation with Cisco to develop and maintain the curriculum and academies. In an article from *The Star* on-line, Yap (Yap, 2002) states that working with established business leaders in developing the education curriculum, especially in information technology (IT), will help greatly in preparing the country and its people to meet the demands of the new economy.

Though the need for education in the area of IT seems to be fairly universally agreed upon, how to do that seems to raise some disagreement. Brett Thompson explains in *Tech Directions* (Thompson, 2004) that two paths have developed; training coupled with education and training performed through standalone proprietary curriculum. The problem is that currently applicable technical skills expire after a few years, which subjects students to employment uncertainty and retraining. The training path can be justified when it is coupled with education. But many times training is used as a shortcut to quick, but often, short-lived employment. The training path is accomplished through stand-alone proprietary curriculum and third-party trainers that offer certification "boot camps" for the sole purpose of producing IT certification.

Implementation of the Cisco Academy has made a difference for students at Marshfield according to Richard Marks (personal communication, June 5, 2005). "It took a program that was non-existent six years ago to a class that enrolls forty plus students a semester, but the long term benefits for students are yet to be seen for such a young program." John Beck, (personal communication, November 15, 2003) an employer of information technology youth apprenticeship students in the Marshfield area, stated at a district technology committee meeting that he is extremely impressed with the level of

technical skill that his youth apprentice students have been prepared with as a part of the Cisco program.

CCNA Certification

Certification has become a popular adjunct to traditional means of acquiring information technology (IT) skills and increasing numbers of job advertisements specify a preference for those holding certifications. Certification intends to establish a standard of competency in defined areas. Unlike traditional academic degrees, certifications tend to be specific to narrow fields or even to individual products. They are designed to provide targeted skills that have immediate applicability in the workplace." (McGill & Dixon, 2005)

The Computer Networking curriculum at Marshfield is based on the Cisco Certified Network Associate (CCNA) professional certification.
According to Cisco (*CCNA-career certifications and paths - cisco systems.*2005)The CCNA certification indicates a foundation in and apprentice knowledge of networking. CCNA certified professionals can install, configure, and operate LAN, WAN, and dial access services for small networks (100 nodes or fewer), including but not limited to use of these protocols: IP, IGRP, Serial, Frame Relay, IP RIP, VLANs, RIP, Ethernet, Access Lists.

Advanced Opportunities for Students

The standardized nature of the curriculum allows for agreements with technical schools and colleges. According to Proctor, (Proctor, 2001)

Articulation refers to a joint agreement between secondary and postsecondary schools on a curriculum for which students may receive advanced credit for courses or sequence of courses successfully completed at the secondary level and thereby eliminates unnecessary coursework repetition at the postsecondary level. Doing so allows them to focus on new material and skills instead of repeating already-mastered skills.

An expert in the field of technology and school-to-work offers praise for the ease of articulation that the Cisco programs offer. According to Richard Marks (personal communication, June 5, 2005)

Not only does the certification program give students a powerful credential when applying for a job in their area of interest, it also gives them a real head start and provides a smooth transition to higher education. Because the curriculum and tests are the same across the board it is a good fit for articulations.

Class Rank and Honors Credit

In the literature it appears there are two major reasons schools employ honors programs and weighted grades. To distinguish between students for the purpose of class rank and to reward students who are taking more rigorous classes. The class ranking formula for Marshfield is listed below.

> "Class rank is determined by adding the ranks of the cumulative semester grade points and the cumulative grade point average beginning in the ninth grade. The total number of credits completed and the semester grades in each class determine total grade points. High-ranking graduates (top 5%) are determined according to the seventh semester class rank. Honor cords are awarded to students who have a

> 4.0 cumulative GPA at the end of the seventh semester and/or are in the National Honor Society. Class rank and honor roll are not the same. Honor roll is determined by grade point average on a quarterly basis. Quarter honor rolls are posted in the hall outside of the Guidance Office. Class rank appears on the 2nd and 4th quarter report cards and is updated at the end of each semester. I and N grades are averaged as F's. Grade changes are figured into the next semester ranking. Students may register for one elective course during grades 9-12 on a pass/fail basis. The student must declare whether the course will be for regular credit or taken on a pass/fail basis by the end of the fourth week. A passing grade will reflect a credit on the transcript, but will not be used to compute grade point average or rank in class. AP Courses may not be taken Pass/Fail" (*Marshfield course of study handbook 05-06.* 2005, p3).

