**APPENDIX C**

**Method of Teaching: Contextual Instructional Strategy**

**Lesson:** 1

**Subject:** Mathematics

**Class:** SS2

**Sex:** Mixed

**Average age:** 16

**Group:** Experimental

**Duration:** 5 periods per week

**Topic:** Expansion of algebraic expressions

**Instructional Materials:** Chalkboard, pencil, eraser, ruler, plain paper, a picture showing row multiplication of two-digit numbers and two binomials placed side by side, and a chart containing a geometrical representation of the product two binomials.

**Teaching Method:** Contextual Teaching Strategy

**Behavioral Objectives:**

By the end of the lesson, the students should be able to:

1. Multiply two linear expressions using algebra tiles and geometric representation.
2. Multiply two linear expressions using the row multiplication method
3. Find the coefficient of terms in quadratics expansions

**Entry Behavior:**

Students were already familiar with:

1. Differentiate between like and unlike terms
2. Distinguish the components of a term
3. Add and subtract algebraic terms
4. Identify linear and quadratic expressions
5. Find the area of rectangles and squares.

**Introduction:**

The teacher instructs his students to answer the following questions:

1. Find the sum of the following: **a.** x2 + 5x2 **b.** x2 + x
2. Identify the variables and coefficients of the terms **a.** 7x2 **b.** –x3 **c.** p
3. Simplify the following **a.** (2x–7) + (x2 + 3x – 5) **b.** (x + 1) + (5x + 11) – (7x–5)
4. Classify each of the expressions as either linear or quadratic **a.** 3x – 1 **b.**  – 7 **c.** 2 – x2
5. Find the areas of the following figures. All dimensions are in cm.

4

5

y

x

**Presentation:** The teacher presents his lesson using the following steps:

**Step 1: Relating**-Process of connecting new information to students’ life experiences.

The lesson started with the review of the following terms: binomials (linear expressions), trinomials (quadratic expressions), and factors. Using the diagrams below, the students will be shown how to use algebra tiles to model a solution for the product of two linear expressions.

1

x

x2

x2

x2

x2

x

x

x

x

x

1

1

1

1

1

1

1

1

Area = x.x =x

x

1

x

x

x

x2

Area = x.x = x2

1

1

Area = 1×1 =1

1

1

1

1

**Figure (a)**

Algebra tile grid

**Figure (b)**

**Figure (c)**

**Students’ activity 1:**

While maintaining their groups, the students were asked to carefully observe and then analyze the arrangement of the area tiles in figures “a” and “b”, verbally. To facilitate learning, the students were instructed to make such arrangements with their concrete algebra tiles. The teacher circulated and checked them while they are on the activity.

**Students’ activity 2:**

Using the dimensions and area of each tile as indicated in the center of the tile, the teacher guided the students while instructing them to:

1. Identify and write the combination of tiles that model each rectangle.
2. Find the area of each rectangle in figure (c) by adding separate areas. Notice that tiles of different areas cannot be added but can only be arranged. Thus:

+ ≠ or

1. Determine the dimensions of each rectangle in figure (b). Notice that you are to enclose each of them in a bracket, as in length = (? + ? ) and breadth = (? + ?).
2. Use your results in (ii) and (iii) to write the relation, area of a rectangle = length × breadth, for each rectangle. What do you notice?

After the activity, the teacher notified them that from now on, we will be using the length and breadth of a rectangle to represent two linear expressions. The area of the rectangle, length × breadth equals the product of the expressions

**Step 2: Experiencing-** Hand-on activity.

**Activity 1:** Multiplying two linear expressions (binomials) using an area diagram

**Example 1**

Find the product of (2x + 1)(x + 2) and the coefficient of x in the expansion

**Solution:**

The area of the rectangle, length × breadth, is the same as the multiplication of (2x + 1)(x + 2). To ease the learning processes, the teacher used the following steps:

1. With the aid of pencil and ruler, draw any reasonable length and breadth of a rectangle to represent the binomial expressions
2. Using the actual measurement of an x-tile from the tile grid, mark and label the sides you have drawn with the terms of the expressions
3. Complete the rectangle by joining lines
4. Label the smaller areas or select the tiles that model the figure. The area of the rectangle, length × breadth, equals the product of the expressions

x

x

x

1

1

1

2x +1

x +2

x

1

x

x

1

1

The visual suggested that by labeling the areas of the rectangles and squares or selecting the concrete tiles that model the figure, one can determine the total area of the overall rectangle.

x2

x2

x

x

x

x

x

Area = 2x2

Area = 5x

Area = 2

1

1

Adding separate areas = 2x2 + 5x + 2

Thus, (2x + 1)(x + 2) = 2x2 + 5x + 2 (trinomial/quadratic expression) and the coefficient of x in the result is 5

**Example 2:** Find the product of (2x + 3)(x – 2)

**Solution:**

Let 2x + 3 and x – 2 be the length and breadth of a rectangle as shown below.

x

x

x

– 1

1

– 1

1

1

x2

x2

x

x

x

– x

– x

– x

– x

– 1

– 1

– 1

– 1

– 1

– 1

2x +3

x –2

x

1

x

x

–1

–1

By labeling or selecting the tiles that model the figure, we have:

-x

x2

-x

x

x

-x

-x

-1

-1

-1

-1

-1

-1

x

x2

Zero pairs

Area = – 6

Area = – x

Area = 2x2

Combining separate areas = 2x2– x – 6

Thus, (2x + 3)(x – 2) = 2x2– x – 6

**Alternative method**

**Activity 2:** Multiplying two linear expressions (binomials) using the row multiplication method

The teacher explained that the product of (2x + 1) and (x + 2) is similar to the row multiplication of 32 and 31. He demonstrated this fact using a picture showing row multiplication of two-digit numbers and two binomials placed side by side.

**Row multiplication:**

3 1

× 3 2

6 2 Multiply 2 by 1 then 3.

9 3 0 Use 0 for place holder, multiply 3 by 1 then 3.

9 9 2 Add accordingly.

Having explained how to multiply two- digits numbers together vertically, next the teacher uses the binomial expressions and repeats the same process of multiplication.

**Example 1:** Find the product of (2x + 1) (x + 2) and the coefficient of x in the expansion**.**

**Row multiplication:**

2x +1

× x +2

4x + 2 Multiply +2 by +1 then 2x.

2x2 + x + 0 Multiply x by +1 then 2x. Line up like terms.

2x2+5x + 2 Add like terms to get the result.

Thus, (2x + 2)(x + 1) = 2x2+5x + 2 and the coefficient of x in the result is 5

**Example 2:** What is the constant term in the expansion of (2x + 5)(x– 6)?

**Row multiplication:**

2x +5

× x – 6

–12x – 30 Multiply – 6 by +5 then 2x

2x2  + 5x + 0 Multiply x by +5 then 2x. Line up like terms

2x2 – 7x – 30 Add like terms to get the result.

