

Final Report

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Part I: Overview	3
Part I: Overview	3
Comments on Revisions	3
Instructional Analysis	3
Motivation.....	3
Motivation Example:	3
Objectives	4
Terminal Objective	4
Prerequisite skills.....	5
Learner Practice and Feedback.....	7
Transfer	9
Conclusion	9
Objectives and Assessment Items.....	10
Part II: Formative Evaluation Report Format	11
OVERVIEW	11
Program Title	11
Target Audience.....	11
Major goal.....	11
PROGRAM DESCRIPTION.....	11
Instructional Objectives	11
Materials	11
TRYOUT PROCEDURES (for Small Group Evaluation).....	12
Participants.....	12
Process	12
Data Sources and Collection.....	13
RESULTS	13
Achievement Data.....	13
Attitude Data.....	14
Observations and Other Data.....	14
DISCUSSION AND REVISIONS FROM SMALL GROUP EVALUATION.....	15
Add more content.....	15
Correct Typographical Errors	15
Conclusion	15
APPENDIX 1 Sample Learner Characteristics Tables.....	16
APPENDIX 2 Posttest Data Summary Table for Individual Learners	17
APPENDIX 3: Sample Table for Performance Data Summary	18
APPENDIX 4 Summary of Attitude Survey Responses.....	19
Table 1:Prerequisite Skills	5
Table 2: Learner Practice and Feedback.....	7
Table 3: Objectives and Assessment Items.....	10
Table 4: Data Sources	13
Table 5: Sample Learner Characteristics	16
Table 6: Learner Performance on Post-Test	17
Table 7: Pre-Test Results by Objective	18
Table 8: Post-Test Results by Objective.....	18
Table 9: Attitude Survey Responses.....	19

Part I: Overview

Comments on Revisions

There were minor revisions made to the Instructional Analysis portion of this project. The revisions made included:

- Minor changes to the Motivational Example
- Changes to the planned learner practice and feedback
 - **Pre-test:** Based on initial learner interviews, it was determined that a pre-test should be administered to check for understanding on some of the expected entry-level behaviors. The pre-test also tested for understanding of some of the critical module objectives, including the terminal objective.
 - **Practice:** The terminal objective will now be tested during the instructional module.

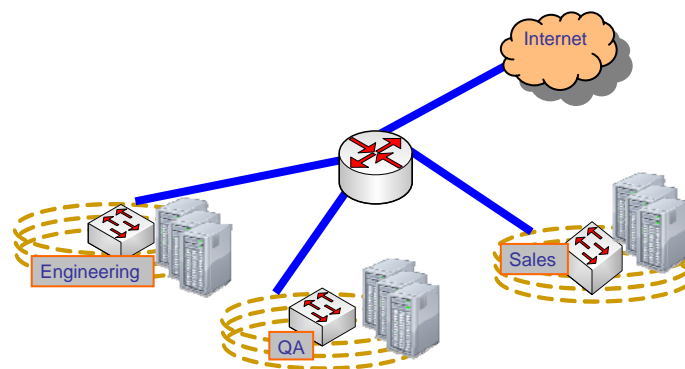
Instructional Analysis

Motivation

I will gain the learner's attention by explaining how the instruction will help them learn to determine basic networking information that will help troubleshoot a network.

Motivation Example:

In a large IP environment, routers are used to break up large networks into subnetworks. This diagram shows a router breaking a network into three subnets; one for engineering, one for QA, and one for sales.



Each node in a network is identified by an IP address and a subnet mask. These two pieces of information can be used to identify on which subnet the node resides. Being able to identify the network information helps make routing between networks efficient.

If you work with any of the Network Management/Configuration products you will need to be familiar with basic network troubleshooting skills.

If you work with any products that are connected to an IP network, you probably need to know how to troubleshoot that IP connection.

By the end of this module, you will be able to take any IP Address and Subnet mask, and using only a pencil and piece of paper determine the network address for that pair.

