University of Michigan-Dearborn

Evaluation of Learning
EDC 554

Project II

A Mathematics Unit
For
Grades 9 – 10

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Purpose:

The objective of this unit is to have the students understand linear equations and learn solving linear equations in addition, subtraction, multiplication, and division with a variable on only one side of the equation and with variables on both sides of the equation. In addition to these, ratios and proportions will be included for application and problem solving. These will be realized through lectures, cooperative learning, guided exercises, independent practice, and projects. These methods will guide the students as they transition through the varied portions of the unit. Thus, the lecture will provide the foundations or principles; the modeling will carry out the principles into use; the cooperative learning will promote collaboration; the guided exercise will offer the opportunity to fill in the learning gap if an information is unclear; independent practice will serve as a reinforcement and finally, the projects will promote innovation and judgment of suitability.

A. Combining terms

1. Knows the concept of algebraic equations. (Knowledge)
   1.1 Defines the parts of an algebraic equation.
   1.2 Identifies the terms of an algebraic equation.
   1.3 Identifies an algebraic expression from an algebraic equation.

2. Understands how algebraic equations work. (Comprehension)
   2.1 Distinguishes between coefficients and variables.
   2.2 Differentiates like terms and unlike terms.
   2.3 Explains how like terms are combined.

3. Analyzes the terms and operations of an algebraic equation. (Analysis)
   3.1 Breaks down the algebraic equation by grouping using the distributive property.
   3.2 Illustrates removing parentheses in an algebraic expression.

4. Knows the concept of a linear equation. (Knowledge)
   4.1 Writes a definition of the linear equation.

5. Comprehends the principles of a linear equation. (Comprehension)
   5.1. Distinguishes between a linear equation and a non-linear equation.
   5.2. Explains what the solution to an equation is.

B. Solving Linear Equations with Addition and Subtraction

6. Knows the concept of equivalent in an algebraic equation. (Knowledge)
   6.1 Defines inverse operations.
   6.2 Describes the concept of equivalent in an equation in addition.
   6.3 Describes the concept of equivalent in an equation in subtraction.

7. Knows the properties of equality. (Knowledge)
   7.1 States the property of equality in addition.
   7.2 States the property of equality in subtraction.

8. Applies the concept of inverse operations. (Application)
   8.1 Solves an equation in addition with inverse operations.
   8.2 Solves an equation in subtraction with inverse operations.

9. Recognizes the relevance of solving linear equations in modeling. (Analysis)
   9.1 Infers from the given word problem, the given information.
   9.2 Infers from the given word problem, the unknown variable.
   9.3 Infers from verbal statements linear equations in addition.
   9.4 Infers from verbal statements linear equations in subtraction.

10. Integrates the learning on the addition and subtraction of equations. (Synthesis)
   10.1 Creates own model with own solution.

C. Solving Linear Equations with Multiplication and Division

11. Knows the concept of equivalent in an algebraic equation. (Knowledge)
   11.1 Describes the concept of equivalent in an equation in multiplication.
   11.2 Describes the concept of equivalent in an equation in division.

12. Knows the properties of equality. (Knowledge)
   12.1 States the property of equality in multiplication.
   12.2 States the property of equality in division.

13. Applies the concept of equivalent and properties of equality. (Application)
   13.1 Solves an equation by dividing each side of the equation.
   13.2 Solves an equation by multiplying each side of the equation.
   13.3 Solves an equation by multiplying a reciprocal on each side of the equation.

14. Recognizes the relevance of solving linear equations in modeling. (Analysis)
   14.1 Infers from the given word problem, the given information.
   14.2 Infers from the given word problem, the unknown variable.
   14.3 Illustrates verbal statements as linear equations in multiplication.
   14.4 Illustrates verbal statements as linear equations in division.

15. Integrates the learning on the addition and subtraction of equations. (Synthesis)
   15.1 Creates own model with own solution.

