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Understanding Challenges in Algebraic Visualization: A Study of Junior High School Students

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ABSTRACT

Understudies can construct models, examine connections, and resolve issues by utilizing a way to deal with thinking and thinking known as algebraic critical thinking. Students, however, only have a limited comprehension of how to formulate and resolve algebraic issues. Algebraic thinking involves deductive reasoning, the use of symbols, and the computation of numbers and the unknown. To succeed in algebra, algebraic thinking should be developed early on. Students are expected to think abstractly and use logic to solve issues, a technique known as "thinking algebraically." Through encouraging the connection between numbers and unknowns that relate to the spatial and structural properties of numbers, algebraic thinking is developed. Pre-algebra, commonly known as arithmetic, is typically taught to young children before algebra. Like other mathematics disciplines, mastering algebra can be challenging for students in general. Lacking the foundational knowledge necessary for algebra, students frequently struggle to solve algebraic problems, simplify equations and algebraic expressions, and interpret quadratic graphs. These challenges force students to focus on memorizing rather than understanding, and this pattern of learning persists through high school and even into the tertiary levels. Because non-routine tasks are beyond their conceptual comprehension, children who use this method of learning can only tackle lower-level thinking problems. The purpose of this study is to examine students' proficiency in solving mathematical problems and their experiences doing so. In this study, descriptive case studies and deliberate sampling were used.

Keywords: *Algebra, Algebraic visualization, Mathematics, High School students, Quadratic equations, Difficulties in algebra.*

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1. INTRODUCTION

One area of mathematics called algebra investigates how to simplify things and solve issues by using symbols. The symbols are then used to represent numbers in general as a way to simplify things and help with problem-solving. Mathematics' study of simplification and symbol-based problem solving is called algebra. In Indonesia, algebra is covered at various educational levels. Each level of algebra also has a number of different subjects, one of which is the Three Variable Linear Equation System. Algebraic thinking involves deductive reasoning, the use of symbols, and the computation of numbers and the unknown. To succeed in algebra, algebraic thinking should be developed early on. Students are expected to think abstractly and use logic to solve issues, a technique known as "thinking algebraically." Through encouraging the connection between numbers and unknowns that relate to the spatial and structural properties of numbers, algebraic thinking is developed. Pre-algebra, commonly known as arithmetic, is typically taught to young children before algebra. Like other mathematics disciplines, mastering algebra can be challenging for students in general. Lacking the foundational knowledge necessary for algebra, students frequently struggle to solve algebraic problems, simplify equations and algebraic expressions, and interpret quadratic graphs. They must employ mathematics in all facets of life, including lessons in Agricultural Science, Introductory Technology, Biology, Chemistry, and Physics. In order to complete a variety of practical activities and overcome real-world obstacles, mathematics is utilized to evaluate, communicate, and present data and ideas. Because mathematics is the application of matter, the teacher must be systematic. Mathematical reasoning, abstract thought, critical analysis, and problem-solving skills bring order to our life. Additionally, mathematics teaches us communication skills that are beneficial to the process of mathematics.

A discipline called mathematics deals with quantities, measurements, forms, and numbers. By visualizing or presenting various instructional resources, teachers in the primary grades need to increase or educate students how to solve problems in order to develop their problem-solving skills. The ability to solve problems creatively teaches the brain to look for information or remedies methodically. The study of mathematics in the first grade can help students develop their self-

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control and logical thinking. Additionally, they find mathematics to be highly challenging because it might take a lot of time and effort to solve a math equation or issue that requires a step-by-step formula. Finding and evaluating problems is a necessary step in problem-solving, which requires the learners' developing mental processes. Students can use the step-by-step instructions in the problem-solving section to formulate or resolve problems. Different teaching tools are required in elementary school so that teachers may readily capture students' attention and engage them in active listening and participation in class activities. Even though the education system is now primarily online, instructional materials still need to be improved using a variety of applications so that teachers can more easily distribute activities to students and that students can more easily access them.