Objectives

I will list all the objectives on the first page, but the objective will be restated at the beginning of the instruction for each objective. The objectives are as follows:

On completion of this module, you will be able to complete the following objectives:

1. Given an IP Address, students will convert the IP address from Decimal to Binary
2. Given a Subnet Mask, students will convert the Subnet Mask from Decimal to Binary
3. Students will perform a Boolean AND operation on the Binary IP Address and Binary Subnet Mask
4. Given the result of a Boolean operation on an IP Address and Subnet Mask, students will convert the binary operation results to decimal format.
5. Students will write the Network Address for the given IP Address and Subnet Mask in dotted decimal notation

The lessons and practice examples in this module are cumulative, that is each lesson and practice example builds on the next lesson. The terminal lesson for this module is as follows:

Terminal Objective

Given an IP Address and Subnet Mask, EMC personnel will be able to determine the Network ID.

Prerequisite skills

Although this is a basic IP networking module, there are some basic required prerequisite skills.

Table 1: Prerequisite Skills

Prerequisite Skill	Helping Learner Recall?	Yes: Explain How No: Explain Why
1.1.1 Identify an IP Address	N	It is expected that all learners will possess this skill
1.1.2. Define dotted decimal notation	Y	It is expected that all learners will possess this skill
1.1.3. Identify octets of an IP Address	Y	<p>Will test in a pre-test by asking learners to break an IP address into its octets. Will test for understanding by asking learners to identify the octets in the example IP Address. The octets will be identified in the answer to the test for understanding.</p> <p>Example: Please fill in the blanks with the correct answer:</p> <p>3. Separate the following IP Address into four octets: 10.192.96.181</p> <p><i>Answer:</i> _____</p> <p>Answer: 10 192 96 181</p>
2.1.1 Order whole decimal numbers	N	It is expected that all learners will possess this skill
2.1.2. Identify Whole decimal numbers	N	It is expected that all learners will possess this skill
2.1.3. Evaluate inequalities of whole numbers	N	It is expected that all learners will possess this skill
2.1.4 Identify the MSD in a binary string.	Y	Will test in a pre-test by asking learners to identify the MSD of the first binary conversion. The definition for MSD will be identified in the first part of the instruction.

		<p>Example: 1. What is the MSB of the following binary number? 1100111 A. 1 B. 0</p> <p>Answer: A</p>
2.2.1. Write whole numbers	N	It is expected that all learners will possess this skill
2.3.1. Subtract whole numbers up to three place values.	N	It is expected that all learners will possess this skill
2.5.1. Identify the LSD in a binary string	Y	<p>Will test in a pre-test by asking learners to identify the LSD of the first binary conversion. The definition for LSD will be identified in the first part of the instruction.</p> <p>Example: 2. What is the LSB of the following binary number? 1100111 A. 1 B. 0</p> <p>Answer: A</p>
2.11.1. Write binary numbers.	N	It is expected that all learners will possess this skill
3.1.1 Identify a Subnet Mask	N	It is expected that all learners will possess this skill