The constant term is –30. Notice that the sum of –12 and 5 is a negative result, since the greater number, 12, has a negative sign.

**Step 3: Applying-** Activity or procedure for using the skill (workplace).

Architects use the knowledge of polynomials when adjusting blueprints to fulfill builder requirements. For instance, if a builder wants to increase the length and height of a structure by the same amount, then the new height and length become *x* + the former dimensions. Problems can be set up and solved utilizing this type of algebraic concept.

**Activity 4:** A small sitting room is 4 feet by 6 feet. Assuming you want to expand the sitting room by the same length on each side, what formula expresses the new area?

**Solution:** Consider the figure below.

Sitting room

6 feet

4 feet

x

x

Let x represent the amount added to each side of the sitting room. Then one side will be represented by x + 4 and the other side by x + 6. The expression for the new area of the sitting room will be the product of the binomials (x + 4)(x + 6).

(6+x)

6

x

x

4 

6

4

x

24

x

6x

x2

4x

(4+x)

x

Notice that the total area can be divided into 4 regions as shown above. The formula for the total area is the sum of the individual areas: x2+ 6x +4x + 24 or x2+ 10x + 24. Suppose we need to expand the sitting room by 3 feet on each side, substitute 3 for x to check if (x + 4)(x + 6) = x2+ 10x + 24. If x =3, then (3 + 4)(3 + 6) = 32+ 10(3) + 24

(7)(9) = 9 + 30 + 24

63 = 63

**Step 4: Cooperating** (How students interact)

**Students’ activity 3:** Since the students can now multiply binomials using row method and algebra tiles or geometrical representation, the teacher paired them up and asked them to alternate using each method to answer the following questions:

1. Find the product using the row method. i.(x + 4)(x + 3) ii**.** (2x + 1)(x + 3)
2. Each pair of factors represents the length and breadth of a rectangle. Draw an area model and find the area of the rectangle. i.(x + 3)(x + 3) ii**.** (2x + 1)(x + 6)

**Step 5: Identifying Transfer of Learning Strategy** (wrap-up or unique situation application)

**Students’ activity 2:**

In other to apply what they have learned in a new situation, the teacher asked them to answer the following questions:

A rectangular piece of metal has a length that is 5 cm greater than its width, W, in centimeters. As part of an assembly, the plate must have four square sections removed from it, each having a width of W.

w

w+5

w

1. Write a formula for the area of the metal plate that remains after the corner pieces are removed.
2. Simplify the formula from part a by isolating the common factor.
3. Use your formula to find the area of the metal plate that remains when the width is chosen as W = 24cm.

**Summary:** The teacher runs through the topic and stresses the important points:

**Conclusion:** The teacher concluded his lesson by marking the students’ activities and working out corrections

**Assignment:**

1. **Think and Discuss**
2. How does the area diagram illustrate the product of two binomials? Show an example.
3. How do you use the row multiplication method to find the product of two binomials? Show an example.
4. Explain how an area diagram can be used to find the product of numbers (28)(32).
5. **Mathematics application**

Match each algebraic product with the correct area on the right that geometrically represents it. Find each product to verify your answer.

(a)

i. (2x + 1)(x + 2)

(b)

ii. (x + 3)(x + 1)

(c)

iii. (x + 1)(2x + 1)

1. **Practice and Problem Solving**
2. If 2x2+kx–14 = (x+2)(2x–7), find the value of k.
3. Find the coefficient of ab in the expansion of (2a–b)(3a+2b)
4. Find the following product using area diagrams: (i) (1–x)(2–3x) (ii) (x + 2)(x–7)

**Lesson:** 2

**Subject:** Mathematics

**Class:** SS2

**Sex:** Mixed

**Average age:** 16

**Group:** Experimental

**Duration:** 5 periods per week

**Topic:** Factoring quadratic expressions

**Instructional Materials:** Chalkboard, area diagram, pencil, eraser, ruler, and plain paper.

**Teaching Method:** Contextual Teaching Strategy

**Behavioral Objectives:**

By the end of the lesson, the students should be able to:

1. Factorize three-termed quadratic expressions.
2. Factorize two-termed quadratic expressions

**Entry Behavior:**

Students are already taught the following concepts:

1. Multiplication of two linear expressions (binomials) using row multiplication method and area diagram.
2. Finding the coefficients of terms in quadratics expansions

**Introduction:**

The teacher instructed the students to answer the following questions:

1. Find the product of (2x – 1) (x + 7) using the row multiplication method.
2. Find the coefficient of x in the expansion (x – 5)(x + 5) using an area diagram

**Presentation:** The teacher presented his lesson using the following steps.

**Step 1: Relating**-Process of connecting new information to students’ life experiences.

The lesson started with the definitions of the terms: Monomial, binomial, trinomial, factor, and factorization. The teacher explained that: A monomial is a constant (e.g. – 2), a variable (e.g. x or y), or an algebraic term. The expression 3x2 is a monomial because it has one term. A trinomial is a three-termed expression such as x2 + 9x + 20. Other examples are 3x2 + 2xy + y2 and 1– 3x – 2x2. The product of (x + 4) and (x + 5), each of which is called a binomial (a two-termed expression) or a factor, is x2 + 9x + 20. Conversely, the factors of (x2 + 9x + 20) are (x + 4) and (x + 5). Hence to factorize a trinomial means to write it as a product of two binomials.

**Step 2: Experiencing-** Hand-on activity.

Using the algebra tiles, the students will be guided on how to sketch (i.e a rectangular arrangement) a model of solution for factoring quadratic expressions.

**Activity 1:** Factoring trinomial with the positive term(s)

**Example 1:** Factorize the expression x2 + 5x + 6 using algebra tiles.

**Procedures:**

1. Represent the given expression with a combination of algebra tiles (i.e by selecting the exact types of tiles) that model it.
2. Build/form a rectangle from the tiles you have just selected.
3. Determine the dimensions of the rectangle (its length and breadth).
4. What are the factors of the expression (i.e the dimensions you found in step ( iv)?
5. Multiply the factors to check your work.

**Solution:**

1. The trinomial x2 + 5x + 6 can be represented by the following positive tiles: 6 blue unit tiles, 5 blue “x” tiles, and 1 blue “x2” tile. See the diagram below.

x

x2

x

x

x

x

x

x

x

1

1

1

1

1

1

1

1

1

1

1

1

1

1

1

1

1

1

Area = 6

Area = x2

Area = 5x

1. These 12 individual areas are then combined to form the below rectangle.

x

x

x

x

x

x2

1

1

1

1

1

1

1

1

1

x

x

1

1

(x + 3)

(x + 2)

1. The length and breadth of the rectangle are: (x + 3) cm and (x + 2) cm respectively.
2. The length x+3 and the breadth x+2 of the rectangle represent the factors of x2 + 5x + 6. That is x2 + 5x + 6 = (x + 3)(x + 2)

**Activity2:** Factoring trinomial with the negative term(s).

Use an area diagram to find the factors of x2 –7x + 12.