D. Solving Linear Equations with The Same Variable on Both Sides of the Equation

16. Applies the concepts and principles of solving linear equations. (Application)
    16.1 Demonstrates the concept of solution types in linear equations.
    16.2 Solves equations by combining like terms.
    16.3 Solves equations applying the distributive property.
    16.4 Solves equations using the properties of equality.

17. Recognizes the relevance of solving linear equations in modeling. (Analysis)
    17.1 Infers from the given word problem, the given information.
    17.2 Infers from the given word problem, the unknown variable.
    17.3 Illustrates verbal statements as linear equations.

18. Judges the application of linear equation in a given word problem. (Evaluation)
    18.1 Concludes from a word problem as it relates to daily application.

E. Ratios and Proportions

19. Understands the principles of ratios and proportions. (Comprehension)
    19.1 Defines ratios.
    19.2 Defines proportions.

20. Applies the concept of ratios and proportions. (Application)
    20.1 Draws the terms of a ratio from a word problem.
    20.2 Computes proportions using cross multiplication.
    20.3 Solves word problems employing proportions.

21. Judges the application of ratios and proportions in word problems. (Evaluation)
    21.1 Concludes from a word problem as it relates to daily application.

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A Two-Way Table of Specifications for the Pre-Post Test

Instructional Objectives

Content Area	Knows Concept	Comprehends Concept	Applies Concept	Analyzes Concept	Total	Percent
Combining Terms	4	5	0	2	11	24%
Solving with Addition & Subtraction	5	0	2	4	11	24%
Solving with Multiplication & Division	4	0	3	4	11	24%
Solving with a Variable On Both Sides	0	0	4	3	7	16%
Ratios and Proportions	0	2	3		5	12%
Total	13	7	12	13	45	
Percent	29%	15%	27%	29%		100%

PRE-POST TEST

A. Combining terms

Multiple Choice

1. An algebraic expression is a collection of

a. numbers, variables, grouping symbols, and operation symbols
b. numbers, variables, words, and pictures
c. symbols, quotes, signs, variables, and letters
d. numerical coefficients and variables

2. An algebraic equation shows

a. equal parts
b. two algebraic expressions equal
c. similar terms of algebraic expressions
d. equalities and inequalities

3. Following the distributive property, the algebraic expression 3a + 24 is also:

a. 3(a – 8)
b. -3(a + 8)
c. 3(a + 8)
d. -3(-a – 8)

4. Removing the parentheses with distributive property, the algebraic expression -¾ (12a + 4) becomes:

a. -36a – 12
b. 36/4a + 12/4
c. 9a + 3
d. -9a – 3

5. Likewise, –3 (3a + 1) results to:

a. a + 1/3
b. -9a – 3
c. -9a + 3
d. 9a + 3

6. Which of the following choices is a linear equation?

a. 9x2 = 18
b. (x + 2)3 = 0
c. 4y2 + 2y = 16
d. 9x + 8 = 10

7. Which of the following is a non-linear equation?

a. 5 + 4a = 12
b. 8y1 + 2 = 25
c. 2x2 + 4x = 16
d.3x + 7 = 15

Short Answer

8. What are the terms in the equation 2 + 5x = 8 – 3y? _____

9. In your own words, how do you combine like terms in the equation: 3x + 8 = x – 4+ ½? (Don't solve for x. Only explain and simplify.)

_____
_____
_____
_____

10. Define linear equation.

_____
_____
_____

11. Explain what the solution to an equation is and give an example.

_____
_____
_____

Completion

12. Fill in the blanks.

_____ are terms with only numerical coefficients different.
_____ are terms that have different variables with different exponents.

