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Teacher Training Module: Mathematics Learning Cycle Sixteen

Squire Roots

Sindh Technical Assistance –
Development through
Enhanced Education Programme
(STA-DEEP)



THE AGA KHAN UNIVERSITY

School Education & Literacy Department (SE&LD)

Government of Sindh.

Introduction and Rationale of the Training

Dear Teachers!

Welcome to the new phase of the Continuous Professional Development (CPD) Program. In the previous phase, we had focused on pedagogical skills that helped you to develop your skills to make classroom more interactive, participative, and joyful for our students. In the new phase, we will continue practicing those pedagogical skills and also learn about the introduced content knowledge and skills in Mathematics, Science, English, Urdu, and Sindhi. As a result, you will be better prepared to deal classroom situation using modern teaching strategies integrated with subject knowledge.

Our vision

Our common goal is to improve the quality of teaching in schools all over Sindh. We want students to become active and collaborative learners, problem solvers, and critical thinkers who approach tasks with creativity and confidence. They are conceptually clear about the subject content and have the skills to link this content with the world around them. To make this possible, we, as teachers, must be better prepared for the classroom demands in pedagogy and the subject content. Moreover, we aim to professionalize these trainings so that the CPD teacher training courses make an impact and substantially change student performance.

Our Teaching Philosophy

The CPD training sessions, including this training, follow a participatory teaching philosophy that engages teachers to apply and practice active and collaborative learning, as well as engage in self and peer reflection to become community of practice. The objective is not only to improve the teaching practices but to help you understand the theory of the subject content and the strategies that help students apply the content in daily life with confidence and mastery.



Supporting You

The training module is designed to support you in your classroom teaching. It will introduce you to the subject content and some approaches for use in the classroom. This will make your teaching more manageable and help you grow as a skillful teacher.

Acknowledgement

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We would like to express sincere gratitude to the following contributors:

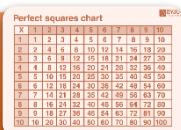
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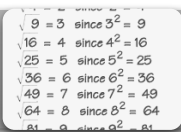
Square roots

Learning Objectives: By the end of the session, the teachers will be able to:



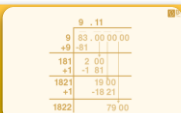
X	1	2	3	4	5	6	7	8	9	10
1	1	4	9	16	25	36	49	64	81	100
2	1	2	3	4	5	6	7	8	9	10
3	1	3	5	7	9	11	13	15	17	19
4	1	4	7	10	13	16	19	22	25	28
5	1	5	9	13	17	21	25	29	33	37
6	1	6	12	18	24	30	36	42	48	54
7	1	7	14	21	28	35	42	49	56	63
8	1	8	16	24	32	40	48	56	64	72
9	1	9	18	27	36	45	54	63	72	81
10	1	10	20	30	40	50	60	70	80	90

Identify square numbers



$\sqrt{9} = 3$ since $3^2 = 9$
$\sqrt{16} = 4$ since $4^2 = 16$
$\sqrt{25} = 5$ since $5^2 = 25$
$\sqrt{36} = 6$ since $6^2 = 36$
$\sqrt{49} = 7$ since $7^2 = 49$
$\sqrt{64} = 8$ since $8^2 = 64$
$\sqrt{81} = 9$ since $9^2 = 81$

Define and identify square roots of given numbers



9 . 11	
9	83.00 00 00
-9	-81

181	2 00
-18	-18

1821	19 00
-18	-18

1822	79 00

Calculate the square roots using prime factorization and division method







Apply their knowledge of square roots to solve real life problems



Session Plan

Instructional strategies/activities

Time	Objective/purpose of the activity	Activities/learning experiences	Materials/resources
 15 min	Activity 1:  Identify square and cube numbers	<p>This activity will help the teachers to recap the square numbers and see the visualization of square numbers.</p> <ul style="list-style-type: none"> • Ask teachers to pick a card, read it and identify the group where the number on the card is aligned with the cards of same number with other representation. • Ask teachers to show their cards within group to ensure that all numbers match with each other. • Discuss that square numbers have different representations including visual representation. Square numbers always represent area of square shapes. 	Handout 16.1
 30 min	Activity 2:  Calculate the square roots using prime factorization method	<p>The facilitator will ask the following question:</p> <p>How can you find the dimensions of a square when you are given its area?</p> <p>The facilitator will ask teachers to discuss in their groups. The facilitator will then collect the responses and then give the following explanation</p>	

When you multiply a number by itself, you square the number.