2. LITERATURE REVIEW

Karimah RKN, et.al (2018) research on the examination of math learning difficulties in messes around with the gatekeeper character type in the HOTS calculation test. As per the review's discoveries, understudies with watchman character types battle to tackle numerical issues including HOTS calculation since they were not capable in learning various numerical ideas. In the critical thinking process including HOTS, a sum of 89 distinct kinds of troubles in view of numerical expertise were found. Furthermore, a sum of 3.37% troubles in number truth expertise, 4.49% hardships in math expertise, 37.08% challenges in data ability, 31.46% challenges in language ability, and 23.60% challenges in visual-spatial expertise were likewise found. The main numerical capacity was found to be data expertise.

Anggara.B. et.al (2018) directed a review in view of levels of likelihood understanding to look at the learning difficulties of senior high school students. The investigation discovered that most of understudy mental levels are at level 2, demonstrating that members had a few proof of utilizing likelihood ideas and the legitimate numeric data, but it's conceivable that these models were either lacking or utilized wrongly. Students found it trying to portray the example space, fabricate the occasion structures for a trial, make numerical models, grasp the hidden ideas, and figure out the standards of occasions.

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Arief Karunia Putraa.et.al (2017) directed a concentrate on middle school students' numerical demeanor as seen by their learning inclinations. As per the review's discoveries, among the various classifications of students' numerical attitude, those with visual learning styles beat those with hear-able and sensation learning styles regarding numbers. On the other hand, those with sensation learning styles beat those with hear-able learning styles regarding numerical attitude.

Bed Raj Acharya (2017) analyzed where the factors impacting math students' hardships in getting the subject. The review reaches the decision that there are different interrelated factors that adversely affect how well government funded school students act in science. The essential determinants of lower achievement in arithmetic are the misjudgement of students' need and interest along with their earlier degree of information and capacities in regards to numerical thoughts. The achievement rate in science increases when students are locked in and warm hearted about math.

Bankhead, M. P. L. (2000) Because of the high degrees of tension, trepidation, and lack of care among students in school algebra courses, the teacher created and tried various numerical showing systems expected to expand students' certainty and excitement in the subject. His examination project was named Lessening "Math Nervousness" in School Algebra Courses incorporating Correlations with Rudimentary Measurements Courses. By and large, this proposition contains different systems that have been analyzed by teachers and students the same. The record recommends a recent report techniques that are examined on the primary day of class and all through the remainder of the course. The students are given useful ideas on the most proficient method to move toward the number related course, and they advance by doing. The speaker rejuvenates the point by utilizing models, for example, the cricket match rules. Other proposed procedures incorporate making part notes accessible to students, offering practice tests in front of finals, and booking additional review meetings. Students are every so often allowed to lead bunch tasks and work in gatherings. A few freebees and worksheet models that were given to students are remembered for this paper. The exploration reaches the resolution that the educator acquired a higher interest and fervor for the topic as well as finding true success in bringing down students' nervousness levels so the teacher could educate more.

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Mishra (1986) There is a positive relationship between high insight and issue tackling capacity, yet a unimportant connection between's low knowledge and critical thinking skill, as per research on the connection among innovativeness and critical ability to think at different degrees of insight.

3. MATERIALS AND METHODS

This study involved 50 grade 11 students, both boys and girls, with an average age of 16 years. These pupils attended the junior high school at MDN Global School at Kaithal, Haryana. Descriptive qualitative research was the approach of choice for this study. To determine the types of challenges shared by children in the same grade when using algebraic expressions, participants were carefully chosen. An exam on factoring and simplifying algebraic terms was completed by each participant. The task consisted of five questions, of which one had a numerical answer and the other four had variable answers (Table 1). It was planned to finish the assignment in 30 minutes. Students were not permitted to utilize any technological devices to analyze the answer for the item that asked them to factorize. The test was given by the teacher of the class, and the questions were in English. We looked at the challenges that students have when trying to simplify algebraic expressions, particularly when the expressions take a different form from what the students are used to. For illustration, students were required to assess. Students were expected to recognize the connection between the numbers, that is, that they can be factored algebraically by applying the distributive property to two terms that can be added. They were additionally expected to perceive the quadratic structure inside the mathematical expression and utilize the distributive property to assess the arrangement. Also, we were keen on how students applied the distributive, commutative, and affiliated properties to algebraic issues. The algebraic properties that were expected to be used were used to examine and code the students' difficulty in completing algebraic operations tasks (Table 1). We also kept track of how many pupils got the right answers and how many didn't. We noted the places where students struggled when using algebraic equations and examined how they came up with particular answers get to it.