**Solution:**

1. Select the tiles that model x2–7x + 12.

x

1

x

1

x

x

1

x

1

x

1

x

1

x

1

1

1

1

1

1

1

1

1

1

1

1

1

x

x2

x

1 x2 tile

7 negative x-tiles

12 positive unit tiles

⇒ Area = x2

⇒ Area = -7x

⇒ Area = 12

1. Place the x2 tile

x

x2

x

1. Place the seven negative x-tiles so that they are positioned in the length and the width of the area model.

-1

-1

-1

-1

-1

-x

-x

-x

-x

-x

-1

-x

-x

x

x2

x

-1

1. Place the twelve unit tiles.
2. Arrange the tiles to form a rectangle so that the positive unit tiles align evenly with the negative x tiles.

1

1

1

1

1

1

1

1

1

1

1

1

-1

-x

-1

-x

-1

-x

-1

-x

-x

-x

-x

x

x2

x

-1

-1

-1

1. What are the dimensions of the rectangle? The dimensions of the rectangle are: x – 4 and x –3.
2. What are the factors of the expression (i.e the dimensions you found in step (vi)? The length x – 4 and the breadth x+2 of the rectangle represent the factors of the expression. That is, x2– 7x + 12= (x – 4) (x –3).

**Activity2:** Factoring quadratic expressions (Binomials).

Use an area diagram to find the factors of (i) x2+3x (ii) 2x2– 4x.

**Solution (i):**

1. Select the tiles that model x2+3x.

x

x2

x

Area = x2

x

x

x

x

1

1

1

Area = 3x

+

1. Place the x2 tile.

x2

x

x

1. Place the three positive x-tiles so that they are positioned either in the length or the width of the area model (x2 tile).

1

x

1

1

x

x2

x

x

x

1. Finally, find the dimensions of the rectangle (i.e. the factors of the expression).

Answer: The dimensions of the rectangle are: x and x + 3. Thus, x2 +3x = x(x + 3).

Notice the following:

1. In the expression, the terms x2 and 3x have x in common. Hence x2 +3x can be written as x×x + 3×x. Isolating common factor, we have x(x + 3).

**Solution (ii):** 2x2– 4x (using the ideas we got from the above notice)

The common factor of the terms 2x2 and 4x is 2x. Therefore, 2x2 – 4x can be written as 2x×x – 2x×2. Isolating common factor we obtain, 2x (x – 2).

**Step 3: Applying-** Activity or procedure for using the skill (workplace).

**Activity 5:** The teacher provides the students with the following real-life questions.

The width of a classroom is 5m less than the length. Its area is 24 m2. Find the new expressions for the dimensions of the classroom.

**Solution:**

Let the length of the classroom be x. Then the width is x – 5.

The area of the classroom, i.e. A = length × breadth: x(x – 5). Hence x(x – 5) = 24.

x2 – 5x = 24, (By clearing the fraction)

x2 – 5x – 24 = 0, (By bringing the constant term to the LHS of the equation)

(x+ 3)(x– 8) = 0, (By factorizing the LHS using algebra tiles)

Thus, the dimensions of the classroom are: (x+ 3) and (x– 8).

**Step 4: Cooperating** (How students interact)

**Students’ activity 2:** While maintaining their groups, the teacher instructed the students to work together and answer the following questions.

1. Use algebra tiles to factorize the trinomials: a.x2+ 8x – 7 b**.** x2 – 4x + 3 c.a2+ a – 6
2. Factorize the following quadratic expressions by isolating the common factors: a.4y2 – 10y b**.** 13 – 13x2 c.2ab – a2.

**Step 5: Identifying Transfer of Learning Strategy** (wrap-up or unique situation application)

**Students’ activity 2:** In other to apply what they have learned in a new situation, the teacher instructed the students to answer the following questions:

1. What is the minimum number of tiles needed to model (i) 7x2+ x – 8, (ii) 12x2+ x – 63 and (iii) x2+ 6x – 27? Show your model on plain paper using color pens.
2. Factorize the following using geometrical diagrams: a.2x2+ 5x – 12 b**.** 5x2− 13x + 6

**Summary:** The teacher wraps up the lesson and stresses the following important points to ensure mastery of the objectives. When factoring trinomials with algebra tiles, always:

1. Start by placing the x2 tile(s),
2. Place the x tiles on both sides of the x2 tile(s) so that they are positioned in the length and the width of the area model,
3. Place the unit tiles diagonally to the x2 tile(s),
4. Finally, read the dimensions of the area model on the sides that contain the x2 tile(s). Notice also that while reading the dimensions of the rectangle, the width of x tiles is either + 1 or − 1.

**Conclusion:** The teacher concludes his lesson by marking the students’ activities and working out corrections.

**Assignment:**

1. **Think and Discuss**
2. Can you rearrange your algebra tiles to form different rectangles from the same trinomial? Illustrate with an example.
3. How do you represent values with negative tiles?
4. Explain how to factorize x2 − 7x + 12 with the use of algebra tiles.
5. Explain the meaning of monomial, binomial and trinomial. Give an example of each.
6. **Mathematics application**

The area of a classroom is 60 cm2. The length is 11 cm more than the width. Find the width of the classroom.

1. **Practice and Problem Solving**
2. Use algebra tiles to factorize the following quadratic expressions. Check your answer where possible, by using row multiplication method. (a) x2 + 7x + 6 (b) 3x2 + 14x + 15 (c) x2 + 7x (d) 4x2 + 8x + 3 (e) x2− x − 6 (f) 24x − 3x2.
3. Factorize the following quadratic expression by isolating the common factors. (a) 7rs − 11r2s2  (b) 64 + 8n2 (c) abc − a2b2c2 (d) 3x − 9x2 (e) 2uvw – 6v2w.

**Lesson:** 3

**Subject:** Mathematics

**Class:** SS2

**Sex:** Mixed

**Average age:** 16

**Group:** Experimental

**Duration:** 5 periods per week

**Topic:** Factorizing quadratic expressions where c < 0, factorizing by grouping …

**Instructional Materials:** Chalkboard, area diagram, pencil, eraser, ruler, plain paper, and multiplication tables.

**Teaching Method:** Contextual Teaching Strategy

**Behavioral Objectives:**

By the end of the lesson, the students should be able to:

1. Determine the coefficients of x2 and x in a given expression
2. Factorize quadratic expressions where c < 0 with the use of algebra tiles.
3. Factorize general quadratic expressions using the trial and error method
4. Find the missing factor of a given quadratic expression
5. Factorizing by grouping terms

**Entry Behavior:** Students are taught how to factorize some quadratic expressions. **Introduction:** The teacher instructed the students to answer the following: (1) What is the minimum number of tiles needed to model (i) 7x2+ x – 8 and (iii) x2+ 6x – 27? Show your model on plain paper using color pens. (2) Classify each of the following expressions as a monomial, binomial or trinomial. State the degree of the polynomial: 4x2+ x, 5x2, – 2, 7x2+ x – 8

**Presentation:** The teacher presented his lesson using the following steps.

**Step 1: Relating**-Process of connecting new information to students’ life experiences.

The lesson started with the following explanations: If we observe some of the examples we have come across in the previous lessons, we shall see that the general form of a quadratic expression is in the form ax2 + bx + c, where a, b and c are numeric values and a ≠ 0. In the ax2 + bx + c, ‘a’ is called the coefficient of x2, ‘b’ is called the coefficient of x and ‘c’ is the constant term. Any three-term quadratic expression (i.e. ax2 + bx + c) is called a quadratic trinomial.

