DISTRICT INSTITUTE OF EDUCATION AND TRAINING,

PALAYAMPATTI, VIRUDHUNAGAR DISTRICT - 626 112.

ACTION RESEARCH

Enhancing the learning attainment of Identities in Algebra among class VII children by using Jigsaw technique.

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Enfacement Slip

ACTION RESEARCH

Theme/Subject	: Post covid-19 issues
Stage of Education	: Upper primary School
Name of the DIET	: DIET, PALAYAMPATTI VIRUDHUNAGAR DISTRICT, Pincode: 626130
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Co-investigator	: Mr. K. Adimoolam Secondary Grade Teacher, Municipal Muslim Middle School, Virudhunagar, Virudhunagar Block, Virudhunagar District, Tamilnadu.
Area of Research	: Jigsaw technique in teaching algebraic Identities.
Title of the Action Research	: Enhancing the learning attainment of Identities in Algebra among class VII children by using Jigsaw technique.
Sample School	: Municipal Muslim Middle School, Virudhunagar, Virudhunagar Block, Virudhunagar District, Tamilnadu.
Sample classes	: VII Standard students
No. of Sample	: 28

Enhancing the learning attainment of Identities in Algebra among class VII children by using Jigsaw technique.

1. Introduction:

"The aim of education should be to teach us rather how to think, than what to think - rather to improve our minds, so as to enable us to think for ourselves, than to load the memory with thoughts of other men." - Bill Beattie.

Education serves various interconnected purposes, each essential for personal growth and societal advancement. Firstly, education strives to foster intellectual growth by nurturing critical thinking, creativity, and problem-solving skills. It empowers individuals to analyze information critically, synthesize knowledge from diverse sources, and adapt to an ever-changing world.

Moreover, education aims to cultivate social and emotional development by promoting empathy, collaboration, and communication skills. Through interaction with peers and exposure to diverse perspectives, individuals learn to navigate relationships, resolve conflicts, and contribute positively to their communities.

Furthermore, education endeavors to instill ethical values, moral principles, and a sense of social responsibility. By fostering empathy, respect for diversity, and a commitment to social justice, education promotes ethical behavior and civic engagement, thereby contributing to the creation of a more just and equitable society.

Additionally, education serves economic purposes by preparing individuals for the workforce and enhancing their employability. It equips learners with vocational skills, technical competencies, and entrepreneurial abilities, enabling them to pursue rewarding careers and contribute to economic productivity and innovation.

In essence, the aim of education transcends the mere transmission of knowledge; it encompasses the holistic development of individuals, the promotion of social cohesion, and the advancement of societal well-being. By nurturing intellectual curiosity, fostering social-emotional growth, cultivating ethical values, and enhancing economic opportunities, education plays a pivotal role in shaping individuals' lives and shaping the future of society.

"Action research is a powerful way of developing professional knowledge and improving professional practice." - David Coghlan and Teresa Brannick

Action research is a systematic approach to inquiry that is focused on solving real-world problems, improving practices, and bringing about meaningful change within specific contexts. Unlike traditional research, which often emphasizes detached observation and analysis, action research actively involves participants in the process of identifying issues, designing interventions, implementing changes, and reflecting on outcomes. This collaborative and iterative approach makes action research particularly well-suited for addressing complex and dynamic challenges in fields such as education, healthcare, community development, and organizational management.

The key characteristics of action research include its participatory nature, emphasis on practical outcomes, and commitment to continuous improvement. Researchers, often working closely with stakeholders such as practitioners, clients, or community members, engage in a cyclical process of planning, acting, observing, and reflecting. This process allows for ongoing learning and adaptation, as insights gained from one iteration inform the next steps in the research process.

Action research can take various forms, including classroom-based interventions in education, quality improvement initiatives in healthcare, or community-based projects in social work. Regardless of the specific context, action research typically follows a similar framework: identifying a problem or opportunity, planning and implementing an intervention, gathering and analyzing data, reflecting on the results, and making adjustments as needed.

By combining rigorous inquiry with practical action, action research offers a powerful means of addressing complex challenges and promoting positive change in diverse settings.

2. Need for the study:

In our district, most of our students are weak in learning algebraic identities among upper primary students. It could be seen through NAS achievement survey 2017 result. So studying teaching-learning strategies in algebraic identities is essential for the following reasons:

1. **Foundation in Algebra**: Algebraic identities form the cornerstone of algebra, serving as fundamental building blocks for solving equations, simplifying expressions, and understanding higher-level algebraic concepts. Proficiency in algebraic identities lays a strong foundation for success in advanced mathematics and related disciplines.
2. **Conceptual Understanding**: Investigating teaching-learning strategies in algebraic identities promotes deeper conceptual understanding among students. By exploring different approaches to teaching and learning these identities, educators can cater to diverse learning styles and help students grasp the underlying principles behind algebraic manipulations.
3. **Problem-Solving Skills**: Mastery of algebraic identities enhances students' problem-solving skills. By employing various strategies to teach and learn these identities, educators can foster students' ability to analyze complex problems, apply appropriate techniques, and derive solutions efficiently.
4. **Critical Thinking**: Studying teaching-learning strategies in algebraic identities encourages critical thinking and mathematical reasoning. Through activities that involve conjecturing, proving, and generalizing algebraic identities, students develop analytical skills and learn to evaluate the validity of mathematical statements.
5. **Preparation for Higher Education and Careers**: Proficiency in algebraic identities is crucial for success in higher education and numerous

careers, particularly in STEM fields. Research on effective teaching-learning strategies equips educators with evidence-based practices to prepare students for the rigors of advanced mathematics courses and future professional endeavors.

6. **Addressing Learning Challenges**: Understanding how different teaching-learning strategies impact students' comprehension of algebraic identities is essential for addressing learning challenges and promoting equity in education. By identifying effective instructional methods and interventions, educators can support diverse learners, including those with varying levels of mathematical proficiency or learning needs.
7. **Continuous Improvement**: Research on teaching-learning strategies in algebraic identities contributes to ongoing efforts to improve mathematics education. By examining the effectiveness of different pedagogical approaches, educators can refine their instructional practices, adapt to evolving educational contexts, and enhance student outcomes over time.

In summary, studying teaching-learning strategies in algebraic identities is essential for promoting conceptual understanding, problem-solving skills, critical thinking, and equity in mathematics education. By advancing our knowledge in this area, educators can better support student learning and prepare them for future academic and professional success.

3. Defining the Problem:

Upper primary children, typically aged between 10 to 12 years old, often encounter various difficulties in learning algebraic identities. Some common challenges include:

I. **Abstract Thinking**: Algebraic identities introduce abstract concepts that may be challenging for upper primary children who are still developing their abstract thinking abilities. Understanding variables, coefficients, and symbolic representations can be difficult for students who are more accustomed to concrete operations.

II. **Symbolism and Notation**: Algebraic identities involve the use of symbols and notation, which can be confusing for some children. Interpreting expressions like $a+b$ or $x^2 + y^2$ and understanding their meanings in relation to concrete quantities can be a barrier to learning.

III. **Lack of Concrete Context**: Unlike arithmetic operations, which often involve tangible quantities and real-world contexts, algebraic identities may lack immediate concrete relevance for upper primary children. Without meaningful contexts to anchor their understanding, students may struggle to grasp the purpose and significance of algebraic manipulations.

IV. **Procedural Focus**: Traditional teaching approaches sometimes prioritize procedural fluency over conceptual understanding, leading to rote memorization of algebraic identities without a deeper comprehension of their underlying principles. This can result in surface-level learning and difficulties applying identities in novel contexts.

V. **Multiple Representations**: Algebraic identities can be represented in various forms, including symbolic notation, verbal descriptions, and graphical representations. Understanding how these different representations relate to one another and how to translate between them can pose challenges for upper primary children.

VI. **Difficulty with Generalization**: Algebraic identities often involve generalizing patterns and making connections between different expressions or equations. Upper primary children may struggle to recognize and articulate these patterns, hindering their ability to apply algebraic identities flexibly in problem-solving situations.

VII. **Misconceptions and Errors**: Misconceptions about algebraic concepts, such as the distributive property or the difference between expressions and equations, can impede children's progress in learning algebraic identities. Common errors, such as incorrect application of rules or misconstruing the meaning of variables, can also contribute to difficulties.

VIII. **Language Barrier**: Understanding the language used in algebraic expressions and equations, including mathematical terminology and vocabulary, can present challenges for upper primary children, especially those with limited language proficiency or vocabulary skills.

Addressing these difficulties requires adopting instructional strategies that promote conceptual understanding, provide concrete contexts for learning, foster multiple representations, encourage active engagement, and address misconceptions effectively. By tailoring instruction to the specific needs and developmental level of upper primary children, educators can support their progress in learning algebraic identities and lay a strong foundation for further mathematical learning.

To overcome this problem, storytelling approach is planned to try out as an action research on the topic of "Enhancing the learning attainment of Identities in Algebra among class VII children by using Jigsaw technique."

4. Causes for the Problem:

I. Learning difficulties in algebraic identities among upper primary children can stem from various causes, including:

II. **Developmental Readiness**: Upper primary children may not yet have fully developed the cognitive abilities necessary for abstract algebraic reasoning. Their brains are still maturing, and they may struggle with the abstract nature of algebraic concepts and symbols.

