RESEARCH PROJECT 2023 - 24 ABSTRACT

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RESEARCH TITLE: STUDENT'S ABILITY IN SOLVING HIGHER ORDER THINKING MATHEMATICS PROBLEMS – A STUDY

1. Introduction

Mathematics is essential for the individual to learn. According to Chen mathematics is very important for various fields with real-life applications, including natural sciences, engineering, medicine, and social sciences. Mathematics can be used to develop skills that involve logical, systematic, critical, careful and creative reasoning skills in communicating ideas or solving problems. Mathematics problems are useful for training students to reflect and analyze mathematics. Therefore, students must be taught how to solve problems with an appropriate problem-solving.

2. Need and Significance of the study

Educational systems worldwide underscore the importance of developing higher-order thinking skills (HOTS) to prepare students for the new challenges of the 21st century. Some pressing issues faced by educators include the ambiguity of the construct; the implementation of HOTS in classroom practices; and the implications for teaching students from linguistically and culturally diverse backgrounds.

We observed that in the National Achievement Survey 2021, The state average of Tamil Nadu in 10th standard in mathematics was 56, which is less than the National average (57). we also find that there are 12 learning outcomes taken for assessment and find the highest average and lowest average in mathematics are 34 and 21 respectively.

We have observed that the performance of 10th-standard students in mathematics is not adequate. If the word problem is given then students are able to understand the given problem, translate the given problem in their own words, select appropriate strategies, solve by using strategies and also review the solution. Especially, if you make any changes in the textbook problem then, students in high achievers also have been find difficulty in solving the given problems. This study mainly focused on low and high achiever's how they differ in

ability to solve higher-order thinking problems. From these necessities, we need to understand how they faced difficulties in solving problems, especially HOT sums.

HOTS assessment to measure students' abilities in the field of Mathematics and Science internationally has been carried out by Trends in the International Mathematics and Science Study (TIMSS) and the Program of International Student Assessment (PISA). Based on the results of the PISA study in 2009, India was ranked 72 out of 73 participating countries. Therefore, to improve the quality of Indian education, especially in the field of mathematics which refers to international education, it can be done by training students' skills in solving HOTS mathematical problems.

3. Objectives:

- To assess the ability of students to solve Higher Order Thinking (HOT) mathematics problems with high and low learning achievement based on Krulik and Rudnick's problem-solving.
- To find the relationship between the ability of students to solve Higher Order Thinking (HOT) mathematics problems and learning achievement.

4. Hypothesis / Research Questions:

- What are the Abilities of Students to Solve Higher Order Thinking Mathematics Problems on Learning Achievement?
- What are the abilities of students to solve Higher Order Thinking Skills (HOTS) mathematics problems among high and low learning achievement based on Krulik and Rudnick's problem-solving?
- Why do students lack in solving HOT Mathematics Problems?
- Is there any correlation between students' Ability to solve Higher Order Thinking Mathematics Problems and their Learning Achievement?

5. Methodology

a) Method

This research uses the **descriptive qualitative method** in the form of **case studies**. The Sample was taking using purposive sampling. In this 3 best performance Government High Secondary Schools in the Ranipet district was chosen. In that schools, there are eight students from 10th standard were chosen based on the results of Half Yearly

Examination score or learning achievement in mathematics. From these 8 students, where 4 students from low achievers and 4 students from high achievers were selected.

b) Sample and Sampling Technique

Population of the present study was tenth standard students in Ranipet District. In this study, the researcher used purposive sampling technique to select the schools. Also, the researcher chosen 24 students in 3 schools which best performance in 10th public exam in the Ranipet District.

c) Tool used in the study

In this research includes tests and interviews. The test in this study uses word problems in 10^{th} Mathematics that contain Higher Order Thinking elements based on Revised Blooms Taxonomy question. The test items consist of 5 higher order thinking-based word problems in different units from the 10th standard Mathematics.

d) Data Analysis / Statistical Techniques

In the present study were used like Descriptive Analysis, Differential Analysis (t - value) and Correlation Analysis (r-value).

6. Findings of the study

The major findings of the present study were listed as follows:

- The average score of Learning Achievement in the half-yearly exam and Average Performance in the solving-based test are 60.96 and 18.67 respectively.
- The average achievement of the Low and High Achievers in the half yearly exam are 34.08 and 87.83 respectively. Also, we found that the test result of HOT HOT-based test, the Average performance of the Low and High Achievers are 2.33 and 35 respectively.
- In question 1, 42% of students got 0 marks, 6% of students got 1 mark, 4% of students got 2 marks, 4% of students got 4 marks and only 25% of students got full marks. Many students didn't know "where question 1 comes from" and they didn't understand the concept in which the topic or sub-topic was covered. 42% of students did not know what to do and some of them wrote irrelevant answers.
- All students are unable to solve question 2 completely. Many of them do not recognise that "the given question in which topic or subtopic is covered?". Also, they

have not understood the question and may not find the relevance of the concepts. All students are unable to solve question 2 completely. 92% of students do not recognise that "the given question in which topic or subtopic is covered?". Also, they have not understood the question and may not find the relevance of the concepts. Even high achievers did not choose the formulae/steps for solving. Low achievers did not respond anything for this question.

