Teacher Training Module:
Mathematics
Learning Cycle 6

Algebraic Identities

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

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.
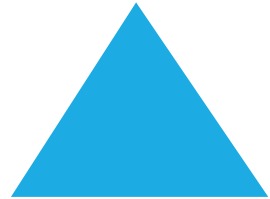
Our vision

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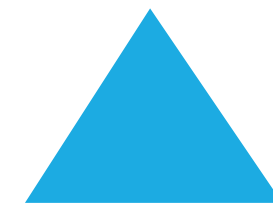
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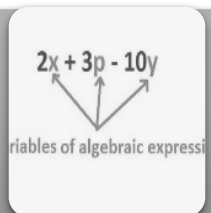
Learning Objectives: By the end of the session, the teachers will be able to:

solve algebraic equations using doing and undoing method;

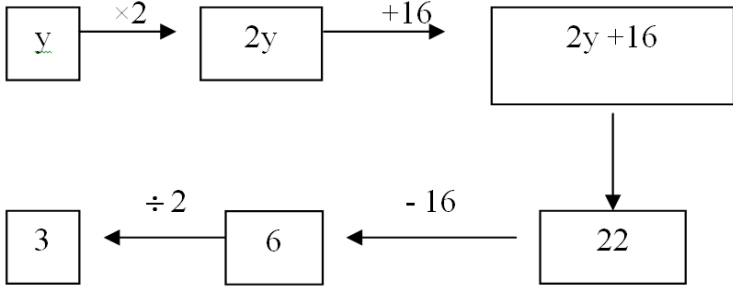exploring algebraic identities through area model and pattern-seeking;

evaluate different mathematical expressions using algebaric identities.

180 mins

Session Plan

Instructional strategies/activities

Time	Objective/purpose of the activity	Activities/learning experiences	Materials/resources

15 mins	**Activity 1: Solving equations using the 'Doing and Undoing Method'**	1. Ask teachers to create an algebraic equation for the following
		   i. Four times a number increased by 5 equals 11
		   ii. Four is added to twice of a number the result is 10
		   iii. The difference of a number and twenty is thirty-two
		   iv. Three subtracted from thrice of a number the result is 1
		   v. Five times of a number divided by 7 is 10
		   vi. I think of a number, multiplied by 2 add 16 to it, and the result is 22. What is my number?"
		
		2. Take responses from teachers and write equations on the board
		3. Ask teachers about the methods they use to solve the equations.
		4. Demonstrate the "Doing and Undoing Method" of solving equations vi.
		
		"I think of a number, multiplied by 2 add 16 to it, and the result is 22. What is my number?"
			5 sets of STB Textbooks Grade 6 and 7
			STB Textbook Link: https://ebooks.stbb.edu.pk/

5. Ask teachers to solve the following equations using the doing and undoing method
   1. $2m + 5 = 13$
   2. $5t - 4 = 6$
   3. $\frac{y}{3} + 1 = 4$

6. Ask teachers in their respective groups, explore chapter 9 from class 6 and 7 textbooks and solve at least 3 equations using the doing and undoing method.
7. Take responses from groups and sum up the session.

15 min	**Activity 2: Exploring numeric and algebraic multiplication using an area model**	1. Discuss ways to perform multiplications without using standard algorithms. 2. Collect responses and demonstrate multiplication using the area model of a) $12 \times 8 = 12 \times (5 + 3)$	Handout-1

5	3

12

5	3
12×5=60	12×3=36

12
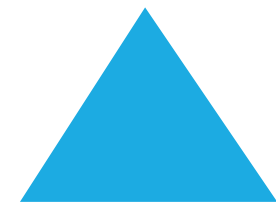
b) 12 × 13 = (10+2) × (10 + 3)
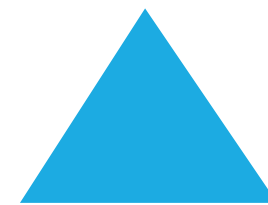
	10	3
10	100	30
2	20	6

Pose the following questions

i. What new things did you learn about multiplication procedures?
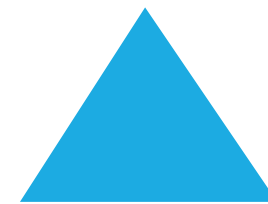ii. How the new learning is important for you as a mathematics learner?