III. **Limited Prior Knowledge**: Children's understanding of basic arithmetic concepts and operations may not be sufficiently developed to support their learning of algebraic identities. Without a solid foundation in arithmetic, they may find it challenging to grasp more complex algebraic concepts.

IV. **Lack of Concrete Context**: Algebraic identities often lack immediate real-world context for upper primary children, making it difficult for them to understand the purpose and relevance of the concepts. Without meaningful connections to their everyday experiences, children may struggle to engage with and internalize algebraic ideas.

V. **Language Barriers**: Understanding the language of algebra, including mathematical terminology and symbolic notation, can be a barrier for some children, especially those with limited language proficiency or vocabulary skills. Difficulty understanding the language of algebra can hinder their ability to comprehend and manipulate algebraic expressions and equations.

VI. **Misconceptions and Errors**: Children may develop misconceptions or misunderstandings about algebraic concepts and operations, such as the distributive property or the role of variables. These misconceptions can lead to errors in reasoning and problem-solving, further exacerbating learning difficulties.

VII. **Teaching Methods**: Ineffective teaching methods or instructional approaches that prioritize rote memorization over conceptual understanding can hinder children's learning of algebraic identities. Without opportunities for hands-on exploration, meaningful problem-solving, and conceptual development, children may struggle to grasp algebraic concepts.

VIII. **Limited Resources and Support**: Children from disadvantaged backgrounds may lack access to quality educational resources, including textbooks, manipulatives, and instructional support. Limited access to resources and support can exacerbate learning difficulties and widen educational disparities.

IX. **Math Anxiety**: Some children may experience math anxiety, which can negatively impact their confidence and performance in learning algebraic identities. Math anxiety can manifest as fear, stress, or avoidance behavior when faced with math-related tasks, making it difficult for children to engage effectively with algebraic concepts.

Addressing these probable causes requires a multifaceted approach that includes implementing effective instructional strategies, providing targeted support and resources, fostering a supportive learning environment, and addressing individual needs and challenges. By addressing these underlying factors, educators can help upper primary children overcome learning difficulties and develop a strong foundation in algebraic identities.

5. **Probable solution:**

5.1 Search for Comfortable Solution::

Addressing teaching-learning difficulties in algebraic identities among upper primary children requires a comprehensive approach that incorporates effective instructional strategies, targeted interventions, and supportive learning environments. Here are some probable solutions to consider:

1. **Hands-on Manipulatives**: Use concrete manipulatives, such as algebra tiles or blocks, to represent algebraic expressions and identities. Hands-on experiences can help make abstract concepts more tangible and accessible for children, facilitating deeper understanding.

2. **Visual Representations**: Incorporate visual representations, such as diagrams, charts, and graphic organizers, to illustrate algebraic concepts and relationships. Visual aids can enhance children's comprehension and help them visualize abstract ideas more effectively.

3. **Real-World Contexts**: Embed algebraic concepts in meaningful real-world contexts that resonate with children's experiences and interests. Relating algebraic identities to everyday situations can make the concepts more relevant and engaging for students.

4. **Interactive Activities**: Engage children in interactive activities, such as group discussions, peer collaboration, and problem-solving tasks, to promote active participation and shared learning experiences. Interactive activities encourage children to explore algebraic concepts collaboratively and learn from one another.

5. **Differentiated Instruction**: Differentiate instruction to meet the diverse needs and learning styles of individual students. Provide varied learning opportunities, instructional scaffolding, and personalized support to accommodate children's different abilities, interests, and learning preferences.

6. **Conceptual Understanding**: Emphasize conceptual understanding over procedural fluency by focusing on the underlying principles and properties of algebraic identities. Encourage children to explore and discover patterns, make connections, and develop their own strategies for solving problems.

7. **Metacognitive Strategies**: Teach children metacognitive strategies, such as problem-solving techniques, self-monitoring, and reflection, to enhance their awareness and control of their learning process. Encourage children to reflect on their thinking, identify areas of difficulty, and adopt effective learning strategies.

8. **Formative Assessment**: Use formative assessment strategies, such as questioning, observation, and student feedback, to monitor children's progress, identify misconceptions, and provide timely feedback. Adjust instruction based on ongoing assessment data to address children's specific learning needs.

9. **Teacher Professional Development**: Provide professional development opportunities for teachers to enhance their knowledge and pedagogical skills in teaching algebraic identities. Offer training workshops, resources, and ongoing support to help teachers implement effective instructional practices and interventions.

10. **Parental Involvement**: Involve parents and caregivers in children's learning by providing resources, guidance, and opportunities for family involvement. Foster partnerships between schools and families

to support children's mathematical development both inside and outside the classroom.

By implementing these probable solutions and fostering a supportive learning environment, educators can help upper primary children overcome teaching-learning difficulties in algebraic identities and develop a strong foundation in algebraic reasoning and problem-solving.

5.2 Search for Probable solutions:

The Jigsaw technique can indeed be a feasible solution to teach algebraic identities among upper primary children. Here's how it could work:

I. **Formation of Expert Groups**: Divide the class into small expert groups, with each group focusing on a specific algebraic identity or concept. For example, one group could work on the distributive property, another on the commutative property, and so on.

II. **In-depth Study**: Within their expert groups, students delve deeply into their assigned algebraic identity. They explore its definition, properties, examples, and applications. They may use textbooks, online resources, manipulatives, and other materials to deepen their understanding.

III. **Collaborative Learning**: After becoming experts on their respective algebraic identities, students return to their original heterogeneous groups, which consist of members from different expert groups. In these heterogeneous groups, students share their expertise with their peers and teach them about their assigned algebraic identity.

IV. **Discussion and Clarification**: Students engage in discussions, ask questions, and clarify any misunderstandings about the algebraic identities being taught. This collaborative learning process fosters peer-to-peer teaching and learning, as well as promotes active engagement and participation.

V. **Application Activities**: Following the jigsaw activity, students participate in application activities that require them to apply their understanding of algebraic identities in problem-solving tasks, real-world scenarios, or creative projects. These activities reinforce their learning and allow them to see the practical relevance of algebraic identities.

VI. **Reflection and Summation**: At the end of the lesson, students reflect on their learning experiences and summarize the key concepts and insights gained from the jigsaw activity. This reflection promotes meta-cognition and helps solidify their understanding of algebraic identities.

VII. **Benefits of Using the Jigsaw Technique:**

i. **Promotes Collaboration**: The jigsaw technique encourages collaboration and cooperative learning among students, as they work together to become experts on different algebraic identities and teach each other.

ii. **Differentiation**: Students have the opportunity to learn from their peers and receive support tailored to their individual learning needs and preferences. This differentiation helps accommodate diverse learning styles and abilities within the classroom.

iii. **Deepens Understanding**: By engaging in in-depth study and peer teaching, students develop a deeper understanding of algebraic identities and their properties. Teaching others reinforces their own learning and enhances their mastery of the concepts.

iv. **Fosters Communication Skills**: The jigsaw technique fosters communication skills as students articulate their understanding of algebraic identities, ask questions, and engage in discussions with their peers. These communication skills are essential for mathematical reasoning and problem-solving.

Overall, the Jigsaw technique offers a dynamic and interactive approach to teaching algebraic identities, promoting collaboration, deepening understanding, and fostering communication skills among upper primary children.

6. Objectives of the study:

1) To identify common misconceptions and areas of difficulty among class VIII students regarding identities in algebra.

2) To Implement differentiated instruction strategies, including tiered assignments, small-group activities, and personalized learning pathways, to cater to the diverse learning needs and abilities of class VIII students in mastering identities in algebra
3) To facilitate collaborative learning experiences, such as peer tutoring, group problem-solving tasks, and cooperative projects, to encourage active participation, communication, and knowledge sharing among class VII students in exploring identities in algebra concepts.

6.1 Operational Definitions:

I. **Enhancing:** In the context of education or learning, "enhancing" refers to the process of improving, enriching, or augmenting a particular aspect of teaching, learning, or educational practice. It involves making modifications, additions, or refinements with the aim of increasing the effectiveness, quality, or impact of educational experiences and outcomes.

Operationally defining "enhancing" involves specifying the actions or strategies employed to bring about improvements or enhancements in a specific educational context. These actions or strategies may vary depending on the desired outcome and the area being targeted for enhancement

II. **Learning attainment:** In the context of education, "learning attainment" refers to the level of knowledge, skills, competencies, or understanding that students have acquired or demonstrated as a result of their learning experiences within a specific timeframe or learning context. It reflects the extent to which students have achieved the learning objectives, goals, or standards set forth in a particular educational program, curriculum, or instructional unit.

Operationally defining "learning attainment" involves specifying the criteria, measures, or indicators used to assess and evaluate students' learning outcomes. These criteria may vary depending on the subject matter, grade level, educational goals, and assessment methods employed.