**Activity 1:** Find the coefficient of x2 and x in the quadratic expression 1– 2x2 + 11x

**Solution:** By rearranging the expression in the form ax2 + bx + c, we have:

1– 2x2 + 11x = – 2x2 + 11x + 1.

Thus, a = – 2, b = 11 and c = 1.

**Students’ activity 1:** What are the coefficients of x2 and x in the following quadratic expressions? (a) 77 – 4x – x2 (b) x2– x – 6 (c) 12 – x – x2

**Step 2: Experiencing-** Hand-on activity.

**Activity 2:** Using the algebra tiles, the students will be guided on how to sketch (i.e a rectangular arrangement) a model of solution for factoring quadratic expressions where c < 0.

**Example 1**. Factorize x2 – x – 12

**Solution:**

1. Use algebra tiles to illustrate x2 – x – 12. Remember to place the large positive square tile in the left upper corner followed by the negative x-tile and the negative unit tiles in the right lower corner as shown in the figure.
2. Complete the rectangular arrangement by adding 3 zero pairs of x-tiles.
3. The length and breadth of the rectangle are: (x – 3) cm and (x + 3) cm respectively. Therefore x2 – x – 12= (x – 3)(x + 2). See the figures below.

(x + 3)

-x

-x

-x

-1

-1

-1

-1

-1

-1

-1

-1

-1

-1

-1

-1

x2

-x

x

-1

x

x

1

x

x

1

1

-1

-1

-1

(x - 4)

x2

-x

-1

-1

-1

-1

-1

-1

-1

-1

-1

-1

-1

-1

?

?

**Alternative Method**

**Activity 3:** Factorizing quadratic expressions using trial and error method

1. **When the coefficient of x2 is unity (1)**

**Example 2**. Factorize x2 – x – 12 (Repeated).

**Solution:**

**Step 1:** x2 – x – 12 = (x - ?) (x +?)

**Step 2:** Look for two numbers whose product is – 12 and whose sum is – 1 (the coefficient of x). These are obviously – 4 and 3.

**Step 3:** The factors are therefore (x – 4) and (x + 3) or x2 – x – 12 = (x – 4) (x + 3)

1. **When the coefficient of x2 is not unity**

**Example 3**. Factorize 6x2 + 11x – 10.

**Step 1:** Try pairs of factors of 6x2 and pairs of factors of – 10, as shown in the following three cases:

6x2

– 10

3x

2x

5

–2

–6x + 10x = +4x

+5x

6x2

– 10

2x

3x

5

–2

15x –4x = +11x

+5x

6x2

– 10

6x

x

5

–2

– 12x + 5x = – 7x

+5x

**Step 2:** Cross multiply these factors and add their product, then look for an arrangement whose result equals the middle term.

**Step 3:** The third arrangement satisfies this condition and the factors are (3x –2) and (2x + 5). Similarly, the factors of 6x4 + 11x2y –10y2 are (3x2 –2y) (2x2 + 5y).

**Activity 4:** Finding a missing factor of a given quadratic expression

If (g − 3) is one of the factors of g2+4g – 21, what is the other factor?

**Solution:**

g2+4g – 21= (g − 3)(g +?), where −3 and +?, are numbers when multiplied yields −21(i.e factors of −21) and when added gives 4.

Therefore, −3 × what? = −21 (Answer = 7).

i.e, −3 × 7 = −21 (product) and −3 + 7 = 4 (sum)

⇒g2+ 4g – 21= (g − 3)(g +7)

**Activity 5:** Factorization by grouping terms

To factorize an expression containing four terms, group them in two pairs in such a way that the terms in each pair have something other than one (1) in common. This is called the highest common factor (HCF). Take out the HCF of each pair outside a bracket. The terms in the brackets in found by division.

**Example 1:** Factorize 3x – 2dy + 3y – 2dx

**Solution:**

The terms 3x and 3y both have 3 in common. The terms 2dx and 2dy both have 2d in common. Rearrange the expression in this order.

3x + 3y – 2dx – 2dy = 3(x + y) – 2d(x + y) = (x + y) (3 – 2d).

The common factor, (x + y), should be written first, outside a bracket and the contents i.e. the terms inside the bracket, (3 – 2d), are found by division.

**Students’ activity 2**

Factorize: (a) ax – ay + 6y – 6x. (b) h (x + y) + (m + n)(x + y). (c) x (2a – b) – 2a + b. (d) ab –2ac – 3b + 6c. (Hint: note that if – ve sign is factored out from (y – x) we get – (x – y), since + = – × –).

**Step 3: Applying-** Activity or procedure for using the skill (workplace).

Highway engineers use algebra in laying out new roads. Most mathematical problems encountered in constructions or those dealing with geometric figures such as those that ask for dimensions, areas, and perimeters use the concepts of algebra.

**Students’ activity 3**

In this activity, the students will be guided and assisted on how to apply their understanding. The teacher will read, interpret and sketch the diagram, and then ask them to answer the question: A rectangular swimming pool whose length is twice its width is to be surrounded by a cement walk 4 feet wide. The total area covered is to be 2880 square feet. Find the dimensions of the pool.

**Step 4: Cooperating** (How students interact)

**Students’ activity 4**

While maintaining their groups, the teacher instructed the students to work together using the trial and error method of factorization or algebra tiles where applicable to complete the following:

1. x2 – 10xy– 11y2 = (x + ?)(? – 11y)
2. 10 –7x – 12x2 = (? + 4x) (2 –?)
3. t2 – 7t– 18 = (t –?)(t +?)

The teacher went around each group to assist students who experience difficulties.