According to *The American Teacher* (Higher-level courses attracting students. 2004) the latest Gallop poll revealed that 50 percent of American adolescents are now taking Advanced Placement courses in school and suggested that such high rates of advanced class participation reflect a response to intense competition to gain entry to good colleges.

In today's competitive educational climate, AP, IB, and other "honors" programs clearly carry an advantage. Just take a look at who gets in. Nearly 90 percent of the freshmen at the California Institute of Technology in Pasadena have taken AP classes, for instance, while over 40 percent of Harvard's arrive with high scores in enough subjects to qualify for sophomore standing. The courses confer an advantage at less selective

schools, as well. At Tulane University in New Orleans, "we absolutely do give weight" to AP or IB, says admissions officer Dave Seaver (Lord, 2005).

Another aspect of honors credit researched was the type of IT classes that are typically taught with honors status and their impacts on students, and programs. After extensive research it appears that there is a lack of credible literature pertaining to this topic. Although it appears that Marshfield would not be unique by offering a honors IT class. The researcher was able to find many high school course listings for courses that would be considered IT.

Standards

One of the criteria for honors status is that the relationship between the curriculum and educational standards must be documented. The Cisco Academy has done this with their standards alignment database. The Standards Alignment Website describes the process that they went through to develop the database. In the first stage of the project, high school Math, Science, and Language Arts teachers across the United States aligned their content area with both State and National Standards against those of Taxonomy of Performance Indicators (TAPI). Next, they worked with Academy program instructors to align TAPI with the Academy program CCNA 1-4 Course objectives. The alignment of these learning objectives to State Standards was extrapolated during this process using TAPI standards as the common indicators. Finally, this data was entered into the Standards Alignment Database and can be viewed via the system-generated reports (Cisco Systems).

The alignment database results for CCNA 1 curriculum aligned with the national standards can be seen in appendix 1. There was no standards alignment data for the State of Wisconsin.

Qualitative Research

Qualitative research is used to perform research that does not lend it self to statistical analysis.

"Qualitative research is a systematic approach to understanding qualities, or the essential nature, of a phenomenon within a particular context." (Brantlinger, E., et. al, 2005 p. 204) One of the tasks of a qualitative researcher is to insure that the research is credible. There are many methods a researcher can employ to accomplish this. Listed below are four credibility methods used during this research. (Brantlinger, E., et. al, 2005)

1. *Disconfirming evidence—after establishing preliminary themes/categories, the researcher looks for evidence inconsistent with these themes (outliers); also known as negative or discrepant case analysis.*
2. *Researcher reflexivity*—researchers attempt to understand and self-disclose their assumptions, beliefs, values, and biases (i.e., being forthright about position/perspective).
3. *Peer debriefing*—having a colleague or someone familiar with phenomena being studied review and provide critical feedback on descriptions, analyses, and interpretations or a study's results.

4. *Prolonged field engagement*—repeated, substantive observations; multiple, in-depth interviews; inspection of a range of relevant documents; thick description validates the study's soundness. (Brantlinger, E., et. al, 2005)

That concludes the review of pertinent literature, chapter three will include A summary, analysis and recommendations made based on the research.

CHAPTER III: SUMMARY, ANALYSIS AND RECOMMENDATIONS

Chapter two included a literature review related to information technology education, the Cisco Networking Academy System and honors credit. Chapter three will summarize, perform analysis, and report recommendations based on information gained in the literature review as related to the research questions.

Research Question One

How do the Computer Networking courses prepare students for post-secondary education? The most direct preparation takes place for those who will go to post-secondary institutions that have a Cisco Academy. By meeting the requirements developed by Cisco for course completion at Marshfield, the student may begin their post-secondary education at the next level. The courses also meet national education standards for math science and language.