III. Identities in Algebra:

In algebra, identities are mathematical expressions that are true for all values of the variables involved. These expressions remain valid regardless of the specific values assigned to the variables. Understanding and applying algebraic identities is crucial in simplifying expressions, solving equations, and manipulating mathematical relationships. Here are some common algebraic identities:

i. **Additive Identity:**
   - The additive identity states that adding zero to any number does not change the value of the number.
   - Example: $a + 0 = a$

ii. **Multiplicative Identity:**
   - The multiplicative identity states that multiplying any number by one does not change the value of the number.
   - Example: $a \times 1 = a$

iii. **Distributive Property:**
   - The distributive property involves multiplying a number by a sum or difference.
   - Example: $a \times (b + c) = a \times b + a \times c$

iv. **Commutative Property:**
   - The commutative property involves changing the order of addition or multiplication without changing the result.
   - Example:
     - Addition: $a + b = b + a$
     - Multiplication: $a \times b = b \times a$

v. **Associative Property:**
   - The associative property involves changing the grouping of numbers in addition or multiplication without changing the result.
   - Example:
     - Addition: $(a + b) + c = a + (b + c)$
     - Multiplication: $(a \times b) \times c = a \times (b \times c)$

vi. **Inverse Property:**

- The inverse property involves the existence of additive and multiplicative inverses.
- Additive Inverse: $a + (-a) = 0$
- Multiplicative Inverse: $a \times \frac{1}{a} = 1$, where $a \neq 0$

vii. **Square of a Binomial:**

- The square of a binomial involves expanding the square of a sum or a difference.
- Example:
    - $(a + b)^2 = a^2 + 2ab + b^2$
    - $(a - b)^2 = a^2 - 2ab + b^2$

viii. **Difference of Squares:**

- The difference of squares involves factoring the difference of two perfect squares.
- Example: $a^2 - b^2 = (a + b)(a - b)$

Understanding and applying these algebraic identities are foundational skills that students develop as they progress through their algebraic studies. These identities are used in various mathematical operations and are essential for simplifying expressions and solving equations in algebra.

IV. Jigsaw technique: The Jigsaw technique is a cooperative learning strategy that promotes collaboration and active participation among students. It can be an effective method for enhancing the learning attainment of identities in algebra among class VIII children. Here's a step-by-step guide on how to implement the Jigsaw technique for this specific topic:

Step 1: Identify Identity Types

- Break down the topic of "Identities in Algebra" into specific types or categories, such as distributive property, additive identity, multiplicative identity, etc.

Step 2: Form Expert Groups

- Divide the class into small groups, assigning each group one specific type of algebraic identity to become experts in. Ensure that each group has a mix of abilities and learning styles.

Step 3: Expert Group Research

- Provide resources (textbooks, online materials, etc.) to each expert group to research and understand their assigned identity thoroughly. Encourage discussion within the group to ensure everyone understands the concepts.

Step 4: Create Teaching Aids

- Ask each expert group to create teaching aids (posters, presentations, diagrams, etc.) that will help them explain their assigned identity to others.

Step 5: Jigsaw Groups Formation

- Reorganize the class, forming new groups that consist of one member from each expert group. In these new "Jigsaw groups," each member will be responsible for teaching their assigned identity to the others.

Step 6: Teach and Learn

- Allow time for each student to teach their assigned identity to the rest of their Jigsaw group. Encourage active participation and questioning. This process helps reinforce their own understanding while learning about other identities.

Step 7: Class Discussion

- Facilitate a class discussion where students can share their insights and findings about different algebraic identities. Encourage questions and clarifications.

Step 8: Application Activities

- Provide practical application activities or problem-solving tasks where students can apply their knowledge of algebraic identities. This could involve solving equations, simplifying expressions, or creating their own examples.

Step 9: Assess Understanding

- Assess students' understanding through quizzes, discussions, or other formative assessment methods. Provide constructive feedback to guide further learning.

Step 10: Reflection

- Conclude the lesson with a reflection session where students can express what they have learned, what challenges they faced, and how the Jigsaw technique helped them understand algebraic identities better.

Additional Tips:

- Encourage a positive and supportive learning environment.
- Monitor group dynamics to ensure everyone is participating.
- Adapt the difficulty level of the material based on the class's overall comprehension.

7. Action Hypothesis:

There is no significant difference between traditional approach and Jigsaw technique approach in enhancing the learning attainment of Identities in Algebra among class VIII children.

8. Design of the Study: Experimental Method.

8.1 Sample:

The investigator has selected Municipal Muslim Middle School, Virudhunagar, Virudhunagar Block. There are 28 students involved in this action research. These students are studying in VII standard in the year 2023-2024.

8.2 Tool:

Investigator constructed and standardised Pre-test and Post-test to measure algebraic identities skills for class VII students.

8.3 Implementation of the selected intervention Techniques:

Teaching Jigsaw technique approach of lesson packages for VII standard concepts of algebraic identities developed by the investigator to the experimental group for 15 days.

By using the Jigsaw technique, it can promote collaboration, critical thinking, and a deeper understanding of algebraic identities among class VIII children.

In algebra, identities are mathematical expressions that are true for all values of the variables involved. These expressions remain valid regardless of the specific values assigned to the variables. Understanding and applying algebraic identities is crucial in simplifying expressions, solving equations, and manipulating mathematical relationships.

Jigsaw Technique:

Here 28 students were divided into four groups of each with seven members and assigned with common algebraic identities as follows:

Group: I. Allotted Identities

1. **Additive Identity:**
    - The additive identity states that adding zero to any number does not change the value of the number.
    - Example: $a + 0 = a$
2. **Multiplicative Identity:**
    - The multiplicative identity states that multiplying any number by one does not change the value of the number.
    - Example: $a \times 1 = a$

Group: II. Allotted Identities

3. **Distributive Property:**
    - The distributive property involves multiplying a number by a sum or difference.
    - Example: $a \times (b + c) = a \times b + a \times c$

4. **Commutative Property:**
    - The commutative property involves changing the order of addition or multiplication without changing the result.
    - Example:
        - Addition: $a + b = b + a$
        - Multiplication: $a \times b = b \times a$

Group: III. Allotted Identities

5. **Associative Property:**
    - The associative property involves changing the grouping of numbers in addition or multiplication without changing the result.
    - Example:
        - Addition: $(a + b) + c = a + (b + c)$
        - Multiplication: $(a \times b) \times c = a \times (b \times c)$
6. **Inverse Property:**
    - The inverse property involves the existence of additive and multiplicative inverses.
    - Additive Inverse: $a + (-a) = 0$
    - Multiplicative Inverse: $a \times \frac{1}{a} = 1$, where $a \neq 0$

Group: IV. Allotted Identities

7. **Square of a Binomial:**
    - The square of a binomial involves expanding the square of a sum or a difference.
    - Example:
        - $(a + b)^2 = a^2 + 2ab + b^2$
        - $(a - b)^2 = a^2 - 2ab + b^2$
8. **Difference of Squares:**
    - The difference of squares involves factoring the difference of two perfect squares.
    - Example: $a^2 - b^2 = (a + b)(a - b)$

The above concepts taught by the researcher in phase: I and then each group assigned with two identities each as above for practice themselves in phase: II. Assigned identities practiced with various strategies by the each group are disseminated to all other groups in phase: III. Here Group head / members took the role of teacher to illustrate their practiced identities to other groups with ample examples.

Groups practice Questions: Group: I. Practice Question:

1. Which one of the following is additive identity in algebra?

   a) $a + 1 = a$

   b) $\boldsymbol{a + 0 = a}$

   c) $a - a = 0$

   d) $a \times 1 = a$

2. Which one of the following is multiplicative identity in algebra?

   a) $a + 1 = a$

   b) $a \times 0 = 0$

   c) $\boldsymbol{a \times 1 = a}$

   d) $a - a = 0$

3. What is the result of adding zero to any number in algebra?

   a) $a + 1 = a$

   b) $\boldsymbol{a + 0 = a}$

   c) $a \times 1 = a$

   d) $a - a = 0$

4. What is the result of multiplying any number by one in algebra?

   a) $a + 1 = a$

   b) $a \times 0 = 0$

   c) $\boldsymbol{a \times 1 = a}$

   d) $a - a = 0$

5. What is the additive inverse of a number?

a) $\boldsymbol{a + (-a) = 0}$

b) $a \times \frac{1}{a} = 1$

c) $a + 0 = a$

d) $a \times 1 = a$

6. What is the multiplicative identity in algebra?

a) $a + 1 = a$

b) $a + 0 = a$

c) $\boldsymbol{a \times 1 = a}$

d) $a - a = 0$

Group: II. Practice Question:

7. Which property allows you to change the order of addition without changing the result?

a) Commutative property

b) Associative property

c) Distributive property

d) Identity property

8. Which algebraic identity is expressed $a \times (b + c) = a \times b + a \times c$?

a. Commutative property

b. Distributive property

c. Associative property

d. Identity property

9. If $3(x + 2) + 2(2x - 1)$ is simplified using the distributive property, what is the result?

a) $5x + 1$

b) $5x - 4$

c. $6x + 1$

d. $\boldsymbol{7x + 4}$

Group: III. Practice Question:

10. Which property involves changing the grouping of numbers in addition or multiplication without changing the result?

a) Commutative property

b) Distributive property

c) Associative property

d) Identity property

11. The side length of a square is $a - b$. What is the expression for the perimeter of the square?

a). $\boldsymbol{4a - 4b}$

b) $4a^2 - 4b^2$

c) $2a - 2b$

d) $2a^2 - 2b^2$

Group: IV. Practice Question:

12. Which identity involves factoring the difference of two perfect squares?

a. Commutative property

b. Distributive property

c. Additive inverse

d. Difference of squares

13. The length of a rectangle is $a + b$ units, and the width is $a - b$ units. What is the expression for the area of the rectangle?

a)$a^2 + 2ab - b^2$

b) $\boldsymbol{a^2 - b^2}$

c) $a^2 - 2ab + b^2$

d) $a^2 + b^2$

14. What does the difference of squares identity state?

a) $\boldsymbol{a^2 - b^2 = (a+b)(a-b)}$

b) $a^2 + b^2 = (a+b)^2$

c) $a^2 - b^2 = (a-b)^2$

d) $a^2 \times b^2 = (a \times b)^2$

15. In a right-angled triangle with legs $a + b$ and $a - b$, what is the expression representing the length of the hypotenuse using the Pythagorean theorem?

a)$2a$

b)$a^2 - b^2$

c)$\sqrt{2a^2 - 2b^2}$

d)$\boldsymbol{\sqrt{2a^2 + 2b^2}}$

16. The side length of a square is $a + b$. What is the expression for the area of the square?

a) $\boldsymbol{a^2 + 2ab + b^2}$

b) $a^2 - b^2$

c) $a^2 - 2ab + b^2$

d)$a^2 + b^2$

17. The length of a rectangular garden is $a + b$ meters, and the width is $a - b$ meters. What is the expression for the area of the garden?

a) $a^2 + 2ab - b^2$

b) $\boldsymbol{a^2 - b^2}$

c) $a^2 - 2ab + b^2$

d) $a^2 + b^2$

18. In a right-angled triangle, one leg $a + b$ units, and the other leg is $a - b$ units. What is the expression for the area of the triangle?

a) $a^2 + 2ab - b^2$

b) $\boldsymbol{\frac{1}{2}(a^2 - b^2)}$

c) $a^2 - 2ab + b^2$

d) $a^2 + b^2$

19. The side length of a square is $a - b$. What are the expressions for both the perimeter and area of the square?

a. Perimeter: $\boldsymbol{4a - 4b}$**, Area:** $\boldsymbol{a^2 - 2ab + b^2}$

b. Perimeter: $2a–2b$, Area: $a^2 + 2ab + b^2$

c. Perimeter: $4a^2 - 4b^2$, Area: $a^2 - b^2$

d. Perimeter: $2a^2 - 2b^2$, Area: $a^2 + b^2$

20. A rectangular garden has a length of $2x + 3$ meters and a width of $x - 1$ meters. Write an expression to represent the area of the garden.

a) $2x + 3 + x - 1$

b) $(2x + 3) - (x - 1)$

c) $\boldsymbol{(2x + 3)(x - 1)}$

d) $\frac{2x+3}{x-1}$

9. Data analysis: Mean, and Standard Deviation T – test, Median, Deviation from median and Gain score, Gain ratio are used to analyse the result.

9.1 TABLE– 1.PRE TEST SCORE

MUNICIPAL MUSLIM MIDDLE SCHOOL, VIRUDHUNAGAR

(UDISE Code: 33260214612), Virudhunagar Block

Class: VII Subject: Mathematics Topic: Identities Medium: English

S.No	Name of the student	Pre-Test Marks (25)	Pre-Test Marks (100)
1	N.Jerald Edison	20	80
2	S.Soorya Rajesh	18	72
3	M.Hareeshwaran	17	68
4	M.Santhosh Praveen	16	64
5	S.Jai Kumur	16	64
6	S.Suvinesh	15	60
7	M.K.Kabilesh	15	60
8	S.Sugathesh	14	56
9	A.Muhammed Aushif	14	56
10	R.Dhilip Kumar	14	56
11	S.Azeem	14	56
12	S.Karthi	14	56
13	I.Hameedhulla Ajma	13	52
14	A.kogul	13	52
15	H.Harran Hamith	13	52
16	K.Jeya Aravind	13	52
17	N.Santhosh Kumar	13	52
18	P.Maheswaran	13	52
19	R.Nagarajan	12	48
20	J.K.Ruso Immanuvela Yosuva	12	48
21	G.Jananth	12	48
22	Kumerswaran	10	40
23	R.Dinesh Kumar	10	40
24	R.Guru Prakash	10	40
25	P.Naveen Kumar	9	36
26	A.Pradheep	7	28
27	R.Sri Saran	6	24
28	A.Mathews	9	36
	Total	362	1448

9.2 Table -2. Statistical Interpretations for Pre Test:

Total Sample	28
Total Pre - test marks	1448
Average on Pre - test marks	51.71
Medium on Pre -test marks	52
Mode on Pre - test marks	52
Range on Pre - test marks	56
Minimum on Pre - test marks	24
Maximum on Pre - test marks	80
Quartiles (Q1) on Pre -test marks	44
Quartiles (Q2) on Pre - test marks	52
Quartiles (Q3) on Pre -test marks	58
Standard Deviation on Pre - test marks	12.37

9.3 TABLE– 3.POST – TEST SCORE

MUNICIPAL MUSLIM MIDDLE SCHOOL, VIRUDHUNAGAR

(UDISE Code: 33260214612), Virudhunagar Block

Class: VII Subject: Mathematics Topic: Identities Medium: English

S.No	Name of the student	Post-Test Marks (25)	Post-Test Marks (100)
1	N.Jerald Edison	20	80
2	S.Soorya Rajesh	21	84
3	M.Hareeshwaran	21	84
4	M.Santhosh Praveen	16	64
5	S.Jai Kumur	19	76
6	S.Suvinesh	19	76
7	M.K.Kabilesh	17	68
8	S.Sugathesh	19	76
9	A.Muhammed Aushif	19	76
10	R.Dhilip Kumar	19	76
11	S.Azeem	17	68
12	S.Karthi	18	72
13	I.Hameedhulla Ajma	20	80
14	A.kogul	17	68
15	H.Harran Hamith	17	68
16	K.Jeya Aravind	19	76
17	N.Santhosh Kumar	16	64
18	P.Maheswaran	19	76
19	R.Nagarajan	17	68
20	J.K.Ruso Immanuvela Yosuva	17	68
21	G.Jananth	17	68
22	Kumerswaran	16	64
23	R.Dinesh Kumar	18	72
24	R.Guru Prakash	20	80
25	P.Naveen Kumar	15	60
26	A.Pradheep	8	32
27	R.Sri Saran	20	80
28	A.Mathews	11	44
	Total	492	1968

9.4 Table -4. Statistical Interpretations for Post Test:

Total Sample	28
Total Post test marks	1968
Average on Post test marks	70.29
Medium on Post test marks	72
Mode on Post test marks	76, 68
Range on Post test marks	52
Minimum on Post test marks	32
Maximum on Post test marks	84
Quartiles (Q1) on Post test marks	68
Quartiles (Q2) on Post test marks	72
Quartiles (Q3) on Post test marks	76
Standard Deviation on Post test marks	11.03

9.5 Paired *t* test results:

Group	Post Test	Pre Test	Calculated t value	Table t value	Test of Significance	Result
Mean	70.29	51.71	5.82241	3.69	Extremely statistically significant	Null hypothesis is rejected
SD	11.23	12.60				
SEM	2.12	2.38				
N	28	28				

In the above table, calculated value is 5.82241 is more than tabulated value (3.69) at 0.005 level of significance.

The above table indicates there is significance mean score in acquisition of knowledge in algebraic identities between Post Test and Pre Test.

Hence there is a significant difference between traditional approach and Jigsaw technique approach in enhancing the learning attainment of Identities in Algebra among class VII children.

9.6 TABLE– 5. Gain Score between Pre-test and Post - test

S.No	Name of the student	Pre-Test Marks (100)	Post-Test Marks (100)	Gain Score
1	N.Jerald Edison	80	80	0
2	S.Soorya Rajesh	72	84	12
3	M.Hareeshwaran	68	84	16
4	M.Santhosh Praveen	64	64	0
5	S.Jai Kumur	64	76	12
6	S.Suvinesh	60	76	16
7	M.K.Kabilesh	60	68	8
8	S.Sugathesh	56	76	20
9	A.Muhammed Aushif	56	76	20
10	R.Dhilip Kumar	56	76	20
11	S.Azeem	56	68	12
12	S.Karthi	56	72	16
13	I.Hameedhulla Ajma	52	80	28
14	A.kogul	52	68	16
15	H.Harran Hamith	52	68	16
16	K.Jeya Aravind	52	76	24
17	N.Santhosh Kumar	52	64	12
18	P.Maheswaran	52	76	24
19	R.Nagarajan	48	68	20

20	J.K.Ruso Immanuvela Yosuva	48	68	20
21	G.Jananth	48	68	20
22	Kumerswaran	40	64	24
23	R.Dinesh Kumar	40	72	32
24	R.Guru Prakash	40	80	40
25	P.Naveen Kumar	36	60	24
26	A.Pradheep	28	32	4
27	R.Sri Saran	24	80	56
28	A.Mathews	36	44	8
	Total	1448	1968	520