3. Elaborate on the use of the area model to perform routine multiplications

4. Extend the use of the area model for multiplication in algebra. For example,

$$a \times (b + c) = ab + ac$$

	b	c
a	ab	ac

Ask to perform given multiplications in Handout-1 using an area model of multiplication.
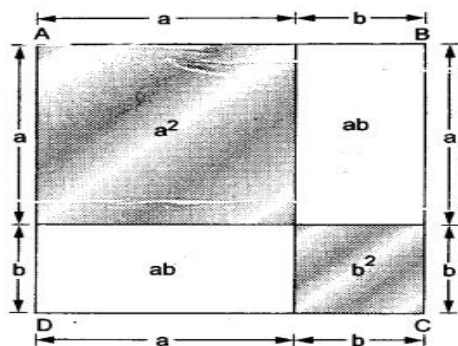
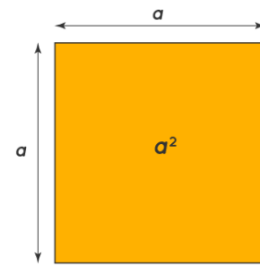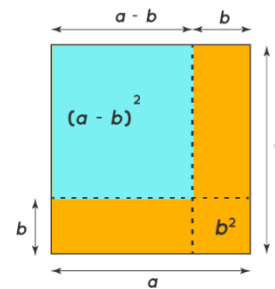|			

⏱️ **30 mins**	**Activity 3: Verification of Algebraic Identities using area model $(a+b)^2$**	1. Show a video to prove $(a+b)^2 = a^2+2ab+b^2$ (link given in the resource column)
		2. Help teachers to derive $(a+b)^2 = (a^2+2ab+b^2)$ using A-4 paper
		
		3. Facilitator's Input:
		
		  i. Area of the square ABCD = $(a + b)^2$
		  ii. Area of the square having each side unit 'a'=a^2
		  iii. Area of the square having each side 'b' = b^2
		  iv. Area of each rectangle = ab
		       $\therefore$
		  v. The total area = $(a^2 +b^2 + ab + ab) = (a^2 + 2ab+b^2) = (a + b)^2$
		
		4. Ask participants to open STB textbooks of class-7 chapter 8 (p.140), take distinct values of a and b and draw using area model
			Video link:
			
			https://www.youtube.com/watch?v=Ygkzh4sJOQE
			
			5 Sets of STB Textbook Grade-7 STB Textbook Link: https://ebooks.stbb.edu.pk/
			
			A-4 paper

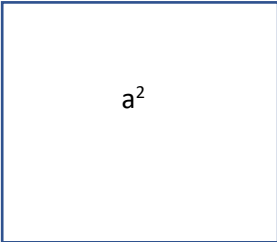|			
⏰ **30 mins**	**Activity 4: Verification of Algebraic Identities using area model (a-b)²**	1. Show a video to prove $(a − b)^2 = a^2 − ab − ab + b^2$. (link given in the resource column) 2. Ask the teachers using an A-4 sheet cut a square of length 'a' as shown below 3. Ask the teachers to reduce the length of all sides by factor b, and forms a new square of side length (a – b) by shading the reduced area using pen as shown below 	Video link: https://www.youtube.com/watch?v=TsaH0GR15V4&t=282s 5 Sets of STB Textbook Grade-7 STB Textbook Link: https://ebooks.stbb.edu.pk/ A-4 paper