Alternative Response

13. Choose A if the given is an algebraic expression
B if the given is an algebraic equation
C if neither

3	A	B	C
4x	A	B	C
x=3	A	B	C
½ y	A	B	C
x=y	A	B	C
4x + 3	A	B	C
.08☺	A	B	C

True or False

14. Distinguish between coefficients and variables.

x is a variable of the term 2x.	True	False
3 is the coefficient of the term 3y.	True	False
In the expression x + 4, 1 is the coefficient of x.	True	False
4/3 is the coefficient in (y + 4) / 3	True	False

B. Solving Linear Equations with Addition and Subtraction

Multiple Choice

15. Inverse operations are operations that undo each other, such as addition and subtraction. Therefore, inverse operations help:

a. isolate the variable in an equation
b. eliminate the variable in an equation
c. add the variables
d. subtract the variables

16. If x – 12 = 10, then solving for x in a single step requires:

a. adding 2 on both sides
b. adding 12 on both sides
c. subtracting 12 on both sides
d. subtracting -12 on both sides

17. If y + 9 = 18, then solving for x in one step necessitates:

a. adding 9 on both sides
b. adding 18 on both sides
c. subtracting 9 on both sides
d. subtracting 8 on both sides

18. Given a = b, the addition property of equality is written as:

a. a + b = c
b. a + c = b + c
c. a2 + b2 = c2
d. a + b = a + c

19. Given a = b, the subtraction property of equality is written as:

a. a – b = c
b. a – c = b – c
c. a2 – b2 = c2
d. a – b = a – c

Multiple Choice with Short Answer

From the word problem, determine the corresponding equation. After this, supply what the unknown variable represents.

20. If you downloaded 25 songs from a website and 5 songs from a compact disc for your MP3 player, how many songs do you have?

a. x + 5 = 25
b. 25 + 5 = x
c. 25 + x = 5
d. x + 25 = -5

x: _____

21. A choir had 30 members in last year's Christmas program. This year there are only 17 members. How many choir members left?

a. x – 30 = 17
b. x + 30 = -17
c. 30 – x = 17
d. 30 – 17 = x

x: _____

22. After filling up the gas tank, the receipt showed $10 less at $50. How much was the receipt before?

a. $x + 10 = 50$
b. $50 + 10 = x$
c. $x – 10 = 50$
d. $50 – x = 10$

x:_____

Matching

23. Solve the equations to match an equation to its corresponding solution.

$x + 9 = 5$	A. $x = 4$
$x + 5 = -4$	B. $x = 52$
$x – 13 = 4$	C. $x = 1$
$x – 36 = 16$	D. $x = -9$
$16 = 12 + x$	E. $x = 17$
$-3 = x – 4$	F. $x = 9$
	G. $x = -4$

C. Solving Linear Equations with Multiplication and Division

Multiple Choice

24. How do you solve for x in ¾ x = 12 with multiplication and division?

a. Multiply 4 on the left side and then, divide by 3 on the left side
b. Multiply 4 on the right side and then, divide by 3 on the right side
c. Multiply 4 on both sides and then, divide by 3 on both sides
d. Multiply ¾ with 12 and then, divide by 4/3

25. Given a = b, the multiplication property of equality is stated as:

a. $c(ab) = abc$
b. $ac = bc$
c. $ab = c$
d. $ac = ab$

26. Given a = b, the division property of equality is stated as:

a. $a/c = b/c$, $c = 0$
b. $c/a = c/b$, $c \neq 0$
c. $a/bc = b/ac$, $c = 0$
d. $a/c = b/c$, $c \neq 0$

Multiple Choice with Short Answer

27. At a school bake sale, you have a batch of cookies, which you divided equally into 20 bags. Each bag contains 4 cookies. How many x cookies were there originally? Choose the correct equation and solve.

a. $x/20 = 4$
b. $20x = 4$

So, x = _____

28. Bob works at a fast food restaurant at x hours a week. He is paid $10 per hour. He plans to buy a video game costing $80. How many hours does he need to work in order to purchase the item? Choose the correct equation and solve.

a. $x/10 = 80$
b. $10x = 80$

So, x = _____

Short Answer

29. Solve each by dividing each side of the equation.

$12x = 36$,	$8y = 64$,	$7w = 1/3$
x = ____	y = _____	w = _____

30. Solve each by multiplying each side of the equation.

$x/5 = 25$,	$(1/9)\ x = -90$,	$y/0.25 = 100$
x = _____	x = _____	y = _____

31. Solve each by multiplying a reciprocal on each side of the equation.

$-2/3\ a = 200$	$4/5\ b = 90$,	$1/8\ c = 72$
a = _____	b = _____	c = _____

D. Solving Linear Equations with the Same Variable on Both Sides of the Equation

Alternative Response

32. Solve the equations to be able to mark A if the equation has one solution; B if it has many solutions; C if it has no solution.