From the above table, we get,

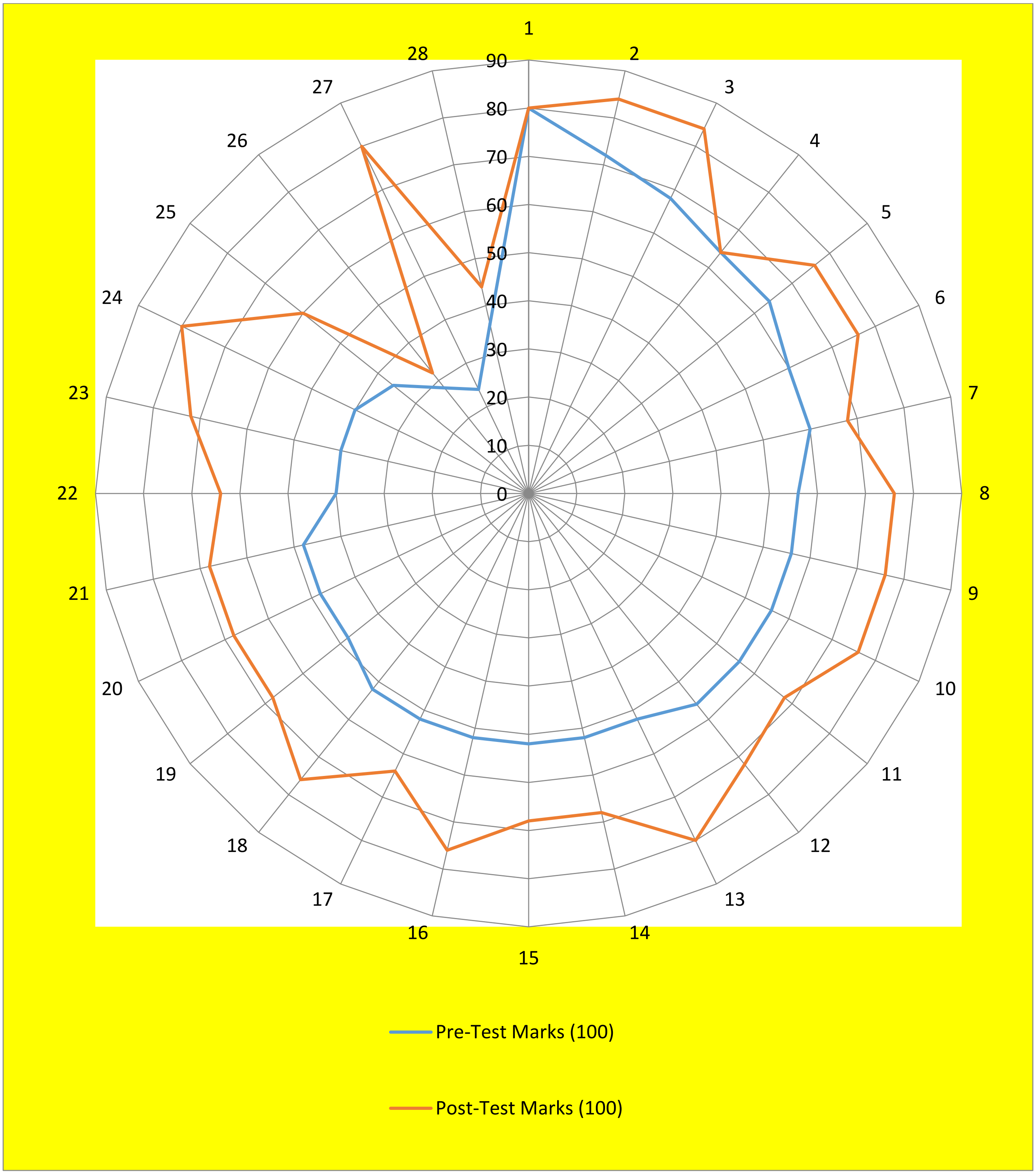
Mean Gain Score	18.57
Gain Ratio=(PostTest Score – PreTest Score) x100% / (Maximum Score-PreTest Score)	38.46

10. Findings:

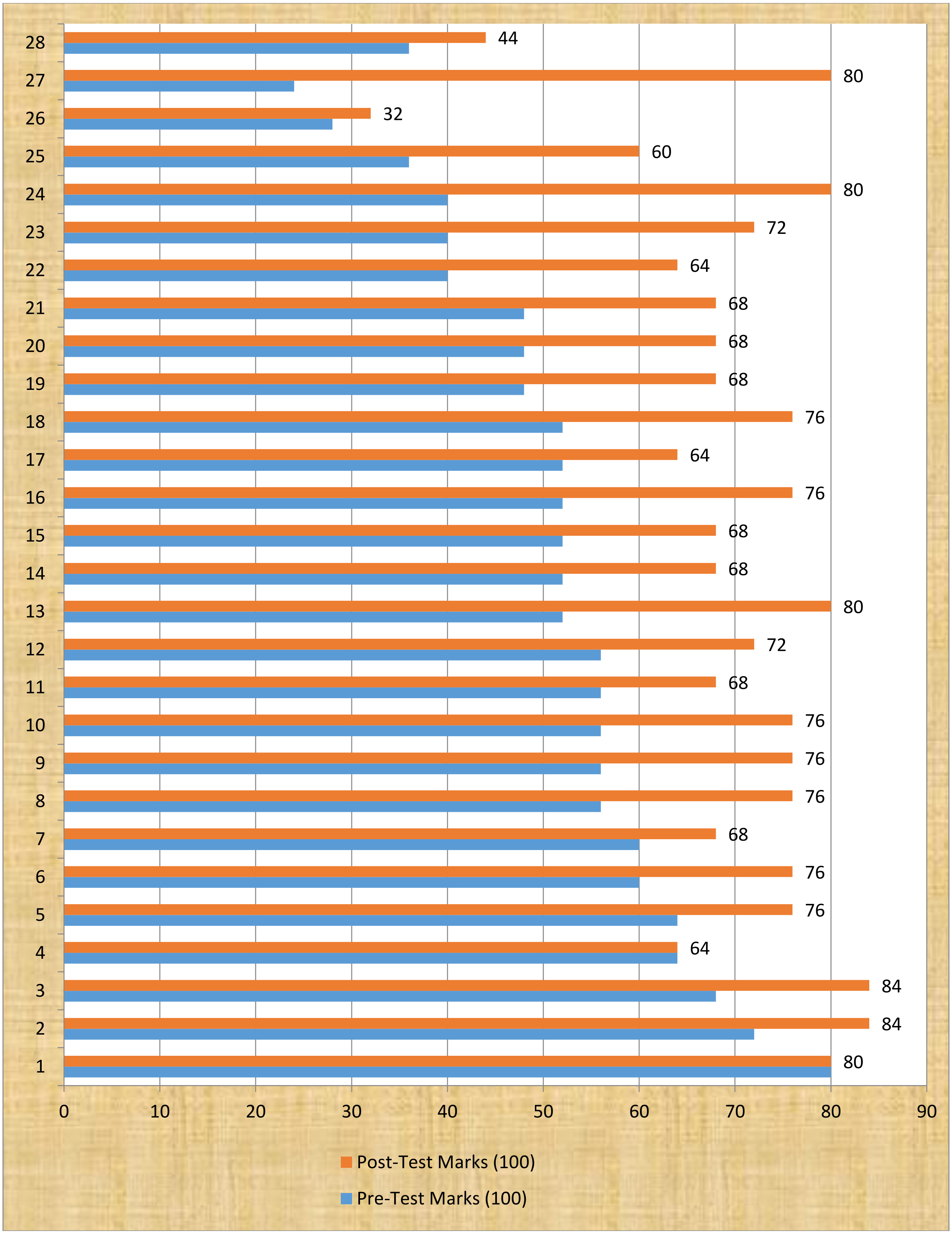
1) Since Mean, Median and average scores are increased in Post-test comparing with Pre-test, it ensures that there is an improvement in acquisition of knowledge in algebraic identities could be seen
2) The decrease of standard deviation in Post-test comparing with Pre-test, it reveals that there is fewer gaps in learning among the learners in Jigsaw technique approach.
3) Comparing to achievement in Post test after intervention is far better than Pre - test. It could be seen through data analysis.
4) There is significance mean score in acquisition of knowledge in algebraic identities between Pre Test and Post Test