Learner Practice and Feedback

Table 2: Learner Practice and Feedback

Objective	Practice Example	Number of Practice Items	Type of Included Feedback																		
<p>1. Given an IP Address, students will convert the IP address from Decimal to Binary</p>	<p>Please fill in the blanks with the correct answer:</p> <p>1. Use the binary conversion chart to convert this IP Address from decimal to binary: 10.16.122.55</p> <table border="1" data-bbox="585 626 1255 740"> <tr> <td>128</td> <td>64</td> <td>32</td> <td>16</td> <td>8</td> <td>4</td> <td>2</td> <td>1</td> <td>Place Value</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Binary</td> </tr> </table> <p><i>Answer:</i> _____</p> <p>Correct Answer:</p>	128	64	32	16	8	4	2	1	Place Value									Binary	<p>1 Item during the instruction 1 Item during the Post-test</p>	<p>The answer will be explained after the Item has been presented during instruction. The way that the answer was determined will be explained as a type of feedback.</p>
128	64	32	16	8	4	2	1	Place Value													
								Binary													
<p>2. Given a Subnet Mask, students will convert the Subnet Mask from Decimal to Binary</p>	<p>2. Use the binary conversion chart to convert this Subnet mask from decimal to binary: 255.255.255.0</p> <table border="1" data-bbox="585 1143 1255 1256"> <tr> <td>128</td> <td>64</td> <td>32</td> <td>16</td> <td>8</td> <td>4</td> <td>2</td> <td>1</td> <td>Place Value</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Binary</td> </tr> </table> <p><i>Answer:</i> _____</p>	128	64	32	16	8	4	2	1	Place Value									Binary	<p>1 Item during the instruction 1 Item during the Post-test</p>	<p>The answer will be explained after the Item has been presented during instruction. The way that the answer was determined will be explained as a type of feedback.</p>
128	64	32	16	8	4	2	1	Place Value													
								Binary													

	Correct Answer:								
3. Students will perform a Boolean AND operation on the Binary IP Address and Binary Subnet Mask	<p>6. Perform a Boolean AND operation on the following binary IP address and binary subnet Mask. Write the Boolean AND results in the following chart:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">00001010011111110110000001111111</td> <td style="text-align: center;">IP Address</td> </tr> <tr> <td style="text-align: center;">111111111111111111111111100000000</td> <td style="text-align: center;">Subnet Mask</td> </tr> <tr> <td style="text-align: center;"> </td> <td style="text-align: center;">Boolean AND Results</td> </tr> </table> <p style="text-align: center;"><i>Answer:</i> _____</p> <p>Correct Answer:</p>	00001010011111110110000001111111	IP Address	111111111111111111111111100000000	Subnet Mask		Boolean AND Results	<p>1 Item during the Pre-Test 1 Item during the instruction 1 Item during the Post-test</p>	<p>The concept of Boolean AND will be tested during the pre-test to determine audience awareness of this concept. The answer will be explained after the Item has been presented during instruction. The way that the answer was determined will be explained as a type of feedback.</p>
00001010011111110110000001111111	IP Address								
111111111111111111111111100000000	Subnet Mask								
	Boolean AND Results								
4. Given the result of a Boolean operation on an IP Address and Subnet Mask, students will convert the binary operation results to decimal format.	<p>6. Covert the following IP address from decimal to binary:</p> <p style="text-align: center;">00001010011111110110000000000000</p> <p style="text-align: center;"><i>Answer:</i> _____</p> <p>Correct Answer:</p>	<p>1 Item during the Pre-Test 1 Item during the instruction 1 Item during the Post-test</p>	<p>The concept of converting binary numbers to decimal format will be tested during the pre-test to determine audience awareness of this concept. The answer will be explained after the Item has been presented during instruction. The way that the answer was determined will be explained as a type of feedback.</p>						
Terminal Objective:	For the following IP Address and Subnet Mask, calculate	1 Item during the Pre-	The concept of the						

<p>Given an IP Address and Subnet Mask, EMC personnel will be able to determine the Network ID.</p>	<p>the Network ID. Do not use a calculator to find the Network ID. Write the Network ID in the space provided.</p> <p style="text-align: center;"> IP Address: 192.168.100.115 Subnet Mask: 255.255.0.0 Answer: _____ </p> <p>Correct Answer:</p>	<p>Test</p> <p>1 Item during the instruction</p> <p>1 Item during the Post-test</p>	<p>terminal objective will be tested during the pre-test to determine audience awareness of this concept. The answer will be given immediately after the item is presented during instruction.</p>
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Transfer

The way I will transfer learning from the classroom to the real-world performance is to explain at the beginning of the module why it is important to understand how to extract the network IP address from the IP address and subnet mask. I will also reinforce that this skill is the one of the foundations of understanding how IP networking operates.

Conclusion

I will end the lesson by congratulating the student on learning a new skill.