R*esearch Question Two*

How are state and national standards integrated into Computer Networking courses? According to the Cisco Standards Alignment chart, CCNA 1 relates to the national standards for math, language arts, and science 599 times. The CCNA 2 curriculum relates to the national standards 610 times. (see Appendix B) The researcher was unable to find standards alignment for the Wisconsin's educational standards.

Research Question Three

How are the Computer Networking courses targeted towards high achieving students? Computer Networking courses are targeted towards high achieving students through the opportunities they present beyond High School. The first is the opportunity to transfer their credits earned at the high school into secondary institutions offering the same curriculum. The second is that the courses prepare students to take the CCNA professional certification exam.

Research Question Four

How does a culminating project demonstrate the use of high level thinking skills? As a part of the Computer Networking I course the culminating project is the case study. This case study allows students to complete a network design, implementation, and troubleshooting project using the skills gained during the course. Students will use the skills that have already been developed to use, make, and connect the proper cabling to the appropriate devices. They also design the IP addressing scheme and troubleshoot the network after completed. The students use their application, evaluation, and synthesis thinking skills in several ways. The Computer Networking II class has a more complicated case study. They are required to design a network for a scenario of a corporate situation with four different locations. The students need to draw on information gained through the previous four semesters in order to develop a sufficient design.

Research Question Five

Is the Computer Networking curriculum relevant to students at Marshfield High School? It becomes evident in the literature that the field of information technology specifically computer networking is becoming extremely relevant in the world that we

live. Marshfield students are no exception. It is not clear whether using a purely Cisco Academy approach is the optimal educational solution for students due to the proprietary nature of the program.

Recommendations for Further Study

The analysis of the Computer Networking courses is the first step in serving high achieving students with Information Technology. The relatively new and constant evolving nature of information technology education more research seems to be required. The recommendations for further research are as follows.

a. It is recommended and planned that research be conducted to determine whether the Cisco Academy Program is the most advantageous curriculum to teach students at Marshfield High School.
b. It is recommended that the Technology Education Department at Marshfield High School research other classes that may meet the criteria for honors credit.
c. If the Computer Networking courses are approved for honors credit, it is recommended that research be conducted to find out implications of honors status on the student population that enrolls in classes.
d. In order for the computer networking courses to meet the criteria for honors, further research would have to be performed to document the alignment with state standards.
e. It is recommended that research should be conducted to review the criteria for honors credit in order to compare them national and state norms.

Recommendations

After research and analysis of the Computer networking classes at Marshfield High School it is found that the classes do meet the criteria for honors credit. It is recommended that steps be taken to pursue the process of approving the courses for honors credit. It is also recommended that this research be used to lay the groundwork for other information technology classes to be approved as well.

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Appendix A

Honors Level Grading Scale

	HONORS			REGULAR		
Grade	1	0.5	0.25	1	0.5	0.25
A	5	2.5	1.25	4	2	1
A-	4.59	2.29	1.147	3.67	1.835	0.917
B+	4.16	2.08	1.04	3.33	1.665	0.832
B	3.75	1.87	0.937	3	1.5	0.75
B-	3.34	1.67	0.835	2.67	1.335	0.667
C+	2.91	1.45	0.727	2.33	1.165	0.582
C	2.5	1.25	0.625	2	1	0.5
C-	2.09	1.04	0.522	1.67	0.835	0.417
D+	1.66	0.83	0.415	1.33	0.665	0.332
D	1.25	0.62	0.312	1	0.5	0.25
D-	0.84	0.42	0.21	0.67	0.335	0.167

Appendix A

CCNA National Standards Alignment

Chapter 1 - Computer Basics

Objective 1.1 - Connecting to the Internet

Standards USA > National Standards > Language Arts
L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math
M2.1 - Understand patterns, relations, and functions

M2.2 - Represents and analyze mathematical situations and structures using algebra...