**Step 5: Identifying Transfer of Learning Strategy** (wrap-up or unique situation application)

**Students’ activity 5**

In other to apply what they have learned in a new situation, the teacher instructs the students to answer the following questions:

(a) 9n2 – 54+ 81 (b) 25x2–121 (c) 4x2 + 74 + 330

**Summary:** The teacher runs through the topic and stresses the important points.

**Conclusion:** The teacher concludes his lesson by marking the students’ activities and working out corrections.

**Lesson Assessment/Assignment:**

1. **Think and Discuss**
2. In a trinomial x2+bx +c, what do you know about the factors of c if
   1. c is positive and b is negative?
   2. c is positive and b is positive?
   3. c is negative and b is positive?
   4. c is negative and b is negative?
3. **Mathematics application**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Sum**  **(a + b)** | **Product**  **(ab)** | **A** | **B** |
|  | 5 | 6 | 3 | 2 |
| a. | 8 | 15 | ? | ? |
| b. | 14 | 48 | ? | ? |
| c. | −4 | 4 | ? | ? |
| d. | −6 | −7 | ? | ? |
| e. | 2 | −8 | ? | ? |
| f. | 9 | 52 | ? | ? |
| g. | 0 | −9 | ? | ? |

To factorize a trinomial, one of the skills needed is the ability to identify pairs of numbers that add to give a certain sum and multiply to yield a certain product. For example, 3 and 2 add to 5, and when multiplied give 6. Copy the table and complete it by providing a pair of numbers whose sum is the number in the first column and whose product is the number in the second column. (The first row is completed for you.)

1. **Practice and Problem Solving**

Using the trial and error method of factorization, factorize the following

1. 2x2 – 3x– 9
2. 6x2+31x+40
3. 15x2 –33x –36
4. 35+18–5x2

**Lesson:** 4

**Subject:** Mathematics

**Class:** SS2

**Sex:** Mixed

**Average age:** 16

**Group:** Experimental

**Duration:** 5 periods per week

**Topic:** Factoring perfect squares, making quadratic expressions perfect squares …

**Instructional Materials:** Chalkboard, algebra tiles, pencil, eraser, ruler, and plain paper.

**Teaching Method:** Contextual Teaching Strategy

**Behavioral Objectives:** By the end of the lesson, the students should be able to:

1. Factorize perfect squares trinomials using algebra tiles.
2. Make quadratic expressions perfect squares.
3. Factorize difference of two squares using algebra tiles.
4. Simplify algebraic fractions by reducing them to their lowest terms using the factorization method.

**Entry Behavior:** Students are already taught how to:

1. Determine the coefficients of x2 and x in a given expression
2. Factorize quadratic expressions where c < 0 using algebra tiles.
3. Factorize general quadratic expressions using the trial and error method
4. Find the missing factor of a given quadratic expression
5. Factorization by grouping terms

**Introduction:** The teacher instructs his students to answer the following questions:

1. Explain how to use algebra tiles to model the trinomial x2− 7x + 6. Hence, find its factors.
2. Explain how to factorize x2− 7x + 6 without the use of manipulative objects.

**Presentation:** The teacher presents his lesson using the following steps.

**Step 1: Relating**-Process of connecting new information to students’ life experiences.

The teacher began with a review on squares of numbers sometimes called perfect squares. He listed the first four perfect squares (i.e squares of numbers 1 to 4) on a chalkboard and asked the students to find more perfect squares. He also urges them to commit to memory, the perfect squares of numbers 1 to 25.

1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169, 196, 225, 256, etc…

Moreover, the teacher explained the following terms: binomial square and perfect square trinomial with the use of a picture. A perfect square trinomial is a special trinomial that can be factored into two identical binomials called a binomial square.

x2 + 6x + 9 = (x + 3)(x + 3) = (x + 3)2

Perfect square trinomial

Two identical binomials

Binomial square

**Students’ activity 1:**

1. Find each product using algebra tiles or row multiplication.
2. (x − 2)(x − 2)
3. (x + 2)(x + 2)
4. (n − m)(n − m)
5. (2 + m )(2 + m)
6. Complete the equation.

(a + b)2 = (? + ?)(? + ?) = (? + ? + ?)

**Step 2: Experiencing-** Hand-on activity.

**Activity 1:** Factoring perfect square trinomial

Is the polynomial 4x2 + 4x + 1 a perfect square?

**Solution:**

The teacher emphasizes that the area model for a perfect square trinomial is a square, which means the length and the breadth are the same. Therefore, if we arrange the areas into the shape of a rectangle, the rectangle is square.

As usual, select the tiles that model the trinomial, then arrange the tiles/areas into a square as shown below. Finally, read the dimensions of the area model on the sides that contain the x2 tile(s).

x

x2

1

x2

x2

x2

x

x

x

4 positive x2 tiles ⇒ Area = 4x2

4 positive x tiles ⇒ Area = 4x

A +ve unit tile ⇒ Area = 1

+

+

x2

x2

x2

x2

x

x

x

x

1

**=**

x

x

1

x

x

1

2x + 1

2x + 1

Since 4x2 + 4x + 1 is factored into (2x + 1) and (2x + 1), two identical binomials, therefore the polynomial is a perfect square.

In other to identify whether a trinomial is a perfect square trinomial or not, the teacher gives them the following clues: A trinomial is said to be a perfect square trinomial if it satisfies three conditions:

1. The first and last terms must be positive.
2. The first and last terms must be perfect squares.
3. Twice the square root of the product of the first and last terms should be the same as the middle term [i.e 2× = 2nd term]

**Students’ activity 2:** Using the clues above, find out whether the following polynomials are perfect square trinomials or not.

(a) x2 + 18x + 81 (b) x2 − 10x + 25 (c) y2 + 2y + 1

**Activity 2:** Completing the squares

**Example 1:** What must be added to x2 − 6x to make the expression a perfect square?

**Solution:**

1. Select the tiles that model x2 −6x, then arrange them in such a way that the tiles on both sides are equal in number since the area model for a perfect square must be a square.

x2

-x

-x

-x

−x

−x

−x

?

1. Since the last term must be positive as stated in the clues, add positive unit tiles to make the total area a perfect square.

x2

-x

-x

-x

−x

−x

−x

1

1

1

1

1

1

1

1

1

-1

x

-1

-1

-1

-1

x

-1

1. Read the dimensions of the area model on the sides that contain the x2 tile.

As seen from the area model, + 9 must be added to the expression. The complete expression, x2 −6x+ 9, is a perfect square since its factors are identical. That is, x2 −6x+ 9 = (x −3) (x −3). From this activity, we found that the value to be added is the same as the square of (−3), i.e the square of half of −6 (the coefficient of x). Hence, if x2 + bx + c is a perfect square, then c = ( of b) 2 = ( × b) 2 or simply and the perfect square x2 + bx + =

**Example 2:** What must be added to x2 − 5x to make the expression a perfect square? Factorize the result.

**Solution:** Recall that if x2 + bx + c is a perfect square, then c = ( × b) 2 where b is the coefficient. of x

Thus, the coefficient of x, which is b, is − 5. Half of − 5 is . The square of = (.)2 = +.

+ must be added.

x2 − 5x + (.)2 = x2 − 5x + is a perfect square.

x2 − 5x + = ()2

**Students’ activity 3:**

Determine whether the constant term of each of the following expressions equals the square of half of the coefficient of x (or whatever letter is involved).