$x + 7 = 2x - 4$	A B C
$2x + 12 = 2(x + 6)$	A B C
$3x - 4 = 3x - 6$	A B C
$2(x - 3) = 4x - 6 - 2x$	A B C
$1/4 + (1/2)\, a = (5/8)\, a$	A B C
$1/2\ (3x + 4) = 2/7\ (5x - 4) + 1$	A B C

33 - 37. A 10' x 10' room needs painting. Two contractors gave their quotes to fulfill the job. Contractor Y offered $100 for the first two hours and $20 per hour thereafter. Contractor Z proposed just $40 per hour. (Use x for the variable.)

Short Answer

Algebraic expression for contractor Y _____
Algebraic expression for contractor Z _____
Equate contractor Y and contractor Z algebraic expressions _____

Multiple Choice

Solving the contractor equation, when will the rates of both contractors be the same?

a. At 5 hours
b. At 7 hours
c. At 8 hours
d. At 10 hours

Short Answer

Make a conclusion as to which contractor will save you money for the job that takes 6 hours to finish the painting. State your reason. _____
_____
_____

38 – 39. You made a class newsletter. You spent $30 for ink and 5 cents for each copy. You decided to sell each newsletter for 50 cents each to cover expenses.

Multiple Choice

What equation relates to this situation.

a. $0.5x = 30 – 0.05x$
b. $30 + 0.05x = 0.5x$
c. $0.5x + 30 = 0.05x$
d. $30 – 0.05x = 0.5x$

Find the approximate number of newsletters to the next whole number that need to be sold so you can break even.

a. 66
b. 67
c. 68
d. 69

E. Ratios and Proportions

Multiple Choice

40. A ratio is a quotient of two quantities, which provides a way to compare two numbers or quantities. Which of the following is not a representation of a ratio:

a. a to b
b. a:b
c. ab
d. a/b

41. Given the proportion, $2/x = 4/9$, the terms of the ratios are:

a. $2/x$ and $4/9$
b. 2, 4, and 9
c. 2, 4, 9, and x
d. 2, $1/x$, 4, and 9

42. Using cross multiplication the value of a in the proportion $(8 – a)/6 = a/4$ is:

a. 3 2/5
b. 3.2
c. 3.15
d. 3 3/5

43. If Shane reads 40 pages of a book in 30 minutes, how long will it take her to read 800 pages?

a. 80 minutes
b. 800 minutes
c. 600 minutes
d. 60 minutes

Multiple Choice with Short Answer

44. Dinah, the cat, consumes 3.5 pounds of food in 10 days. How many pounds of food does she consume in 30 days? Which of the proportions does not represent this problem?

a. 3.5/10 = x/30
b. 10/3.5 = 30/x
c. 3.5/10 = 30/x
d. (3.5) (1/10) = x(1/30)

So, solving the proportion, x = _____.

Completion

45. A proportion is a statement of equality between two _____.

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Assessment Utilizing One Type of Intelligence

Mathematics from Fiction Reading

Purpose:

The purpose of this activity is to assess how students can relate solving linear equations to their own experiences. This will be implemented by allowing the students to utilize their favorite fiction book to derive ideas in the application of solving linear equations involving the 3 concepts covered in class: combining like terms, solving with addition and subtraction as well as solving with multiplication and division with the variable on one side of the equation. This will ***develop their verbal/linguistic intelligence*** when they write a report for oral presentation on their made up mathematical applications based on selected but mathematically related portion(s) of their chosen book. In order to facilitate understanding of this undertaking, the student will be asked to read the article entitled "Galleons, Magic Potions, and Quidditch: The Mathematics of Harry Potter" by Jim Barta and Linda L'Ai for examples. In addition to these, the students will have the opportunity to make an appraisal of their own work in collaboration with the teacher using a rating scale in the first person perspective.