Table 1: Algebraic attributes.

Question	Algebraic Property	Task

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1a)	Implementing algebraic order of operations	Simplify: $2x + 12x \div 6 - 2x$
1b)	Algebraic terms and group-like terms that commute	Simplify: $3xy - yz + 5yz - 6xy$
2	Calculating common fractions in algebra	Simplify: $\frac{x^2 + 3x + 2}{x + 1}$
3	Recognizing an algebraic structure in a numerical problem	Evaluate: $145^2 - 147 \times 143$
4	Identifying a three term expression with rational factor	Factorize: $a^2 - 2b^2 - 2ab + ax$

Table 2 records the ten algebra gives that were utilized in this examination.

Table 2: The Algebraic Issues

Number	Problems
1	Language Comprehension
2	Data Expertise: Utilizing Procedural Control
3	Language Capacity: Numeracy
4	Issues with the text and new settings
5	Math Procedural Information and Ability
6	Data Ability: Data Control
7	Data Expertise: Perceive the Objective
8	Utilization of Visual-Spatial Expertise to Day to day existence
9	Visual-spatial Capacity - Shape Direction
10	Utilization of Visual-Spatial Ability to Day to day existence

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4. RESULTS AND DISCUSSIONS

The unmistakable measurements for every variable are shown in Table 3. Out of the 10 things that addressed algebraic critical thinking questions, thing 8 had the highest standard deviation of 0.97. The students' capacity to tackle word issues was evaluated from thing 1 to thing 5, while their capacity to settle diagrammatic issues was tried from thing 6 to thing 10. Table 3's outcomes show that among all the word issues, Thing 1 had the highest standard deviation of 0.95, though among every one of the diagrammatic issues, Thing 8 had the highest standard deviation of 0.97.

Table 3: The Descriptive Statistics of All Variables (N = 50)

Item	**Min.**	**Max.**	**Mean**	**Standard Deviation**
Item 1	2	4	0.65	0.95
Item 2	2	4	1.65	0.81
Item 3	2	4	0.37	0.76
Item 4	2	4	0.17	0.55
Item 5	2	4	0.30	0.71
Diagram Problem				
Item 6	2	4	0.40	0.81
Item 7	2	4	0.40	0.81
Item 8	2	4	0.70	0.97
Item 9	2	4	0.52	0.89
Item 10	2	4	0.15	0.51

The main findings of our study are shown in Table 4 below, along with the number of students that received the correct and erroneous responses for each issue. The findings indicate that 40 out of 50 pupils struggle to perform algebraic operations in the right order. Additionally, a few students

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(44/50) demonstrated difficulty recognizing algebraic structures concealed within a numerical form. All 50 students were unable to recognize a three-term quadratic expression with rational elements. The students found questions 3 and 4 to be the most challenging. While question 2 was the simplest as evidenced by the 49/50 students who correctly identified the answer. The findings also demonstrate that the majority of pupils factor quadratic expressions with the typical structure of $ax^2 + bx + c$ without any issues.

Table 4: Result of Test

Question	Correct Answer	Incorrect Answer
1a)	12	22
1b)	28	6
2	31	3
3	6	28
4	2	32

Some students struggled to connect algebraic terms in the right order of operations. Some pupils failed to notice the existence of specific terms that need to be evaluated first before the others when given a task like Simplify: $2x + 12x \div 6 - 2x$. The tendency among students is to view things superficially rather than first addressing division. The majority of pupils find addition easier, and they should be aware of the right order of operations when doing so. In the scenario mentioned above, they were required to perform addition, then $12x \div 6$, and finally subtraction. Students are not sufficiently familiar with algebra's commutative property. In some cases, pupils struggle to comprehend the definitions and formats of algebraic fractions. Some students have a propensity to perform improper operations. This is because students already know how to cancel common factors in the denominators, but they don't fully get the implications of doing so, so they just cancel the same variables in the wrong conditions.