M2.4 - Analyze change in various concepts

M4.1 - Understand measurable attributes of objects and the units, systems and proc...

M5.1 - Formulate questions that can be addressed with data and collect, organize a...

M5.3 - Develop and evaluate inferences and predictions that are based on data

Standards USA > National Standards > Science
S2.1 - Abilities necessary to do scientific inquiry

S6.2 - Abilities of technological design

Objective 1.2 - Network Math

Standards USA > National Standards > Language Arts
L12 - Student use spoken, written, and visual language to accomplish their own pu...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L5 - Students employ a wide range of strategies as they write and use different

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math
M1.1 - Understand numbers ways of representing numbers, relationships among number...

M1.3 - Compute fluently and make reasonable estimates

M10.2 - Select, apply and translate among mathematical representations to solve pro...

M2.2 - Represents and analyze mathematical situations and structures using algebra...

M6.2 - Solve problems that arise in mathematics and in other contexts

M6.3 - Apply and adapt a variety of appropriate strategies to solve problems

M9.3 - Recognize and apply mathematics in contexts outside of mathematics

Chapter 2 - Networking Fundamentals

Objective 2.1 - Networking Terminology

Standards USA > National Standards > Language Arts
L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Science
S8.3 - Historical perspectives

Objective 2.2 - Bandwidth

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L2 - Students read a wide range of literature from many periods in many genres t...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math
M1.1 - Understand numbers ways of representing numbers, relationships among number...

M1.3 - Compute fluently and make reasonable estimates

M2.2 - Represents and analyze mathematical situations and structures using algebra...

M6.2 - Solve problems that arise in mathematics and in other contexts

M6.3 - Apply and adapt a variety of appropriate strategies to solve problems

M7.2 - Make and investigate mathematical conjectures

M9.3 - Recognize and apply mathematics in contexts outside of mathematics

Standards USA > National Standards > Science
S1.1 - Systems, order, and organization

S2.1 - Abilities necessary to do scientific inquiry

S6.2 - Abilities of technological design

Objective 2.3 - Networking Models

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math
M1.2 - Understand meanings of operations and how they relate to one another

M2.1 - Understand patterns, relations, and functions

Standards USA > National Standards > Science
S1.1 - Systems, order, and organization

S1.2 - Evidence, models, and explanation

S6.2 - Abilities of technological design

S8.3 - Historical perspectives

Chapter 3 - Networking Media

Objective 3.1 - Copper Media

Standards USA > National Standards > Language Arts
L12 - Student use spoken, written, and visual language to accomplish their own pu...

L2 - Students read a wide range of literature from many periods in many genres t...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math
M2.1 - Understand patterns, relations, and functions

Standards USA > National Standards > Science
S3.2 - Structure and properties of matter

S3.4 - Motions and forces

S8.3 - Historical perspectives

Objective 3.2 - Optical Media

Standards USA > National Standards > Language Arts
L12 - Student use spoken, written, and visual language to accomplish their own pu...

L2 - Students read a wide range of literature from many periods in many genres t...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Objective 3.3 - Wireless Media

Standards USA > National Standards > Language Arts
L12 - Student use spoken, written, and visual language to accomplish their own pu...

L2 - Students read a wide range of literature from many periods in many genres t...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Chapter 4 - Cabling Testing

Objective 4.1 - Background for Studying Frequency-Based Cable Testing

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L11 - Students participate as knowledgeable, reflective, creative, and critical m...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L2 - Students read a wide range of literature from many periods in many genres t...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math

M1.1 - Understand numbers ways of representing numbers, relationships among number...

M1.2 - Understand meanings of operations and how they relate to one another

M10.2 - Select, apply and translate among mathematical representations to solve pro...

M2.1 - Understand patterns, relations, and functions

M4.1 - Understand measurable attributes of objects and the units, systems and proc...