Objectives and Assessment Items

This table shows each objective and the specific post-test or pre-test item that were used to measure learner attainment of each objective.

Table 3: Objectives and Assessment Items

Objective		Number of Practice Item
1. Given an IP Address, students will convert the IP address from Decimal to Binary		Post-test Item 1
	1.1.3. Identify octets of an IP Address	Pre-test Item 3 Pre-test Item 4
2. Given a Subnet Mask, students will convert the Subnet Mask from Decimal to Binary		Post-test Item 2
	2.1.4 Identify the MSD in a binary string.	Pre-test Item 1
	2.5.1. Identify the LSD in a binary string	Pretest Item 2
3. Students will perform a Boolean AND operation on the Binary IP Address and Binary Subnet Mask		Pre-test Item 5 Post-Test Item 3
4. Given the result of a Boolean operation on an IP Address and Subnet Mask, students will convert the binary operation results to decimal format.		Pre-test Item 6 Post-Test Item 4
Terminal Objective: Given an IP Address and Subnet Mask, EMC personnel will be able to determine the Network ID.		Pre-test Item 7 Post-Test Item 5

Part II: Formative Evaluation Report Format

Name of Developer: Gina Minks

Date: 12/06/2008

OVERVIEW

Program Title

Determine a Node's IP Address Network

Target Audience

The targeted audience is employees of EMC Corporation who must troubleshoot IP networks. Audience members may be from customer support organizations, Professional Services organizations, Engineering, IT, or Educational Services.

Employees in these roles generally have a technical Bachelor's degree (e.g. Computer Science or MIS). In general terms, EMC personnel are used to troubleshooting host and storage issues, as well as issues with Storage Attached Networks (SANs) and Network Attached Networks (NAS). Traditionally these employees have not had to work with the IP networking protocols. However, recent acquisitions by EMC have introduced Network Management software products. Additionally, EMC has a growing suite of management software that is made available via the IP network. EMC personnel must be proficient in troubleshooting IP networks.

Major goal

Given an IP Address and Subnet mask, learners will use the binary conversion chart to correctly convert the IP address and subnet mask to their binary equivalent and find the network address for the given pair.

PROGRAM DESCRIPTION

Instructional Objectives

By the end of this module, the learner will be able to perform the following actions:

- Given an IP Address, convert the IP address from Decimal to Binary
- Given a Subnet Mask, convert the Subnet Mask from Decimal to Binary
- Perform a Boolean AND operation on the Binary IP Address and Binary Subnet Mask
- Given the result of a Boolean operation on an IP Address and Subnet Mask, convert the binary operation results to decimal format
- Write the Network Address for the given IP Address and Subnet Mask in dotted decimal notation

Materials

The instructional program consists of the following materials:

- Pretest
- Instructional Module
- Posttest
- Attitude Survey

TRYOUT PROCEDURES (for Small Group Evaluation)

Participants

Participants were recruited in several ways. The managers of several Education Services development teams were asked to provide the names of developers who were new to the concepts of IP network management. In addition, social media was used to recruit learners. A blog post on EMC's social media site was used to recruit learners. Facebook, Twitter, and Yammer messages were used to alert people to this blog post.

There were nine learners that participated in the tryout procedure. Five of the learners were from the Education Services department, two came from different roles in the CTO Office, and one was from Engineering. The IT industry experience level of the learners ranged from as little as two years to over twenty years. Please see Appendix 1, Table 5 for more detailed learner characteristic information.

The students took the module and provided feedback the week after Thanksgiving, which was the first month of the last quarter of the year. Since this is a time of intense activity at EMC, all of the feedback was gathered electronically.

Once learners were identified, they were provided the URL of the website that was hosting the learning materials. The website directed the learners how to proceed through the project.

Process

The following procedures were followed to conduct small group evaluation:

- Even though for the most part the entire process was delivered using electronic means, the entire process was described for the learner on the webpage. Instructions were also given for each step of the process to set the learners at ease.
- The learners were instructed to take the pre-test first. The pretest explained that the purpose for the pretest was to determine their level of knowledge about the information in the module. The learners were asked not to use a calculator.