1. Integrates learning from different areas of linear equations into a plan for solving problems. (Synthesis)
   1.1 Relates a unique perspective on the application of solving linear equations through fiction reading.

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The Rating Scale

Directions: On a scale of 0 to 4, with 4 representing the highest score, place an X on the cell that reflects the student's performance.

	0	1	2	3	4
Familiarity with Selected Book	I was not able to present my selected book.	I had to get acquainted with the book more. My summary had many missing details.	I had an acceptable insight of the book content. My summary had several missing details.	I had a very satisfactory know-how of the book content. My summary had few missing details.	I had an excellent understanding of the book content. I provided a complete summary.
Relevance of Chosen Book Segment with Linear Equations	I was not able to present my selected book	I was not able to connect linear equations with my chosen book segment(s).	I was able to relate at most 1 of the 3 concepts in linear equation with my chosen book segment(s).	I was able to relate at most 2 of the 3 concepts in linear equation with my chosen book segment(s).	I was able to relate all 3 concepts in linear equation with my chosen book segment(s).
Clarity of Delivery	I was not able to present my selected book	I was not able to explain clearly. I had no visual aids.	I did an acceptable presentation. I could have improved on my visual aids.	I did a very satisfactory presentation and had reasonable visual aids.	I did an excellent presentation and had effective visual aids.

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A Gaming Summative Assessment
The Final Examination

Purpose:

This is an alternative type of summative assessment in two parts. The first module aims to measure the students' ability to put together all the concepts learned into a coherent whole by creating applicable mathematical games. The second component is designed to determine the students' proficiency in evaluating the significance of their learning experience with the goal of making practical judgments by problem solving that involves marketing the games they created.

General Instructional Objectives and Specific Instructional Objectives

1. Integrates all the concepts and principles learned in solving linear equations to introduce new ideas. (Synthesis)

    1.1 Creates a mathematical game that incorporates the concepts and principles of solving linear equations.

2. Judges the adequacy with which conclusions are supported by data. (Evaluation)
    2.1 Concludes from a given problem in order to make viable, real life decisions.

Student Instructions

Each part constitutes 50 points for a total of 100 points following the guidelines on the rubric.

Part 1

Students are divided into groups of 3. They will create a game that contains the essential elements of the chapter on solving linear equations. Specifically, these are computations and applications of:

1. Solving linear equations with addition and subtraction
2. Solving linear equations with multiplication and division
3. Solving linear equations on one side and on both sides of the equation
4. Ratios and proportions

These can be in the form of computer games, board games, or card games. They have to come up with colorful brochures of the rules, which they will have to present in class.

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Part 2

Students will be working on the problem-solving test individually.

Problem Solving Test

Your game is finished and you plan to make copies of it for sale. You need to hire companies to work on the patent, the manufacturing and packaging, the merchandising, and the promotion of your game.

Option A

Patent, merchandising, and promotion cost $13000 at Marketing Inc. As for the manufacturing and packaging needs, Production Corp. gave a quote at $500 for the first 250 reproductions and $20 per game thereafter.

Option B

The All Around Business enterprise submitted a proposal to fulfill all the services required for 500 copies at $35000 for 6 months, which is renewable and negotiable thereafter.

Use the following guided questions to make a practical conclusion at the end. **Questions 1-3 pertain to Option A.**

1. If you want to make 500 reproductions, given the offer made by Production Inc, how many more reproductions of the game do you need?
2. Applying your answer from #1, how much will you spend for manufacturing and packaging needs alone with Production Inc.?
3. Knowing the Production Inc. cost for 500 reproductions, how much will you spend for 500 reproductions inclusive of patent, merchandising, and promotion costs?
4. On Option A, how much is spent per reproduced game?