Symbol for squaring
is the exponent 2.

$$4^2 = 4 \cdot 4$$

$$= 16$$

4 squared is 16.

To “undo” this, take the *square root* of the number.

Symbol for square root
is a radical sign, $\sqrt{\quad}$.

$$\sqrt{16} = \sqrt{4^2} = 4$$

The square root of 16 is 4.

The facilitator then will have small discussion on calculating square roots through factorization. The facilitator will explain the following examples through interactive discussions.

EXAMPLE 1 Finding Square Roots of a Perfect Square

Find the two square roots of 49.

$$7 \cdot 7 = 49 \text{ and } (-7) \cdot (-7) = 49$$

So, the square roots of 49 are 7 and -7 .

The symbol $\sqrt{\quad}$ is called a **radical sign**. It is used to represent a square root. The number under the radical sign is called the **radicand**.

Study Tip

Zero has one square root, which is 0.

Positive Square Root, $\sqrt{\quad}$	Negative Square Root, $-\sqrt{\quad}$	Both Square Roots, $\pm\sqrt{\quad}$
$\sqrt{16} = 4$	$-\sqrt{16} = -4$	$\pm\sqrt{16} = \pm 4$

EXAMPLE 2 Finding Square Roots

Find the square root(s).

a. $\sqrt{25}$

Because $5^2 = 25$, $\sqrt{25} = \sqrt{5^2} = 5$.

$\sqrt{25}$ represents the positive square root.

b. $-\sqrt{\frac{9}{16}}$

Because $(\frac{3}{4})^2 = \frac{9}{16}$, $-\sqrt{\frac{9}{16}} = -\sqrt{(\frac{3}{4})^2} = -\frac{3}{4}$.

$-\sqrt{\frac{9}{16}}$ represents the negative square root.

c. $\pm\sqrt{2.25}$

Because $1.5^2 = 2.25$, $\pm\sqrt{2.25} = \pm\sqrt{1.5^2} = 1.5$ and -1.5 .

$\pm\sqrt{2.25}$ represents both the positive and the negative square roots.

The facilitator will then explain the procedure of calculating square root by prime factorization

Calculate Square Root by Prime Factorization *Perfect Square*

a. $\sqrt{225} = 15$

$$\begin{array}{c} 225 \\ / \quad \backslash \\ 5 \quad 45 \\ \quad / \quad \backslash \\ \quad 5 \quad 9 \\ \quad \quad / \quad \backslash \\ \quad \quad 3 \quad 3 \\ \sqrt{5 \cdot 5 \cdot 3 \cdot 3} = 5 \cdot 3 = 15 \end{array}$$

b. $\sqrt{196} = \sqrt{2^2 \cdot 7^2}$

$$\begin{array}{c} 196 \\ / \quad \backslash \\ 2 \quad 98 \\ \quad / \quad \backslash \\ \quad 2 \quad 49 \\ \quad \quad / \quad \backslash \\ \quad \quad 7 \quad 7 \end{array} = 2 \cdot 7 = 14$$

2	576
2	288
2	144
2	72
2	36
2	18
3	9
3	3
	1

For finding the square root, firstly we have to pair the common factors.

$$576 = \underline{2} \times \underline{2} \times \underline{2} \times \underline{2} \times \underline{2} \times \underline{2} \times \underline{3} \times \underline{3}$$

$$\Rightarrow 576 = 2^2 \times 2^2 \times 2^2 \times 3^2$$

The square root of 576 will be:

$$2 \times 2 \times 2 \times 3 = 24$$



40 mins

Activity 3:

Calculate the square roots using division method

The facilitator will show the following picture of finding square root by division method to the teachers.

$$\begin{array}{r}
 42 \\
 \hline
 4 \overline{) 1764} \\
 \underline{+ 4} \\
 82 \\
 \hline
 164 \\
 \underline{164} \\
 0
 \end{array}$$

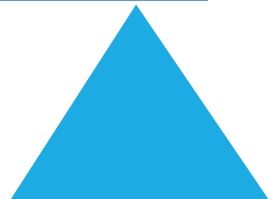
And then ask the following questions:

- Why we need to cap the digits in pairs of the numbers to be squared root?
- Why we need to double the number on the left side (add 4 to 4)?
- Why the addition of 4 and 4 be placed on the tens unit place?
- Can you give any reasoning in the steps/procedure of finding square roots through long division method?
- Can you give visual representation of find square roots by long division methods?