The learners were given the following options for delivering their answers to the pre-test:

- Print the pre-test, write the answers on the test, and give it to me.
 - Type the answers on the test, and email it to me as an attachment
 - Type the answers into an email and send it to me.
- After taking the pre-test, the learners were instructed to download the module. They were given the option of printing the module, or just reading from their computer. They were informed that they needed to make calculations throughout the module, and that if they decided not to print the module they would need to have paper and pencil handy.
 - After taking the module, the learners were instructed to download the post-test. It was explained that the post-test was designed to determine if they had learned the material in the module. They were reminded not to use a calculator.

The learners were given the following options for delivering their answers to the pre-test:

- Print the pre-test, write the answers on the test, and give it to me.
- Type the answers on the test, and email it to me as an attachment

- Type the answers into an email and send it to me.
- After the learners submitted their post-test, I emailed them the learner interview. The learners were asked to answer all questions honestly, and email them back to me. I had trouble getting the interview from four of the learners. I sent the learner interview to those learners on Facebook.
- I thanked the learners, and promised a write-up of the experience on EMC’s internal social media site

Data Sources and Collection

The following data was collected:

Table 4: Data Sources

Type of Data Collected	Instrument Used	When Collected
Entry Level Behaviors and Skills	Pre-Test	Immediately before the learner took the instructional module
Performance on Instructional Material	Post-Test	Immediately after the learner took the instructional module
Learner’s perception of the materials	Attitude Survey	Immediately after the Post-Test.
Student Characteristics <ul style="list-style-type: none"> ● Name ● Email ● EMC Department ● Title ● Years of IT Experience 	Attitude Survey	During the Attitude Survey, administered immediately after the Post-Test.
Time required to Complete Materials	Attitude Survey	During the Attitude Survey, administered immediately after the Post-Test.

RESULTS

Achievement Data

Pre-test

Two learners from the target group were interviewed early in the development process for this module. After evaluating the results of the interviews, it was determined that a pre-test should be administered to evaluate if learners had the expected entry level behaviors. Since the first learners interviewed seemed confident with the topic, it was also decided to test module

objectives (including the terminal objective) in the pre-test to determine if the training topic was too simplistic for this target audience.

The results from the pre-test indicate that the learners did have most of the expected entry-level behaviors (please see Appendix 3, Table 7 for details). For two of the behaviors (identify an MSD and LSD of a binary string) the learners had a mean score of 8.8 out of 10. However, learners had problems with identifying octets, scoring only 15.5 out of 20 on the questions addressing that entry-level behavior.

While the learners did fantastic on the converting binary to decimal (100%), they struggled with performing Boolean operations (44%) and the terminal objective of calculating the Network IP Address and Subnet mask (44%) This indicates that the learners possess the entry-level skills required for the module, and they also could benefit from the instructional objectives of the module.

Post-Test

The performance data collected from the post-tests indicated that the students learned the materials in the module (please see Appendix 3, Table 8 for details). 100% of the students were able to convert an IP Address from decimal to binary during the post-test. 75% of the students were able to convert a subnet mask from decimal to binary. The students also scored 75% on performing a Boolean AND operation and the terminal objective, both up from 44% in the pre-test. This is an indication that the instruction facilitated learning of these objectives.

The learners only had a problem with converting the result of the Boolean AND operation from binary to decimal. Only 65% of the learners successfully answered this question.

Attitude Data

All 9 students participated in the attitude survey. The student's attitude was overall positive; with an overall score of 2.3 out of 3 (please see Appendix 4, Table 9). Several students liked learning about Boolean AND operations, and indicated that the module was well presented and easy to understand. Most people commented to me that they enjoyed the feedback that was presented during the module.

Several students indicated that the instruction was not challenging enough. This is interesting, because the scores on the pre-test were lowest on the test items for the training objectives.