M4.2 - Apply appropriate techniques, tools and formulas to determine measurements

M5.3 - Develop and evaluate inferences and predictions that are based on data

M6.1 - Build new mathematical knowledge through problem solving

M6.3 - Apply and adapt a variety of appropriate strategies to solve problems

Objective 4.2 - Signals and Noise

Standards USA > National Standards > Language Arts

L1 - Students read a wide range of print and nonprint texts to build an understa...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Chapter 5 - Cabling LANs and WANs

Objective 5.1 - Cabling the LAN

Standards USA > National Standards > Language Arts

L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L11 - Students participate as knowledgeable, reflective, creative, and critical m...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L2 - Students read a wide range of literature from many periods in many genres t...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math
M1.1 - Understand numbers ways of representing numbers, relationships among number...

M1.2 - Understand meanings of operations and how they relate to one another

M1.3 - Compute fluently and make reasonable estimates

M10.2 - Select, apply and translate among mathematical representations to solve pro...

M2.1 - Understand patterns, relations, and functions

M4.1 - Understand measurable attributes of objects and the units, systems and proc...

M4.2 - Apply appropriate techniques, tools and formulas to determine measurements

M5.1 - Formulate questions that can be addressed with data and collect, organize a...

M5.3 - Develop and evaluate inferences and predictions that are based on data

M6.1 - Build new mathematical knowledge through problem solving

M6.3 - Apply and adapt a variety of appropriate strategies to solve problems

M8.3 - Analyze and evaluate the mathematical thinking and strategies of others

Objective 5.2 - Cabling the WAN

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L11 - Students participate as knowledgeable, reflective, creative, and critical m...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L2 - Students read a wide range of literature from many periods in many genres t...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math

M1.1 - Understand numbers ways of representing numbers, relationships among number...

M1.2 - Understand meanings of operations and how they relate to one another

M1.3 - Compute fluently and make reasonable estimates

M10.2 - Select, apply and translate among mathematical representations to solve pro...

M2.1 - Understand patterns, relations, and functions

M4.1 - Understand measurable attributes of objects and the units, systems and proc...

M4.2 - Apply appropriate techniques, tools and formulas to determine measurements

M5.1 - Formulate questions that can be addressed with data and collect, organize a...

M5.3 - Develop and evaluate inferences and predictions that are based on data

M6.1 - Build new mathematical knowledge through problem solving

M6.3 - Apply and adapt a variety of appropriate strategies to solve problems

M8.3 - Analyze and evaluate the mathematical thinking and strategies of others

Chapter 6 - Ethernet Fundamentals

Objective 6.1 - Ethernet Fundamentals

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L11 - Students participate as knowledgeable, reflective, creative, and critical m...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Objective 6.2 - Ethernet Operation

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L11 - Students participate as knowledgeable, reflective, creative, and critical m...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L2 - Students read a wide range of literature from many periods in many genres t...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Chapter 7 - Ethernet Technologies

Objective 7.1 - 10-Mbps and 100-Mbps Ethernet

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L11 - Students participate as knowledgeable, reflective, creative, and critical m...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Objective 7.2 - Gigabit and 10 Gigabit Ethernet

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L11 - Students participate as knowledgeable, reflective, creative, and critical m...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Chapter 8 - Ethernet Switching

Objective 8.1 - Ethernet Switching

Standards USA > National Standards > Language Arts

L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L11 - Students participate as knowledgeable, reflective, creative, and critical m...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L2 - Students read a wide range of literature from many periods in many genres t...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Objective 8.2 - Collision Domains and Broadcast Domains

Standards USA > National Standards > Language Arts

L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L11 - Students participate as knowledgeable, reflective, creative, and critical m...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L2 - Students read a wide range of literature from many periods in many genres t...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Chapter 9 - TCP/IP Protocol Suite and IP Addressing

Objective 9.1 - Introduction to TCP/IP

Standards USA > National Standards > Language Arts

L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L11 - Students participate as knowledgeable, reflective, creative, and critical m...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math
M1.1 - Understand numbers ways of representing numbers, relationships among number...

M1.2 - Understand meanings of operations and how they relate to one another

M10.2 - Select, apply and translate among mathematical representations to solve pro...