**a.** x2 − 18x + 81 **b.** 4y2 − 12y + 9 **c.** 9a2 + 24a + 16

**Activity 3:** Factoring difference of two square.

**Example 1.** Factorize x2− 4 using algebra tiles

**Solution:**

The teacher explains that the terms x2 and 4 are perfect squares. Hence, the expression x2− 4 is called the difference of two squares. To factorize x2− 4 means to write it as a product of two binomials. Since the terms of difference of two squares are perfect squares, the area model for it is also a square. Below are the procedures one should follow while using algebra tiles in factoring the expression.

**Procedures:**

1. Select the tiles that represent x2− 4.

x2

−1

−1

−1

−1

4 −ve unit tiles ⇒ Area = −4

A positive x2 tiles ⇒ Area = x2

1. Place the x2 tile and arrange the four negative unit tiles in a square form, then place them diagonally to the x2 tile.

x2

−1

−1

−1

−1

1. Add an equal number of positive and negative x tiles (zero pairs) on both sides of the x2 tile to complete the square.

1

x

x

−x

−x

x2

−1

−1

−1

−1

−1

x

x

1

−1

1. Determine the factors of x2− 4 by reading the dimensions of the area model. From the area model, the dimensions of the square are (x + 2) and (x − 2). Therefore, x2 − 4 = (x + 2) (x − 2).

In Activity 3, we discovered that x2− 4 or x2− 22, the difference between the squares of x and 2, is the same as the product of the sum and difference of between x and 2. Therefore, the fundamental identity is a2−b2 or a.a − b.b = (a + b) (a − b).

**Example 2.** Factorize 9a2 − 16x2

**Solution:**

The expression is the difference between the squares of 3a and 4x. (3a)2 − (4x)2 = 3a.3a − 4x.4x = (3a + 4x)( 3a − 4x). Therefore, the factors of 9a2 − 16x2 are (3a + 4x)( 3a − 4x)

**Example 3.** Factorize 9x2 − 81

**Solution:**

The terms 9x2 and 81 have a common factor of 9. Isolating common factor we obtain, 9 (x2 − 9). 9 (x2 − 9) = 9 [(x)2  − (3)2] = 9 [x.x − 3.3] = 9 (x − 3) (x + 3).

**Activity 4:** Simplifying algebraic fractions by reducing them to their lowest terms using factorization.

**Example 1.** Simplify

**Solution:** When simplifying algebraic fractions, it is often helpful to:

1. first, take out the common factor outside a bracket;
2. factorize the top and bottom expressions completely and
3. divide the numerator and denominator by the common factor

The common factor of the terms in the numerator is 5 and the terms, 4x and 6 in the denominator have 2 in common. Isolating the common factors we obtain,. Using algebra tiles, the trinomial is factored into = =

**Example 2.** Simplify

**Solution:**

Using algebra tiles, the expressions are factored and reduced thus:

= =

**Step 3: Applying-** Activity or procedure for using the skill (workplace).

The idea of the difference of two squares can be applied in the constructing and calculating of areas and volumes of hollow objects such as circular washers, decorative bricks, nuts, fish ponds, rectangular water tanks, pipes, lampshades, plastic/metal buckets, ring, etc.

**Activity 4:**

The teacher provided the students with an activity that include real-life problems.

**Question:** A square playground’s area is represented by the trinomial x2 − 2x + 1. Write an expression, using the variable x, which represents the perimeter of the playground.

**Solution:**

Using algebra tiles, x2 − 2x + 1= (x− 1)2. Hence, the perimeter in terms of x = 4(x− 1) = 4x− 4.

**Step 4: Cooperating** (How students interact)

**Students’ activity 4:**

While maintaining their groups, the students were instructed to complete these exercises.

Use algebra tiles to complete the following:

**Factors**

**Trinomial**

?

x2− 4x + 4

?

9x2− 12x + 4

? (7 + y)(7 + y)

2x2 + 5x + 3 (2x + 3) (? + ?)

The teacher went around each group to give some explanations and finally write out what result of each group on the chalkboard.

**Step 5: Identifying Transfer of Learning Strategy** (wrap-up or unique situation application)

In other to apply what they have learned in a new situation, the teacher instructed the students to answer the following questions:

1. Using the shortcut, a2− b2 or a.a − b.b = (a + b)(a − b), factorize:

**a.** 16x2− 49 **b.** 25q2− 1 **c.** a2− 100 **d.** a2 – 81b4

1. A square has sides of length 2*x* −3. What is the area of the square in terms of *x*?
2. Simplify completely by dividing out the common factor in each case. The first one has been done for you.

a. = =

b.

c.

d.

**Summary:** The teacher runs through the topic and stresses some important points:

1. A trinomial is said to be a perfect square trinomial if it satisfies three conditions:
   1. The first and last terms must be positive.
   2. The first and last terms must be perfect squares.
   3. 2nd term = 2×
2. If x2 + bx + c is a perfect square, then c = ( × b) 2
3. When factorizing, first look for an obvious factor
4. To simplify an algebraic fraction, always reduce its top and bottom expressions by factorization.

**Conclusion:** The teacher concludes his by marking the students’ activities and working out corrections

**Assignment:**

1. **Think and Discuss**
2. What happens to the middle term when you multiply the sum and difference of the same two numbers or terms?
3. How do you determine the middle term when you square a binomial?
4. What is the general rule or shortcut for finding the product of the sum and difference of the same terms?
5. What is the general rule or shortcut for squaring a binomial?
6. How can you use the general rules for multiplying in these special cases to find the factors of special trinomials?
7. **Mathematics application**

You are constructing a large rack to hold small pots while the seeds in them germinate. You plan to have approximately 500 pots in the rack. You would like the rack to be as close to “square” as possible. The rack should have an equal number of pots in each row and an equal number of pots in each “column” (although possibly different from the number in each row). What are some possible numbers of pots per row and pots per column that would give a “nearly square” layout for the following total number of pots?

**a.** 480 **b.** 500 **c.** 520 **d.** Is there some total number of pots near 500 that you can use to create a perfectly square layout? If so, what is it?

1. **Practice and Problem Solving**
2. Use algebra tiles to factorize these trinomials. Check your answer by using row multiplication method. (i) 9 −16 x2 (ii) x2−2ax + a2 (iii) x2−2x +1 (iv) 4x2−12x +9
3. Simplify completely by factorization (i) (ii) (iii)

**Lesson:** 5

**Subject:** Mathematics

**Class:** SS2

**Sex:** Mixed

**Average age:** 16

**Group:** Experimental

**Duration:** 5 periods per week

**Topic:** Quadratic equations 1

**Instructional Materials:** Chalkboard, algebra tiles, pencil, eraser, ruler, and plain paper.

**Behavioral Objectives:**

By the end of the lesson, the students should be able to:

1. Solve quadratic equations by factorization.
2. Solve equations with irrational roots.
3. Solve quadratic equations by completing the square.