- 58% of students got 0 marks and 17% of students got 1 mark, so 75% of students were unable to understand, plan and solve question 3. 83% of Students answered irrelevantly or selected wrong formulae. They were unable to solve due to not understanding the given calculation properly, not knowing how to convert it into a mathematical statement, not knowing how to choose the optimal formula, and not using the formula properly.
- 79% of students got 0 marks, 8% of students got 1 mark, and 13% of students got 2 marks so 100% of students did not solve question 4 completely. It reveals that most of the students could not recognize and understand the given problem. Most of the students could not recognize and understand the given problem. They found it difficult to solve the given problem based on the application of the criterion of similarity.
- 54% of students scored 0, 17% of students scored 1, 8% of students scored 2% so in total 79% of students were solved partially to question 5. 54% of students did not get any marks for question 5. It reveals that more than half of the students do not read and understand the given problem.
- It revealed the value of r is 0.767 which is significant at the 0.01 level and there exists a good positive relationship between students' Ability to solve Higher Order Thinking Skills (Hots) Mathematics and their Learning Achievement.

7. INTERPRETATION AND DISCUSSION

The researcher conducted interviews related to the answers of students based on their learning achievements. Interview activities are conducted to determine student's ability to

solve Higher Order Thinking Skills (HOTS) mathematics problems. Analysis of student's ability to solve HOTS mathematics problems based on Krulik and Rudnick's problem-solving steps as follows:

Low-achieving students:

This study reveals that the overall performance in solving HOT-based Mathematics problems was not good and not appreciated level. Here are the reasons for the lack of solving HOT mathematics problems as follows:

1. They were not capable of reading the given problem because their language proficiency was not adequate.
2. They were not able to recognize 'which topic or subtopic is covered?' because either they were unable to find the key terms in the word problem or they did have not enough practice in such topics.
3. They were not able to find the relevant concepts because lack of understanding of the question.
4. They were not able to recall the formula to solve the problem because they did have not enough practice or mnemonic techniques for recalling formulae.

5. Some students find the correct formulae, but they could not substitute properly or they could not continue steps one by one because they did not find given values to the corresponding variables or they were lack of solving skills.

High-achieving students:

1. Even high achievers did not choose the correct formulae for the given problem or they did not continue the steps to solve it because they did not have enough exposure to solve lengthy word problems in Sum of arithmetic progression, Sum of squares of n natural numbers and Congruency.
2. Most of the students could not recognize and understand the given problem. They found it difficult to solve the given problem based on the application of the criterion of similarity.

Students experience obstacles in determining the find the answer and also cannot understand the concepts of Function, Equation, Arithmetic Progression, Squares of natural numbers, Congruency and Volume of 3D. This makes it difficult to determine the next step in solving. Students are not able to continue their work, so students with low learning

achievement cannot solve HOTS math problems. It also reveals that learning achievers both could not perform well in overall. The teachers believe that students with high learning achievement were able to solve HOTS math problems but it did not happen in real.

8. Conclusion

a) Based on data analysis that has been done by researchers about the ability of students to solve Higher Order Thinking Skills (HOTS) mathematics problems with high and low learning achievement, it reveals that high learning achievement students have better HOTS-solving ability than low learning achievement students but the overall performance is not sufficient level.

b) High learning achievement students can do the problem-solving process correctly and with the right answer, but low learning achievement students are unable to recognize the problem, unable to find the strategy, select the wrong steps and cannot continue the next step, so the low learning achievement students cannot find the right answer.

c) Most of the high learning achievement students where find the difficult to solve problems which are in Sum of an Arithmetic Progression, sum of squares of first n natural numbers and congruency triangle.

9. Educational Implication

Today the world is moving towards achieving 21st-century skills. In this problem solving is one of the important skills in 21st century skills. The purpose of this study was to describe student's ability to solve HOTS mathematics problems with high and low learning achievement. This study reveals that both learning achievers differ in solving HOT, but overall performance is not appropriate level.

This study will help the teachers to understand better with high learning achievement students could not perform well, because when we make some changes to textbook problems, students are unable to understand, unable to plan for the right strategy and solve the problem.

This study reveals that students with low learning achievement did not understand what was given in the problem, what they wanted to find, whether the word problem was clearly defined or not and also, they were unable to find where it came from. In this, the STAR

strategy (Search - Translate-Answer- Review) or Krulik and Rudnick's steps ((Read and think - Explore and plan - Select a strategy - Find an answer - Reflect and extend)) to solve the word problems can be used by the teachers in their teaching-learning process.

Now we are in a crucial stage to build the student's capacity like solving the HOT-based problem with different contexts and posing different questions. In that case, teachers ask different kinds of problems in the classroom and give enough space to solve the non-routine problems and pose questions. Hence School Education Department and SCERT will take taken necessary steps for students to solve HOT sums in their classes frequently.

Teachers ensure frequently in solving HOT problems capacity of students in their classes. Teachers may also assess the capacity of students not only to solve textbook problems than beyond textbook problems. Teachers can have a list of difficult topics for further learning improvement or further teaching.

PHOTOS