M2.1 - Understand patterns, relations, and functions

Objective 9.2 - Internet Addresses

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math
M1.1 - Understand numbers ways of representing numbers, relationships among number...

M1.3 - Compute fluently and make reasonable estimates

M10.2 - Select, apply and translate among mathematical representations to solve pro...

M2.2 - Represents and analyze mathematical situations and structures using algebra...

M6.2 - Solve problems that arise in mathematics and in other contexts

M9.3 - Recognize and apply mathematics in contexts outside of mathematics

Objective 9.3 - Obtaining an IP Address

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math
M10.1 - Create and use representations to organize, record, and communicate mathema...

M10.2 - Select, apply and translate among mathematical representations to solve pro...

M10.3 - Use representations to model and interpret physical, social, and mathematic...

M2.4 - Analyze change in various concepts

M6.1 - Build new mathematical knowledge through problem solving

M6.3 - Apply and adapt a variety of appropriate strategies to solve problems

Standards USA > National Standards > Science
S2.1 - Abilities necessary to do scientific inquiry

Chapter 10 - Routing Fundamentals and Subnets

Objective 10.1 - Routed Protocol

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L2 - Students read a wide range of literature from many periods in many genres t...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math
M10.2 - Select, apply and translate among mathematical representations to solve pro...

M10.3 - Use representations to model and interpret physical, social, and mathematic...

M2.4 - Analyze change in various concepts

M4.1 - Understand measurable attributes of objects and the units, systems and proc...

Standards USA > National Standards > Science
S1.1 - Systems, order, and organization

S1.2 - Evidence, models, and explanation

S2.1 - Abilities necessary to do scientific inquiry

S3.4 - Motions and forces

Objective 10.2 - IP Routing Protocols

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math
M10.2 - Select, apply and translate among mathematical representations to solve pro...

M10.3 - Use representations to model and interpret physical, social, and mathematic...

M2.4 - Analyze change in various concepts

M4.1 - Understand measurable attributes of objects and the units, systems and proc...

Standards USA > National Standards > Science
S1.1 - Systems, order, and organization

S1.2 - Evidence, models, and explanation

S2.1 - Abilities necessary to do scientific inquiry

S3.4 - Motions and forces

Objective 10.3 - The Mechanics of Subnetting

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L11 - Students participate as knowledgeable, reflective, creative, and critical m...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math
M1.1 - Understand numbers ways of representing numbers, relationships among number...

M1.3 - Compute fluently and make reasonable estimates

M2.2 - Represents and analyze mathematical situations and structures using algebra...

M6.1 - Build new mathematical knowledge through problem solving

Chapter 11 - TCP/IP Transport and Application Layer

Objective 11.1 - TCP/IP Transport Layer

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L11 - Students participate as knowledgeable, reflective, creative, and critical m...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math
M1.1 - Understand numbers ways of representing numbers, relationships among number...

M1.2 - Understand meanings of operations and how they relate to one another

M10.2 - Select, apply and translate among mathematical representations to solve pro...

M2.1 - Understand patterns, relations, and functions

Objective 11.2 - The Application Layer

Standards USA > National Standards > Language Arts
L1 - Students read a wide range of print and nonprint texts to build an understa...

L10 - Students whose first language is not English make use of their first langua...

L11 - Students participate as knowledgeable, reflective, creative, and critical m...

L12 - Student use spoken, written, and visual language to accomplish their own pu...

L3 - Students apply a wide range of strategies to comprehend, interpret, evaluat...

L4 - Students adjust their use of spoken, written, and visual language (e.g., co...

L5 - Students employ a wide range of strategies as they write and use different

L6 - Students apply knowledge of language structure, language conventions (e.g.,...

L7 - Students conduct research on issues and interests by generating ideas and q...

L8 - Students use a variety of technological and information resources (e.g., li...

Standards USA > National Standards > Math

M1.2 - Understand meanings of operations and how they relate to one another

M10.2 - Select, apply and translate among mathematical representations to solve pro...

M2.1 - Understand patterns, relations, and functions

M2.4 - Analyze change in various concepts