10.1 Pictorial Representations of the statistical Report:

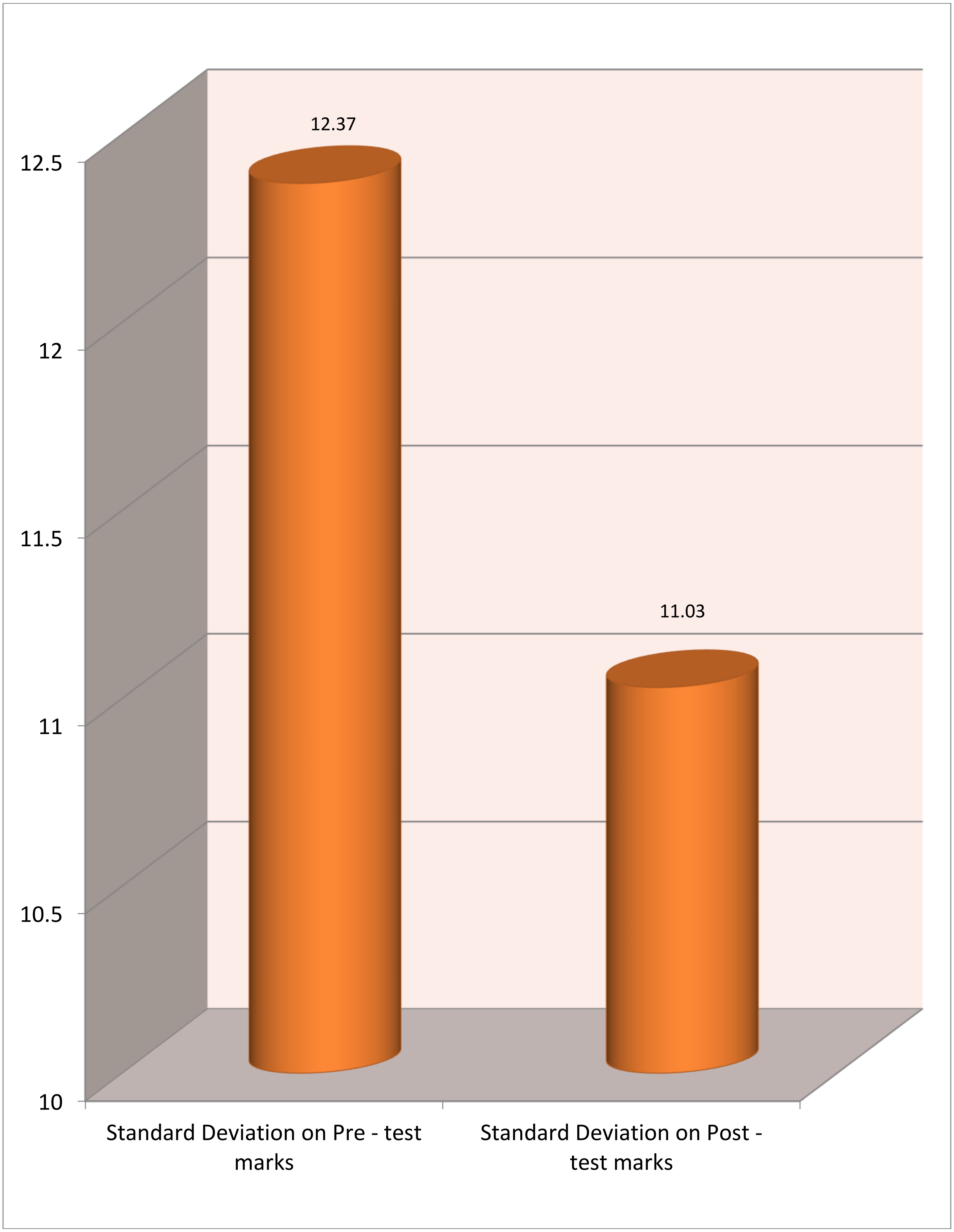
1. Radar Comparison between Pre Test and Post test Score:



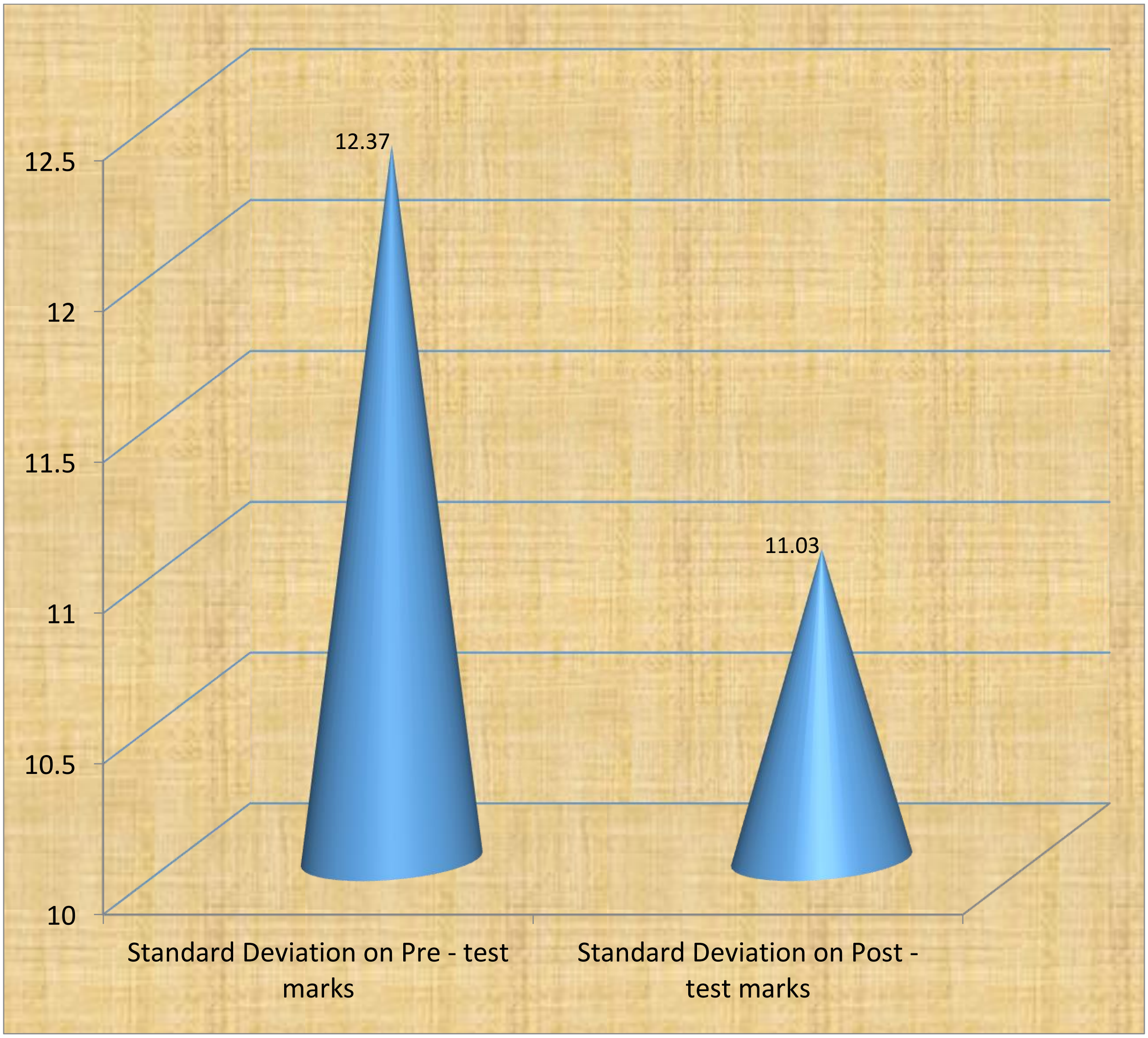
10.2. Bar graph on total score of Pre Test and Post test Score:



10.3. Bar diagram on Average score of Pre Test and Post test Score:


12.37
11.03
12.5
12
11.5
11
10.5
10
Standard Deviation on Pre - test marks
Standard Deviation on Post - test marks

10.4. Comparison between Standard deviation of Pre Test and Post test Score:



11. Conclusion:

Therefore, there is a significant difference between traditional approach and Jigsaw technique approach in enhancing the learning attainment of Identities in Algebra among class VII children.

Hence, I conclude that by promising that this action research helps both the class of VII students of Municipal Muslim Middle School, Virudhunagar, Virudhunagar District to develop their skills in algebraic identities and their self-confidence interest in mathematical activities and motivated towards the subject.

Questionnaire

Pre - Test / Post - Test Question Paper.

MUNICIPAL MUSLIM MIDDLE SCHOOL, VIRUDHUNAGAR

(UDISE Code: 33260214612), Virudhunagar Block

Name of the student: ________________________ **Class: VII A** Medium: **English**

I. Multiple Choice Questions:

1) Which one of the following identity is called as additive identity in algebra?

   a) $a \div a = 1$ b) $a + 0 = a$

   c) $a - a = 0$ d) $a \times 1 = a$

2) Which one of the following identity is called as multiplicative identity in algebra?

   a) $a + 0 = a$ b) $a \times 0 = 0$

   c) $a \times 1 = a$ d) $a - a = 0$

3) Which algebraic identity is expressed $a \times (b + c) = a \times b + a \times c$?

   a) Commutative identity b) Distributive identity

   c) Associative identity d) Inverse Identity

4) Find the value of $(x + 5)(x - 5)$

   a) $x^2 + 25$ b) $x^2 - 10x + 25$

   c) $x^2 + 10x + 25$ d) $x^2 - 25$

5) $3(x + 2) + 2(x - 2) =$

   a) $5x + 1$ b) $5x - 4$

   c) $5x + 2$ d) $6x - 4$

6) Find the value of $(x + 3)(x + 1)$

   a) $x^2 + 4x + 3$ b) $x^2 + 5x + 3$

c) $x^2 + 6x + 3$ d) $x^2 + 3x + 3$

7) If $a = 2$ and $b = 3$, then $a^2 + 2ab + b^2 =$

a) 64 b) 36

c) 49 d) 25

8) What is the additive inverse of a number?