**Entry Behavior:**

Students are already taught how to:

1. Factorize quadratic expressions with both +ve and –ve terms.
2. Factorize perfect squares trinomials and complete the square
3. Factorize difference of two squares

**Introduction:**

The teacher instructs his students to answer the following questions:

1. Explain how to use algebra tiles to model the trinomial 4x2−12x +9. Hence, find its factors.
2. What must be added to x2 − 5x to make the expression a perfect square?
3. Factorize x2− 1 using algebra tiles

**Presentation:** The teacher presents his lesson using the following steps.

**Step 1: Relating**-Process of connecting new information to students’ life experiences.

The lesson started with the following explanations: From our previous lessons, we have seen that the general form of a quadratic expression is ax2 + bx + c, where a, b and c are numeric values and a ≠ 0. This becomes quadratic equation when it is written as ax2 + bx + c = 0. To solve a quadratic equation means to find the values of the unknowns called the roots of the equation. To find the roots:

1. Arrange the equation in the form ax2 + bx + c = 0
2. Factorize the LHS if possible (i.e to write it as a product of two linear expressions)
3. Using the principle that, if a × b = 0, then either a = 0 or b = 0 (or both a and b are 0) to find the roots.

**Activity 1:** Solving equation using zero product principle.

**Example 1:** Solve the equation (x + 4)(x − 9) = 0

**Solution:** If (x + 4)(x − 9) = 0, then either x + 4 = 0 or x − 9 = 0

x = − 4 or x = 9

**Example 2:** Solve the equation x(x + 3)(x − 5)2 = 0

**Solution:** If x(x + 3)(x − 5)2 = 0,

then either x = 0, x + 3 = 0 or x − 5 = 0 twice

⇒ x = 0, x = − 3 or x = 5

⇒ x = 0 or − 3 or 5 twice

**Activity 2:** Solving equations with irrational roots.

If x2 = c, x = ± i.e by taking the square roots of both sides.

Hence, if x2 = 25, then x = ±

x = ±5

Similarly, if (x − 3)2 = 25

then x − 3 = ±5

and x = 3 ± 5

x = 8 or − 2 (i.e. 3 + 5 = 8 or 3 − 5 = − 2)

**Example 3:** Solve the equation (x + 3)2 = 7

If (x + 3)2 = 7

Then x + 3 = ± i.e. by taking the square roots of both sides.

x = − 3 ±

The roots are irrational because they cannot be written as the ratio of two integers. The roots may be found approximately by writing ± as ± 2.65.

**Students’ activity 1:**

Solve the following: i.(x − 1)(x − 2)(x − 3) = 0 ii**.** (x − 2)2 = 6 iii.(x − 8)2 = 3

**Step 2: Experiencing-** Hand-on activity.

**Activity 3:** Solving quadratic equations by factorization

Using algebra tiles, the students will be guided how to model a solution for solving quadratic equations.

**Example 4:** Solve the equation 2x2 + 3x = 15.

**Solution:** If 2x2 + 3x = 15

⇒ 2x2 + 3x − 15 = 0 by rearranging it in the form ax2 + bx + c = 0

* (2x + 15)(x − 1) = 0 using algebra tiles
* 2x + 15 = 0 or x − 1 = 0 using zero product principle
* 2x = − 15 or x = 1
* x = 7 or x = 1

**Example 5:** Solve the equation x2 − 16 = 0.

**Solution**: If x2 − 16 = 0

* (x + 4)(x − 4) = 0 using algebra tiles
* x + 4 = 0 or x − 4 = 0 using zero product principle
* x = − 4 or x = 4

**Activity 4:** Solving quadratic equations by completing the squares

**Example 7:** Solve the equation x2 = 1− 4x by completing the square.

**Solution:** To solve the equation, the teacher used the following steps.

Step 1: Arrange the equation in such a way that only the constant term is on the RHS

x2 + 4x= 1

Step 2: Make the expression on the LHS of the equation a perfect square by adding

( × b) 2 i.e. x2 + 4x + (2)2 = 1 + (2)2

Step 3: Factorize the LHS and also simplify the RHS

(x + 2)2 = 5

Step 4: Take the square roots of both sides

x + 2 = ±

x = − 2 ±

x = − 2 + or − 2 −

**Students’ activity 3:**

(a) Using trial and error method of factorization, solve the equation 21x = 8x2 − 9

(b) Complete the square of the expression b2 + 10b.

**Step 3: Applying-** Activity or procedure for using the skill (workplace).

The knowledge of algebraic concepts such as quadratic equations is widely used in many fields of life. For example, physicians use quadratic formulas to calculate the proper medicine for a patient based on the patients’ weight. An engineer manipulates quadratic equations to form the most effective parabolas for their designs. Below is one of its applications in a company.

**Students’ activity 4:**

The students will be asked to answer the following question: A paper company produces a rectangular label that has an area of 54cm2. If the length is made 3cm greater than the width, what will be the length and width of the label?

**Step 4: Cooperating** (How students interact)

**Students’ activity 5:**

Since the students can solve quadratic equations by factorisation and completing the square, the teacher paired them up and asked them to alternate using each method to answer the following questions: i.x2 +11x+24 = 0 ii**.** 6x2 +31x + 40 = 0 iii.2x2 – 3x – 9 = 0.

The teacher went around each group to encourage and assist them.

**Step 5: Identifying Transfer of Learning Strategy** (wrap-up or unique situation application). In other to apply what they have learned in a new situation, the teacher instructed the students to answer the question below:

With the use of drawing materials, sketch an area diagram to find the factors of each of the expressions on the LHS of the given equations and hence find their roots.

i.q2 − 11q +24 = 0 ii**.** 2h2 − 5h + 3 = 0 iii.15 − 2e − e2 = 0.

**Summary:** The teacher runs through the topic and stresses some important points:

**Conclusion:** The teacher concludes his lesson by marking students’ activities and working out corrections

**Assignment:**

1. **Think and Discuss**
2. Explain how to solve quadratic equation x2 − 6x + 8 = 0 by each of the following methods. (a) Factorization (b) Completing the square.
3. How is the zero product principle is been used to solve quadratic equations?
4. **Mathematics application**

Solve using quadratic equations.

1. The length of a playing area is 2 meters longer than its width. If the area of the playing area is 120 meters, find the dimensions of the playing area.
2. The sum of two whole numbers is 21, their product is 108. Find the numbers.
3. **Practice and Problem Solving**
4. In each of the following, add the term that makes the given expression into a perfect square. Write the result as the square of a bracketed expression. (a) a2 − 3a (b) b2 + b (c) z2 +2z
5. Solve the following equations. If an equation has irrational roots, leave the answer in the form given in example 3. (a) (x − )2 = (b) (x + )2 =1 (c) (x − 1)2 =

**Lesson:** 6

**Subject:** Mathematics

**Class:** SS2

**Sex:** Mixed

**Average age:** 16

**Group:** Experimental

**Duration:** 5 periods per week

**Topic:** Quadratic equations 2

**Instructional Materials:** Chalkboard, algebra tiles, pencil, eraser, ruler, and plain paper.

**Behavioral Objectives:**

By the end of the lesson, the students should be able to:

1. Identify the values of a, b, and c of any given quadratic equation by comparing it with the general form ax2 + bx + c = 0
2. Solve quadratic equations by using the quadratic formula
3. Derive the quadratic formula
4. Find the discriminant of a given equation and use its value to describe the roots.