Observations and Other Data

The time taken by learners to complete the module indicates that more instruction could have been included. Almost one quarter of the learners (22%) finished the module in 15 minutes. One learner even finished the module in five minutes! This would seem to validate the students' claims that the learning was not challenging.

It seems that the learners did pick up some new knowledge, as the times for completing the post-test were lower than the times for completing the pre-test.

From informal chats with the learners, I found that the learners did enjoy understanding the way to put disparate pieces of information together to figure out the network address. The skills themselves were not challenging, but using those skills in a different way than they have previously used them are what seemed to be of greatest interest to them.

DISCUSSION AND REVISIONS FROM SMALL GROUP EVALUATION

Add more content

Even though the final module was 49 pages long, the majority of users were able to complete the instruction in 15 minutes or less. This supports the indication given by some learners that the instruction was not challenging enough. More investigation should be done to determine if the module can be made more interesting by tying skills most EMC employees have that support Fibre Channel networking to IP Networking principles. Perhaps more than just determining the network IP address should be taught during this module.

Correct Typographical Errors

There were typographical errors in both the module and in the post-test. If there had been an SME review, these errors would have been caught.

Module Error

There was an error on two pages of the module. This was pointed out by the first person to complete the module. These errors should be corrected.

Post-Test Error

The one test item that gave the learners trouble addressed converting the results of a Boolean AND from binary to decimal. Since the learners did well on this objective in the pre-test these results were surprising. After examining the test question, it was determined that that question had a typo. This question will need to be revised for any future learning audiences. The raw data from the post test can be examined in Appendix 2, Table 6.

Conclusion

The learners achieved all objectives including the terminal goal of the module, which was to be able to determine the Network IP address if they were given an IP address and a Subnet mask. There did not seem to be a correlation of time spent on the module to the time spent on the post-test. However, all of learners spent less time on the post-test than they did on the pre-test which would indicate some level of learning was achieved.

The students' observation that the module was not challenging enough should be taken into serious consideration. This module should be expanded to include at least one other IP networking basic skill, perhaps instruction on subnetting a network.

APPENDIX 1 Sample Learner Characteristics Tables

Table 5: Sample Learner Characteristics

Learner	Gender	IT Experience (Years)	EMC Organization	Title
VB	F	2	Education Services	Technical Education Specialist
ED	M	3	Education Services	Technical Education Specialist
MR	F	18	Education Services	Senior Technical Education Consultant
MN	M	2	Education Services	Technical Education Specialist
JC	M	3	Education Services	Technical Education Specialist
WE	M	3	Education Services	Technical Education Specialist
SM	M	13	CTO Office	Technologist
ST	M	22	Engineering	Distinguished Engineer
AB	M	3	CTO Office	Software Configuration & Release Engineer

APPENDIX 2 Posttest Data Summary Table for Individual Learners

Table 6: Learner Performance on Post-Test

Objective	Item	Learners									#Learners correct	#Learners mastering objectives
		VB	WE	ED	MR	MN	JC	SM	ST	AB		
1.	1	√	√	√	√	√	√	√	√	√	9	9
2.	2	√	√	√	√	√	√	√	√	√	9	9
3.	3	√	√	X	√	√	√	X	√	√	7	7
4.	4	√	/	√	√	√	X	√	/	√	6	Unknown
Terminal	5	√	√	√	√	√	√	√	√	√	7	7

Key: (√) Represents a correct response. (X) Represents an incorrect response.(/) Represents a blank