a) $a + (-a) = 0$

b) $a \times \frac{1}{a} = 1$

c) $a + 0 = a$

d) $a \times 1 = a$

9) Find the value of 99^2 by using the identity $(a - b)^2 = a^2 - 2ab + b^2$

a) 10201 b) 9901

c) 9801 d) 10101

10) Find the value of 101^2 by using the identity $(a + b)^2 = a^2 + 2ab + b^2$

a) 9901 b) 10201

c) 9801 d) 10101

11) Find the value of 101×99 by using the identity $(a + b)(a - b) = a^2 - b^2$

a) 10209 b) 9809

c) 9999 d) 10109

12) The length of a rectangle is $a + b$ units, and the breadth is $a - b$ units. What is the expression for the area of the rectangle?

a) $a^2 + 2ab - b^2$ b) $a^2 - b^2$

c) $a^2 - 2ab + b^2$ d) $a^2 + b^2$

13) In a right-angled triangle with base and height are $(a+b)$ and $(a-b)$ respectively. What is the expression representing the length of the hypotenuse using the Pythagorean theorem?

a) $2a$ b) $a^2 - b^2$

c) $\sqrt{2a^2 - 2b^2}$ d) $\sqrt{2a^2 + 2b^2}$

14) The side length of a square is $(a+b)$. Then its area is

a) $a^2 + 2ab + b^2$ b) $a^2 - b^2$

c) $a^2 - 2ab + b^2$ d) $a^2 + b^2$

15) The side length of a square is $a - b$. What are the expressions for both the perimeter and area of the square?

a) Perimeter: $4a - 4b$, Area: $a^2 - b^2$

b) Perimeter: $4a - 4b$, Area: $a^2 - 2ab + b^2$

c) Perimeter: $4a^2 - 4b^2$, Area: $a^2 - b^2$

d) Perimeter: $2a^2 - 2b^2$, Area: $a^2 + b^2$

II. True/False Questions:

16) The distributive property involves changing the order of addition or multiplication without changing the result. (True / False)

17) The commutative property of addition states that $a + b = b + a$ for any real numbers a and b. (True / False)

III. Fill in the Blank:

18) A rectangular garden has a length of $(x+3)$ meters and a width of $(x+1)$ meters. Then the expression to represent the area of the garden is ………………………………

19) $3(x+2)-2(x+1) =$ ______________________________.

IV. Match the following:

20)	$a+(-a) =$	a
21)	$a \times \frac{1}{a} =$	$b+a$
22)	$a \times 1 =$	$b \times a$
23)	$a+b =$	1
24)	$a \times b =$	$(a-b)^2$
25)	$a^2-b^2 =$	0
		$(a+b)(a-b)$

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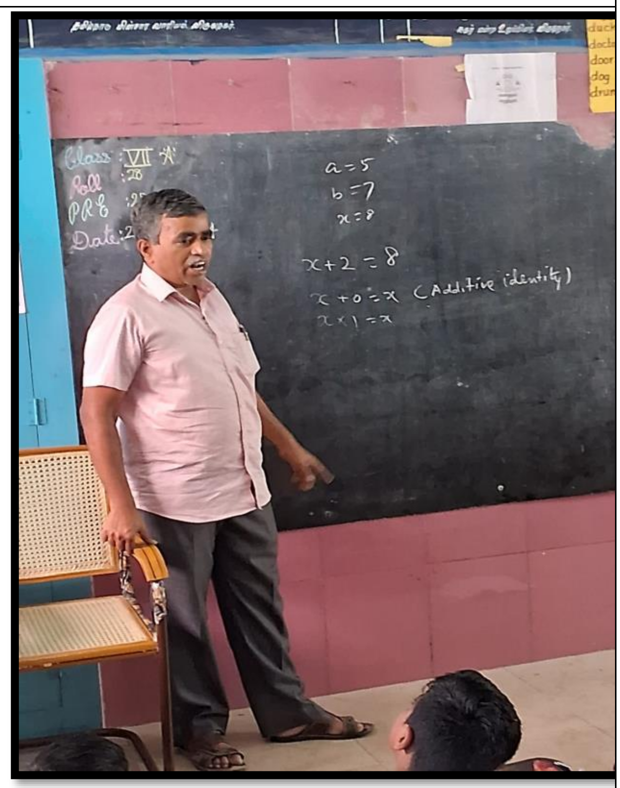
Answer Key for Pre – Test

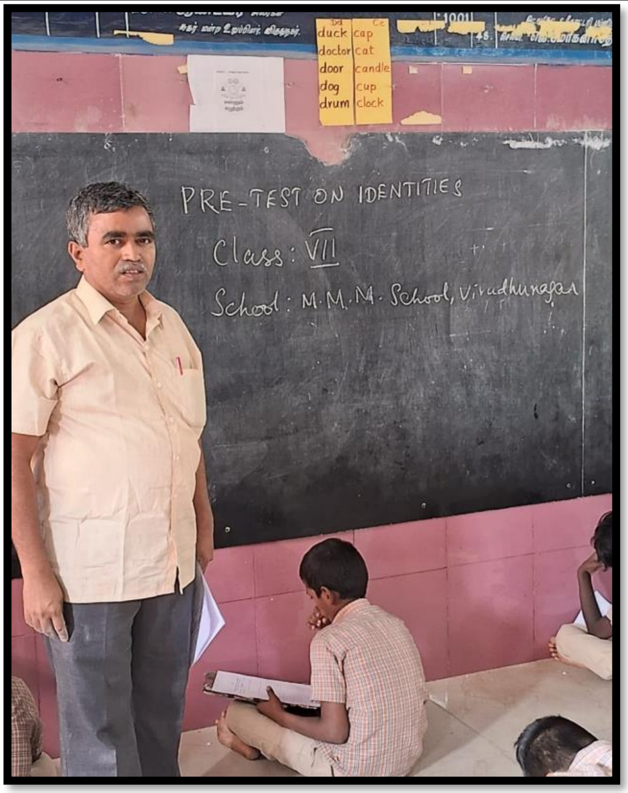
1)	2)	3)	4)	5)
b) $a + 0 = a$	c) $a \times 1 = a$	b) Distributive identity	d) $x^2 - 25$	c) $5x + 2$
6)	7)	8)	9)	10)
a) $x^2 + 4x + 3$	d) 25	a) $a + (-a) = 0$	c) 9801	b) 10201
11)	12)	13)	14)	15)
c) 9999	b) $a^2 - b^2$	d) $\sqrt{2a^2 + 2b^2}$	a) $a^2 + 2ab + b^2$	b) Perimeter: $4a$–$4b$, Area: $a^2 - 2ab + b^2$
16)	17)	18)	19)	20)
False	True	$(x + 3)(x + 1)$ sq. m	$x + 4$	0
21)	22)	23)	24)	25)
1	a	$b + a$	$b \times a$	$(a + b)(a - b)$