The facilitator will ask teachers to discuss these questions in their respective groups. Then the facilitator will collect responses from the groups and jot down the responses on the board/chart..

<https://www.youtube.com/watch?v=P0hCnWurM6g>

		<p>The facilitator then will invite the teachers to watch the video on calculating square root by long division method and its visual representation.</p> <p>https://www.youtube.com/watch?v=P0hCnWurM6g</p> <p>The facilitator will ask teachers to keep in mind the above questions while watching the video.</p> <p>After watching the video, the facilitator will ask teachers to discuss in their respective groups the above questions again. How much the video helped you to find the responses of the above questions?</p> <p>The facilitator will generate the interactive discussion on the visual representation of long division method depicted in the video. The facilitator will use the board to draw the visual representation to explain the steps if needed.</p> <p>The facilitator will ask teachers to find the square root of the following numbers by long division method along with its visual representation.</p> <p>Group 1 4624 Group 2 5329 Group 3 3294 Group 4 5929</p> <p>The facilitator will provide onsite feedback while the teachers will be working in the groups to calculate square roots.</p>	
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20 mins

Activity 4:**Real-life application
of Square roots**

The facilitator will ask teachers to think about the use of square roots in the real life. Where we need to calculate square roots in our daily life. Then the facilitator will collect the responses and write them on the board/chart and make a list of the areas where the concept of square roots used in our daily life.

The facilitator will ask teachers to solve the following problems.

1225 students stand in rows in such a way that the number of rows is equal to the number of students in a row. How many students are there in each row?

A rectangular field has an area of 18432 square meters. Its width is half as long as its length. Find its perimeter.

The facilitator will provide the feedback onsite in their respective groups and help them in any ambiguity or difficulty.



15 mins

Activity 5:**Assessment**

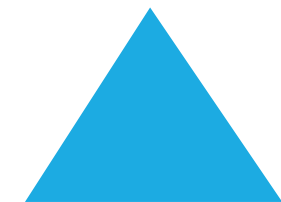
-Teachers will be asked to complete the assessment related to the learning cycle.

1. A square garden has an area of 121 square meters. What is the length of each side of the garden?





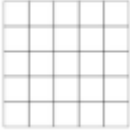

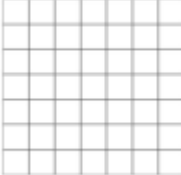

A) 10 meters
B) 11 meters
C) 12 meters
2. A square farm has an area of 1,600 square meters. The farmer wants to divide the farm into 4 equal smaller square plots. What will be the side length of each smaller plot?

A) 20 meters
B) 25 meters
C) 30 meters
3. A square swimming pool has a side length of 12 meters. Surrounding the pool is a pathway that is 2 meters wide. What is the area of the pathway?

		<p>A) 40 square meters B) 96 square meters C) 112 square meters</p> <p>4. Create a real-life problem involving square roots and provide a detailed solution. Explain how Understanding Square roots helps in solving your problem.</p> <p>5. Calculate the square root of 5776 by prime factorization and long division method.</p>	
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Handout 16.1

Pictorial Representations								
Number with Exponent	1^2	2^2	3^2	4^2	5^2	6^2	7^2	8^2
Square Numbers	1	4	9	16	25	36	49	64

For reference:

List of 1-20 LCs topics

Learning Cycles (LCs)	Topics
LC-1	Developing Number Sense
LC-2	Fractions
LC-3	Decimal and Percentage
LC-4	Ratio and Proportion
LC-5	Introduction to Algebra
LC-6	Algebraic Identities
LC-7	Angle and its Constructions
LC-8	Area and Perimeter
LC-9	Three Dimensional Shapes
LC-10	Information Handling
LC-11	Place Value
LC-12	Highest Common Factor (HCF) and Least Common Multiple (LCM)
LC-13	Fraction Addition and Subtraction
LC-14	Fraction Multiplication
LC-15	Laws of Exponents
LC-16	Square Roots
LC-17	Simultaneous Linear Equations
LC-18	Unit Conversion
LC-19	Pythagoras Theorem
LC-20	Construction of Different Types of Triangles

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