APPENDIX 3: Sample Table for Performance Data Summary

Table 7: Pre-Test Results by Objective

Question	Max. Points	Mean Score	%
Objective 2.1.4: Identify the MSD in a binary string	10	8.8	88%
Q.1 Identify the MSD in a binary string	10	8.8	88%
Objective 2.5.1: Identify the LSD in a binary string	10	8.8	88%
Q. 2 Identify the LSD in a binary string	10	8.8	88%
Objective 1.1.3: Identify octets of an IP Address	20	15.5	60%
Q. 3 Separate an IP Address into four octets	10	10	100%
Q.4 Convert the first octet of a Subnet mask from decimal to binary	10	5.5	55%
Objective 3: Perform a Boolean AND operation on the Binary IP Address and Binary Subnet Mask	20	8.8	44%
Q. 5 Perform a Boolean AND on a binary numbers	20	8.8	44%
Objective 1: Given an IP Address, students will convert the IP address from Decimal to Binary	20	20	100%
Q.6 Using the conversion chart, covert a binary number to decimal	20	20	100%
Terminal Objective: Given an IP Address and Subnet Mask, EMC personnel will be able to determine the Network ID	20	8.8	44%
Q. 7 For the following IP Address and Subnet Mask, calculate the Network ID	20	8.8	44%
TOTAL:	100	70.7	71%

Table 8: Post-Test Results by Objective

Question	Max. Points	Mean Score	%
Objective 1: Given an IP Address, convert the IP address from Decimal to Binary	20	20	100%
Q. 1 Convert the IP address from Decimal to Binary	20	20	100%
Objective 2: Given a Subnet Mask, convert the Subnet Mask from Decimal to Binary	20	15.5	75.5%
Q. 2 Convert the Subnet Mask from Decimal to Binary	20	15.5	75.5%
Objective 3: Perform a Boolean AND operation on the Binary IP Address and Binary Subnet Mask	20	15.5	75.5%
Q. 3 Perform a Boolean AND operation on a Binary IP and Subnet Mask	20	15.5	75.5%
Objective 4: Given the result of a Boolean operation on an IP Address and Subnet Mask, convert the binary operation results to decimal format	20	13.3	65.5%
Q. 4 Convert the result of the binary operation from binary to decimal format	20	13.3	65.5%
Terminal Objective	20	15.5	75.5%
Q. 5 Compute network address from an IP address and Subnet mask	20	15.5	75.5%
TOTAL:	100	79.8	80%

APPENDIX 4 Summary of Attitude Survey Responses

Circle your answer for each statement based on the following key:

SA – strongly agree	D – disagree
A – agree	SD – strongly disagree

Table 9: Attitude Survey Responses

	SA	A	D	SD	Mean
	(3)	(2)	(1)	(0)	
1. The <i>Determining Network IP Address</i> module was interesting.	12	10	N/A	N/A	2.4
2. The <i>Determining Network IP Address</i> module was easy to learn.	15	8	N/A	N/A	2.5
3. Information in the <i>Determining Network IP Address</i> module was well presented and easy to understand.	18	6	N/A	N/A	2.6
4. The <i>Determining Network IP Address</i> module helped me learn how to determine a node's network IP Address.	9	12	N/A	N/A	2.3
5. I now understand how to determine a node's network address by evaluating its IP Address and subnet mask.	15	8	N/A	N/A	2.5
6. I can now convert an IP address from decimal to binary without using a calculator.	18	6	N/A	N/A	2.6
7. I can now convert a subnet mask from decimal to binary without using a calculator.	21	4	N/A	N/A	2.7
8. I can now perform Boolean AND operations on binary strings.	24	2	N/A	N/A	2.8
TOTAL	132	56	N/A	N/A	2.35
9. What did you like the most about the instruction?				9 *	
• Information was well presented and easy to understand				6	
• Interesting examples				0	
• Learning how to convert IP addresses from decimal to binary and vice versa				0	
• Learning to perform Boolean AND operations				3	
• Other: _____					
10. What did you like the least about the instruction?				9	
• Difficult to understand in places				1	
• Redundant explanations				0	
• Liked everything				5	
• Too many strange terms				0	
• Too much reading/text				0	
• Topic not challenging				3	
• Other				0	

*Number of times mentioned.

Time in minutes	2	5	10	8	15	25	30	Total
How long did it take you to complete the pre-test?	1	1	5		2			9
How long did it take you to complete the module?		1			4	2	2	9
How long did it take you to complete the post-test?	1		7	1				9