Learners also lack algebraic visualization. This means that some students struggle to recognize an algebraic structure that can describe particular numerical representations. Students failed to

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recognize that the value 145 can be represented by any variable, for instance, for the item: Evaluate: $145^2 - 147 \times 143$. Here, the numerical form is transformed into an algebraic form, such as $a^2 - (a + 2)(a-2)$. The solution is just 6 when reduced. For pupils to easily do algebraic operations instead of expending time and energy on lengthy multiplication, they require such a depiction. Students who struggle with long multiplication may make numerous computational mistakes that lead to incorrect results or simply give up in frustration. Students exhibit a type of mechanical thinking where they memorize steps to get the right answers without giving the topic at hand any context. They lack specialized methods for resolving specific quadratic problems presented in various formats. Teachers are expected to give students access to materials that promote the development of mathematical reasoning and critical thinking skills in order to facilitate learning.

Although some responses are ultimately valid, it is nonetheless important to observe the techniques and procedures that students occasionally employ. Instead of just focusing on the final solution, it is crucial to carefully evaluate the pupils' work. Some pupils have had difficulty comprehending the significance of common elements. When they notice comparable numbers, they decide to cancel without considering the reasons. By simply canceling out 1 and 4, the student was left with the figures that gave him or her he right answer from the identical challenge. Some students frequently answer problems using the wrong arithmetic models and methods. Teachers must stress to pupils how to evaluate problems with algebraic forms using the distributive property. Teachers of mathematics must determine the type of scaffolding that will assist pupils in overcoming these types of challenges. Students can struggle to recognize basic topics when they are presented to them in a format other than the usual structure. They continue to think in terms of the shapes they are accustomed to. Many students become perplexed when the forms change, and they fail to finish some assignments. Some pupils failed to group related words together and rearrange the expressions so that they took the familiar three-term form $ax^2 + bx + c$, which can be factored to produce rational roots. Students lack the fortitude to try various assignment completion methods. They struggle to find solutions to issues with varying contexts.

Furthermore, understanding divisions as well as the cooperative and distributive parts of algebraic expressions are important preconditions for defeating algebraic activities challenges. To encourage

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pupils to persevere in finishing mathematical assignments rather than giving up before they are finished, teachers must give learning resources. Students are better able to understand because they can see each other's errors in this way. Furthermore, students should utilize inventiveness while doing algebraic tasks and while concentrating on some other area of science. Assumptions prescribe that students be educated to algebra right off the bat in lower grades to limit the progress from number-crunching to algebra to resolve gives that students might experience in auxiliary school. The performance of pupils in algebra later in secondary school has been improved by a number of teaching tactics suggested by authors. These include methods that emphasize fractional understanding when students are still in lower grades. We recommend effective teaching techniques, such as group projects, to encourage discussion and idea sharing among students. Along these lines, it is significant for schools to configuration learning conditions and informative materials that encourage students' imagination, decisive reasoning, and any remaining numerical abilities.

5. CONCLUSION

We make the inference that specific middle school students find it trying to utilize the distributive and cooperative properties of algebraic tasks in light of current realities and conversation introduced previously. Furthermore, it has been noticed that students often need algebraic representation. This shows that once the expression has been marginally changed to such an extent that it is given in an alternate structure, individuals experience hardships working algebraic expressions. Furthermore, we saw that specific issues with utilizing algebraic expressions are the consequence of deficient earlier comprehension of thoughts like portions, factors, and constants in algebraic expressions. Indeed, success in mathematics depends on a grasp and mastery of algebraic principles. Algebraic skills are essential for kids in the 21st century if they want to excel in school and afterwards. In fact, the activities carried out here center on demonstrating the various ways in which pupils fail mathematics, with algebra serving as the "gatekeeper" of the students' lives. Keeping students' struggles with algebraic operations hidden will undoubtedly have an adverse effect on their academic success, which is equivalent to closing the "gate" of life for them. In the classroom, the instructor plays the role of a scientist who continuously investigates the problems

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there. These concerns include identifying the challenges that pupils have during studying and attempting to assist them in some way. In order for pupils to understand new concepts, teachers are also urged to focus and look into the students' existing knowledge.