Photo Gallery
Intervention by the researcher

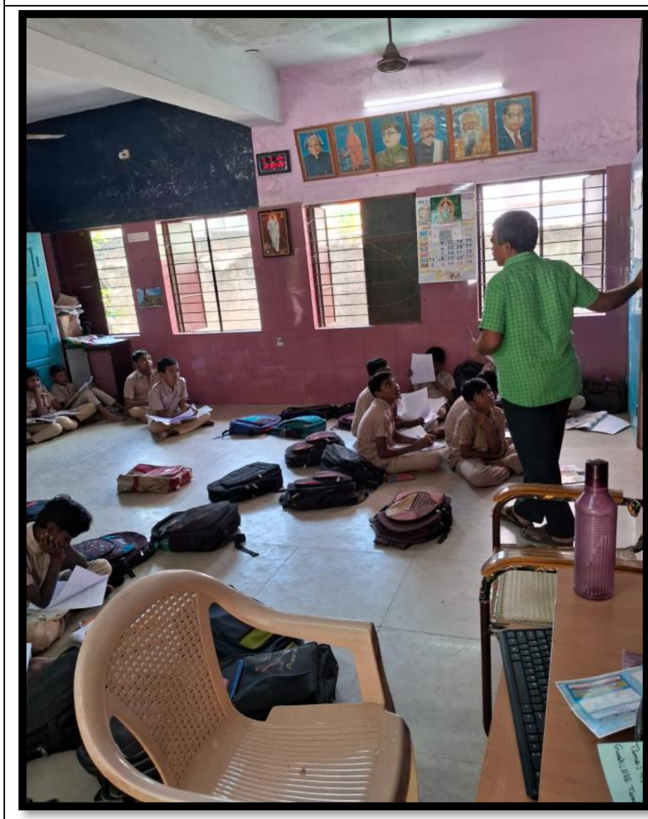
Intervention by the researcher

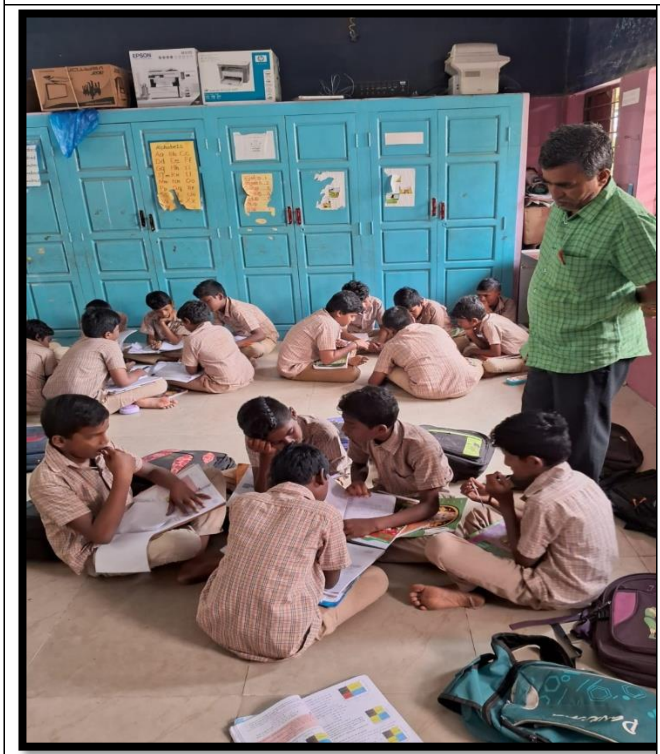
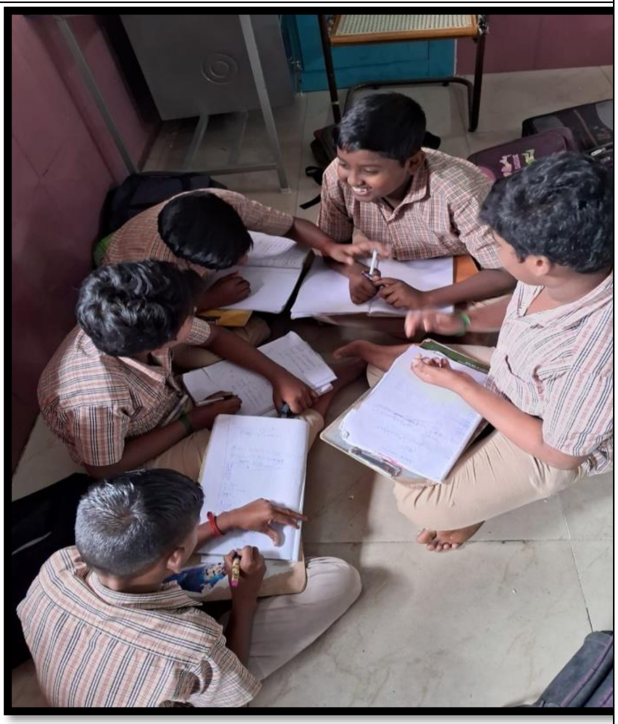


Pre – Test Photos

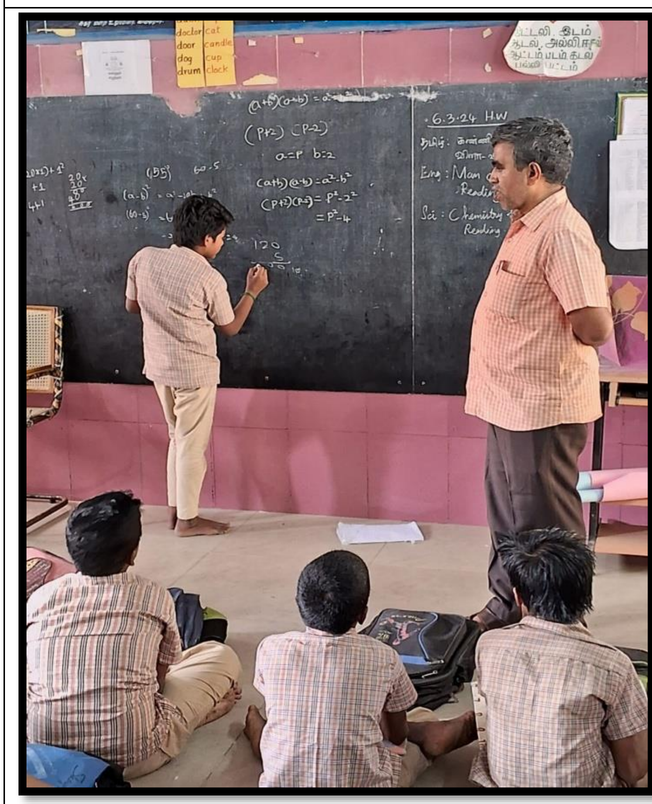


Dividing the class into four groups (Jigsaw)

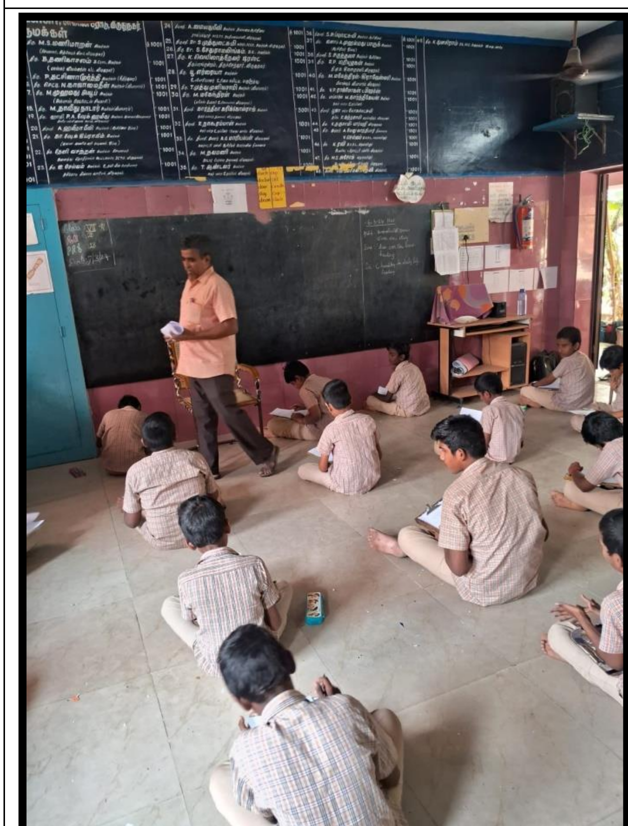


Four groups interaction on their identities (Jigsaw)	
	
	

Four groups dissemination on their identities (Jigsaw technique)



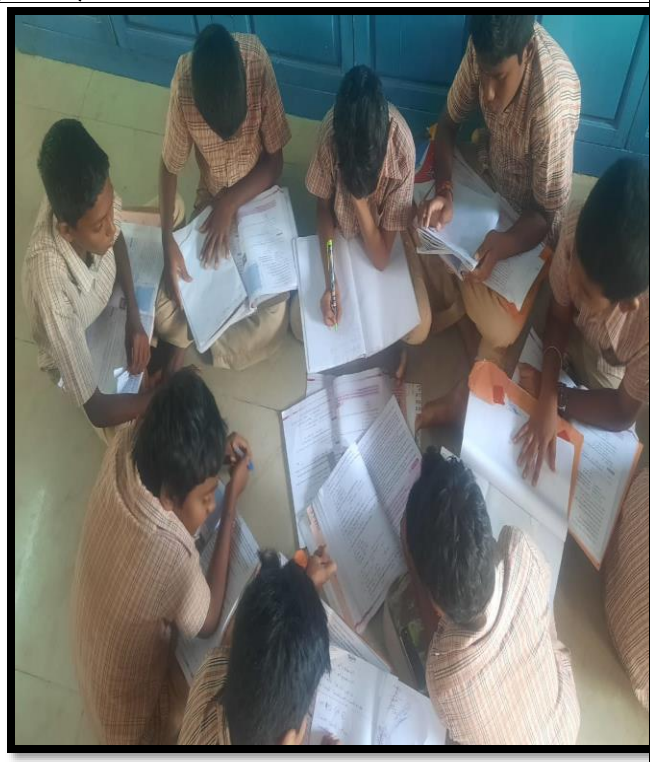
POST TEST - Action Research

Four groups interaction and preparation on their identities (Jigsaw)

Four groups interaction and preparation on their identities (Jigsaw)



References:

1) https://www.teachhub.com/teaching-strategies/2016/10/the-jigsaw-method-teaching-strategy/
2) https://www.teachertrainingasia.com/teaching-blog/1388-Jigsaw-Teaching-Method---A-Technique-For-Cooperative-Learning-blog.php
3) https://www.jigsaw.org/#google_vignette
4) https://www.facinghistory.org/resource-library/jigsaw-developing-community-disseminating-knowledge
5) https://www.schreyerinstitute.psu.edu/pdf/alex/jigsaw.pdf
6) https://journals.lww.com/jsci/fulltext/2022/49030/jigsaw_technique__an_innovative_teaching_strategy.21.aspx
7) https://www.adlit.org/in-the-classroom/strategies/jigsaw
8) https://www.mariancollege.org/miitle/assets/downloads/mitle/resources/Resources-teaching-methods-jigsawtechnique.pdf
9) https://ies.ed.gov/ncee/wwc/docs/practiceguide/wwc_algebra_040715.pdf
10) https://www.amsi.org.au/teacher_modules/pdfs/Algebraic_expressions.pdf

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