5. On Option B, how much is spent per reproduced game?

Make a conclusion as to which option is more profitable if you plan to sell 500 copies for 6 months at $75 each. Accompany your justification with algebraic solutions. (Hint: Use the cost spent per game.)

_____

_____

_____

_____

_____

Rubrics for the Summative Assessment

Rubrics
Part 1 (Project Rubric)

	Not Completed 0	Unacceptable 2	Inadequate 4	Adequate 6	Commendable 8	Exceptional 10	Score
Comprehensiveness Of the Game	Project was not submitted.	Did not encompass the required concepts.	Encompassed a few concepts. Showed little understanding.	Encompassed some important concepts. Showed some understanding.	Encompassed the required concepts. Showed satisfactory understanding.	Encompassed the required concepts beyond the acceptable level. Showed proficient understanding.	
Ingenuity of The Application	Project was not submitted.	There was no connection between the concepts and the game.	The integration of the concepts with the game was minimal. It was disengaging.	The integration of the concepts with the game was acceptable but sometimes vague.	The integration of the concepts with the game was developed. It got attention.	The integration of the concepts with the game was well developed. It was engaging.	
Clearness of The Brochure	Project was not submitted.	The brochure was poor. It had irrelevant information.	The brochure was plain. The rules were confusing.	The brochure was simple. The rules were not completely explained.	The brochure was appealing. The rules were explained but with few missing details.	The brochure was attractive. The rules were complete and clearly explained.	
Clarity of Presentation	Project was not submitted.	The presentation was unrelated.	The presentation lacked explanation.	The presentation had enough explanation on certain areas.	The presentation had enough explanation in most areas.	The presentation thoroughly explained all areas of the project.	
Timeliness	Project was not submitted.	The project was turned in more than 2 days late.	Project was turned in 2 days late.	Project was turned in a day late.	Project was turned in within the due date but after class hour.	Project was turned in within the due date and class hour.	

Part 2 (Generalized Scoring Rubric)