**Entry Behavior:**

Students are already taught how to:

1. Solve quadratic equations by factorization.
2. Solve equations with irrational roots.
3. Solve quadratic equations by completing the square.

**Introduction:**

The teacher instructs his students to answer the following questions:

1. Explain how to solve quadratic equation x2 + 3x − 2 = 0 by completing the square.
2. Can the LHS of the equation in (i) be solved by the method of factorization? Show your workings.
3. Solve the following: (a) (d + 7)2(d − 1)= 0 (e) (x − 2)2 =

**Presentation:** The teacher presents his lesson using the following steps.

**Step 1: Relating**-Process of connecting new information to students’ life experiences.

The lesson started with the following explanations: From our previous lessons, we have seen that the general form of a quadratic equation is ax2 + bx + c = 0 and we also learned how to solve the equation by factorization and by completing the square. If a quadratic equation does not factorize, the roots of the equation can be found by applying a quadratic formula which is given as:

x =

**Students’ activity 1**

Students are asked to make a chart for the values of a, b and c for each of the following equations. See a sample below. i.2x2 + 5x + 15 = 0 ii**.** x2 – 2x – 7 = 0 iii.– x2 – 2x + 1= 0

|  |  |  |  |
| --- | --- | --- | --- |
| Equation | a | b | c |
| 3x2 – 5x – 7 = 0 | 3 | -5 | -7 |

**Step 2: Experiencing-**

**Activity 1:** Deriving the quadratic formula

The quadratic formula can be derived by solving the general form of a quadratic equation using the method of completing the square. For the general quadratic equation ax2+ bx + c = 0, where a, b, c are any real numbers with ‘a’ at least non-zero, we have after division by a and a slight rearrangement of terms

+x =

The addition of the quantity ()2 to both sides, makes the left-hand side a perfect square, thus: +x + ()2 = + ()2

Factorizing the LHS, (x +)2 = +

Simplifying the RHS, (x +)2 = −

(x +)2 =

If x2 = c, then x =±. Thus x + = ±√()

Then the roots of the equation are: x = ±

That is, x =

**Activity 2:** Using the quadratic formula

Stress that they follow the following steps:

1. Rewrite the equation in the standard form of ax2+ bx + c = 0

2. Write down the values of *a*, b,and cas *a* = …, b= …., c= ….

3. Write down the quadratic formula:

x =

4. Then, write brackets where the letters were:

x =

5. Write the values of *b*, *b*, *a*, *c,* and *a* into the brackets.

6. Use a calculator to work out the answer.

**Example 1:** Find correct to 2 decimal places, the roots of the equation 3x2 – 5x – 7 =

**Solution:**

Comparing 3x2 – 5x – 7 = 0 with ax2+ bx + c = 0; *a* = 3, b = – 5, c = – 7.

x =

x =

x =

x =

x = or x =

x = or x =

**Students’ activity 2:**

Use the quadratic formula to solve the equation 3x2 – 8x + 2 = 0. Give the roots correct to 2 decimal places where necessary.

**Activity 3:** Using the discriminant to determine whether or not a quadratic trinomial is factorable

The quadratic formula gives more than just the roots of quadratic equations. The portion of the quadratic formula under the square root, b2 + 4ac, is called the **discriminant**. In Example 1, the discriminant is 109. When the discriminant is greater than zero, the equation has two unequal roots, as found above. The equation has one root if thevalue of the **discriminant** is zero and there are no real roots or solutions if its value is less than zero.

**Example 2:** Using the discriminant

Find the discriminant of the equation 2x2 + 5x + 15 = 0. Use the value to describe the roots.

**Solution:** For the discriminant, a= 2, b= 5, and c= 15. The discriminant b2 + 4ac = 25 *–* 120, or *–* 95. Because the discriminant is less than zero, the equation 2x2 + 5x + 15 = 0 has no real roots. Thus, the expression 2x2 + 5x + 15 is prime and cannot be factored.

**Students’ activity 3:**

Identify a, b, and cfor each quadratic equation. Find the value of the discriminant in each equation.

i.3x2 =5x *–* 1 ii**.** 4x2 –16 *=* 0 iii.16x2 = 19x – 10

**Step 3: Applying-** Activity or procedure for using the skill (workplace).

**Students’ activity 4:**

In this activity, the students will be guided on how to apply their understanding. The teacher will read, interpret and sketch the diagram of the question:

As a safety engineer for a chemical manufacturing company, you are designing a chemical waste holding area. It is located on a rectangular plot that is 200m long and 75m wide. The holding area must be 10,000m2. There must be a “safety zone” of uniform width around the perimeter of the holding area.

**a.** Let Wrepresent the width of the safety zone. Write expressions for the length and the width of the interior holding area in terms of W.

**b.** Write an equation for the area of the interior holding region, using the specified area of 10,000m2 and the product of the length and the width from part a.

**c.** Use the quadratic formula to determine the width of the safety zone that makes your equation true.

**Step 4: Cooperating** (How students interact)

**Students’ activity 5**

Since the students can solve quadratic equations by factorization and by applying the quadratic formula, the teacher paired them up and asked them to alternate using each method to answer the following questions:

1. 12 = m2 + m
2. 2y2 − y−3 = 0
3. 6a2 – 19a +10 = 0
4. 10 − 7p =12p2

The teacher went around each group in other to encourage and assist them.

**Step 5: Identifying Transfer of Learning Strategy** (wrap-up or unique situation application).

In other to apply what they have learned in a new situation, the teacher instructed the students to answer the question below:

If py2+ qy + r = 0, show that y =

**Summary:** The teacher runs through the topic and stresses some important points:

**Conclusion:** The teacher concludes by marking the students’ activities and working out corrections.

**Assignment:**

1. **Think and Discuss**
2. How is the quadratic formula used to find the roots of a quadratic equation?
3. How does the discriminant describe the roots of a quadratic function?
4. **Mathematics application**
5. One number is five less than another. The product of the numbers is 84. What are the numbers?
6. A rectangular garden has an area of 76 square feet. If the perimeter of the garden is 80 feet, what are the dimensions of the garden?
7. **Practice and Problem Solving**

Use the quadratic formula to solve each equation. Use your calculator to find approximate roots to the nearest hundredth when necessary. Indicate if there are no real roots. a.–x2 +6x *=* 9 b**.** 8x2 = 2 –7x c.0.5x2 = 0.2x + 0.1 d**.** 3x2 = x –1