|		4. **Facilitator's Input:**	
		i. Subtracting the vertical and horizontal strips that have the area a × b. Removing a × b twice will also remove the overlapping square at the bottom right corner twice hence add b^2. ii. Rearranging the squares, we get $(a - b)^2 = a^2 - ab - ab + b^2$. 5. Ask teachers to open STB textbooks of class-7 chapter 8, take distinct values of a and b and try out the area model of identities.	
30 mins	**Activity 5: Verification of Algebraic Identities using area model a^2-b^2**	1. Show a video to prove $a^2 - b^2 = (a - b)(a + b)$ (link given in the resource column) 2. Ask the teachers to cut a square of length 'a' of A-4 paper as shown in the picture a^2	Video link: https://www.youtube.com/watch?v=24gWbMSEVVw 5 Sets of STB Textbook Grade-7 STB Textbook Link: https://ebooks.stbb.edu.pk/ A-4 paper
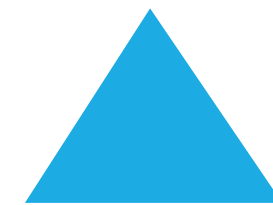
3. Cut a small (blue) square of area b.
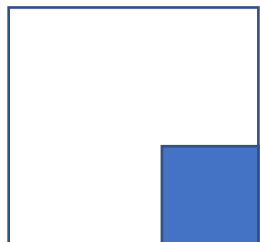
4. Then pose the following questions:
   i.   What will be the area of the remaining (White) piece?
   ii.   If we rearrange the remaining in the form of a rectangle. What are its length and breadth?
   iii. How could we represent its area?
   iv.   What do you conclude?
5. **Facilitator's Input:**
   i.   If we cut a small area named b^2 from larger area a^2, the remaining area will be $a^2 - b^2$
   ii.   If we rearrange in the form of a rectangle, we can write its length as $(a - b)$ and breadth as $(a + b)$
   iii. Area of the rectangle can now as $(a - b) (a + b)$
   iv.   With the help of the above illustrations the facilitator will help participants to drive its identity; $a^2 - b^2 = (a - b) (a + b)$

6. Ask teachers to open STB textbooks of class-7 chapter 8, take distinct values of a and b and try out the area model of identities.

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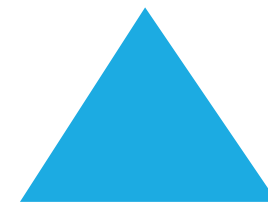
⏱️
20 mins
	Activity 6:
	Exploring a² – b² = (a + b) (a–b) through pattern-seeking
		1. Ask teachers to evaluate the following expression. Allow the use of calculators for the first four expressions.
		
		100 × 100 = 10, 000
		101 × 99 = 9999
		102 × 98 = 9996
		103 × 97 = 9991
		
		2. Collect responses from teachers and write responses on the board
		3. Ask teachers to observe the above pattern and think what could be the answer to the following tasks? Now restrict the use of calculators so as to promote thinking using pattern seeking
		
		104 × 96 =?
		105 × 95 =?
		106 × 94=?
		107 × 93=?
		
		4. Collect the responses from teachers
		
		5. **Facilitator's Input:**
		Conclude the activity of pattern-seeking by discussing the following points
		  i. If we generate the same pattern by replacing 100 with 'a' we get,
		
		  100 × 100 = 10, 000 $a \times a = a^2$
		  101 × 99 = 9999 *(a+1) (a-1) =?*
		  102 × 98 = 9996 *(a+ 2) (a-2) =?*
		  103 × 97 = 9991 *??*	

		ii. The numbers in the above pattern can be replaced with letters a and b and we get, *(a + b) (a - b) = a² - b²*	
30 mins	**Activity 7: Application of identities to solve numeric task**	i. Ask the teachers to open the STB book of class 8 and refer to unit 6, exercise 6.1, questions # 1 and 2 and perform the following tasks; ii. **Task:** Create the product table of the given questions using the algebraic identities used in the given questions and discuss your understanding in the group. The facilitator will then call a representative from each group and ask them to share their understanding.	5 Sets of STB Textbook Grade-8 STB Textbook Link: https://ebooks.stbb.edu.pk/
10 mins	**Reflection**	Invite teachers to share their learning experience during the session with the whole class (refer to the reflection question)	
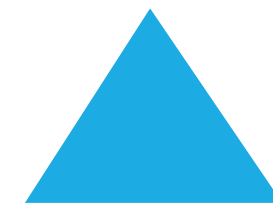
Task: Perform the given multiplication using an area model

    a. 12×6

    b. 14×3

    c. 24×2

    d. 13×12

    e. 14×16

    f. $a \times (b + c)$

    g. $m \times (2p + 3q)$

    h. $(r + s) \times (c + d)$

    i. $(m + n) \times (o + p)$

    j. $(4s + t) \times (3p + 4d)$