REFERENCES

1. *Andini W and Suryadi D 2017 Student Obstacles in Solving Algebraic Thinking Problems J. Phys. Conf. Ser. 895 2–8.*
2. *Anggara.B (2018). Learning difficulties of senior high school students based on probability understanding levels. 4th International Seminar of Mathematics, Science and Computer Science Education. IOP Conf. Series: Journal of Physics: Conf. Series 1013 (2018) 012116 doi :10.1088/1742-6596/1013/1/012116.*
3. *Arief Karunia Putraa.et.al (2017). Mathematical Disposition of Junior High School Students Viewed from Learning Styles.AIP Conference Proceedings 1868, 050025 (2017); doi: 10.1063/1.4995152.https://doi.org/10.1063/1.4995152.*
4. *Bed Raj Acharya (2017). Factors Affecting Difficulties in Learning Mathematics by Mathematics Learners. International Journal of Elementary Education.6 (2).8- 15. http://www.sciencepublishinggroup.com/j/ijeedu.*
5. *Chakraborty (2018) 4 Tips for Solving 2nd Grade Math Word Problems.*
6. *Cherry (2020) Problem-Solving Strategies and Obstacles.*
7. *Dr. Powell, Dr. Fuchs, and Hobbs (2012) Early Numerical Competencies and Students with Mathematics Difficulty.*
8. *Galbraith, P.L. (1986). The Use of Mathematical Strategies: Factors and Features Affecting Performance. Educ. Stud. Math., 17, 413–441.*
9. *Kamariah, A. B., Jennifer, W., & Janette, B. (2016). Young Children's Drawings in Problem Solving. Mathematics Education Research Group of Australasia, 86–93. Adelaide: MERGA.*
10. *Karimah RKN et.al (2018). Analysis of difficulties in mathematics learning on students with guardian personality type in problem-solving HOTS geometry test. IOP Conf. Series:*

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Volume4 Issue3
December 2022
Impact Factor:10.2
Subject Mathematics

Journal of Physics: Conf. Series 1008 (2018) 012076 doi :10.1088/1742-6596/1008/1/012076.

11. *Lester, F. (1987). Teaching mathematical problem solving Why Is Mathematical Problem Solving Difficult for Students ?,(November). Retrieved from http://ncm.gu.se/pdf/namnaren/3243_88_3.pdf.*
12. *Mishra B (1986). "Relationship between creativity and problem solving ability of different level ofintelligence," Indian Educational Review , Vol XXI, No. 04 p. 112-118.*
13. *National Focus Group (2005). [Position paper] Teaching of Mathematics. National Council of Educational Research and Training. Retrieved from www.ncert.ac.in.*
14. *Olga, J. (2010). Model-Drawing Strategy to Solve Word Problems for Students with LD. Miami: IARLD Conference, The Frostig Center.*
15. *Pehkonen, E., Naveri, L., & Laine, A. (2013). On Teaching Problem Solving in School Mathematics. CEPS Journal, 3(4).*
16. *Powell, S.R., & Fuchs, L.S. (2014). Does early algebraic reasoning differ as a function of students' difficulty with calculations versus word problems?. Learning Disabilities Research & Practice (Wiley-Blackwell), 29(3), 106-116. doi:10.1111/ldrp.12037*
17. *Puspita I, Kaniawati I and Suwarma I R 2017 Student Obstacles in Solving Algebraic Thinking Problems 2–8.*
18. *Sokolowski (2018) The Effects of Using Representations in Elementary Mathematics: Meta Analysis of Research. Lone Star College, Houston, Texas, USA.*
19. *Warger (2018) Use Visualization Strategies to Help Students Solve Math Word Problems.*
20. *Wu, H. (2016). Teaching School Mathematics: Algebra. American Mathematical Society.*

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