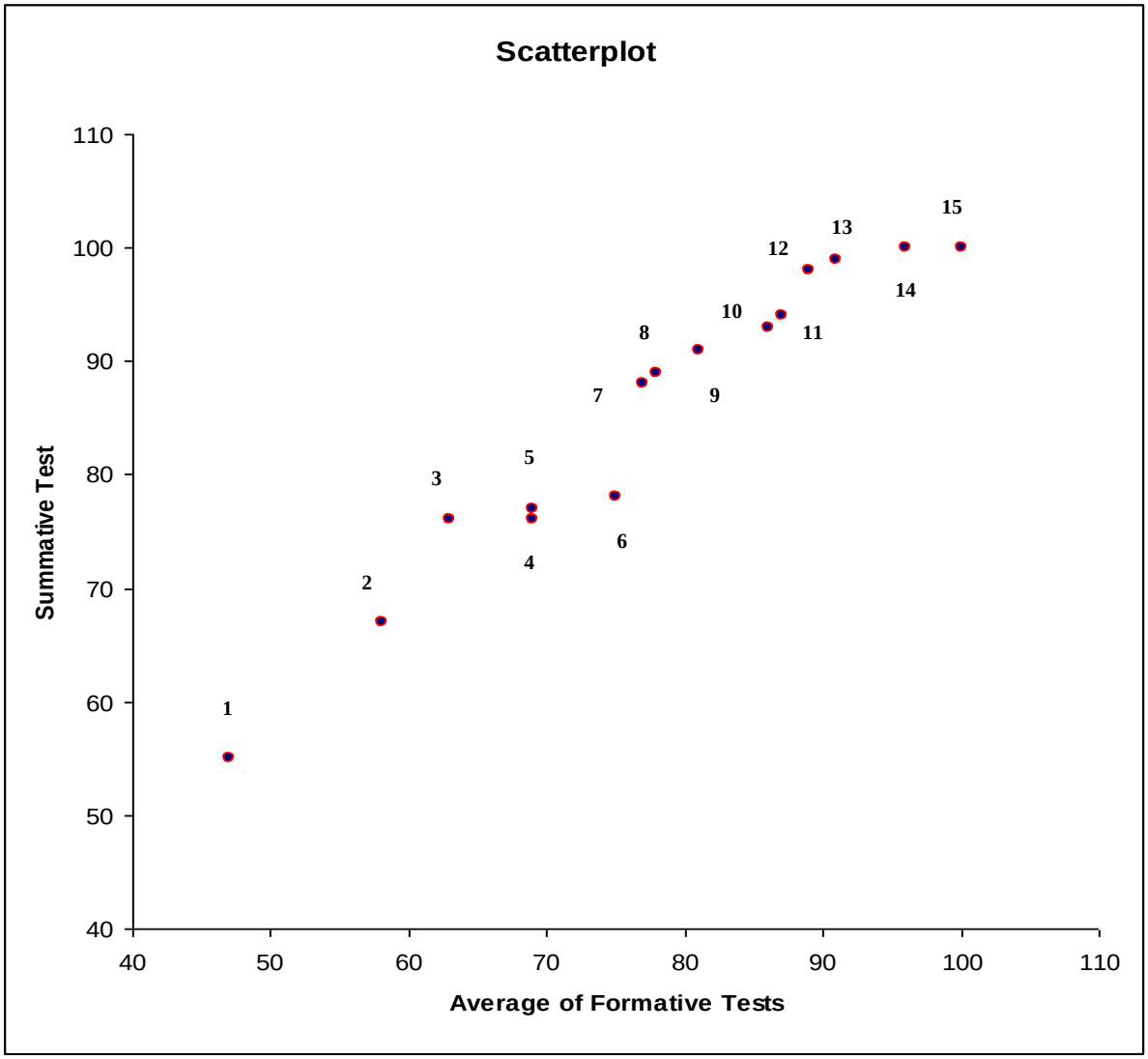
Correct and Complete 50	The conclusion made was correct. It was derived from answering the guided questions. If not, an innovative but correct solution was made. These answers were used to support the conclusion made. The explanation included correct algebraic solutions.
Correct but Incomplete 40	The conclusion was correct but was not completely derived from answering the guided questions. The explanation included an incomplete or different yet incorrect algebraic solution.
Partially Correct 30	The conclusion was essentially correct but the explanation was not complete. The conclusion was not derived from answering the guided questions. The algebraic solution may be different.
Incorrect with Reasonable Attempt 20	The conclusion is incorrect but there was a reasonable attempt to derive the answer from the guided questions. The algebraic solution is incorrect.
Incorrect without Relevance 10	The conclusion is incorrect. The supporting statements do not relate to the problem.
No Answer 0	There was no attempt to make the conclusion.

Analysis

Student	Average of Formative Tests	Summative Test
1	47	55
2	58	67
3	63	76
4	69	76
5	69	77
6	75	78
7	77	88
8	78	89
9	81	91
10	86	93
11	87	94
12	89	98
13	91	99
14	96	100
15	100	100
	Mean = 77.73 Median = 78 Mode = 69	Mean = 85.4 Median = 89 Mode = 76, 100

Comparing the relationship of Formative Tests and the Summative Test.
Predictor: Average Percent on Formative Tests
Criterion: Summative Test

Scatter Plot of the Relationship



The relationship is positive (though slightly imperfect), which shows that the average of a student on formative tests is a predictor of the student's grade on the summative test.

Stem and Leaf Plot

N = 15

Ave. on Formative Tests	Stem	Summative Test
0	10	0 0
6 1	9	1 3 4 8 9
9 7 6 1	8	8 9
8 7 5	7	6 6 7 8
9 9 3	6	7
8	5	5
7	4	

Frequency Distribution of the Summative Test (Finals)

Class Interval	Tally	Frequency
96 – 100	llll	4
91 – 95	lll	3
86 – 90	ll	2
81 – 85		
76 – 80	llll	4
71 – 75		
66 – 70	l	1
61 – 65		
56 – 60		
51 – 55	l	1

Graphic Representation: Histogram of the Summative Test